Initial Environmental Examination

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India: Integrated Urban Flood Management for the Chennai-Kosasthalaiyar Basin Project – Additional Financing

Restoration of Eco-system Services of Kadapakkam Lake in Chennai-Kosasthalaiyar Basin Project

Prepared by Greater Chennai Corporation, Government of Tamil Nadu.

CURRENCY EQUIVALENTS

(as of 04 March 2022)

Currency unit	–	Indian rupee (₹)
₹1.00	=	$0.013
$1.00	=	₹75.84

ABBREVIATIONS

ADB	–	Asian Development Bank
AAQ	–	Ambient Air Quality
CMA	–	Chennai Metropolitan Area
COVID 19	–	Corona virus disease of 2019
CPCB	–	Central Pollution Control Board
EA	–	Executing Agency
EAC	–	Expert Appraisal Committee
EC	–	Environmental Clearance
EHS	–	Environmental Health and Safety
EIA	–	Environmental Impact Assessment
EMP	–	Environmental Management Plan;
ES	–	Environmental Specialist
ESS	–	Environmental and Social Safeguards
GEF	–	Global Environment Facility
GOI	–	Government of India
GoTN	–	Government of Tamil Nadu
GCC	–	Greater Chennai Corporation
GRM	–	Grievance Redress Mechanism
IA	–	Implementing Agency
IEE	–	Initial Environmental Examination;
MLD	–	Million liters per day
MFF	–	Multi-Tranche Financing Facility
MOEFCC	–	Ministry of Environment, Forest and Climate Change
NOC	–	No Objection Certificate
NGO	–	Non-Governmental Organization
NAAQ	–	National Ambient Air Quality
PWD	–	Public Works Department
PPTA	–	Project Preparatory Technical Assistance
REA	–	Rapid Environmental Assessment Checklist
SEIAA	–	State Environmental Impact Assessment Authority
SEMP	–	Site environmental management plan
SPS	–	Safeguard Policy Statement, 2009
STP	–	Sewage Treatment Plant
TMP	–	Traffic Management Plan
TNPCB	–	Tamil Nadu Pollution Control Board
WHO	–	World Health Organization

WEIGHTS and MEASURES

°C	-	Degree Celsius
km	-	kilometer
lpcd	-	liters per capita per day
m	-	meter
Mgd	-	million gallons per day
Mld	-	million litres per day
mm	-	millimeter
nos	-	numbers
km^2	-	square kilometer
m^2	-	square meter

NOTE

In this report, $ refers to United States dollars.

CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF APPENDICES

EXECUTIVE SUMMARY

The Asian Development Bank (ADB) funded “Integrated Urban Flood Management for the Chennai-Kosasthalaiyar Basin Project” (the project) will strengthen climate and disaster resilience in the Chennai-Kosasthalaiyar River basin. It will reduce the exposure of 1.9 million people to seasonal flooding by (i) improving climate-resilient urban flood protection infrastructure; (ii) enhancing the urban flood preparedness of the Greater Chennai Corporation (GCC), the civic body that governs the city of Chennai, and project communities; and (iii) establishing measures for sustaining the operation and maintenance of the stormwater drainage system in the GCC. The project is aligned with the following impact: Chennai City made a safe place to live in, with reduced vulnerability to disaster. The project will have the following outcome: climate and disaster resilience in the Chennai-Kosasthalaiyar River basin strengthened.

As part of this Project, it is proposed to restore the ecosystem to enhance the flood retention capacity of the Kadapakkam lake situated in the project area, i.e., Chennai-Kosasthalaiyar River basin using an additional grant from Global Environment Facility (GEF). This will demonstrate nature-based solutions for climate change adaptation through rejuvenation of water body, promoting integrated flood risk management to strengthen climate and disaster resilience, mitigate environmental degradation, and enhance biodiversity. Additional financing will strengthen capacity in the GCC and other stakeholders and awareness of nature-based solutions for urban flood risk management. It will promote knowledge dissemination and replication through national and global platforms created in partnership with the National Institute of Urban Affairs of India and Urban Shift.

Chennai Metropolitan area is blessed with several water bodies, which play vital role in providing eco-system services including water security and flood management. Located off the coromandel coast of the Bay of Bengal, and with its flat terrain, Chennai is vulnerable to natural disasters like cyclones, and floods have become a regular phenomenon. Rapid urbanization, unplanned constructions, indiscriminate dumping of solid waste, debris etc., entry of wastewater, sewage etc., leading to degradation of water bodies. Most of the water bodies suffer from reduced and polluted inflow and shrinking of water retention capacity. The condition of water bodies located in the outer areas, like Kadapakkam Lake, are comparatively better, but they do face threat from rapid urbanization and land use change, and therefore there is a need for immediate interventions to conserve. Rejuvenation and augmentation of water bodies in urban area is especially important from a public health perspective as they provide various ecosystem services. GCC has identified Kadapakkam Lake, a major water body located near Manali in north Chennai in Greater Chennai Corporation area, for restoration under this project. This lake is part of Kosathalayar River Basin.

Executing and implementing agencies. The Municipal Administration and Water Supply Department (MAWS) of GOTN is the executing agency. GCC will be the Implementing agency, responsible for coordinating procurement and construction of the project. The Project Support Consultant (PSC) assists GCC in managing the project including procurement and assures technical quality of design and construction. PSC carries out construction supervision during project implementation. The Contractor will be responsible for execution of all construction works. The contractor will work under the guidance of PSC and GCC. A biodiversity specialist engaged under GEF component will support PSC and GCC. Contractor staff will also include a biodiversity expert with experience in forestry/plantation in Miyawaki method. A lake management committee (LMC) will be established for management of the lake.

Categorization. The potential environmental impacts of the project have been assessed using UNEP (Safeguard Risk Identification Form (SRIF) Checklist and ADB's Rapid Environmental

Assessment (REA) checklist. Based on the assessment, the proposed project is not likely to have any significant adverse environmental impacts that are irreversible, diverse, or unprecedented. Potential impacts are mostly site-specific and in most cases mitigation measures can be designed with uncomplicated measures commonly used at construction sites and known to civil works contractors. Based on the assessment and ADB Safeguard Policy Statement (SPS), the project is classified as Environmental Category "B" and accordingly this Initial Environmental Examination (IEE) has been prepared.

Existing Condition of Kadapakkam Lake. Kadapakkam village, which is closer to Manali, is under the administrative control of GCC and it is in semi-urban area, where agricultural activities are still prevalent, alongside developing industrial and residential areas. The lake is spread over an area of around 0.55 square kilometer (km^2) (55 hectare) and has water holding capacity of 1.1 million cubic meter (MCM). Lake receives inflow from its catchment area mainly via an inlet drain that also connects the lake with the upstream Sembium Manali Lake (located in the northern direction). Via this drain outflow/surplus from Sembium Manali Lake reaches Kadapakkam Lake. In the downstream, Kadapakkam lake is connected to Ariyaloor lake with a drain through which the surplus water from the Kadapakkam Lake flows into Ariyaloor Lake (located in the southern direction). Besides, the lake has four sluices to allow water to be released into downstream areas. The lake is not polluted by sewage/ wastewater discharges. However, dumping of agriculture wastes along the periphery of the lake, and activities like vehicle washing, open defecation etc., has been observed. Lake is situated at about 2 km from an arterial road (Tiruvottiyur-Ponneri High Road), and easily accessible via Vichoor road. Kadapakkam village habitation is located in the south of the lake. The lake is seasonal and monsoon dependent, and normally fills up during the monsoon, but almost dries up in summers. Lake water is used for agricultural in the close by downstream areas. Local people also catch fish mainly for local consumption. Due to the runoff from the nearby agriculture lands, the lake is heavily silted and lost its actual water holding capacity. Three (3 nos) temples (small size) on the lake bund, mostly worshipped by local community. The lake is surrounded by mixed land use pattern comprising mostly of agriculture, followed by residential and commercial (mostly warehouse/ godown). Being a seasonal lake, it does not host healthy flora and fauna population.

Project Components. Under this subproject, it is proposed to enhance flood retention capacity of Kadapakkam Lake through ecosystem restoration. Through rejuvenation of water body, this will promote integrated flood risk management to strengthen disaster resilience, mitigate environmental degradation, and enhance biodiversity. Desilting will restore water holding capacity in the lake and double its volume from 1.1 million to 2.2 million cubic meters. The project proposes a bund 20 meters wide with a cycle track on the upper tier and a walking path on the lower tier. A bird island is proposed with a 2 hectare forest of various native trees planted using the Miyawaki method. Recreation will be enhanced by a children's play area, an open-air theatre, a library, and hobby fishing and boating facilities, all with features friendly to the elderly, women, children, and persons with disables (EWCD). The proposed works will maximize the use of environmentally friendly materials and approaches, reusing dredged soil with geotextile underlay to shore up the bund, paving with fly ash brick, and fencing with shrubbery and trees. The project components/ activities that are proposed for the Kadapakkam lake restoration works are detailed in the following table:

S. No	Description of Work	Remarks
1.	Desilting and Deepening of Lake	142,570 cubic meter (m3) of silt has to be excavated. Excavators on floating platforms will be used to dig silt and Pump dredging will be used to create island

S. No	Description of Work	Remarks
2.	Provision of shallow ponds in the inlet area	First flush water which are typically polluted and carries sediments will be deposited in the pond bottom and only relatively clear water will spill over the weir in the shallow pond
3.	Strengthening of Bund and Bund Formation for 3Km	Clearing of *Prosopis juliflora* jungle and strengthening of Bund & Bund formation using Clay core, Boulders and Excavated Good earth from the site and using Geo textile to control soil erosion and Turfing with plant materials and bund formation for bird island
4.	Providing Foot Path arrangements	using Precast fly ash Kerb and fly ash Pavers
5.	Construction of Peripheral Drain around the Bund	-
6.	Children's Park and Play Field	Using Precast fly ash Pathway, Outdoor play equipment's, Open Lawn, Sculpture using Recycled materials, Construction of Open-Air Theatre (OAT), Skating Ground.
7.	Lighting system	LED light system for streetlights, Bollards, High mast lights, post tops, laser lights etc
8.	Construction of Toilet Blocks	using fly ash bricks, Terracotta jali, Art works on outer wall
9.	Pre-cast structures Shaded Seaters	Seating and canopies, Mushroom structure act as a rain water collector
10.	Construction of Entrance Arch/ Plaza	With Water feature, Pathway, Pergola and Planting materials- using fly ash pavers, cobble stone and Precast structure
11.	Construction of Admin Block with Library	using fly ash bricks
12.	Rejuvenation of Inlet and Outlet Channels	-
13.	Construction of Bio fencing along the lake bund	-
14.	Construction of Pump Room	-
15.	Construction of Control Room	-
16.	Construction of septic tank for sewage	Septic tank will be built with fully sealed bottom and sides to prevent seepage of collected sewage and contamination of groundwater. The recommendations for septic systems in the IFC General EHS Guidelines shall also be adopted.
17.	Rejuvenation of Surplus Weirs	2 Nos of Surplus Weirs
18.	Rejuvenation of Tank Sluices	3 Nos of Tank Sluices
19.	Supply and Fixing of Dust Bins	3 models (Tilting type)
20.	Supply and fixing of Signage Boards	-
21.	Provision for Boating arrangements with Safety Equipment's	Floating boat jetty, arrangement using HDPE pontoon
22.	Urban Forest	Using Native species (Miyawaki method), Bio fencing, Installation of Irrigation for Soft Landscapes
23.	Constructing bore well and R.O treated water facility	-

Project design interventions. Based on the existing condition of the lake, the following design interventions are proposed for the sustainable restoration of lake.

Sl.no	Design Interventions	Proposed Activities
1.	Hydrologic Interventions	• Hydraulic Improvement of Feeders (Cleaning, deepening, widening and Embankment stabilization), • Periodical Maintenance of all the Hydraulic Structures • Deepening of Lake • Forebay Pond provision • Sluice Gate improvements
2.	Environmental and Ecological Intervention	• Creating Awareness on solid waste dumping in the lake ecosystem • Stakeholder Involvement in the maintenance of lakes. • Bund Strengthening and improvements • Urban Forest using Native species (Miyawaki method), Bio fencing, Installation of Irrigation for Soft Landscapes • Supply and fixing of Signage Boards • Supply and Fixing of Dust Bins • Provision of Bird Island
3.	Engineering Interventions	• Renovating the Existing inlet and outlet structures of the lake for their contribution in storing the water in the lake and taking corrective measures • GCC though Revenue Department to carry out a detailed survey of inlet and outlet channel and Perambuku lands to prevent unauthorized encroachments • Adequate fencing and security of lake periphery to stop unauthorized entry • Planned desilting activities, especially of shallow forebay pond, to reduce entry of silt into main lake. Since this shallow pond traps the sediments given its capacity, it needs regular removal of bottom sediments
4.	Recreational and Architectural Interventions	• Provision for Boating arrangements with Safety Equipment's (Floating boat jetty, arrangement using HDPE pontoon) • Children's Park and Play Field (using Precast fly ash Pathway, Outdoor play equipment's, Open Lawn, Sculpture using Recycled materials, Construction of OAT, Skating Ground). • Pre-cast structures (Seating and canopies, Mushroom structure act as a rainwater collector) • Construction of Entrance Plaza (With Water feature, Pathway, Pergola and Planting materials- using fly ash pavers, cobble stone and Precast structure). • Construction of Admin Block with Library (using fly ash bricks)

Description of the Environment. The project area (Kadapakkam Lake) geo-coordinates 13°12'12.53"N and 80°15'10.45"E is located in a developing residential area in North Chennai. The project area is characterized by flat terrain and sloping gently from west to east direction towards the Bay of Bengal. The land use pattern surrounding the Kadapakkam Lake catchment area is predominately agricultural land and open space, which is followed by a mix of residential and commercial (warehouse/ godown). The project area experiences tropical wet and dry climate. The hottest part of the year is late May and early June with maximum temperatures around 38°C to 42°C. The coolest part of the year is January, with minimum temperatures around 18°C to 20°C. The project area receives most of the rainfall in the Northeast monsoon, the annual average rainfall is 823 mm. The prevailing wind direction is the southwesterly between the end of May to end of September and the northeasterly during the rest of the year.

Field sampling surveys were conducted in the project area for ambient air quality and soil/lake sediment quality on 10 Dec 2020, and, for noise and water quality on 10 Dec 202 and 5 May 2021. Air monitoring results exhibits less pollution in the project area with monitored values well within the ambient air quality standards (SO_2 is 8.37 µg/m^3, NO_x is 19.46 µg/m^3, PM_{10} is 45.36 µg/m^3 and $PM_{2.5}$ is 18.51 µg/m^3). However, the ambient noise levels are observed to be high for residential category/ sensitive zone, the recorded noise levels range between 58.1dB(A) to 73.2 dB(A), the high noise levels may be due to the movement of lorry/truck traffic, which carries the materials to the warehouse/ godown located near the lake. Water quality of the lake is found to be very close to drinking water standard as per IS 10500 (2012) - Class A (Drinking water source without conventional treatment but after disinfection). Outcome of the soil test shows that up to 3 m from top found to be clayey nature soil and ideal for bund construction. Sediment analysis proves the sediment is dominated by clay in nature without any heavy metal contamination.

Field survey for biodiversity assessment was conducted during 28-29 Dec 2020, and 4-5 Jan 2021. Result of the biodiversity assessment revealed a total of 124 floral species belonging to 51 families; 26 families were represented by a single species. Nearly 13% of the species recorded were represented by one or few numbers at scattered locations. Many non-woody species such as herbs (31%) forming dense mat on the lake bund. Hydrophytes (20%) consist of submerged, emergent and floating habits, and shrubs (13%) at scattered locations and climbers (10%). The faunal population includes 12 species of fish were recorded from Kadapakam lake, which is comparatively less than other lakes along the regions. One invasive species Tilapia or Egyptian Mouthbreeder *Oreochromis mossambicus* was encountered during the survey. 2 species of Amphibian and 8 species of Reptiles were identified. 30 species butterflies and 14 species of Odonates were identified. 46 species of birds belonging to 17 orders and 34 families were recorded. Almost all the species of both fauna and flora listed are either least concerned (45 species) or not evaluated except the Spot-billed Pelican (Pelecanus philippensis) categorised as “Near Threatened” according to the International Union for Conservation of Nature (IUCN) Red List. Even this species was recorded in very less number and very few time in a year. The project area is free of forest areas; there are no eco-sensitive areas located within or near the project area within a radius of 10 km.[1] Pulicat Lake (located at an aerial distance of 23.8 km) and the Guindy National Park (21.2 km) are the nearest protected areas.

As per decennial census (2011), the Kadapakkam village has a population of 2,941 of which 1,436 are males while 1,505 are females. The project area is well connected by the road network, the presence of SH56 connects Manali to Pooneri. There are no archaeological importance sites within the close proximity, the nearest ASI site (Old Town Wall) is located at Tondiarpet, which is around 15 km from the project area. The project area does not have developed infrastructure including storm water drain and sewerage facility.

Potential environmental impacts and mitigation measures. Potential environmental impacts were identified especially those concerning pre-construction, construction and operation phases. Planning principles and design considerations have been reviewed and incorporated into the site planning and design process wherever possible; thus, environmental impacts as being due to the project design or location were not significant. The project is unlikely to cause significant adverse impacts that are irreversible, diverse or unprecedented because: (i) The components will involve construction works with minimal impacts and it is very much localized. (ii) Project area is mostly urban and peri urban nature; and (iii) Predicted impacts are site-specific and likely to be associated with the construction process and are produced because the process is invasive,

[1] As per the MoEF&CC, 10 km radius is chosen as a study area for the infrastructure projects undergoing environmental clearance.

involving excavation, desilting and earth movements. Due to the current COVID-19 pandemic situation, there is a risk of virus spread at the work sites and offices, endangering the health and lives of workers and staff, and surrounding community, Proper measures need to be put in place at the work sites, and offices as stipulated by the government regulations and advisories issued by international organizations such as World Health Organization (WHO), International Labour Organization (ILO) etc.,, and GCC should ensure that proper measures are put in place and ensure compliance. GCC should also encourage vaccination of all workers and staff engaged in project work.

- **Pre-construction impacts**. As per the prevailing acts and rules adopted by the Government of India and Government of Tamil Nadu, the project related Consents/ Permissions/ NoC's have to be obtained. The GCC and the Contractor should consult the concerned department (Public Works Department (PWD), Tamil Nadu Electricity Board (TNEB), Tamil Nadu Water Supply and Drainage Board (TWAD) etc., for shifting of Utilities or amenities (if any) surrounding the lake area. The three small temples located surrounding the lake area has been surveyed and included in the project design, which shall not be disturbed during the construction phase, access to the public/ local communities shall be provided. It is suggested to locate the construction and labour camp near the project area, and not to disturb the nearby communities. Extreme care will be taken to avoid disposals near water bodies. It is suggested to procure the construction materials from the authorised vendors or quarries permitted/licensed by Department of Geology and Mining/ Concerned department. The GCC confirmed that the proposed project will have no adverse impact on existing water users (farmers). The project interventions shall not alter the overflow weir level or the sluice levels and therefore shall not affect the present water availability of the farmers. During the construction phase, the existing access roads shall not be disturbed, appropriate plan for the same shall be prepared to reduce any impacts to the public/ local communities.
- **Construction Impacts**. Key impacts during construction are envisaged on the following aspects: (i) Transportation of construction materials, (ii) Dust generation, air and noise pollution from construction activities, (iii) Disposal of excavated materials (including sand and silt), and solid waste materials (Municipal solid waste, construction and demolition waste), (iv) Disturbance to the local ecology, (v) Handling of construction materials at site and, (vi) Adoption of safety measures during construction.
    - **Transportation of construction materials** to the site shall be planned during the off-peak traffic hours to minimize the impact on the accessibility for the public/ local communities, accordingly a Traffic Management Plan shall be prepared.
    - **Generation of the dust and noise from the construction activities** is inevitable, which shall be minimised by sprinkling of water and covering the construction materials with tarpaulins/ canvases.
    - **During the excavation works/ desilting/ deepening of lake**, significant quantity of silt (1,42,570 cu.m) will be excavated, as per the sediment analysis, the silt material do not contain heavy metals and its property also favours that it can be used for construction works and hence nearly 80% of the excavated material (silt) shall be used for bund formation, remaining 20% shall be given to the farmers or it shall be disposed at Kodungaiyur solid waste dumping area (owned and managed by GCC). Short-term changes in water quality during and after project execution is anticipated, which will temporarily increase the turbidity of the water quality and will be

back to normal. Silt traps shall be provided at appropriate locations to prevent any water quality impacts due to the construction activities. Other construction waste materials shall be managed by adopting measures suggested in the Waste Management Plan (to be prepared by the Contractor and approved by the GCC).

- **Disturbance to the local ecology**. There is no natural habitat of forest, grassland of significant size within the restoration area that support a high diversity of terrestrial wildlife, which will be disturbed during restoration. There was no rare, protected or endangered wildlife species in the project area based on literature and survey except the Near Threatened (NT) species Spot-Billed Pelican (*Pelecanus philippensis),* and this species will be benefited after the completion of restoration. It is suggested to perform the desilting works in the summer season, as the lake is seasonal and hence the impact on the biodiversity, especially the aquatic environment will have minimal impact. As per the survey the terrestrial flora will have minimal impact, as there are few trees (3 nos) at present in the entire lake area, which will be preserved and included in the design, the presence of wild vegetation (*Prospis juliflora* and *Acacia nilotica*) shall be removed prior to bund strengthening, the floral population will be strengthened by providing the bird island and other greeneries as part of landscaping for the project area.
- **Handling of construction materials at site.** Materials required in construction works shall be stored and handled in a manner to prevent deterioration and damage to the materials, ensure safety of workmen in handling operations and non-interference with public life including safety of public, prevention of damage to public property and natural environment.
- **Workers safety during the project construction**, appropriate safety measures as per best international practices (OSHAS) will be adopted.

- **Operation Impacts**. During operation phase, this project will positively contribute to improve the surface water quality of the lake, it restores the ecology of the lake (including the flora and fauna); and also improves the environmental status of the area around the lake. Restoration of lake would improve the groundwater quality and increases the groundwater recharge capacity in the surrounding areas, which will be beneficial for the local community. Providing walkway, jogging track and other amenities would benefit the local people and thereby misuse of lake area will considerably be reduced. The project would improve awareness of the people around the lake and develop positive attitude towards the environment. With doubling water retention capacity by deepening, improvement of inlet and bunds, increasing green cover etc., will ensure that lake maintains good water level, with at least minimum water level even during summers. Therefore, no notable impact on aesthetic value of lake anticipated.

Environmental Management Plan. Based on the assessed environmental impacts for various stage of the project implementation, an Environmental Management Plan (EMP) is prepared as part of this IEE, which includes (i) Mitigation measures for environmental impacts identified during the pre-construction, construction and operation stages; (ii) An environmental monitoring program and the responsible entities for mitigating, monitoring and reporting; (iii) Stakeholders/ Public consultations and information disclosure procedure; and (iv) Grievance redress mechanism. The EMP will be included in the civil work bidding and contract documents**.**

Consultation, Disclosure and Grievance Redress. One on one consultations have been conducted in February 2021 following the COVID19 protocols (with the locals residing surrounding the lake area) throughout the IEE process and their view have been examined and included in the project design/ planning and development of the project. A total of 17 persons, including 7 farmers owning the agricultural land near the lake, were consulted. Local community is supportive of the project, and indicated that agricultural is groundwater dependant, but supplemented by lake overflow when it is available. Project team indicated availability of overflow to agriculture after lake restoration, and explained improvements being done at the lake. Community suggested that the three temples on lake bund should be retained, and accordingly integrated into the design. Further consultations will be conducted once the situation becomes conducive The feedback/ outcome from the consultation will be appropriately considered in project design, construction and operation, and IEE will be updated accordingly. The consultation process will be continued and expanded during project implementation to ensure that stakeholders are fully engaged in the project and have the opportunity to participate in its development and implementation. A multi-tier project-specific grievance redress mechanism will be established to receive, register, and redress any public grievances in a time-bound and effective manner. The IEE will be disclosed on the ADB and GCC websites.

Monitoring and Reporting. The PMC cum IE and Contractor will be responsible for performing environmental monitoring and they will be supervised by the GCC. The PMC cum IE with the support from the Contractor will submit semi-annual monitoring reports to the GCC. The GCC will consolidate the semi-annual reports in assistance of PMC cum IE and will send it to ADB for review and approval. ADB after approval will post the environmental monitoring reports on its website.

Conclusions and Recommendations. The proposed project is unlikely to cause major environmental impacts. The potential impacts that are associated with design, construction and operation can be mitigated through proper engineering design and the incorporation or application of recommended mitigation measures and procedures. Based on the findings of the IEE, it shall be concluded that there are no significant environmental impacts in implementing this project and accordingly the project is classified as Category “B” project (as per SPS, 2009) thus further study or detailed Environmental Impact Assessment (EIA) is not required.

I. INTRODUCTION

A. Background

1. Water bodies, especially in urban/ peri-urban areas face tremendous pressure from rapid urbanization, unplanned development and population increase. Water bodies in Chennai are no different, and over a period, many surface water bodies are encroached upon to in varying extent. Urbanization and development in catchment areas, disturbed inflows, outflows and encroachments lead to shrinking of lake area. Activities such as indiscriminate and illegal disposal of sewage and wastewater, municipal solid waste, agricultural waste (in peri urban areas), industrial effluent, construction debris, open defecation, cattle, vehicle washing, etc led to pollution of water bodies. Water bodies are also accumulated with considerable amounts of bottom silt, further reducing the water retention capacity. Eutrophication due to high nutrient content contributed by pollutants and siltation due to land use practices and activities also impact the water holding capacity of water bodies.

2. The Greater Chennai Corporation (GCC), either individually or in association with other government departments, has taken an initiative to rejuvenate the surface water bodies through various programs. In Kosasthalaiyar River Basin, the GCC has identified Kadapakkam Lake, located in the industrial belt of Manali, for eco-restoration and also to develop as a recreation place in northern outskirts of Chennai. This will enhance water holding capacity, promote groundwater recharge, and protect lake area from future encroachments, and will play role in flood management. The restoration works will be funded by the Asian Development Bank (ADB) under program of Global Environment Facility (GEF).

B. Objectives of The Project

3. The key objectives of the project are as follows:

(i) Comprehensive improvement and restoration of water body thereby increasing the tank storage capacity.
(ii) Sustainable Groundwater recharge.
(iii) Increased availability of water for domestic and irrigation throughout the year.
(iv) Improvement in cascaded tanks and flood management
(v) Environmental benefits and biodiversity stability
(vi) Community participation and self-supporting system for sustainable management of water body.
(vii) Capacity building of communities, in better water management.
(viii) Development of recreational, cultural activities etc.

C. Purpose of this IEE Report

4. ADB requires the consideration of environmental issues in all aspects of the bank's operations, and the requirements for environmental assessment as described in ADB's Safeguard Policy Statement (SPS), 2009. The potential environmental impacts of the project have been assessed using UNEP (Safeguard Risk Identification Form (SRIF) Checklist (refer **Appendix 1A**) and ADB's Rapid Environmental Assessment (REA) Checklist (refer **Appendix 1B)**. The potential negative impacts were then identified in relation to pre-construction, construction and operation phases of the proposed Kadapakkam lake restoration works and the results of assessment shows that the project is unlikely to cause significant adverse impacts that are irreversible, diverse or unprecedented. Thus, this Initial Environmental Examination (IEE) has been prepared in

accordance with ADB SPS's requirements for environment category 'B' project. This IEE is based on the Detailed Project Report (DPR) prepared by GCC through an external DPR consultant.

5. The IEE report is based mainly on field reconnaissance surveys and secondary source of information. Field sample surveys were conducted for ambient air, noise, silt, and surface water quality. For all the relevant ambient parameters, a suitable environmental monitoring program has been developed as part of the Environmental Management Plan (EMP), which will require the Contractor to establish the baseline environmental conditions prior to commencement of civil works. The results will be reported as part of the environmental monitoring report and will be the basis to ensure no degradation will happen during project implementation. Stakeholder consultation was an integral part of the IEE and will continue throughout the project implementation.

D. Report Structure

6. This Report contains the following ten (10) sections including the executive summary at the beginning of the report:

(i) Executive summary
(ii) Introduction
(iii) Description of the project
(iv) Policy, legal and administrative framework
(v) Description of the environment
(vi) Anticipated environmental impacts and mitigation measures
(vii) Public consultation and information disclosure
(viii) Grievance redress mechanism
(ix) Environmental management plan, and,
(x) Conclusion and recommendation.

II. DESCRIPTION OF THE PROJECT

A. Need for the Project

7. This project will enhance flood retention in the Kadapakkam Lake through ecosystem restoration. The lake, spread over an area of 55 hectares is in the extended area of Greater Chennai Corporation, near Manali industrial hub, in north Chennai. The project involves implementing nature-based solutions (NbS) for climate change adaptation through rejuvenation of water body, promoting integrated flood risk management to strengthen climate and disaster resilience, mitigate environmental degradation, and enhance biodiversity. The project will also support non-structural measures which will (i) enhance capacity in the GCC and other government entities and awareness in local communities of urban water body rejuvenation using nature-based solutions, (ii) promote the replication of nature-based solutions by other cities in Tamil Nadu through the development of an investment readiness roadmap, (iii) disseminate to other Indian cities knowledge and practices from this demonstration investment as a model for nature-based urban flood risk management, and (iv) strengthen understanding in the GCC and other cities in Tamil Nadu of integrated sustainable urban development through participation in national and global dialogues organized by UrbanShift.

B. Project Area

8. Kadapakkam Lake (geo-coordinates 13°12'12.53"N and 80°15'10.45"E) is located in a developing area in North Chennai, surrounded by Edayanchavadi in the East, Vichoor in the West, Vellivoyal in the North, and Mathur to the South. Kadapakkam and other nearby villages of Ariyalur, Sembiummanali and Vichoor, have been experiencing rapid development with large number of new Industries and residential developments coming up in the area.

9. The lake can be approached through Vichoor main road from Tiruvottiyur-Ponneri High Road and Kanniyammanpettai Kadapakkam road from Andarkuppam-Redhills Road.

Figure 1: Satellite imagery of Kadapakkam Lake

C. Existing condition of Kadapakkam Lake

10. The existing condition of the Kadapakkam Lake has been surveyed and the observations are illustrated in the following sections.

1. Lake Catchment area

11. The original channel as shown in the Toposheet (obtained from Survey of India [SoI]) in the sub-catchments have been altered by people during habitation and developed for housing/infrastructure activities in the recent past, which has resulted in alteration of the natural hydrological regimes of these streams/nullas. The vegetation cover of these areas has also experienced heavy pressure from agricultural to fully paved surfaces and open spaces.

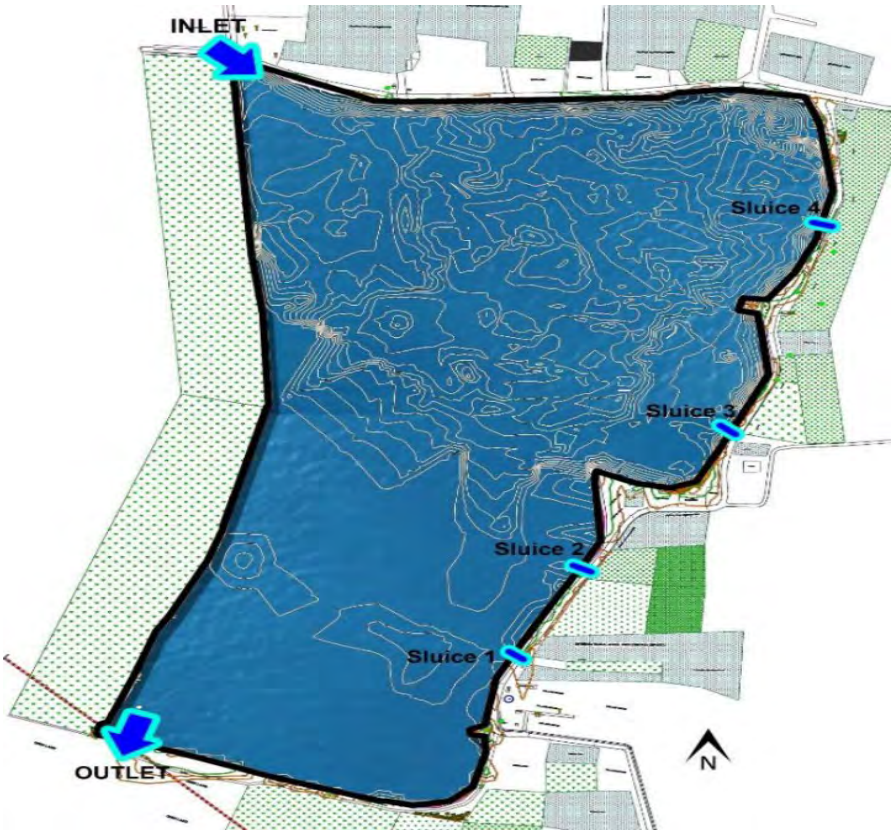
Table 1: Kadapakkam Lake Catchent Area

Name	Lake Area (km^2)	Catchment Area (km^2)		Water spread area (km^2)	Capacity (MCM)
		Free	Combined		
Kadapakkam Lake	0.55	3.2	13.4	0.55	1.1

2. Inlet and Outlet Channels

12. The existing conditions of water inlet and outlet drains, and the lake, were surveyed and cross sections were measured to estimate the quantity to be desilted. The following figure illustrates the survey outcome. There is one major inlet to Kadapakkam Lake (Inlet 1), which is from Sembium Manali Lake and enters from the northern end. There are four sluices located on the bund at various locations. There is one major outlet, which is located in the south, which connects to Ariyalur Lake in the downstream. This way, Kadapakkam Lake is connected in the upstream with Sembium Manali Lake in the north and in downstream with Ariyaloor Lake in the south. The excess water overflows through the outlet sluices located on the bund to command area for agricultural uses, and surplus then reaches the Kosathalaiyar River by surface flow.

Figure 2: Survey Map Showing Inlets and Outlet in Kadapakkam lake



3. Runoff Estimation for Kadapakkam Lake

13. Digital Elevation Model (DEM) of the catchment and drainage network were created for Kadapakkam Lake using SRTM. The runoff was generated using the rainfall data and DEM. The monthly and annual runoff potential generated for Kadapakkam Lake is presented in following table.

Table 2: Run-off Estimation for Kadapakkam Lake for the years 2004-2013

Year	Annual Rainfall (mm)	Annual Runoff (MCM)
Kadapakkam		
2004	1169.40	1.400
2005	2397.50	3.876
2006	1326.00	1.654
2007	1455.40	1.935
2008	1755.00	2.433
2009	1307.00	1.778
2010	1469.60	1.691
2011	1485.96	1.896
2012	941.30	1.063
2013	1117.60	1.024

Source: DPR 2021

4. Antecedent Soil Moisture Condition (AMC)

14. AMC indicates how wet or dry the soil storage sponge is when it starts to rain (i.e., condition of soil preceding the rains). If the soil storage sponge is already saturated before the storm hits, only a small percentage of the rainfall can be absorbed, meaning a large portion of the rainfall total will become runoff. The AMC has been estimated for Kadapakkam Lake. The AMC condition is based on the five-day antecedent precipitation, which is given in following table.

Table 3: Classification of antecedent moisture classes for SCS method

AMC group	Soil characteristics	Total 5-day Antecedent Rainfall (mm)	
Dormant season		**Growing Season**	
I	Soils are dry but not to wilting point; Satisfactory cultivation has taken place	<13	<36
II	Average condition	13-28	36-53
II	Heavy rainfall or light rainfall and low temperatures have occurred within the last five days; saturated soil	>28	>53

Source: DPR 2021

15. The land use and the soil maps were overlaid in geo-processing wizard of ArcGIS. The resultant coverage will have attributes of both the coverage. The antecedent moisture conditions for different combinations of soil and land use are given based on the AMC criteria. Using MapInfo software, all the polygons having a particular land use and hydrological soil group were selected and the curve numbers were assigned to these polygons using conditional assignment of attributes. Thus, the curve number coverage is generated in which different polygons have different curve number values.

Table 4: Runoff Estimation of Kadapakkam Lake for Dependable Rainfall

Month	Runoff (MCM)	
	50% Probability	75% Probability
Jan	0	0
Feb	0	0
Mar	0	0
Apr	0.014	0
May	0	0
Jun	0	0
Jul	0.015	0
Aug	0	0.001
Sep	0	0.045
Oct	0	0
Nov	0.471	0.205
Dec	0.255	0.152
Total	0.755	0.403

Source: DPR 2021

5. Geo Technical investigation

16. Geo Technical investigation was carried out to understand the soil condition for the purpose of using the soil for bund formation, creation bird Island and for providing structural arrangement for proposed structures. Two number of boreholes to the depth of 10 m have been drilled to explore the soil condition. It is revealed that first 3 m comprised of clay and is suitable for bund formation.

6. Water Holding Capacity

17. The current water holding capacity of the lake, estimated based on the actual DEM developed and the runoff was estimated based on the rainfall only, which is with minimal human interventions, is 1,195,271 cubic meter (1.1 million cum). The overflow from the surplus weir is only applicable when the lake is full and does not have any bearing on the amount of water stored within the lake, however, the seepage loss forms the critical component playing a vital role in the availability of water within the lake. During the survey carried out by Hydrological expert in 2019, illegal groundwater withdrawal takes place just adjacent to lake bed. Mining activities were taking place mainly after the 2005 to illegally mine the lake soil, thus enhanced the seepage loss. This can be attributed as one of the factors for the reduction of the water availability in Kadapakkam Lake in the recent past. Further, under present situation, the runoff and water holding capacity of the tank is intervened due to extensive human interventions.

D. Identified Issues and solutions

1. Hydrological issues

(i) Due to the obstructions in the Upstream/Downstream of the lake, the supply and surplus channels were either not useful or not in good maintenance hence it is proposed to desilt the area of inlet channel and outlet channel
(ii) Shallow Pond will be provided in the Inlet area so that the first flush water which are typically polluted and carries sediments will be deposited in the pond bottom and only relatively clear water will spill over the weir, this shallow pond or forebay pond will provide easy opportunity in the dry season every year for maintenance
(iii) Inlet and Outlet channels will be improved at the end up to disposal point
(iv) Change of Landuse in Watershed/Catchment, Blockages of Inlet and Outlets by excessive solid waste dumpling and poor maintenance of supply and surplus channels to be improved.
(v) Decreased Storage capacity and increased storage capacity due to mining, this will be handled by deepening the entire lake.

2. Environmental issues

18. The lake is not contaminated by sewage or industrial effluent, however, dumping of agricultural waste is noted. The other causes of pollution of Kadapakkam is lake are: washing commercial vehicles/trucks, washing of cloths, cattle and open defecation in and around the lake. The lake is easily approachable and well connected to an arterial road, and with no protection or fencing and proper lake bunds, trucks and other vehicles enter the lake area and use lake water for vehicle washing. The easy and unrestricted access to lake and lack of awareness are reasons for prevalence of dumping of agricultural waste, open defecation, and other activities in and around the lake. As part of lake restoration, improvement of lake bunds, a proper fencing, restricted entry and exit, and overall improvement of the lake, use of lake area for recreational purposes, increased people presence in and around lake area etc., will prevent these activities. Awareness creation activities will be conducted, and GCC will also link the communities with ongoing sanitation initiatives such as Swatch Bharat Mission (SBM) to provide toilets, if required. The proposed environmental intervention includes protection of bund, creation of Bird Island, urban forestry, aerator and usage of green materials.

3. Ecological issues

19. The lake water has been dominated with alien invasive species such as Hyacinth and Prosopis, which shall be removed. The proposed urban forestry and adding fresh water fishes of native species that are currently in the lake and aquatic plants will help in restoring the lake ecology. No new fish species (native or otherwise) will be added. Since the lake is connected to other lakes, it is expected that during the monsoon and rains, other fish species will come via connecting drains/streams.

4. Social issues & Intervention

20. The lake shall be protected from any of the encroachment, it is also proposed to provide (i) facilities for children to play, (ii) facilities for local agriculture communities (sluice gate to use lake water for agriculture), (iii) providing library, gathering space and hobby fishing facility. It is planned to develop the lake aesthetically attractive and socially connected using various architecture elements and facilities such as walking path, running/jogging track, cycle track, boat jetty, camping facility and open-air theatre.

E. Proposed Project Components

21. Restoration of Kadapakkam Lake primarily focuses on desilting aiming to double the lake's water holding capacity from 1.1 million cubic meter (MCM) to 2.2 MCM. The inflow is filtered in a forebay pond with shallow depth to ensure better quality water entering the main lake. The project proposes a bund 20 meters wide with a cycle track on the upper tier and a walking path on the lower tier. A bird island is proposed with a 2-hectare forest of various native trees planted using the Miyawaki method. Recreation will be enhanced by a children's play area, an open-air theater, a library, and hobby fishing and boating facilities, all with features friendly to the elderly, women, children, and persons with disables (EWCD). The proposed works will maximize the use of environmentally friendly materials and approaches, reusing dredged soil with geotextile underlay to shore up the bund, paving with fly ash brick, and fencing with shrubbery and trees.

22. The project components/ activities that are proposed for the Kadapakkam lake restoration works are detailed in the following table.

Table 5: Proposed activities

S. No	Description of Work	Remarks
1.	Desilting and Deepening of Lake	142,570 cu.m of silt has to be excavated. Excavators on floating platforms can be used to dig silt and Pump dredging shall be used to create island
2.	Provision of shallow ponds in the inlet area	First flush water which are typically polluted and carries sediments which will be deposited in the pond bottom and only relatively clear water will spill over the weir in the shallow pond
3.	Strengthening of Bund and Bund Formation 3km	Clearing of *Prosopis juliflora* jungle and strengthening of Bund & Bund formation using Clay core, Boulders and Excavated Good earth from the site and using Geo textile to control soil erosion and Turfing with plant materials and bund formation for bird island

S. No	Description of Work	Remarks
4.	Providing Foot Path arrangements	using Precast fly ash Kerb and fly ash Pavers
5.	Construction of Peripheral Drain around the Bund	-
6.	Children's Park and Play Field	Using Precast fly ash Pathway, Outdoor play equipment's, Open Lawn, Sculpture using Recycled materials, Construction of Open Air Theatre (OAT), Skating Ground.
7.	Lighting system	LED lights systems for streetlights, Bollards, High mast lights, post tops, laser lights etc
8.	Construction of Toilet Blocks	using fly ash bricks, Terracotta jali, Art works on outer wall
9.	Pre-cast structures Shaded Seats	Seating and canopies, Mushroom structure act as a rain water collector
10.	Construction of Entrance Arch/ Plaza	With Water feature, Pathway, Pergola and Planting materials- using fly ash pavers, cobble stone and Precast structure
11.	Construction of Admin Block with Library	using fly ash bricks
12.	Rejuvenation of Inlet and Outlet Channels	-
13.	Construction of Bio fencing along the lake bund	-
14.	Construction of Pump Room	-
15.	Construction of Control Room	-
16.	Construction of Collection Tank for Sewage	-
17.	Rejuvenation of Surplus Weirs	2 Nos of Surplus Weirs
18.	Rejuvenation of Tank Sluices	3 Nos of Tank Sluices
19.	Supply and Fixing of Dust Bins	3 models (Tilting type)
20.	Supply and fixing of Signage Boards	-
21.	Provision for Boating arrangements with Safety Equipment's	Floating boat jetty, arrangement using HDPE pontoon
22.	Urban Forest	Using Native species (Miyawaki method), Bio fencing, Installation of Irrigation for Soft Landscapes
23.	Constructing bore well and R.O treated water facility	

Source: DPR 2021

F. Proposed Restoration Master Plan

23. The plan to restore Kadapakkam lake was developed based on the analysis and findings derived from the engineering, hydrological, environmental, ecological, and social analysis of the lake and its catchment. The suggestions provided by the stakeholders have been taken into consideration. The plan was developed in such a manner to ensure the sustainable restoration and protection of Lake. Accordingly, the following interventions have been identified as essential for sustainable restoration of Lake in an integrated manner: The following table depicts the proposed interventions.

Hydrologic Interventions

- Hydraulic Improvement of Feeders (Cleaning, deepening, widening and Embankment stabilization),
- Periodical Maintenance of all the Hydraulic Structures
- Deepening of Lake
- Forebay Pond provision
- Sluice Gate improvements

Environmental and Ecological Intervention

- Creating Awareness on solid waste dumping in the lake ecosystem
- Stakeholder Involvement in the maintenance of lakes.
- Bund Strengthening and improvements
- Urban Forest using Native species (Miyawaki method), Bio fencing, Installation of Irrigation for Soft Landscapes
- Supply and fixing of Signage Boards
- Supply and Fixing of Dust Bins
- Provision of Bird Island

Engineering Interventions

- Renovating the Existing inlet and outlet structures of the lake for their contribution in storing the water in the lake and taking corrective measures
- GCC though Revenue Department to carry out a detailed survey of inlet and outlet channel and Perambuku lands to prevent unauthorized encroachments
- Adequate fencing and security of lake periphery to stop unauthorized entry
- Regularization of excavation of soil from lake bed.

Recreational and Architectural Interventions

- Provision for Boating arrangements with Safety Equipment's (Floating boat jetty, arrangement using HDPE pontoon)
- Children's Park and Play Field (using Precast fly ash Pathway, Outdoor play equipment's, Open Lawn, Sculpture using Recycled materials, Construction of OAT, Skating Ground).
- Pre-cast structures (Seating and canopies, Mushroom structure act as a rainwater collector)
- Construction of Entrance Plaza (With Water feature, Pathway, Pergola and Planting materials- using fly ash pavers, cobble stone and Precast structure).
- Construction of Admin Block with Library (using fly ash bricks)

Source: DPR, 2021

Table 6: Proposed Design Interventions

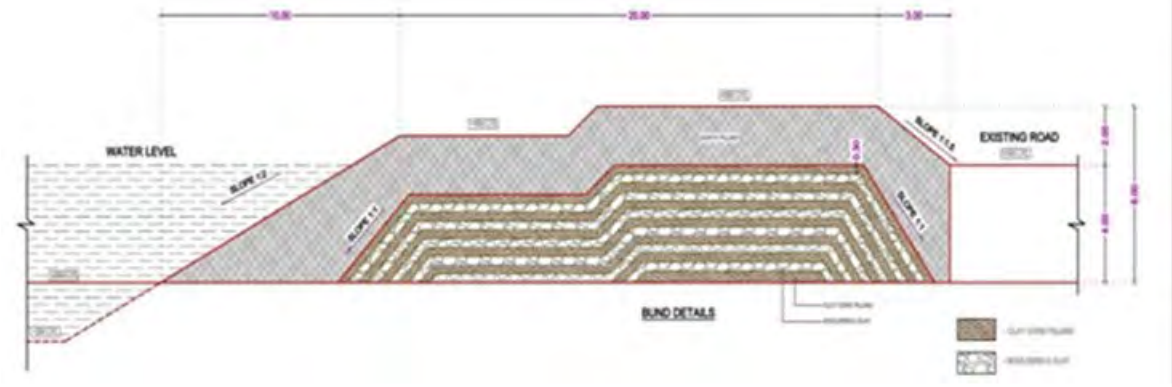
Sl.no	Activity	Remarks
1.	Desilting and deepening of Lake	• It is proposed to desilt and deepen the lake bed up to 2 m • The desilted material will be utilized for bund formation/ strengthening
2.	Strengthening of the existing bund and formation of new bund	• The existing bund on the three sides (east, north and south) of the lake is proposed for strengthening and west side of the lake shall be protected by formation of new bund (3100m / 3.1 km). • The top bund width is fixed at 20 m and slope of 1:1:5 • Water side of bund is proposed to be strengthening by Geo Fabric and 1:2 slope. • To drain the rainwater from the bund, chute provision is made 30 m along the bund
3.	water capacity	Existing water holding capacity is about 11,95,271 cum (1.1 million cum), which will be increased to store water twice the capacity i.e.,

Sl.no	Activity	Remarks
		22,34,390 Cum (2.2 Million Cum) by desitling the lake and maintaining 4m level.
4.	Sustainable Design Principle	The project design aim is to create a Sustainable Waterfront area to promote sustainable development. Design aims development of waterfront as a public resource, with energy efficient design in building materials and design elements, also ensuring the accessibility to all age groups and physically challenged. It is designed to create a wider bund of 20m width in two levels, to provide exclusive pathway for pedestrian and cycle track. These two bunds will be in two different levels, well defined and surrounded with shaded trees and shaded seating area. Visibility and Accessibility to all age groups makes it a safe public space. Following are the key aspects for the development of the lake. • Sense of place • Flexibility • Secure by design • Energy efficiency • Biodiversity and Conservation • Public realm Green Elements are predominantly preferred in this project. Following elements are used against conventional practice. • Geotextile against the practice of Revetment • Bio Fencing instead of RCC compound wall • Gabion seating instead of plastic seating • Sculptures using recycled materials • Precast RCC structure • Drip Irrigation • Solar Lights and LED Lights • Grass Pavers
5.	Sustainable Design	Sustainable design focuses on proper plant selection (use of native species and low maintenance landscapes), drip irrigation, rain gardens, rainwater collection, mushroom canopies – which act as a collection point to capture storm water, and the use of recyclable materials for sculptures.
6.	Urban Forest	Miyawaki Forestation will be adopted. In this technique, Various Native trees, Plants, shrubs are planted close to each other, so that the greens receive Sunlight from top and grow taller. As a result, the trees grow fast upwards and the plantation becomes 30 times denser, grows 10 times faster and becomes maintenance free after a span of three years. A combination of Perforators, water retainers, Fertilizers are mixed with existing soil and act as a medium for the vegetation
7.	Bird Island	The excavated earth from the water body will be used to create a 5 acre Bird island. Forest trails, Fishing and camping are proposed inside.
8.	Bund	20m wide bund is proposed to be constructed around the water body, using the earth which is excavated from the lake along with boulders in the layers of 300mm, this will act as clay core and seepage will be stopped due to soil in clayey nature. Bund slope will be gentle as 1:2 and wider bund with clay core inside is stronger and sustainable. By deepening the Lake, it is providing the increased capacity of the water body and making use of the excavated earth for the creation of bund over the existing bund. Which is stabilized with layers of clay core and Boulders in

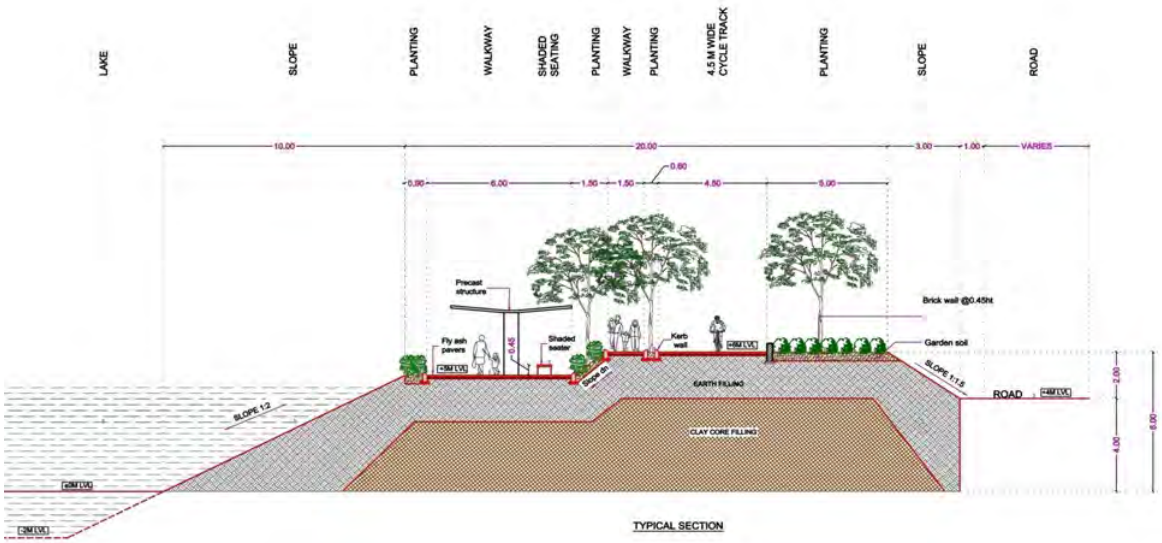
Sl.no	Activity	Remarks
		the centre of the bund and the slope is retained using Geotextile fabric. Bund is created with two levels, which provide access and movement for different users Deep rooted perennials and Grasses are proposed on the berm to hold the soil. These plants help in preventing the erosion and gives Beautiful green environment. These features are beneficial to the Environment and Beautiful at the same time
9.	Providing Maintenance Access	The proposed 4.5 m wide cycle track will be doubled as maintenance access road. Vehicles suitable to ply on this track will be used (no heavy vehicles). Maintenance activities will be conducted as and when needed, either during outside public visiting times or by restricting entry for any emergency or major maintenance activities.
10.	Providing Sluice Gate	It is proposed form a Sluice gate with the control structure to release water up to 3m for irrigation use in the existing location, which can be operated by community cooperation
11.	Supply and Erection of solar lights	It is proposed to erection solar light along the Walking and cycling track. The technical specifications of the solar lights are 20 W LED and 75watt SPV module
12.	Supply and erection of solid waste bins	It is proposed to provide solid waste bin, 1.50 m^3 capacity at selected locations
13.	Information Education and communications (IEC) activities	Awareness generation among the stakeholders through meetings, distribution of awareness materials such as posters and pamphlets and organizing rally through NGC ecoclub students of the local government school
14.	Post project seasonal water quality monitoring for 4 years	To assess the change in the water quality over a period of the time after the implementation of the project, it is proposed to monitor the water quality at every quarterly in a year for 4 years

Figure 3: Proposed Design of Kadapakkam Lake

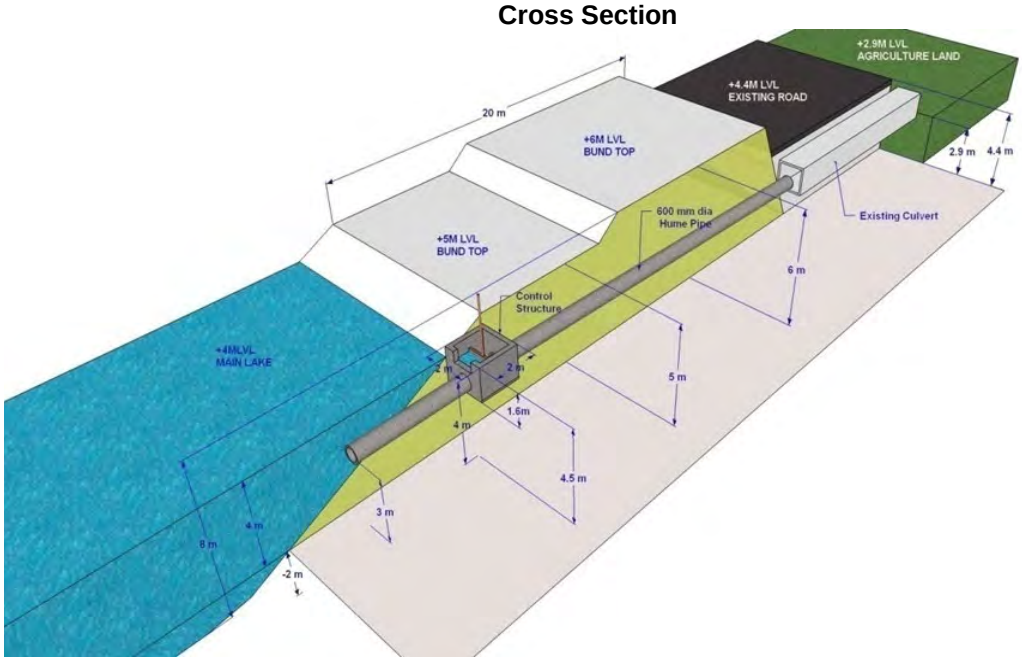
Master Plan



Bund Section showing Clay core



Cross Section



Irrigation Sluice gate arrangement

Pathway

Bird Island

Play area

Parking

G. Implementation Schedule

24. It is proposed to implement the project under 3 phases. Phase 1 shall cover Inception work for Kadapakkam lake Restoration, (ii) Phase 2 shall cover Engineering work for Kadapakkam lake Restoration and Phase 3 shall cover Ecological cum Environmental Intervention works for

Kadapakkam Restoration and O&M. The proposed project activities has been split into eight key components, the tentative duration for the completion of the project activities are as follows:

(i) Desilting and Deeping (3 months),
(ii) Bund Construction (2 months),
(iii) Drainage structure works (2 months)
(iv) Landscaping works (3 months),
(v) Other building works (4 months),
(vi) Pathway related works (3 months)
(vii) Amenities works (3 months)
(viii) MEP works (1.5 months)

25. The tentative time period required for completion of the project activities has been estimated to be 19.5 months. The Bids / Tender will be invited in the month of February 2022.

H. Analysis of Alternatives

26. Alternatives considered in the project preparation and design in discussed below, including with and without project scenario. The "with" project scenario has positive beneficial impacts on the ecosystem, biodiversity, local communities / population living surrounding the Kadapakkam Lake and larger Chennai metropolitan area. The direct benefits includes pollution prevention to the water body, increased water storage capacity, restoration of lakes biodiversity, recreation facilities, formation of bird island with more trees/ landscaping to enrich the local biodiversity, opens up door for people to visit the lake and spend time leisurely. Indirect benefits includes increased groundwater recharge potential, promotes agriculture activities during summer season, opens up way for commercial activities for the tourist/ lake visiting people. In comparison, the "Without" project scenario can lead to further deterioration of the lake, increased water pollution due to the open defecation, vehicle washing, illegal use of water and chances of illegal soil mining. Project adopted nature based solutions, and the material and methods proposed are predomonantly eco-friendly and with native species.

Use of nature based solutions: use of eco-friendly materials and solutions and native species	Green elements are predominantly preferred in this project and the following elements are used against conventional practice: • Geotextile against the practice of bund revetment • Bio-fencing instead of RCC compound wall • Gabion seating instead of plastic seating • Sculptures using recycled materials • Drip Irrigation • Native plants and native fish species • Drought tolerant and low maintenance landscapes • Permeable paving with grass pavers • Reduced lawn area • Use of recyclable materials for sculptures • Use of fly ash bricks in place of clay bricks Advantage of Fly ash bricks over normal bricks. Fly ash brick is made from coal ash generated in the thermal power plants. It is considered eco-friendly as it avoids requirement of mining and abstraction of construction material (clay) for making normal clay bricks and avoids carbon

<table>
<tr>
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<td>emissions from entire brick making process. More importantly, the fly ash avoids environmental issues that would result if it was disposed on land or into water.
As presented in the below table, in comparison with clay bricks, fly ash bricks also have other advantaged, and therefore used in the restoration work.

<table>
<tr><th>Properties</th><th>Red Bricks/ Clay Bricks</th><th>Fly Ash Bricks</th><th>Remarks</th></tr>
<tr><td>Density</td><td>1600-1750 kg/m^3</td><td>1700-1850 kg/m^3</td><td>Higher load bearing</td></tr>
<tr><td>Compressive strength</td><td>30-35 kg/cm^2</td><td>90-100 kg/cm^2</td><td>Higher load bearing</td></tr>
<tr><td>Absorption</td><td>15-25%</td><td>10-14%</td><td>Less dampness</td></tr>
<tr><td>Dimensional stability</td><td>Very low tolerance</td><td>High tolerance</td><td>Saving in mortar up to 25%</td></tr>
<tr><td>Wastage during transit</td><td>Up to 10%</td><td>Less than 2%</td><td>Saving in cost up to 8</td></tr>
<tr><td>Plastering</td><td>Thickness vary on the both sides of wall</td><td>Even on both sides</td><td>Saving in plaster up to 15%.</td></tr>
</table>
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<tr>
<td>Adopting Miyawaki forest method for plantation in lake</td>
<td>Due to the following advantages, Miyawaki forest plantation method adopted over conventional plantation in urban areas.
• Trees in a Miyawaki forest grow up to ten times faster at around a metre per year, reaching a stable multi-layered forest community in 20 to 30 years instead of hundreds of years
• The growing trees absorb more carbon in a Miyawaki forest than in a plantation or in standard afforestation projects because they grow more quickly and there are thirty times as many
• Native trees thrive in the conditions to which they are adapted and are more resilient to environmental changes
• Miyawaki forests have been found to have far higher biodiversity than neighbouring woodland
• Rapid restoration of land, development of an entire ecosystem (instead of just plants),
• Much faster development of greenery as compared to conventional forests,
• Minimal maintenance and care, low-cost, etc.
• Reduces air pollution in cities
• Promoting natural vegetation on land destroyed by natural calamities and man-induced mistakes
• The trees grow faster and are free of chemical and fertilisers
• The saplings need minimum maintenance</td>
</tr>
</table>

III. POLICY, LEGAL AND ADMINISTRATIVE FRAMEWORK

A. ADB policy

27. ADB requires the consideration of environmental issues in all aspects of ADB's operations, and the requirements for environmental assessment are described in ADB SPS, 2009. This states that ADB requires an environmental assessment of all ADB investments.

28. **Screening and Categorization**. The nature of the environmental assessment required for a project depends on the significance of its environmental impacts, which are related to the type and location of the project; the sensitivity, scale, nature and magnitude of its potential impacts; the availability of cost-effective mitigation measures. Projects are screened for their expected environmental impacts and are assigned to one of the following four categories.

(i) **Category A.** a proposed project is classified as category 'A' if it is likely to have significant adverse environmental impacts that are irreversible, diverse, or unprecedented. These impacts may affect an area larger than the sites or facilities subject to physical works. An Environmental Impact Assessment (EIA) is required.
(ii) **Category B.** a proposed project is classified as category 'B' if its potentially adverse environmental impacts are less adverse than those of category 'A' projects. These impacts are site-specific, few of them are irreversible, and in most cases, mitigation measures can be designed more readily than for category 'A' projects. An Initial Environmental Examination (IEE) is required.
(iii) **Category C.** a proposed project is classified as category 'C' if it is likely to have minimal or no adverse environmental impacts. No environmental assessment is required although environmental implications needs to be reviewed.
(iv) **Category FI.** a proposed project is classified as category 'FI' if it involves an investment of ADB funds to or through a Financial Intermediary (FI). An Environmental and Social Management System (ESMS) is required.

29. **Analysis of Alternatives.** The best fit option should be identified for the implementation of the project in terms of location, design, technology and/or components that would avoid, and, if avoidance is not possible, minimize adverse environmental impacts and risks.

30. **Anticipated Adverse Impact Mitigation and Management**. When the potentially significant adverse impacts and risks cannot be avoided or prevented, appropriate mitigation measures and management actions have to be identified so that the project / subprojects are designed, constructed, and operated in compliance with ADB SPS 2009.

31. **Environmental Management Plan (EMP)**. An EMP, which addresses the potential impacts and risks identified by the environmental assessment, shall be prepared. The level of detail and complexity of the EMP and the priority of the identified measures and actions will be commensurate with the project's impact and risks.

32. **Public Consultation**. Carry out meaningful consultation with affected persons and facilitate their informed participation. Ensure women's participation in consultation. Involve stakeholders, including affected persons and concerned NGOs, early in the project preparation process and ensure that their views and concerns are made known and understood by decision makers and taken into account.

33. **Grievance Redress Mechanism (GRM)**. Establish a grievance redress mechanism (GRM) to receive and facilitate resolution of the affected person's concerns and grievances regarding the project's environmental performance.

34. **Public Disclosure:** GCC shall disclose relevant project information to the affected people, other stakeholders, and the public, in accessible manner so that they can provide meaningful inputs into the project design and implementation. GCC shall submit the following documents to ADB to post on its website:

(i) Final or updated IEE upon receipt; and
(ii) Environmental monitoring reports submitted by the implementing agency during project implementation upon receipt.

35. The ADB guidelines, stipulate addressing environmental concerns, if any, of a proposed activity in the initial stages of project preparation. For this, the ADB Guidelines categorizes the proposed components into categories (A, B or C) to determine the level of environmental assessment required to address the potential impacts. This project on "*Restoration of Biodiversity and Ecosystem Services in Kadapakkam Lake in Chennai - Kosathalaiyar Basin*" has been categorized as "B" and accordingly this IEE has been prepared to address the potential impacts, in line with the structure for Category "B" projects.

B. GEF's Policy on Environmental and Social Safeguards

36. Environmental and Social Safeguards Policy sets out mandatory requirements for identifying and addressing Environmental and Social Risks and Impacts in GEF-financed projects and programs; and for documenting, monitoring, and reporting on associated measures throughout the project and program cycles and at the portfolio level.

37. The policy on Environmental and Social Safeguards has the following nine Minimum Standards for Agency policies, procedures, systems and capabilities related to identifying and addressing Environmental and Social Risks and Impacts in projects and programs:

Sl.no	Minimum Standards	Applicability to this Project
1.	Environmental and Social Assessment, Management and Monitoring	Applicable
2.	Accountability, Grievance and Conflict Resolution	Applicable
3.	Biodiversity Conservation and the Sustainable Management of Living Natural Resources	Applicable
4.	Restrictions on Land Use and Involuntary Resettlement	Applicable
5.	Indigenous Peoples	Not applicable
6.	Cultural Heritage	Not applicable
7.	Resource Efficiency and Pollution Prevention	Applicable
8.	Labor and Working Conditions; and	Applicable
9.	Community Health, Safety and Security	Applicable

38. GCC has to establish that they have in place the necessary policies, procedures, systems and capabilities to meet minimum standards 1–9 for which GCC adopts the ADB SPS 2009, which covers all the requested minimum standards of the GEF.

C. National Environmental Laws

39. The Lakes are presently not covered by any specific legal statute but several legislations enacted till date have relevance & provisions for conservation of lakes. Some of these are:

(i) The Forest Conservation Act, 1980,
(ii) The Wildlife Act, 1972,
(iii) The Water (Prevention & Control of Pollution) Act, 1974, and
(iv) The Environment (Protection) Act, 1986.

40. The Forest Conservation Act and Wildlife Protection Act may not be applicable for this project as the lake area is not under the control of the forest department.

41. The National Environment Policy (NEP), 2006 also seeks for setting up of a legally enforceable regulatory mechanism for lakes to prevent their degradation and enhance their conservation. Till any specific regulatory framework for lakes is formulated, the Lake Conservation may be covered under the provisions of existing Central and State Legislations as follows:

(i) The Water (Prevention & Control of Pollution) Act, 1974 as amended deals comprehensively with water issues. It empowers the Government to maintain the wholesomeness of National Water Bodies. The Act also provides for prohibition on use of stream (includes inland water whether natural & artificial) or well for disposal of polluting matter etc. It enables the Government through Central & State Pollution Control Boards to prescribe standards and has provisions for monitoring & compliance and penal provisions against the violators of the Act.
(ii) The Environment (Protection) Act, 1986 defines the power of the Central Government to take measures to protect and improve environment which includes water, air and land and the inter relationship which exists among and between water, air and land and human beings, other living creatures, plants, micro-organisms and property.
(iii) The National Environment Policy (NEP), 2006, recognises the ecological services rendered by the water bodies like lakes & wetlands. The NEP states that lakes are under threat from drainage and conversion for agriculture & human settlements besides pollution. The reduction in economic value of their environmental services due to pollution, as well as the health costs of the pollution itself, are not taken into account while using them as a waste dump. The NEP identifies an Action Plan for these water bodies which importantly include formulation of conservation & prudent use strategies, integration of wetland and lake conservation into sectoral development plans for poverty alleviation and livelihood improvement, formulation of eco-tourism strategies prove multi stakeholders partnership and above all setting up of a legally enforceable regulatory mechanism for these water bodies.

42. Other Acts and Rules applicable for this project are listed in the following table.

Table 7: Applicable Environmental Regulations

Law	Description	Requirement
Noise Pollution (Regulation and Control) Rules, 2000 and amended	Rule 3 of the Act specifies ambient air quality standards in respect of noise for different areas/zones.	To comply with the CPCB Ambient Noise Standards. (see rule 3(1) and 4(1))
Air (Prevention and Control of Pollution) Act,	Applicable for equipment and machinery's potential to emit air pollution (including but not limited to	Equipment and machinery such as diesel generators, wet mix plants, stone crushers, etc. if installed for

Law	Description	Requirement
1981, amended 1987 and it's Rules, 1982.	diesel generators and vehicles);	construction to comply with applicable emission standards.
Municipal Solid Wastes Management Rules, 2016	Rules to manage municipal solid waste generated; provides rules for segregation, storage, collection, processing, and disposal.	The solid waste generated at proposed facilities shall be managed and disposed off by following the SWM Rules
Construction and Demolition (C & D) Waste Management Rules, 2016	Rules to manage construction and waste resulting from construction, re-modelling, repair and demolition of civil structure. Rules define C & D waste as comprising of building materials, debris resulting from demolition / re-modelling or repairs	Construction and demolition waste generated from the project shall be managed and disposed as per the rules
Central Ground Water Authority, Notification, 1997	It provides for regulation and control of ground water development and management	Permission for the extraction of Groundwater for construction purposes from Central Groundwater Board (CGWB)
Tamil Nadu State Ground Water (Development and Management) Act, 2003	This Act is to protect groundwater resources and provide safeguards against groundwater overexploitation, and to ensure its planned development and management; notifies areas for development, regulation and control of groundwater; prohibits sinking of wells and groundwater transport in notified areas without prior permission of the designated authority; requires all wells to be registered	Groundwater abstraction in any of the notified areas will be subject to the provisions of this Act.
Labor Laws	The contractors shall not make employment decisions based upon personal characteristics unrelated to job requirements. The contractors shall base the employment relationship upon the equal opportunity and fair treatment and shall not discriminate concerning aspects of the employment relationship, including recruitment and hiring, compensation (including wages and benefits), working conditions and terms of employment or retirement, and discipline. The contractors shall provide equal wages and benefits to men and women for work of equal value or type.	**Appendix 2** provides applicable labor laws including amendments issued from time to time applicable to establishments engaged in the construction of civil works.
Inter-State Migrant Workmen (Regulation of Employment and Conditions of Service) Act, 1979	Act is applicable to any establishment that employs 5 or more inter-state migrant workers through an intermediary (who has recruited workers in one state for employment	Contractor to register with the Labour Department in case of hiring of inter-state migrant workers. Adequate and appropriate amenities and facilities to be provided to workers including housing, sanitation, portable water,

Law	Description	Requirement
	at an establishment situated in another state).	medical aid, traveling expenses from home to work place, etc.
Building and Other Construction Workers (Regulation of Employment and Conditions of Service) Act, 1996	It regulates the employment and conditions of service of building and other construction workers and provides for their safety, health and welfare	This act is applicable for safeguarding the construction labours/ workers engaged in this project.
Ancient Monuments and Archaeological Sites and Remains Acts, 1958, its Rules, 1959 and notification, 1992. Ancient Monuments and Archeological Sites and Remains (Amendment and Validation) Act, 2010	This act provides, inter alia, for the preservation of ancient and historical monuments and archaeological sites and remains of national importance • Notifies 100m around the monument as a prohibited area and 100 to 300m as a regulated area for construction works; • No excavation/ construction work is allowed within 100m of the boundary of the protected monument; • Requires prior permission of National Monument Authority (NMA) for taking up works within 300m of the boundary of protected monuments	There are no protected monuments in project area. Hence not applicable to the project.

43. **ADB SPS Requirements**. During the design, construction, and operation of the project, the GCC will apply pollution prevention and control technologies and practices consistent with international good practice, as reflected in internationally recognized standards such as the World Bank Group's Environment, Health, and Safety Guidelines. These standards contain performance levels and measures that are normally acceptable and applicable to projects. When the Government of India regulations differ from these levels and measures, the GCC will achieve whichever is more stringent. If less stringent levels or measures are appropriate in view of specific project circumstances, the GCC will provide full and detailed justification for any proposed alternatives that are consistent with the requirements presented in ADB SPS.

Table 8: WHO Ambient Air Quality Guidelines

Parameters	Averaging Period	Guidelines Value in $\mu g/m^3$
Sulfur Dioxide (SO_2)	24-hour 10 minutes	125 (Interim Target-1) 50(Interim Target-2) 20(Guidelines) 500(Guidelines)
Nitrogen Dioxide (NO_2)	1-Year 1-hour	40 (Guidelines) 200 (Guidelines)
Particular Matter PM_{10}	1-Year	70 (Interim target-1) 50 (Interim target-2) 30 (Interim target-3) 20(Guidelines)
	24-hour	150 (Interim target-1) 100 (Interim target-2) 75 (Interim target-3) 50(Guidelines)

Parameters	Averaging Period	Guidelines Value in μg/m³
Particular Matter $PM_{2.5}$	1-Year	35 (Interim target-1) 25 (Interim target-2) 15 (Interim target-3) 10(Guidelines)
	24-hour	75 (Interim target-1) 50 (Interim target-2) 37.5 (Interim target-3) 25 (Guidelines)
Ozone	8-hour daily Maximum	160 (Interim Target-1) 100 (Guidelines)

Table 9: World Bank Group's EHS Noise Level Guidelines

Receptor	One Hour Leq (dBA)	
	Daytime 07.00-22.00	Night Time 22.00 – 07.00
Residential, Institutional educational	55	45
Industrial, Commercial	70	70

Table 10: Water Quality Standard as per WHO

Group	National Standards for Drinking Water			WHO Guidelines for Drinking-Water Quality, 4th Edition, 2011	Applicable Per ADB, SPS
	Parameter	Unit	Max. Concentration Limit		
Physical	Turbidity	NTU	1 (5)	-	1 (5)
	pH		6.5 – 8.5	None	6.5 – 8.5
	Color	Hazen Units	5 (15)	None	5 (15)
	Taste and Odor		Agreeable	-	Agreeable
	TDS	mg/l	500 (2,000)	-	500 (2,000)
	Iron	mg/l	0.3	-	0.3
	Manganese	mg/l	0.1 (0.3)	-	0.1 (0.3)
	Arsenic	mg/l	0.01 (0.05)	0.01	0.01
	Cadmium	mg/l	0.003	0.003	0.003
	Chromium	mg/l	0.05	0.05	0.05
	Cyanide	mg/l	0.05	None	0.05
	Fluoride	mg/l	1 (1.5)	1.5	1 (1.5)
	Lead	mg/l	0.01	0.01	0.01
	Ammonia	mg/l	0.5	none established	0.5
Chemical	Chloride	mg/l	250 (1,000)	none established	250 (1,000)
	Barium	mg/l	0.7	None	0.7
	Sulphate	mg/l	200 (400)	None	200 (400)
	Nitrate	mg/l	45	50	45
	Copper	mg/l	0.05 (1.5)	2	0.05 (1.5)
	Total Hardness	mg/l	200 (600)	-	200 (600)
	Calcium	mg/l	75 (200)	-	75 (200)
	Zinc	mg/l	5 (15)	none established	5 (15)
	Mercury	mg/l	0.001	0.006	0.001
	Aluminum	mg/l	0.1 (0.3)	none established	0.1 (0.3)
	Anionic Detergents	mg/l	0.2 (1.0)	None	0.2 (1.0)
	Phenolic Compounds	mg/l	0.001(0.002)	None	0.001(0.002)

Group	National Standards for Drinking Water			WHO Guidelines for Drinking-Water Quality, 4th Edition, 2011	Applicable Per ADB, SPS
	Parameter	Unit	Max. Concentration Limit		
	Residual Chlorine	mg/l	0.2	5	0.2
Microbial indicator	E-coli	MPN/100ml	Must not be detectable in any100 ml sample	Must not be detectable in any 100 ml sample	Must not be detectable in any 100 ml sample
	Total Coliform	MPN/100ml			

IV. DESCRIPTION OF THE ENVIRONMENT

A. Methodology Used for Baseline Study

44. **Data collection and stakeholder consultations.** Data for this study has been collected through a comprehensive literature survey, field monitoring, discussion with stakeholder agencies and field visits to the proposed project area. The literature survey broadly covers the following:

(i) Project details, reports, maps and other documents prepared by DPR consultant,
(ii) Discussions with ADB and GEF Consultants, GCC, DPR Consultants, and other relevant government agencies
(iii) Secondary data from previous project reports and published articles, and
(iv) The literature on land use, soil, geology, hydrology, climate, socioeconomic profiles and other planning documents collected from Government agencies and websites.

45. Field monitoring survey and a secondary source of information broadly covered (i) ambient air quality monitoring, (ii) noise levels/ quality monitoring, (iii) surface water sampling, (iv) sediment quality assessment and (v) biodiversity assessment.

46. **Ocular inspection.** Site visits to the project area and field monitoring surveys were made during the IEE preparation in 2020 and 2021. The purpose of the inspection is to assess the existing environment (physical, biological, and socioeconomic) and gather information concerning the proposed site and scale of the proposed project. Field sampling surveys for air, noise, water and soil quality were conducted in December 2020 and May 2021. Biodiversity survey was conducted in December 2020 and January 2021. A separate socioeconomic study was conducted to determine demographic information, existing service levels, stakeholder needs, and priorities.

B. Physical Environmental

47. **Topography**. The project area (Kadapakkam Lake) is located at 13º12’13.35 latitude and 80º15’08.25 longitude is characterized by flat terrain and sloping gently from west to east direction. The elevation is around 2 to 3m msl.

48. **Land use**. The land use pattern surrounding the Kadapakkam lake catchment area is predominately agricultural land and open space. Landuse of the command area is predominantly agricultural, Industries and sparse rural settlements. A drone survey of the lake area, conducted on December 10, 2020, has also confirmed the same.

49. **Geology and Soils**. The project area falls under the Kosasthalaiyar River basin which has varied geological profile. The western part is underlain by hard crystalline rocks (Precambrian) while the eastern part contains sedimentary rocks, alluvium and Laterite. Sand and clay are predominant within the Kosasthalaiyar River basin. Specific gravity was found in the range of 2.35 to 2.66. Natural moisture content in the soil was found in the range of 17 to 40%.

50. **Climate**. The project area experiences tropical wet and dry climate. For most of the year, the weather is hot and humid. The hottest part of the year is late May and early June with maximum temperatures around 38°C to 42°C. The coolest part of the year is January, with minimum temperature around 18°C to 20°C.

51. **Rainfall**. The project area gets most of its seasonal rainfall from the north-east monsoon, from mid-September to mid-December. Annual average rainfall is 823 mm. The maximum amount of monthly rainfall (1104.2 mm) occurred during the month of November 2015 and maximum amount of daily rainfall (320 mm) occurred on 2 December 2015.

52. The most prevailing wind direction is the south-westerly between the end of May to end of September and north-easterly during the rest of the year.

53. **Air Quality**. As part of IEE for the ADB funded "*Integrated Urban Flood Management for the Chennai - Kosasthalaiyar Basin Project*" 24 hours ambient air quality (AAQ) monitoring has been conducted by the GCC at the following 5 locations in Chennai - Kosasthalaiyar Basin on 10 June 2019: (i) Manali high road, Kalaignarnagar (commercial area), (ii) St. Joseph's Matriculation Higher Secondary School, Kathivakkam (sensitive area), (iii) Near Zuari Cement Grinding Unit, Athipattu (industrial area), (iv) Near Ashok Leyland Technical Centre, Vallur (sensitive area), and (v) Manali New Town (residential area) on 22nd and 23rd April, 2019. Per results, the PM_{10} was in the range between 61 to 112 µg/m^3. $PM_{2.5}$ was found to be within 60 µg/m^3 at all locations. Similarly, the SO_2 and NO_2 concentration was observed to be within the limits of 80 µg/m^3. The observed values for SO_2 and NO_2 are within the WHO ambient air quality guideline. For this project, a 24-hour ambient air quality monitoring was conducted at Veerathi Kadaliayamman Temple, located on the Kadapakkam Lake bund, on 10th December 2020 (Refer **Appendix 3**). Key air quality parameters including SO_2, NO_x, and Particulate Matters (PM_{10} and $PM_{2.5}$) were measured, and as presented in the below table, the monitored values are well within the NAAQ standard and WHO ambient air quality guideline.

Table 11: Air sampling Test Results

S. No	Parameters	Unit	Results	NAAQ Standard (24 Hours)	WHO Guideline (24 Hours)
1	Sulphur Di Oxide	µg/m^3	8.34	80	20
2	Nitrogen Oxides	µg/m^3	19.46	80	40 (1-year)
3	PM_{10}	µg/m^3	45.36	100	50
4	$PM_{2.5}$	µg/m^3	18.51	60	25

Source: DPR 2021

54. **Noise Quality**. Ambient noise quality has been conducted at 3 locations at the Kadapakkam Lake on 10 Dec 2020 and 5 May 2021. The recorded noise level ranges between 58.1 to 73.2 dB(A). From the inference, it is evident that the ambient noise levels are observed to be high in comparison with the stipulated noise limit for residential area and sensitive zones as per the Noise Pollution (Regulation and Control) Rules 2000 as well as World Bank Group's EHS Noise Level Guidelines (Refer **Appendix 3**).

Table 12: Noise Monitoring Results

S. No	Location	Noise Level in dB (A) - Daytime	NAAQ Permissible Limits (Leq dB(A)	World Bank Group's EHS Noise Level Guidelines - One Hour Leq (dBA)
1	Near Veerathi Kadaliyamman Temple (10 Dec 2020)	73.2	55 (Residential Area) 50 (Sensitive Zone)	55 (Residential, Institutional educational)
2	Near Karumariyamman Temple (Amman Kulam), Kadapakkam (5 May 2021)	58.1		

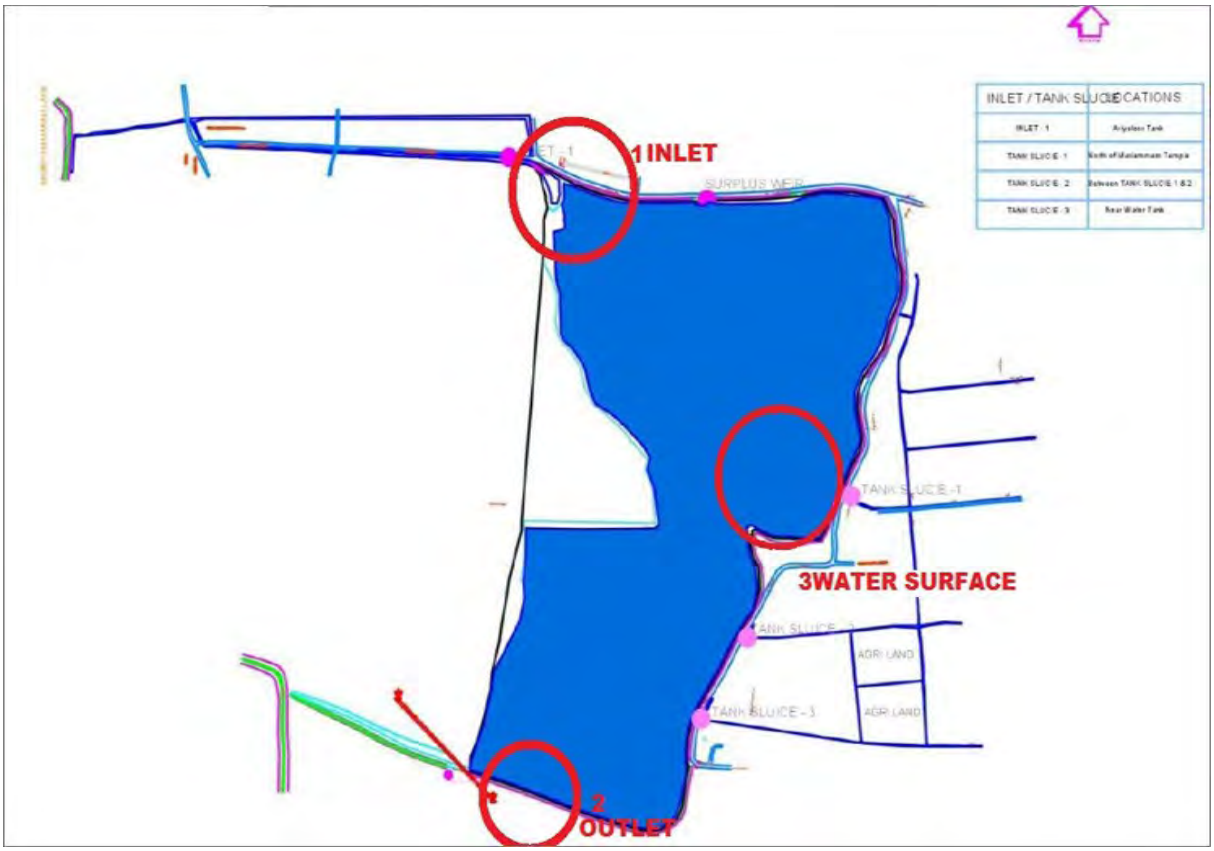
S. No	Location	Noise Level in dB (A) - Daytime	NAAQ Permissible Limits (Leq dB(A)	World Bank Group's EHS Noise Level Guidelines - One Hour Leq (dBA)
3	Near Perumal Temple - Kanniyamman Pettai, Kadapakkam (5 May 2021)	60.2		

Source: DPR 2021

55. **Ground Water Quality.** Based on the secondary information on groundwater in Kadapakkam village tested in May 2018 (source: Central Ground Water Board), groundwater quality is poor, and contains high amounts of hardness (1210 mg / l as against the standard of 200 mg/l), chlorides (744 mg/l - 250 mg/l), calcium (172 mg/l - 75 mg/l), magnesium (190 mg/l-30 mg/l)and sulphates (953 mg/l - 200 mg/l) in comparison with the drinking water standard (IS 10500). Concentration of nitrate (5-mg-45 mg/l) and fluoride (1.4 mg/l – 1.5 mg/l) are well within the permissible limit.

56. **Surface water Quality**. During the IEE study, three surface water samples were collected from the Kadapakkam Lake and tested for its physcio-chemical and biological parameters (Refer **Appendix 3**). The surface water sample from the middle section of the lake was collected in the post monsoon season (10 Dec 2020) and other two samples (inlet to the lake and outlet to the lake) has been collected during the pre-monsoon season (5 May 2021). Location maps showing the water sample collection points are shown in Figure 4.

Figure 4: Surface water sampling location - Kadapakkam lake



57. Results of the water quality analysis were compared with the IS 2296-1982 (Table 13) standards for surface water quality. From the observation, the water samples collected from the inlet and middle section of the lake meets the requirements for Class A and the water sample collected from outlet of the lake meets the Class B requirements.

Table 13: IS: 2296-1982 Class of surface Water

Classification	Type of Use
Class A	Drinking water source without conventional treatment but after disinfection
Class B	Outdoor bathing
Class C	Drinking water source with conventional treatment followed by disinfection.
Class D	Fish culture and wild life propagation
Class E	Irrigation, industrial cooling or controlled waste disposal

Table 14: Surface Water Quality Results

Sl.no	Water Quality Parameters	1. Inlet of the lake	2. Outlet of the lake	3. Middle section of the lake
1.	pH (25°C)	7.76	7.25	7.5
2.	Electric Conductivity (μS/cm)	346.0	467.0	260.0
3.	Chloride (mg/l)	51.46	74.23	36.25
4.	Total Dissolved Solids (mg/l)	178.0	272.0	142.0
5.	Sulphate (mg/l)	3.85	31.75	14.5
6.	Fluoride (mg/l)	BDL	0.23	BDL
7.	Nitrate (mg/l)	3.3	4.2	3.7
8.	Iron (mg/l)	0.17	0.12	0.34
9.	Total Suspended Solids (mg/l)	48.0	45.0	47.0
10.	BOD, 3 days @27°C (mg/l)	4.0	2.0	4.0
11.	Chemical Oxygen Demand (mg/l)	32.0	16.0	36.0
12.	Dissolved Oxygen (mg/l)	6.4	6.6	6.3
13.	Ammonia (mg/l)	0.13	0.84	0.43
14.	Total Kjeldahl Nitrogen (mg/l)	0.17	0.11	0.55
15.	Ammonical Nitrogen (mg/l)	0.11	0.07	0.36
16.	Dissolved Phosphate (mg/l)	0.18	0.73	0.45
17.	Total Coliforms	<2	<2	<2

Source: DPR 2021

58. **Sediment Quality**. For the lake restoration works, the desilting process involves removal of huge quantity of sediment and soil from the lake bed. Considering the soil physical and chemical characteristics, it is necessary to devise a plan to dispose the excess quantity in activities like bund restoration, utilization for agricultural purposes. Therefore, lake bed samples were collected on 10th December 2020 and analysed for soil texture, physical (pH and Colour), chemical (Sodium, Phosphate and Nitrate) and heavy metal parameters (Trivalent Chromium, Hexavalent Chromium, Mercury, Manganese and Iron) in a NABL certified laboratory (Refer **Appendix 3**). From the analysis, it was observed that the sediments are dominated by clay (smaller size of particles, feels sticky) in nature without any heavy metal contaminations. The pH of the sediment is 6.34 and Soil electrical conductivity is 76.4 mS/m is ideal for agricultural uses.

Table 15: Sediment Quality Analysis Results

S. No	Parameters	Units	Results
1	pH	-	6.34
2	Exture	-	Clay
3	Sand	%	3.50

S. No	Parameters	Units	Results
4	Silt	%	6.48
5	Clay	%	90.02
6	Electrical conductivity	-	76.4
7	Sodium	mg/kg	477.0
8	Phosphate	mg/kg	22.38
9	Colour	-	Yellowish
10	Nitrates	mg/kg	11.44
11	Iron	mg/kg	105.47
12	Hexavalent Chromium	mg/kg	BLQ (LOQ 0.5)
13	Trivalent Chromium	mg/kg	0.70
14	Manganese	mg/kg	118.83
15	Mercury	mg/kg	BLQ (LOQ 0.1)

Source: DPR 2021

C. Biological Environment

59. Biodiversity Assessment has been conducted for the Kadapakkam Lake (Refer Appendix 9), for ensuring that development proposals integrate biodiversity considerations and include mechanisms for the conservation of biodiversity (with the aim of no net loss of biodiversity), resulting in sustainable use of biodiversity resources, and provide fair and equitable sharing of the benefits arising from use of biodiversity. The summary from the assessment has been discussed in the following sections.

60. **Flora and Fauna surveys and assessment methodology**. The proposed lake has four different habitats such as the terrestrial ecosystem, the freshwater ecosystem, the fragmented scrub jungle ecosystem and the wetland ecosystem (agriculture) the terrestrial floral species and macro fauna were surveyed in these habitats. Primary data on flora and fauna (fish, amphibians and reptiles, butterflies, odonates and birds) were collected by the DPR consultants during Post monsoon (northeast monsoon) in December 2020 via the walkthrough survey / visual observation and photo and videography. Further, baseline data on the status of the lake and survey of flora and fishes, amphibians, butterflies, odonates and birds was collected during this IEE study by ADB consultant via walkthrough survey / visual observation and photo during 28th to 29th December 2020 and 4th and 5th January 2021. The following objectives were considered for the studies:

(i) The on-ground status of the habitats along the proposed lake and the interlinking areas.
(ii) The biodiversity and associated ecosystem of the lake and its surrounding.
(iii) Identification of Critically Endangered Species, Endemic Species; Migratory Species and Regionally unique and highly threatened habitat or ecosystems influenced by the project
(iv) Propose measures for no or minimum damage to the biodiversity

61. Secondary source of information in identifying the species are obtained from the following documents/ literature.

(i) Regional and National literatures
(ii) Integrated Biodiversity Assessment Tool (IBAT);
(iii) The World Database of Key Biodiversity Areas website (WPDA);
(iv) Important Bird Areas (Birdlife International);

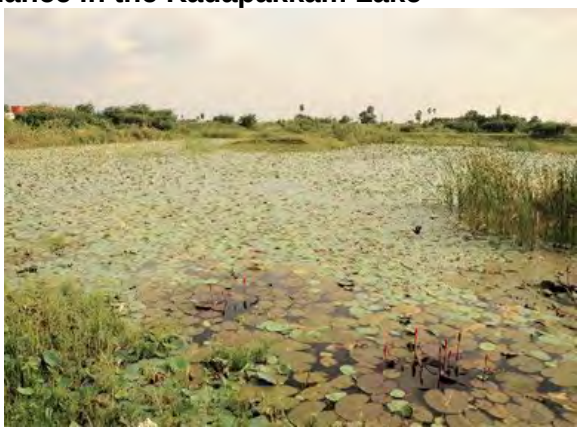
(v) Ramsar website;
(vi) IUCN Redlist;
(vii) UNEP-WCMC (2017) Global Critical Habitat screening layer

1. Flora

62. Terrestrial vegetation in the project areas typically consists of small isolated pockets of vegetation and farmland and small plantations adjacent. Terrestrial plants are restricted to the lake bund area with few tree species. Total of 124 species belonging to 51 families were recorded, and, intrestingly 26 families were represented by a single species. A maximum of 13 species were of Fabaceae, followed by 13 of Poaceae and 8 of Asteraceae. Eubhorbiaceae and Cyperaceae familes represented by 7 species each. Good density of hydrophytes were observed; species like *Spirodela polyrhiza, Aponogeton natans, Alternanthera sessilis, Hydrilla verticillata, Pistia stratiotes, Nymphaea nouchali, Nymphaea rubra* were identified and good density of like *Nelumbo nucifera, Nymphaea pubescens* and *Nymphaea nouchal* were observed throughout the water body. Water quality was good and the presence of more number of hydrophytes are the good indicator of it. Nearly 13% of the species recorded were represented by one or few numbers at scattered locations. Many non-woody species such as herbs (31%) forming dense mat on the lake bund. Hydrophytes (20%) consist of submerged, emergent and floating habits, shrubs (13%) at scattered locations, climbers (10%, Asclepiadaceae, Cucurbitaceae and Convoluvaceae) running on trees, and Capparidaceae on the ground and grasses comprise 10%. During the summer, when the water level dries up on the water spread areas, it supports temporary habitat for herbs and grasses.

63. Hard wood and Thorny trees like *Prospis juliflora* and *Acacia nilotica* in the water spread were found and these serve as nesting place for Herons, especially purple heron, which breeds in these trees. Very few numbers of trees like *Azardiracta indica* and *Morinda* were identified along the bund.

View of aquatic vegetation dominance in the Kadapakkam Lake



Fragmented small patch of vegetation along the lake and less or no vegetation along the bund

Table 16: Aquatic plants in Kadapakkam Lake

S. No	Scientific name	Common Name	Local Name
1	*Alternanthera philoxeroides*	Alligator weed	Seemai Karisilangani
2	*Aponogeton natans*	Floating Lace Plant	Kottikizhangu
3	*Ceratophyllum demersum*	Hornwort	Velampasi
4	*Cyperus rotundus*	Common Nut Sedge	Koraikizhangu
5	*Eichornia crassipes*	Water Hyacinth	Venkayatamarai
6	*Hydrilla verticillata*	Water Thyme	Amiranappaci
7	*Hygrophilla auriculata*	Marsh Barbel	Neer Mulli
8	*Ipomea aquatica*	Swamp morning-glory	Nali
9	*Ipomea carnea*	Bush morning glory	Neyveli kattamanaku
10	*Kyllinga bulbosa*	Spikesedges	Koraipul
11	*Lemna minor*	Common duckweed	Vathumithavai
12	*Ludwigiaad scendens*	Water Primrose	Kattukkirampu
13	*Marsilea quadrifolia*	Water Shamrock	Neer-aarai
14	*Nelumbo nucifera*	Sacred lotus	Thamarai
15	*Nymphaea alba*	White Waterlily	Ambal
16	*Nymphaea nouchali*	Blue Water Lily	Neelaambal
17	*Nymphaea pubescens*	Pink Water Lily	Vellambal
18	*Nymphaea rubra*	Red Water Lily	Sivappuaambal
19	*Nymphoides hydrophylla*	Crested Floatingheart	Chinnambal
20	*Nymphoides indica*	Water snowflake	Chinnambal
21	*Polygonum glabra*	Dense flower knot weed	Atlaria, Atalari
22	*Salvinia molesta*	Giant salvinia	Periyasalvinia
13	*Scirpus articulates*	Pendulous bulrush	Korai
24	*Typha angustifolia*	Common cattail	Sambu
25	*Utricularia aurea*	Golden bladderwort	-

Source: Reconnaissance Survey

Table 17: Trees observed around Kadapakkam Lake

S. No	Scientific name	Common Name	Local Name
1	*Acacia nilotica*	Babool	Karuvel
2	*Azardiracta indica*	Neem tree	Veppamaram
3	*Borassus flabellifer*	Palm tree	Panaimaram
4	*Cassia siamea*	Siamese cassia	ManjaKondrai
5	*Ficus religiosa*	Pepul tree	Arasamaram
6	*Lannea coromandelica*	Indian Ash tree	Othiyamaram

S. No	Scientific name	Common Name	Local Name
7	*Millingtonia hortensis*	Indian cork tree	Maramalli
8	*Phoenix sylvestris*	Silver Date Palm	Eachamaram
9	*Pongamia pinnata*	Indian Beech Tree	Pungamaram
10	*Prosopis juliflora*	Mesquite	Velikaruvaimaram
11	*Tamarindus indica*	Tamarind	Puliyamaram
12	*Samanea saman*	Monkey pod tree	Thoongumunjimaram
13	*Ziziphus mauritiana*	Ber	Elandai
14	*Morinda tinctoria*	Indian mulberry	Nona chedi
15	*Ficus hispida*	Hairy fig	Pei atthi
16	*Limonia acidissima*	Elephant apple	Vila
17	*Leucaena leucocephala*	Wild Tamarind	Savundalmaram

Source: Reconnaissance Survey

Table 18: Shrubs observed around Kadapakkam Lake

S. No	Scientific name	Common Name	Local Name
1	*Abutilon indicum*	Indian Abutilon	Paniyarattuti
2	*Abutilon indicum guineense*	Country mallow	Thuthi
3	*Azima tetracantha*	Needle Bush	Sangumul
4	*Cadaba fruticosa*	Indian Cadaba	Vizhudhi
5	*Calotropis gigantea*	Crown flower	Erukan chedi
6	*Cassia alata*	Candle bush	Seemaiagathi
7	*Cassia obtusifolia*	Sicklepod	Chiru takarai
8	*Cassia occidentalis*	Coffee Senna	Peiavarai
9	*Cassia tora*	Foetidcassi	Senavu
10	*Chrozophorarottleri*	Rottler's Chrozophora	Purapirakkai
11	*Datura innoxia*	Recurved thorn-apple	Vellammattai
12	*Hibiscus vitifolius*	Tropical rose mallow	Siruthutthi
13	*Jatropha gossypifolia*	Cotton-leaved jatropha	Seemayamanakku
14	*Lantana camera*	Lantana	Unni chedi
15	*Phyllanthus reticulatus*	Black-Honey Shrub	Sivapupoola
16	*Ziziphus oenoplia*	Jackal Jujube	Suraimul

Source: Reconnaissance Survey

Table 19: Herbs observed around Kadapakkam Lake

S. No	Scientific name	Common Name	Local Name
1	*Acalypha indica*	Indian acalypha	Kuppameni
2	*Achyranthes aspera*	Prickly Chaff Flower	Naaiuruvi chedi
3	*Aerva lantana*	Mountain Knot Grass	Sirupoola poo
4	*Alternanthera sessilis*	Sessile Joyweed	Ponnanganni
5	*Alternanthera tenella*	True Yellow Calico Plant	Keeri
6	*Alysicarpus monilifer*	Alyce Clover	Kaasukkodi
7	*Blume amollis*	Soft Blumea	Narakkarandai
8	*Boerhaavia diffusa*	Hog weed	MukkarattaiKeerai
9	*Cleome viscosa*	Asian Spider Flower	Naaikadugu
10	*Coldenia procumbens*	Creeping Coldenia	Seruppadai
11	*Commelina benghalensis*	Day Flower	Kanangkozai
12	*Corchorus aestuans*	East Indian Mallow	Perumpinnakkukkirai
13	*Croton sparsiflorus*	Ban tulasi	Naimelakkai
14	*Eclipta alba*	False Daisy	Vellaikarisilankanni
15	*Euphorbia hirta*	Asthma weed	AmmaanPachcharisi
16	*Glinusoppositifolia*	Bitter cumin	Peruntiray
17	*Gomphrena serrata*	Prostrate Gomphrena	Vellaivadamalli
18	*Heliotropium indicum*	Indian heliotrope	Thelkodukku
19	*Leucas aspera*	Common Leucas	Thumbai
20	*Lippianodiflora*	Frog fruit	Podutalai
21	*Mimosa pudica*	Common Sensitive Plant	Thottasinungi
22	*Parthenium hysterophorus*	Parthenium weed	Mookuthipoo
23	*Phyllanthus amarus*	Stone breaker.	Killanelli
24	*Physalis angulata*	Groundcherry	Sodakkuthakkali
25	*Ruellia tuberosa*	Minnie Root	Tapas kaai
26	*Sida acuta*	Common wireweed	Vattathirupi
27	*Sida cordifolia*	Country mallow	Sidhamooti
28	*Spermacoce articularis*	Jointed Buttonweed	Nathaichoori
29	*Stachytarpheta indica*	Indian Snakeweed	Seemainayuruvi
30	*Trianthema portulacastrum*	Black pig weed	Mookaratai

S. No	Scientific name	Common Name	Local Name
31	*Tridax procumbens*	Coat buttons	Vettukkaaya-thalai
32	*Vernonia cinerea*	Little ironweed	Neichitti
33	*Phyla nodiflora*	Frog Fruit	Poduthalai
34	*Commelina diffusa*	Climbing day flower	Kanavalai
35	*Emilia sonchifolia*	Lilac tasselflower	Muyalccevi
36	*Mollugo pentaphylla*	Carpetweed	Kuttuttiray
37	*Xanthium strumarium*	rough cocklebur	Maruloomathai
38	*Scoparia dulcis*	Sweet broom weed	Kallurukki

Source: Reconnaissance Survey

Table 20: Climbers observed around Kadapakkam Lake

S. No	Scientific name	Common Name	Local Name
1	*Cardiospermum halicacabum*	Heart seed	Mudakattan
2	*Cissis vitiginea*	South Indian Treebine	Kattumunthiri
3	*Clitoriaternetea*	Asian pigeon wings	Sangu Poo
4	*Coccinia grandis*	Ivy gourd	Kovakkai
5	*Oxystelma esculentum*	Rosy Milkweed Vine	Usippalai
6	*Passiflora foetida*	Fetid passionflower	Siruppunaikkalikodi
7	*Pentatropis capensis*	Ambarvel	Upilankodi
8	*Pergularia daemia*	Pergularia	Uttamani
9	*Solanum trilobatum*	Purple Fruited Pea Eggplant	Tuduvalai
10	*Wattakaka volubilis*	Sneeze Wort	Kurinjan
11	*Ipomea separia*	Purple heart glory	Senthali
12	*Rivea hypocrateriformis*	Midnapore Creeper	Musuttai
13	*Capparis zeylanica*	Ceylon caper	Aathondai
14	*Maerua oblongifolia*	Desert caper	Boomi sakkaraivallikilangu
15	*Merremia emarginata*	Kidney leaf morning glory	Elikkadhukeerai
16	*Luffa aegyptiaca*	Sponge guard	Egipthuvellari

Source: Reconnaissance Survey

Table 21: Grasses observed around Kadapakkam Lake

S. No	Scientific name	Common Name	Local Name
1	*Alloteropsis cimicina*	Summer grass	Kodaipul
2	*Apluda mutica*	Mauritian Grass	Moongilpul
3	*Chloris barbata*	Swollen Finger Grass	Mayilkondaipul
4	*Cynodan dactylon*	Bermuda grass	Arugampul
5	*Sporobolus coromandelianus*	Smut grass	Pul
6	*Cyperus compressus*	Poorland Flat Sedge	Korai kizhangu
7	*Cyperus exaltatus*	Tall Flat Sedge	Korai
8	*Arundo donax*	Giant Reed	Southaimoongil
9	*Dactyloctenium aegyptium*	Egyptiyan crowfoot	Kakkakalpul
10	*Kyllinga bulbosa*	Whitehead Spikehedge	Koraipul
11	*Saccharum spontaneum*	Wild Sugarcane	Peikarumbu
12	*Schoenoplectiella articulata*	Sedge grass	Korai

Source: Reconnaissance Survey

2. Fauna

2.1. Fishes

64. Kadapakkam freshwater habitat provides habitat for locally predominant fish species. The increase or decrease of fish diversity and population has a direct impact on the interpretation of

the success or failure of restoration / interventions since they are the most reliable indicators where interventions in water are planned and executed. Occurrence of smaller size native fish indicates the lake is healthy and least impacted by invasive Tilapia and other anthropogenic threats. A total of 12 species were encountered in the Kadapakam Lake, which is comparatively less than other lakes along the regions.

65. One invasive species was encountered during the survey. The Tilapia or Egyptian Mouthbreeder *Oreochromis mossambicus* introduced from Africa as a protein substitute food fish, this species finds prominent mention in the list of "100 of the world's worst invasive alien species". During all fishing sessions *Oreochromis mossambicus* was caught but comparatively less in numbers, which need to be kept in control.

View of *Pseudetroplus maculatus* (Orange Chromid) and fishing activity at the Kadapakkam lake

Table 22: Icthyofauna observed in Kadapakkam Lake

S. No	Scientific Name	Common name	IUCN / Wildlife Protection Act 1972 - Status
1	*Channa striata*	Snake head murrel	LC
2	*Channa punctata*	Spotted snakehead	LC
3	*Oreochromis mossambicus*	Tilapia	LC
4	*Glossogobius giuris*	Tank goby	LC
5	*Mystus vittatus*	Stripped dwarf catfish	LC
6	*Puntius sophore*	Pool barb	LC
7	*Puntius chola*	Swamp barb	LC
8	*Pseudetroplus maculatus*	Orange chromid	LC
9	*Rasbora dandia*	Rasbora	LC
10	*Pethia conchonius*	Rosy barb	LC
11	*Pethiaticto*	Ticto barb	LC
12	*Xenantadon cancilla*	Freshwater garfish	LC

Source: Reconnaissance Survey, LC – Least Concern

2.2. Amphibians and Reptiles

66. Amphibians and reptiles are bio-indicators that provide valuable insights into the state of the ecosystem they inhabit. Marginal and suboptimal habitat patches present near human settlements often harbor a good number of biodiversity. 2 species of Amphibian and 8 species of Reptiles were identified.

Table 23: Amphibians observed around Kadapakkam Lake

S. No	Scientific Name	Common Name	Local name
1	*Hoplobatrachus tigerinus*	Indian bullfrog	Thavalai
2	*Duttaphrynus melanostictus*	Asian common toad	Periyatherai

Source: Reconnaissance Survey

Table 24: Reptiles observed around Kadapakkam Lake

S. No	Scientific Name	Common Name	IUCN / Wildlife Protection Act 1972 -Status
1	*Naja naja*	Indian cobra	LC
2	*Bungarus caeruleus*	Indian krait	LC
3	*Daboia russelii*	Russels viper	LC
4	*Ptyas mucosus*	Indian rat snake	LC
5	*Xenochrophis piscator*	Asiatic water snake	LC
6	*Ahaetulla nasuta*	Common vine snake	LC
7	*Eryx conicus*	Common sand boa	LC
8	*Melanochelys trijuga*	Indian pond terrapin	LC

Source: Reconnaissance Survey, LC – Least Concern

2.3. Butterflies and Odonates

67. A baseline study of the Butterflies and Odonata (dragonflies and damselflies) was carried out as a part of the biodiversity survey, the study targeted in identifying the existing population of Butterflies and Odonates, which also act as the bio-indicators for the health of any eco-system and can subsequently be used to gauge the progress of the restored lake in future stages of development. Butterflies are beneficial as they serve as pollinators and indicators of environmental quality and are appreciated for their aesthetic value and are vital for the agriculture lands around. The variety of butterflies in an area varies in direct proportion to the diversity of the local vegetation since butterfly species feed on different species of plants. 30 species butterflies and 14 species of Odonates were identified. Some of the butterfly host plants identified were *Amaranthus, Barleria, Calotropis, Pergularia, Tylophora, Capparis, Cleome, Ipomea, Acacia, Abutilon, Sida, Hibiscus* and species of *Poaceae* and *Papilionoideae*.

Table 25: Butterflies observed around Kadapakkam Lake

S. No	Scientific Name	Common Name	IUCN / Wildlife Protection Act 1972 -Status
1.	*Calotis danae*	Crimson tip	LC
2.	*Appias libythea*	Western Striped Albatross	LC
3.	*Colotis eucharis*	Plain orange tip	LC
4.	*Ixias pyrene*	Yellow orange tip	LC
5.	*Catopsilia pomona*	Common emigrant	LC
6.	*Catopsilia pyranthe*	Molttled emigrant	LC
7.	*Cepora nerissa*	Common gul	NE
8.	*Danaus chrysippus*	Plain tiger	LC
9.	*Danaus genutia*	Common tiger	LC
10.	*Euploea core*	Indian Common Crow	LC
11.	*Acraea terpsicore*	Tawny coaster	LC
12.	*Pantoporia hordonia*	Common laskar	NE

S. No	Scientific Name	Common Name	IUCN / Wildlife Protection Act 1972 -Status
13.	*Junonia orithya*	Blue pansy	LC
14.	*Junonia lemonias*	Lemon pansy	LC
15.	*Junonia almana*	Peacock Pansy	LC
16.	*Tirumala septentrionis*	Dark blue tiger	LC
17.	*Tirumala limniace*	Blue tiger	NE
18.	*Parantica aglea*	Glassy tiger	LC
19.	*Pantoporia hordonia*	Common lascar	LC
20.	*Hypolimnas misippus*	Danid eggfly	LC
21.	*Hypolimnas bolina*	Great eggfly	LC
22.	*Junonia iphita*	Chocolate pansy	LC
23.	*Hemiargus ceraunus*	Ceraunus blue	LC
24.	*Zizeeria otis*	Lesser grass blue	LC
25.	*Zizeeria karsandra*	Dark grass blue	NE
26.	*Papilio demoleus*	Lime butterfly	LC
27.	*Papilio polytes*	Common morrnon	LC
28.	*Atrophaneura aristolochiae*	Common rose	NE
29.	*Atrophaneura hector*	Crimson rose	NE
30.	*Ampittia dioscorides*	Bush hopper	NE

Source: Reconnaissance Survey, LC – Least Concern, NE – Not Evaluated

Table 26: Dragonflies and Damselflies observed around Kadapakkam Lake

S. No	Scientific Name	Common Name	IUCN / Wildlife Protection Act 1972 -Status
1	*Rhyothemis variegata*	Common picture wing	LC
2	*Trithemis kirbyi*	Orange winged dropwing	LC
3	*Trithemis aurora*	Crimson marsh glider	LC
4	*Diplacodes nebulosa*	Black tipped ground skimmer	LC
5	*Brachydiplax sobrina*	Little blue marsh hawk	LC
6	*Diplacodes trivialis*	Ground skimmer	LC
7	*Orthetrum sabina*	Green marsh hawk	LC
8	*Trithemis pallidinervis*	Long legged marsh glider	LC
9	*Acisoma panorpoides*	Trumpet tail	LC
10	*Zyxomma petiolatum*	Brown dusk hawk	LC
11	*Rhodothemis rufa*	Rofous marsh glider	LC
12	*Anaciaeschna jaspidea*	Rusty darner	LC
13	*Ceriagrion cerinorubellum*	Coromandel marsh dart	LC
14	*Agriocnemis pygmaea*	Pygmy dartlet	LC

Source: Reconnaissance Survey, LC – Least Concern

2.4. Birds

68. Totally, 46 species belonging to 17 orders and 34 families were recorded. According to the IUCN Red List of threatened species, 45 species identified were observed as Least Concern (LC) and one species are listed as Near Threatened (NT): Spot-Billed Pelican (*Pelecanus philippensis)*. Terrestrial habitat along the lake bund provides feeding habitat for terrestrial birds, flowers attract variety of insects (larva, bees and butterflies) which in turn attracts insectivorous birds, fruits attract frugivorous, bushy vegetation provides ideal habitat for reptiles (snakes and lizards) which in turn attracts omnivorous birds.

69. The areas along the project site includes some portion of fragmented scrubland with Palmyra Palm (*Borassus flabellifer*) and other trees like Neem (*Azadirachta indica*). The area has indigenous floral species predominantly; and thus, it still supports a good variety of bird species. Spot-billed Pelican were recorded in very less numbers and very few times in a year at Kadapakkam Lake and it is not a breeding or nesting site currently and it can be referred as occasional visitor of the lake. Kadapakkam Lake is about 23 km away from the Pulicat lake, the nearby breeding site of Spot-Billed Pelican. There are currently four stable large breeding colonies of Spot-billed Pelican in Tamil Nadu: Vedanthangal Bird Sanctuary, Koonthangulam Bird Sanctuary, Karaivetti Bird Sanctuary, and Karikilli Bird Sanctuary. In Chennai, Spot-billed Pelican breeds sites are spotted at Pallikaranai wetland and Pulicat, besides it utilizes Mutukadu backwaters, Adyar Estuary and along the coastal wetlands of South Chennai. All the above mentioned sites are more than 30 km from Kadapakkam Lake. The Kadapakkam Lake has 12 species of fishes and the wetland spread area and vegetation does not support it for nesting. Pelicans prefer Barringtonia acutangula, Tamarindus indica and Acacia nilotica tress, very few numbers < 5 trees of Acacia nilotica is present in the lake and no other two species.

Table 27: Avifaunal (Aquatic) species observed in Kadapakkam Lake

S. No	Scientific Name	Common Name	IUCN / Wildlife Protection Act 1972 -Status
1	*Alcedo atthis*	Common Kingfisher	LC
2	*Ceryle rudis*	Pied kingfisher	LC
3	*Halcyon smyrnensis*	White-throated kingfisher	LC
4	*Ardeola grayii*	Pond Heron	LC
5	*Bubulcus ibis*	Cattle egret	LC
6	*Egretta garzetta*	Little egret	LC
7	*Ixobrychus flavicollis*	Black bittern	LC
8	*Ardea cinerea*	Grey heron	LC
9	*Ixobrychus cinnamomeus*	Cinnamon bittern	LC
10	*Anhinga melanogaster*	Darter	NT
11	*Anastomus oscitans*	Asiatic openbill stork	LC
12	*Anas poecilorhyncha*	Spot billed duck	LC
13	*Porphyrio porphyrio*	Purple moorhen	LC
14	*Gallinula chloropus*	Common Moorhen	LC
15	*Amaurornis akool*	Brown crake	LC
16	*Amaurornis phoenicurus*	White breasted waterhen	LC
17	*Fulica atra*	Common coot	LC
18	*Vanellus indicus*	Red Wattles Lapwing	LC
19	*Sterna aurantia*	River tern	LC
20	*Pelecanus philippensis*	Spot billed pelican	NT
21	*Phalocorax niger*	Little Cormorant	LC
22	*Tachybaptus ruficollis*	Little grebe	LC
23	*Actitis hypoleucos*	Common Sandpiper	LC
24	*Esacus recurvirostris*	Great thick-knee	LC
25	*Nycticorax nycticorax*	Black crowned night heron	LC

Source: Reconnaissance Survey, LC – Least Concern, NE – Not Evaluated, NT – Near Threatened

Table 28: Avifaunal (Terrestrial) species observed in Kadapakkam Lake

S. No	Scientific Name	Common Name	IUCN / Wildlife Protection Act 1972 - Status
1	*Psittacula krameri*	Rose Ringed Parrot	LC
2	*Eudynamys scolopaceus*	Asian Koel	LC
3	*Centropus sinensis parroti*	Southern coucal	LC
4	*Corvus splendon*	Common Crow	LC
5	*Corvus culminatus*	Indian Jungle crow	LC
6	*Acridotheres tristis*	Common Myna	LC
7	*Argya affinis*	Yellow billed babbler	LC
8	*Coracias benghalensis*	Indian Roller	LC
9	*Pycnonotus cafer*	Red Vented Bulbul	LC
10	*Merops orientalis*	Green bee eater	LC
11	*Accipiter badius*	Shikra	LC
12	*Dicrurus macrocercus*	Drongo	LC
13	*Spilopelia chinensis*	Spotted dove	LC
14	*Columba livia*	Rock pigeon	LC
15	*Leptocoma zeylonica*	Purple rumped sunbird	LC
16	*Passer domesticus*	House sparrow	LC
17	*Copsychus fulicatus*	Indian robin	LC
18	*Motacilla alba*	White wagtail	LC
19	*Francolinus pondicerianus*	Grey francolin	LC
20	*Cypsiurus balasiensis*	Asian palm swift	LC
21	*Orthotomus sutorius*	Tailor bird	LC

Source: Reconnaissance Survey, LC – Least Concern

D. Biodiversity Assessment

70. The Integrated Biodiversity Assessment Tool (IBAT) has been utilized for identifying the critical habitat / hotspots/ areas having rich biodiversity in the project area. Screening and assessment indicated two protected areas within 50km radius from the project area: (i) Guindy National Park, 21.2 km southwest of project area, and (ii) Pulicat Bird Sanctuary, 23.8 km north of project area. As their location is far away from project area, project activities are unlikely to interfere with these environmentally sensitive areas, and therefore no adverse impacts are anticipated.

Figure 5: Distance of Pulicat Lake and Guindy National Park from the project area

71. **Pulicat Lake (Pulicat Bird Sanctuary).** The vegetation in the islands are dominated by the Tropical Dry Evergreen Forest (TDEF) species, Mangrove and Mangrove associated flora and the Halophytes. A total of 180 floral species are found in the Pulicat Lake, of which 117 species are dicotyledonous plants, 51 species are of monocotyledonous plants. 6 species of mangroves and 35 mangrove associated species are recorded. TDEF species such as *Manilkara hexandra, Albizia amara*, *Strychnos nux-vomica* and *Maba buxifolia* are found in good numbers. The sand dunes are dominated by *Ipomea pesr-carpae,* the intertidal and saline environment, salty marsh is dominated by halophytes species like *Aeluropus lagopoides, Atriplex repens, Cressa cretica, Crotalaria retusa, Cyperus haspan, Fimbristylis ferrugenea, Salichornia brachiata, Sensuvium portulacastrum, Suaeda* species. etc. Halophytes like *Salcornia, Sensuvium* and *Suaeda* grow in hypersaline areas. Herbs like *Suaeda nudiflora* and *Suaeda maritima* are dominant. The sea grass species *Halophila ovalis* occurs prominently all along the margins of Buckingham canal. About ten species of mangroves were recorded from the Pulicat Lake; now it is restricted to nearly 6 species, the most dominant species was *Excoecaria agallocha* now its *Avicennia marina*. 88 species of Zooplankaton, 81 species of Benthos. 12 species of prawns, 19 species of crabs and 168 species of finfish and Pulicat Lake harbours several endemic, endangered and keystone species. 115 species of birds both water (aquatic) as well as land (terrestrial) were recorded in the Pulicat Bird Sanctuary. Birds are the important components in the Pulicat Lake ecosystem and this lagoon area has been announced as a RAMSAR site.

72. **Guindy National Park.** Guindy National Park is 2.70 km^2 protected area of Tamil Nadu, located in Chennai, India, is the 8th smallest National Park of India and one of the very few national parks situated inside a city. The park and the diverse vegetation provides an ideal habitat for over 150 species of birds. 9 species of amphibians, 14 species of mammals, 3 species of tortoise and turtles 60 species of spiders and 60 species of butterflies. There are more than 350

species of plants and over 24 variety of trees, including the sugar-apple, Atlantia monophylla, wood-apple, *Annona squamosa, Atlanta monoplylla, Feronia limonia, Azadirachta indica* and many others are found in this park. The park and the diverse vegetation provides an ideal habitat for over 150 species of birds. About one-sixth of the park has been left as open grassland to preserve that habitat for blackbucks. Though both the species of blackbuck and spotted deer have their natural habitat in grassland, the spotted deer prefer bushes.

73. Based on the IBAT information, the protected habitats located within 50km radius were assessed to identify the critical habitat and hotspots areas having rich biodiversity, for the presence of any (i) Critically Endangered or Endangered Species, (ii) Endemic or Restricted-range Species, (iii) Migratory or Congregatory Species and (iv). Regionally unique and highly threatened species. The Pulicat Lake and Guindy National Park are 23.8 and 21.2 Kms from the project site respectively. The Guindy National Park is within the urban limit and it is well protected and managed. The Pulicat is the second largest brackish water lagoon in the country spreading about 450 km^2. Pulicat Lake is ornithological rich and nominated by the Global Nature Fund as "*Threatened* Lake of the Year 2010".

74. Two of the above (i) and (iii) criteria, Critically Endangered / Endangered Species and Migratory or Congregatory Species are applicable to the site. The migratory species comes to Pulicat from many habitats in India and other countries during different times of the year, due to seasonal limitations in factors such as food, sunlight, and temperature. Six species of water birds; Great Thick-knee *Esacus recurvirostris*, Black-Tailed Godwit *Limosa limosa*, Eurasian Curlew *Numenius arquata*, Painted Stork *Mycteria leucocephala*, Spot-billed Pelican *Pelecanus philippensis* and Black-headed Ibis *Threskiornis melanocephalus* were categorised as “Near Threatened” according to the International Union for Conservation of Nature (IUCN) Red List. Five species of raptors Black-winged Kite *Elanus caeruleus*, Oriental Honey Buzzard *Pernis ptilorhynchus*, Shikra *Accipiter badius*, Brahminy Kite *Haliastur indus* and Whitebellied Sea eagle *Haliaeetus leucogaster* were categorised as “Schedule I” according to the Wildlife Protection Act 1972. Migratory birds are common in Pulicat.

E. Socio-economic Environment

75. Kadapakkam is a large village located in Mathavaram Taluka of Thiruvallur district, Tamil Nadu with total 787 families residing. The Kadapakkam village has a population of 2,941 of which 1,436 are males while 1,505 are females as per Population Census 2011. Children population with age 0-6 is 306 which makes up 10.40 % of total population of village. Average sex ratio of Kadapakkam village is 1048 which is higher than Tamil Nadu state average of 996. Child Sex Ratio for the Kadapakkam as per census is 1170, higher than Tamil Nadu average of 943.

76. Kadapakkam village has higher literacy rate compared to Tamil Nadu. In 2011, literacy rate of Kadapakkam village was 83.34 % compared to 80.09 % of Tamil Nadu, in which male literacy stands at 92.20 % while female literacy rate was 74.78 %.

Table 29: Kadapakkam Village Census details (2011)

Sl.no	Particulars	Total	Male	Female
1	Total No. of Houses	**787**	-	-
2	Population	**2,941**	1,436	1,505
3	Child (0-6)	**306**	141	165
4	Schedule Caste	**825**	400	425
5	Schedule Tribe	**0**	0	0
6	Literacy	**83.34 %**	92.20 %	74.78 %

Sl.no	Particulars	Total	Male	Female
7	Total Workers	**1,318**	916	402
8	Main Worker	**1,164**	-	-
9	Marginal Worker	**154**	88	66

Source: census 2011

77. Kadapakkam village has substantial population of Schedule Caste (SC), constituting 28% of total population. There are no Schedule Tribe (ST) population. Out of total population, 1318 were engaged in work activities. 88.32 % of workers describe their work as “main work” (employment or earning more than 6 Months) while 11.68 % were involved in marginal activity providing livelihood for less than 6 months. Of 1,318 workers engaged in main work, 132 were cultivators (owner or co-owner), 495 were agricultural labourer and remaining are engaged in secondary and tertiary sectors.

78. The project area is well connected by the road network, the presence of State Highways (SH) 56 connects Manali to Ponneri. The project area is surrounded by mixed landuse including the agriculture and industrial (mainly warehouse). There are no archaeological importance sites within the close proximity, the nearest ASI site (Old Town Wall) is located at Tondiarpet, which is around 15km from the project area. There are three small temples located in the boundary of the Kadapakkam Lake, which are visited and worshipped mostly by local people (See below image). These will be retained as per the detailed design/ master plan for the lake. There are no other historical or archaeological or cultural places of interest in or close to site. The project area do not have storm water drain and sewerage facility. However, water supply has been provided for the residential areas. Other infrastructure including electricity, road network is provided. Schools and hospitals are located at Manali new town which is located at a distance of 4.8 km.

V. ANTICIPATED ENVIRONMENTAL IMPACTS AND MITIGATION MEASURES

79. This chapter identifies the positive and negative impacts of the proposed Kadapakkam Lake restoration works during pre - construction stage, Construction stage and Post Construction stage. The analyses of the impacts caused because of proposed interventions would help in identifying the array of mitigation measures for each identified impact.

A. Positive Impacts of the Project / Project Benefits

(i) Proposed Kadapakkam lake restoration works will increase the water storage capacity, improve the surface water quality, it restores the ecology of the lake (including the flora and fauna); and also improves the environmental status of the areas around the lake.
(ii) Restoration of lake would improve the ground water quality and increases the groundwater recharge capacity in the surrounding areas, which will not only be beneficial to local community but also to improve overall groundwater resource in Greater Chennai area.
(iii) Providing walkway, jogging track and other amenities would benefit the local people and thereby misuse of lake area will considerably reduced
(iv) Increase in storage of water, improvement in ground water recharge, and reduction in flooding of nearby areas are the major positive impacts envisaged from the project.
(v) As an indirect positive impact, the land value surrounding the lake area will increase.
(vi) Preventing potential discharge of untreated Sewage / Industrial effluent in to lake will reduce the adverse impacts to the community living around the lake.
(vii) Preventing open defecation, disposal of garbage/ solid waste/ agricultural waste into lake area would have indirect health benefit to the community living around the lake.
(viii) Restoration works, including bio-fencing, security etc., will protect the lake area from any encroachments, including existing practice of vehicles, trucks entering the lake for washing and cleaning.
(ix) The project would improve awareness of the people around the lake and develop positive attitude towards the environment.

B. Pre-Construction Impacts

80. **Consents, permits, clearances, no objection certificate (NOC), etc.** Necessary consents/NOC as per Table 6 will be required during pre-construction phase and before any civil works commence. A copy of Consent/Permission/Clearance/ NoC should be included in the monitoring reports and submitted to the GCC by the Contractor. Failure in obtaining the same will result in delay of work and may lead to stoppage of works.

81. **Mitigation measures**. The following measures will be conducted during the detailed design and pre construction phase prior to start of construction:

(i) GCC to obtain all necessary consents, permits, clearance, NOCs, etc. prior to start of civil works.
(ii) Contractor to obtain necessary consents, permits, license etc., required for construction, and submit copies to PIU; PIU to acknowledge in writing
(iii) GCC to update IEE and EMP prior to starting of works to reflect any changes in

project design during design verification and detailed field survey, and submit to ADB for clearance and disclosure

(iv) Contractor to prepare SEMP based on the updated EMP, and approved by PIU prior to commencement of works

(v) Include in detailed design drawings and documents, all the conditions and provisions stipulated in permits, consents issued by regulatory agencies, if any.

(vi) The excavated materials should be recycled to the maximum extent possible (3R concept should be adopted).

(vii) the proposed construction activities should be implemented in a controlled manner minimizing the noise levels. The dB(A) levels for residential area (day time noise level 55 dB(A) and night time noise level 45 dB(A)) should be maintained. In work locations, close to the existing roads where noise levels are exceeding the threshold limit the project should not result in an increase of more than 3 dB(A) over existing ambient noise levels at the nearest receptor location off-site.

(viii) Contractor to conduct pre-construction (baseline) environmental monitoring as indicated in Table 32. The monitoring results shall be referred as baseline quality for key environmental parameters of air, water and noise)

(ix) Contractor to conduct lake bottom soil testing during the desilting works to check the physical, chemical, heavy metal, and biological quality parameters

(x) Continue consultation with the local communities during detailed design, and implementation and provide information in the language that is understandable to the local community regarding project activities and the anticipated impacts as part of the project information dissemination.

(xi) Due to the current COVID-19 pandemic situation, there is a risk of virus spread at the work sites and offices, endangering the health and lives of workers and staff, and surrounding community, Proper measures need to be put in place at the work sites, and offices as stipulated by the government regulations and advisories issued by international organizations such as World Health Organization (WHO), International Labour Organization (ILO) etc.,, and GCC should ensure that proper measures are put in place and ensure compliance. GCC should also encourage vaccination of all workers and staff engaged in project work.

82. **Utilities**. Interruption of services (water pipelines, electricity lines, street lights etc.) will be scheduled and intermittently related to localized construction activities. To mitigate impacts, GCC will:

(i) Identify and include locations and operators of these utilities in the DPR to prevent unnecessary disruption of services during the construction phase.

(ii) Require contractor to prepare a contingency plan to include actions to be done in case of unintentional interruption of services.

(iii) Require contractor to obtain from the GCC/ concerned department the list of affected utilities and operators;

(iv) If relocations are necessary, contractors along with GCC will coordinate with the providers/line agencies to relocate the utility.

(v) Consult with the local communities if there is a need for interruption of services

(vi) Immediately inform local communalities of any accidental service interruptions that may occur due to works

83. **Social and Cultural Resources**. There are three small temples on the lake bund that are visited and worshipped mostly by local people. There are no other notable cultural or historical

places. There is always a risk that any work involving ground disturbance can uncover and damage archaeological and historical remains. The GCC shall:

(i) Ensure the ADB SPS, 2009 requirements are met while dealing with physical cultural resources
(ii) The existing three temples should not be disturbed during the lake restoration works
(iii) Develop a chance find protocol for use by the construction contractor in conducting any excavation work, to ensure that any chance finds are recognized, and measures are taken to ensure they are protected and conserved, this must include stopping work if any suspected cultural heritage item is found.
(iv) Consider alternatives if the site is found to be of medium or high risk.

84. **Site selection of construction work camps, stockpile areas, storage areas, and disposal areas**. Priority is to locate these near the project location. However, if it is deemed necessary to locate elsewhere, sites to be considered will not promote instability and result in destruction of property, vegetation, irrigation, and drinking water supply systems. Residential areas will not be considered for setting up construction camps to protect the human environment (i.e., to curb accident risks, health risks due to air and water pollution and dust, noise, and to prevent social conflicts, shortages of amenities, and crime). Extreme care will be taken to avoid disposals near water bodies.

85. **Site selection of sources of materials**. Since it is proposed to reuse the desilted material for bund construction, the requirement of construction materials significantly reduced. It is also proposed to use materials such as brick made from fly ash waste (fly ash bricks), adopt nature based solutions like bio-fencing, geotextiles, etc to avoid minimize of traditional construction materials. Nevertheless, some quantities of construction materials including bricks, coarse aggregate and fine aggregate will be required for the construction works. Contractor should procure these materials only from the authorised vendors or quarries permitted/licensed by Department of Geology and Mining/ Concerned department.

86. **Erosion control.** Most of the impacts will occur due to excavation and earth movements during construction phase. Prior to commencement of civil works, the contractor will be required to:

(i) Develop an erosion control and re-vegetation plan to minimize soil loss and reduce sedimentation. Minimize the potential for erosion by balancing cuts and fills to the extent feasible.
(ii) Native grass like *Vetiveri zizanioides* (Vetiver), *Cymbopogon citratus* (Lemon Grass) are suitable for planting on the newly formed bunds of the lake which can prevent soil erosion, reduce flooding, detoxify the air and water, improve the local climate, and store carbon that would otherwise contribute to global climate change.
(iii) Plant species such as *Barringtonia acutangula*, *Calamus rotang*, *Calophyllum inophyllum*, *Mitragyna parvifolia*, *Suregada angustifolia*, *Thespesia populnea*, and *Vitex negundo* are most suitable for plantation around water bodies and spillway areas to avoid soil erosion.

87. **Access**. Hauling of construction materials, construction waste, and equipment can cause traffic problems. Construction traffic will access work area from the existing road (Vachoor Road), which connects the lake with Tiruvottiyur-Ponneri High Road. Due to reuse, the requirement of construction material and waste soil transport reduced significantly. Potential impacts will be of

short-duration, localized and can be mitigated. The Contractor will need to adopt the following mitigation measures:

(i) Plan transportation routes so that heavy vehicles do not use narrow local roads, except in the immediate vicinity of delivery sites.
(ii) Schedule transport and hauling activities during non-peak hours.
(iii) Locate entry and exit points in areas where there is low potential for traffic congestion.
(iv) Keep the site free from all unnecessary obstructions.
(v) Drive vehicles in a considerate manner.

C. Construction Impacts

88. The impacts during the proposed lake restoration works are standard and site-specific to the construction activities and are not expected to be significant. The Environmental Management Plan (EMP) specifies the necessary mitigation measures to be strictly followed by the contractor and supervised by the GCC. Key impacts during construction are envisaged on the following aspects: (i) transportation of materials, (ii) dust generation, air and noise pollution from construction activities, (iii) Disposal of solid waste materials (Municipal solid waste, construction and demolition waste), (iv) Sourcing of water for construction activities, (v) handling of construction materials at site and, (vi) adoption of safety measures during construction. However, the prepared EMP (refer to chapter VIII) should be updated as construction EMP based on the site conditions by the contractor under the supervision of the GCC.

89. **Impacts on Air Quality.** During the construction phase, activities such as de-silting, and reconstruction/repairing of bund and inlet/outlet structures, other activities including casting of CC Blocks and its transportation will generate dust. Unless adequate care is taken through mitigation measures it may have adverse impacts on environment, the workers and the nearby habitations. There is potential for increased dust, particularly during summer/dry season due to various construction activities including stockpiling of construction materials. Emission from vehicles transporting construction materials and debris/materials to be disposed may cause increase in air pollutants within the construction zone. These are inherent impacts which are site-specific, low magnitude, short in duration and can be easily mitigated. The contractor will be required to:

(i) Conduct regular water spraying on earth piles, trenches and sand piles.
(ii) Maintain access roads and internal vehicle and equipment movements area in good condition; ensure that there is no loose / dry soil on the surface; wet the surface regularly; put in place speed limits, and create awareness among the drivers to drive on designated routes with considerable care
(iii) Cover the construction material/waste during transport in open trucks to avoid dust generation and spillage; clean the undercarriage and wheels of construction vehicles to avoid dust generation
(iv) Erect barricading or wind breakers as required to reduce effect of high winds that would disturb loose soils and generate dust
(v) Conduct regular visual inspection in the construction zones to ensure that there are no excessive dust emissions.
(vi) Maintain construction vehicles and obtain “Pollution Under Control” (PUC) certificate from Emission Testing Centres.
(vii) Minimize idling of vehicles at construction sites to 3-5 minutes
(viii) Obtain CtE and CtO for batching plants, crushers, diesel generators, etc., if is to be used in the project from Tamil Nadu Pollution Control Board.

(ix) Conduct periodical environmental monitoring for ambient air as per the Environmental Monitoring Plan.

90. **Impacts on Water Quality.** It is proposed to use the excavated silt from the lake for bund strengthening, in addition to turfing and concrete blocks. Concrete blocks are being casted away from the lake area, so no spillage of any construction materials into the lake is expected. Minimal amount of diesel would be brought to the site to meet emergency fuel requirement for vehicles. In case of any storage of fuel at the site, safe storage and fire management facilities shall be provided. Construction materials shall be stacked in covered sheds, with fire management facilities.

91. Water pollution may be caused due to spillage of grease and oil from the heavy machine being used for construction. Since most of the construction work will take place in the dry season de-silting will take place during low flows which will minimise turbidity in the downstream. Embankments will be stabilized immediately after its construction to minimise soil erosion due to rain.

92. A major cause of concern regarding the water quality during construction works is the possibility of increased solid waste dumping in the lake from the road and from habitations / agriculture areas nearby. Suitable waste management mechanism would be carried out on regular basis to prevent garbage dumping. Based on the assessment, there will be significant water quality impacts are anticipated and hence, the contractors will be required to:

(i) The groundwater quality in the project area has high concentration of TDS and hence the contractor should arrange water for construction, it shall be either purchased from the local authority or the TWAD. The agreement and / or MoU has to be shared with the GCC. For any other arrangements for the source of water, the evidence of the same has to be furnished to the GCC.
(ii) Schedule civil works during non-monsoon season, to the maximum extent possible.
(iii) Ensure drainages within the construction zones are kept free of obstructions.
(iv) Keep loose soil material and stockpiles out of drains and flow-lines.
(v) Avoid stockpiling of excavated and construction materials (sand, gravel, cement, etc.) unless covered by tarpaulins or plastic sheets.
(vi) Conduct periodic Environmental Monitoring to check the water quality.
(vii) Use silt trap for the surface runoff to prevent sediments entering into the lake.
(viii) Re-use/utilize, to maximum extent possible, excavated materials.
(ix) Dispose any residuals at identified disposal site (GCC will identify approved sites).
(x) Dispose waste oil and lubricants generated as per provisions of Hazardous Waste (Management and Handling) Rules, 1989.

93. **Noise and Vibration impacts**. Except desilting activity, the other construction activities shall mostly be done manually without involving heavy equipment / machineries and hence the chances for noise and vibration impacts are not envisaged. Earth movers, excavators, loaders, etc., may be used for desilting the lake, and formation of bunds, and will generate noise. The contractor will be required to:

(i) Plan activities in consultation with the GCC so that activities with the greatest potential to generate noise are conducted during periods of the day which will result in least disturbance.
(ii) Minimize noise from construction equipment by using vehicle silencers and fitting

jackhammers with noise-reducing mufflers.

(iii) Create awareness among drivers not to use horns unless it is necessary to warn other road users or animals of the vehicle's approach.

(iv) Shut off idling equipment.

(v) Night time construction activities should be avoided, and only be considered on an emergency basis or due to high day-time traffic as per prevailing conditions at the time of construction

(vi) Follow day time ambient noise levels as per Noise Pollution (Regulation and Control) Rules and conduct periodical environmental monitoring for ambient noise as per schedules given in the EMP.

(vii) Ensure vehicles comply with Government of India noise limits for vehicles. PUC should be available for every construction equipment and vehicles.

Impacts on the Land Environment. This project would not involve any major construction activity except de-silting and bund strengthening, the project activity would not result to any adverse impact to soil. As per the sediment analysis, the silt is suitable for construction works and hence nearly 80% of the silt (1,14,056 cu.m) shall be utilised for bund formation and remaining 20% (28,514 cu.m) shall be disposed in the Kodungaiyur solid waste dumping area (owned by GCC).

94. Kodungaiyur dumping area is located at about 10 km south of Kadapakkam Lake. This is spreads over an area of 157.5 acres, and used by GCC for municipal solid waste and construction waste disposal.

95. **Impacts on Topography & Geology.** No soil will be brought from outside to the project area and the desilted earth (80%) from the lake will be used for bund strengthening while the remaining (20%) shall be disposed in the Kodungaiyur solid waste dumping area. Hence, the proposed renovation activity will not result to any adverse impact to Topography and Geology. No major land modification/ construction is envisaged under this project.

96. **Impact due to handling of construction materials at site.** Incorrect handling is a common factor in work-related injuries. The contractor will need to adopt the following mitigation measures:

(i) Materials shall be stored and placed so as not to endanger the public, the workers or the adjoining property.

(ii) Materials shall be stacked on well -drained, flat and unyielding surface.

(iii) Material stacks shall not impose any undue stresses on walls or other structures

(iv) Materials shall be separated according to kind, size and length and placed in neat, orderly piles.

(v) High piles shall be staggered back at suitable intervals in height.

(vi) Piles of materials shall be arranged so as to allow a minimum 800 mm wide passageway in between for inspection and removal.

(vii) All passageways shall be kept clear of dry vegetation, greasy substance and debris

(viii) Stairways, passageways and gangways shall not be obstructed by storage of building materials, tools or accumulated rubbish

(ix) Special and specified care should be taken for inflammable and destructive chemicals and explosive during storage

(x) Materials stored at site, depending upon the individual characteristics, shall be protected from atmospheric actions, such as rain, sun, winds and moisture, to avoid deterioration.

97. **Impact due to Waste Generation**. Construction activities will produce excess excavated soils, excess construction materials, and solid wastes (such as removed concrete, wood, packaging materials, empty containers, oils, lubricants, and other similar items). These impacts are negative but short-term and reversible by mitigation measures. The contractor will need to adopt the following mitigation measures:

(i) Prepare and implement a Waste Management Plan.
(ii) Manage solid waste according to the following hierarchy: reuse, recycling and disposal. Include designated/approved disposal areas in waste management plan.
(iii) Coordinate with Local authority/ GCC for beneficial use of excavated materials or immediately dispose to designated areas.
(iv) Recover used oil and lubricants and reuse; or remove from the site.
(v) Avoid stockpiling and remove immediately all demolished materials, excess construction materials, and solid waste (removed concrete, wood, packaging materials, empty containers, oils, lubricants, and other similar items).
(vi) Prohibit disposal of any material or wastes (including human waste) into drainage, nallah, or lake.
(vii) Any waste that contains asbestos, or is contaminated with asbestos, must be double-bagged, labelled and placed in a covered, locked skip. This includes asbestos sheets, asbestos pipeline, asbestos cement etc. Care should be taken in disposal of the asbestos materials as per the relevant protocols/ hazardous waste management rules 2016 and following the World Bank Group's Good Practice Note on Asbestos: Occupational and Community Health Issues and other international best practices (May 2009).

98. **Impacts due to desilting operations**. During restoration of Kadapakkam Lake, to improve the water storage capacity of lake; the lake bed would be de-silted. This desilting process involves removal of considerable quantity (1,14,056 cu.m) of sediment and soil from lake bed. As per the sediment analysis, the property of the sediments are suitable for construction purposes, it has no heavy metals, hence it has been proposed to utilise all the sediments for the bund strengthening and improvement purposes, due to this, the adverse impact on the disposal of de-silted material elsewhere will be reduced significantly. For the excess sediments, it shall be disposed in the Kodungaiyur dumping yard (a municipal waste dumping facility owned and managed by GCC) located at about 10 km south of Kadapakkam lake. The following measures will be adopted to mitigate the potential impacts from de-silting and when reusing the sediments.

(i) Desilting will be carried out using suitable equipment's only, depending upon the terrain of the area to be desilted.
(ii) Use techniques (e.g., silt curtains[2]), to minimise adverse impacts on aquatic life from the re-suspension of sediments
(iii) Though the preliminary analysis shows the sediments are good for construction purposes, suspected pollutants in the desilted material shall be analysed for their physical, chemical, biological, and engineering properties prior to material desilting and reuse
(iv) Reuse of sediments for bund strengthening and improvement works should be conducted in a way that no negative impacts may occur, meaning no discharge of polluted excess water, etc.

[2] Silt Curtains are constructed to meet different waterway conditions with the objective to provide a settling time and allow the dispersed silt or sediment time to fall to the bottom. The purpose of a Silt Curtain is to control the migration of suspended silt and sediment and facilitate localised settling.

(v) Excess soil shall be handled, transported, and disposed in the dumping yard properly; before loading it shall be ensured that it is dried so no water spills during transport, and material also should be covered during transport to avoid spillage and dust.

99. **Impacts on Flora and Fauna.** Scrub on the lake boundary, mainly consisting of *Prospis juliflora* and *Acacia nilotica* near / on the bunds will be removed prior to bund strengthening. However, these would quickly grow back after construction. During construction it will be ensured that the existing trees near the bund are not disturbed. Weeds in the lake will be removed. As evident, it would be difficult to work on the lake desilting works during the rainy season, with high water level in the lake. Care would be taken to stage the construction during non-monsoon days/ summer season. This would prevent disturbance to visiting water birds which are more during this time. In addition, work area would be cordoned off while working in portions of the lake with higher numbers of visiting avifauna. Spot-Billed Pelican, the only IUCN listed near threatened species recorded at the site is an occasional visitor, and lake is not nesting or breeding site for this species. No nest has been reported by the study team, however there is possibility nest by waterbirds and small birds (other than Spot Billed Pelican). Measures are required to safeguard these.

100. As per detailed design, tree-cutting is not required. This will be reassessed during pre-construction phase. There are no protected areas in the direct and indirect impact zones and no diverse ecological biodiversity is found within the project area thus there are no significant impacts on flora and fauna. But in general, the Contractor will be required to:

(i) Scheduling the clearance and desilting works during the summers and non-monsoon season (March-October); normal bird breeding season (including of Spot-Billed Pelican) is between October-March
(ii) Conduct a rapid survey of the lake area for presence of nest; and isolate the area without disturbing them until they hatch; conducting site clearance and desilting works in summer when most birds don't breed will avoid this impacts
(iii) Planting trees (more numbers and tall trees as recommended) and restoring the lake will increase the biodiversity of the lake and enhance the chances of Pelican to visit feed and roost in the lake and in long run it can support breeding as well.
(iv) Workers has to be trained and made aware if nest noticed during the restoration activity should report to the monitoring team and should isolate the place.
(v) Conduct site induction and environmental awareness.
(vi) Limit activities within the work area.
(vii) Do not remove or harm existing vegetation except those required under proposed contract.
(viii) Strictly instruct workers not to cut trees for fuel wood.
(ix) Replant trees in the area using minimum ratio of 10 trees for every 1 tree cut, if any. Replacement species must be approved by District Forest Department.

101. **Impact on Biodiversity**. Intervention in Kadapakkam Lakes involves removal of weeds and floating matter, desilting, bund strengthening. The expected impacts of the project on the biodiversity can be in different stages from the initiation of desilting work to completion. These activities will have their own impacts at different magnitude, such impacts are localized and temporary or short term. In operation phase of the project, very less impact is predicted except siltation. The negative impacts anticipated from implementation of this project are minimal and the benefits will be considerable in long-term perspective.

102. The Kadapakkam Lake doesn't have a rich biodiversity and almost all the species of both fauna and flora listed are either least concerned or not evaluated except the Spot-billed Pelican *Pelecanus philippensis* categorised as "Near Threatened" according to the International Union for Conservation of Nature (IUCN) Red List. Even this species was recorded in very less number and very few times in a year.

103. In long-term view after the completion of the project, in the evolutionary processes no structural changes in the region is expected, such as change in the topography, geology, soil, temperature, and vegetation, and combination of any of these components. This region is not a biological corridor for any species of both fresh water and terrestrial species which can restrict species migration and gene flow.

104. The lake restoration project is likely to change or influence the ecology and environment of the region. The desilting and bund formation will naturally have impacts on the flora such as trees, herbs and shrubs, in the Kadapakkam lake, the vegetation in the bund is very sparse and mostly occupied by *Prosopis* thus the impact of vegetation during execution is very minimal.

105. Bird Islands, either natural or man-made, always constitute a very special environment for fauna. It's a land isolated and away from other lands, and protected from land-dwelling predators that cannot or will not swim to the islands, including grazing livestock that damage the flora. Thus, bird islands naturally increase opportunities for propagation of more diverse fauna with diverse habitat in water, at the water edge, and on the island. The nesting birds enable nutrient transfer from one habitat to another. Fish and other aquatic prey are high on organic compounds and are consumed by aquatic birds. The birds then visit farmlands and fields were they either roost or feed. The excreta they produce is especially rich in nitrogen, phosphate and potassium and hence very good for agriculture. These places also provide various social, recreational, and educational benefits, and increase awareness among the communities and promote overall well-being and sustainable development.

106. The Pulicat Lake and the Guindy National Park are not a highly threatened ecosystems according to the criteria listed by International Union for Conservation of Nature (IUCN) 1994, 2012, 2014 (Areas representing ≥5% of the global extent of an ecosystem type meeting the criteria for IUCN status of CR or EN, and areas not yet assessed by IUCN but determined to be of high priority for conservation by regional or national systematic conservation planning). Similar to the Red List for Threatened Species, IUCN has developed Red List of Ecosystems..

107. Both Pulicat Lake and the Guindy National Park are located more than 20 km away from the project site, and both the protected areas are no way influenced by the project area and doesn't fall within the ecological limit of the project site. Kadapakkam Lake is far from the catchment of the Pulicat lake and the Guindy National Park, is restricted to the urban environment and receiving water needs from the Coovum basin catchments. Therefore, proposed restoration works at Kadapakkam lake, will not any impacts on protected areas.

108. Based on the assessment the following mitigation measures are to be implemented to minimize / mitigate the anticipated impacts.

(i) Short-term changes in water quality during and after project execution is anticipated, which will temporarily increase the turbidity of the water and will be back to normal based on the retention. Construction works will be conducted during dry season when the lake has no water or has very low water level

(ii) Physical impacts can be caused due to erosion and deposition within the lake if

the execution happens during monsoon, thus restoration activity (desilting and bund formation) during monsoon seasons has to be restricted also precautionary measures (measures to prevent soil erosion) needs to be implemented during pre-monsoon season

(iii) The agriculture landscape along the lake should remain undisturbed for the micro habitats to develop.

(iv) The local ecosystem of the lake with the fragmented scrub, grassland and the agriculture lands has an associated flora and diversity of fauna. At the transition area between two systems, one can find species of both systems interacting and sharing (even temporarily) the same space. This limit, called “ecotone”, always presents great species diversity and richness, being “fed” from both systems. The boundary between the lake and the agriculture fields are vital and is an ecotone that needs to be protected for the long-term sustainability of the biodiversity.

(v) Environment friendly nature signage along the bunds and viewing platforms will enhance community and visitor participation. Interpretative signage concerning the different facets of the natural environment of the Kadapakkam Lake and the surrounding area can be an attraction if the signage is created with natural material.

(vi) Rest places with information boards along the bunds can be built near the edges of the lake in locations to be agreed with the local people

(vii) Environmental awareness / education programs designed for schools and local people should involve children, parents and teachers ensuring that different levels of the community take away the information. The programs can be designed in different ways to make sure that there is on-site learning and classes designed for in-house sessions in schools as a follow up to field sessions. Thus, helping us strike a balance between experiential learning and theoretical understanding of various topics. The following topics needs to be covered:

a. Biodiversity
b. Watershed and wetlands
c. Land and water
d. Energy
e. Sewage and Solid waste management
f. Ecosystem services
g. Climate change

(viii) Native plants are indigenous to a particular region and are adapted to the local micro climate and soil conditions, and therefore work well for restoration / landscaping and wildlife habitat creation. Once established, they rarely need watering, mulching and protection. It is advisable to reintroduce native plant species for resilience in the plantation areas

(ix) Include fruit yielding species like *Alangium salvifolium*, *Eugenia bracteata*, *Rauv*olfia tetraphylla, Mimusops elengi, Phyllanthus emblica and Syzygium cumini that provide food and shelter for birds and animals.

(x) Aquatic ecosystem of the lake will be improved with addition fish population of the same species currently present in the lake. Existing fish species are listed in baseline environment section, Fish biodiversity of Kadapakkam lake is comparatively poorer than other lakes in the area. Since the lake is connected to other lakes in the upstream and downstream, it is expected that new fish species will come into the lake via connecting drains/stream during monsoon / rains. This will further enhance the biodiversity.

109. **Impacts on Occupational Health and Safety**. Workers need to be aware of occupational hazards which can arise during proposed construction activities. Exposure to work-related chemical, physical, biological and social hazard is likely to occur during proposed works. Potential impacts are negative and short-term but reversible by adopting mitigation measures. Overall, the contractor should comply with all the mitigation measures as per best international practices which include but not limited to:

(i) Disallow worker exposure to noise level greater than 85 dB(A) for a duration of more than 8 hours per day without hearing protection. The use of hearing protection shall be enforced actively.
(ii) Develop a comprehensive site-specific health and safety (H&S) plan. The overall objective is to provide guidance to Contractor on establishing a management strategy and applying practices that are intended to eliminate, or reduce, fatalities, injuries and illnesses for workers performing activities and tasks associated with the project.
(iii) Include in H&S plan measures such as: (i) type of hazards during excavation works; (ii) corresponding personal protective equipment for each identified hazard; (iii) H&S training for all site personnel; (iv) procedures to be followed for all site activities; and (v) documentation of work-related accidents.
(iv) The working hours will be 8 hours daily. Night works should be avoided, however, it may be considered on an emergency basis or due to high day-time traffic as per prevailing conditions at the time of construction.
(v) Provide H&S orientation training to all new workers to ensure that they are appraised of the rules of work at the site, personal protective protection, and preventing injury to fellow workers.
(vi) Ensure that first aid kit (along with antivenom/antivenin drug) is available at site and it should be easily accessible for all workers in terms of emergency.
(vii) Provide medical insurance coverage for workers.
(viii) Secure construction zone from unauthorized intrusion and accident risks through provision of barriers, guards and warning signs.
(ix) Ensure the core labour standards are adopted (i). Universal and indivisible human rights, (ii) Freedom from forced labour (iii) Freedom from child labour (iv) Freedom from discrimination at work
(x) Provide supplies of potable drinking water.
(xi) Provide clean eating areas where workers are not exposed to hazardous or noxious substances.
(xii) Provide visitor orientation if visitors to the site can gain access to areas where hazardous conditions or substances may be present. Ensure also that visitor/s do not enter hazard areas unescorted.
(xiii) Ensure the visibility of workers through their use of high visibility vests when working in or walking through heavy equipment operating areas.
(xiv) Ensure moving equipment is outfitted with audible back-up alarms.
(xv) Mark and provide sign boards in the construction zone, and areas for storage and disposal. Signage shall be in accordance with international standards and be well known to, and easily understood by workers, visitors, and the general public as appropriate.
(xvi) COVID-19. WHO has declared COVID-19 as a pandemic which has affected the entire world including India. In view of the prevailing COVID-19 pandemic, the contractor and workers would need to take additional measures to avoid the spread of the disease and shall follow various guidelines/guidance notes issued

by the national/state government, WHO, ILO, World Bank/IFC from time to time. As described in these guidelines, the contractors shall undertake a COVID risk assessment of project area and prepare a COVID Response and Management Plan (C-R&MP) and submit to GCC for approval. A brief guidance on "To Do" List prepared from these documents is provided in **Appendix 4**.

(xvii) GCC should also encourage staff and workers engaged in project to get vaccinated

D. Post Construction Impacts

110. **Site clean-up after construction activities**. The Contractor will be required to:

(i) Backfill any excavation and trenches, preferably with excess excavation material generated during the construction phase.
(ii) Use remove topsoil to reclaim disturbed areas.
(iii) Re-establish the original grade and drainage pattern to the extent practicable.
(iv) Stabilize all areas of disturbed vegetation using weed-free native shrubs, grasses, and trees.
(v) Restore staging areas and temporary work areas.
(vi) Remove all tools, equipment, barricades, signs, surplus materials, debris, and rubbish and dispose in designated disposal sites.
(vii) Request in writing from GCC that construction zones have been restored.
(viii) Solid waste (debris, excavated soils, etc.) from the restoration of water body site should be disposed by the contractor as per the guidance of the Environmental specialist of GCC.

E. Operations and Maintenance (O&M) Impacts

111. **Impacts on environmental conditions associated with the O&M** of the project components pertain to impacts related to increased visitors in the areas resulting to increased vehicular movement along the roads, increased demands for services, and increased solid waste generation. These impacts can be mitigated by:

(i) Increased vehicular movement along the roads - speed restrictions, vehicle entry restrictions, provision of appropriate road signage and well-located rest points for pedestrians shall minimize impacts on safety of the visitors
(ii) Increase demands for services – line agency to provide adequate public facilities
(iii) Increase solid waste generation – GCC with help of local authority to put in place solid waste management programs in the affected areas.
(iv) Lack of proper amenities like washrooms/ toilets for visitors will create filthy and unhealth conditions at the lake and surroundings; provide and maintain adequate number of washrooms, toilets, and create awareness and ensure that there is no open defecation;
(v) Wastewater outlets from washrooms, toilets shall be connected to septic tanks (water sealed on all sides and bottom to avoid contamination of soil and groundwater). Semi treated wastewater from septic tanks should sent to sewage treatment plants (using mobile tankers with suction systems) for further treatment and disposal. Cleaning and desludging operation of septic tanks shall not be conducted manually.
(vi) The restored lake during operation will attract visitors; In the wake of COVID19 pandemic situation, proper prevention and control measures should be put in place to safeguard health and well-being of staff and visitors, following applicable

government guidelines and advisories issued by agencies like WHO and ILO.

(vii) Presence of venomous reptile species around the lake, also pose a risk to visitors and staff. Reptiles are mostly nocturnal and opportunistic, when there are no activities it tends to move out and as a precautionary measure antivenom/antivenin drug will be made available along with the First aid kit. Information on drug shall be displayed prominently, and awareness will be created not to harm the reptiles.

112. **Reduced recreational value due to potential drying up of lake.** The proposed project will develop recreational facilities mainly based on lake-front, and therefore drying up of lake will reduce the aesthetic value and will also have impact on recreational facilities to be provided under the project. This impact is however considered minimal due to the fact that water storage capacity of the lake is being doubled under the project by deepening while maintaining the current spread of the lake as it. The project will also increase the green cover around the lake. Improvement on inlet channels, and bunds etc will ensure entry of inflow and water storage to its capacity. The lake is expected to at least maintain minimum water level even during summers.

113. **Impact on the existing water users (Farmers)**. Presently, at downstream areas of the lake, farmers grow seasonal crops using the water available through the discharge sluices. When the storage goes below the sluice level there are instances of farmers resorting to pumping. The GCC has confirmed that the proposed project will have no adverse impact on existing water users (farmers). The project interventions shall not alter the overflow weir level or the sluice levels and therefore shall not affect the present water availability of the farmers. Moreover, the strengthening of bunds and desilting would enhance storage capacity of the lake leading to longer water availability period and thus help farmers to further improve the crop types and cropping pattern and negate the need for pumping.

VI. PUBLIC CONSULTATION AND INFORMATION DISCLOSURE

A. Public Consultation

114. In order to understand the present dependency of the lake, one-to-one consultations (due to COVID-19 safety protocols) were conducted to identify the perception, concerns and apprehensions of the local residents, if any, towards the execution of the project. One-to-one interactions with local people were planned and utmost precautions were taken during the meeting due to COVID -19 restrictions. All participants were provided with face mask, hand sanitizers and maintained social distance throughout the process. Local people were also consulted during biodiversity study to understand the overall lake ecosystem and species.

115. The farmers who own land adjacent to the lake were met during one-to-one interaction and their valuable opinions were documented. Non-agricultural sector persons were also consulted to understand their views, concerns, and opinions. A questionnaire, which was translated to regional language (Tamil) for easy understanding of local people, was used. The questionnaire primarily focused on participant's occupation, income status for the entire year, lake water usage, in case of farmers - land details, crops and seasonal variations in cropping, water use and irrigation source and whether they are likely to be affected due to this project. Due care was taken to cover the entire year's cropping pattern and water source details. The consultation was conducted on 23 February 2021. During consultation, it was noted that the local farmers do not directly depend on lake water. None of the consulted person falls under BPL (below poverty line) Category. Due to rapid transition of semi-urban to urban, many locals have access to employment. All the people have responded about their secondary occupation to support their needs.

116. During interaction with individuals, it has been clearly mentioned that the construction work will be undertaken in such a way that no harm will be caused to any person due to project execution activity. Project outcomes and benefits were explained to the stakeholders. During the consultation, community people were explained in detail regarding the proposed developments of the Lake under the grant linked to the ADB project. All the participants extended support to the project. In total, 17 people have been consulted among which 7 people (41%) were farmers who own the land adjacent to the lake.

117. **Key points discussed:**

(i) The Kadapakkam residents are interested in the lake restoration project.
(ii) The farmers are dependent on borewell water for the irrigation of their fields across all seasons including the summer seasons. During the interactions, it was noted that surplus water from the lake is allowed to flow via surplus discharge channel, which is used for irrigation and this also recharges the groundwater. This input was noted and the design has been so modified that the farmers will have access to the lake water surplus during the operation period, ensuring that there is no impact of the project on the farmers.
(iii) In the last decade, seven children were drowned to death after which locals stopped using the lake water for drinking and household activities.
(iv) Farmers requested the provision to use the surplus water for agricultural uses. This input has been noted and the design has been modified as mentioned in point (ii) above to allow undisturbed access to the surplus water as currently prevalent even during the construction and operations phase.

(v) Women insisted on fencing the restored lake to stop/avoid unauthorized activities like open defecation on the lake bund.

(vi) Local residents requested a drinking water treatment facility and supply along with the lake restoration project as they get municipal water supply once in three days.

(vii) Among the non-user group of lake water, owners of tea shop, grocery shop, bakery etc in the area were consulted to register their opinion and expectations of this project. They expressed their aspiration towards the tourism and infrastructure development outcomes of the proposed project.

(viii) Fishing activity in the lake is carried out for self-consumption and as a hobby, hence livelihood impact due to loss of income from fishing is not anticipated.

(ix) The three small temples on lake bund are visited and worshipped by local community, and therefore should be retained as it is.

Snap shots from the Public Consultation

118. Further consultations will be conducted once the situation becomes conducive. The outcome/ feedback from consultations will be appropriately considered in project design, construction and operation, and IEE will be updated and submitted to ADB for review and approval.

B. Information Disclosure

119. An executive summary of the IEE will be translated in Tamil and made available at the offices of GCC and also displayed on their notice boards. Hard copies of the IEE will be accessible to citizens as a means to disclose the document and at the same time creating wider public awareness. An electronic version of the IEE in English and Executive Summary in Tamil will be placed on the official website of the Greater Chennai Corporation after approval of the IEE by ADB. Local disclosure of the IEE will be done at least two weeks before public consultations to allow the public time to read, look for information or consult experts, and form opinions. Stakeholders will also be made aware of the grievance register and redress mechanism. IEE will also be disclosed on ADB website.

120. Public information campaigns to explain the project details to a wider population will be conducted. Public disclosure meetings will be conducted at key project stages to inform the public of progress and plans. Prior to the start of construction, the GCC will issue Notification on the start date of implementation in local newspapers. A board showing the details of the project will be displayed at the construction sites for the information of the general public.

121. Local communities will be continuously consulted regarding the location of construction camps, access and hauling routes and other likely disturbances during construction as required. The road closure, if any, together with the proposed detours will be communicated via advertising, pamphlets, radio broadcasts, road signage, etc.

VII. GRIEVANCE REDRESS MECHANISM

A. Common Grievance Redress Mechanism (GRM)

122. GCC has a well-established public grievance and redressal system[3] to address concerns, complaints and grievances related to the various functions and services of GCC. In addition, the project will have a Grievance Redress Mechanism (GRM) established at three levels and will cover both environment and social issues related to the project, including interdepartmental concerns related to utility shifting and/or damages to utilities. The GRM will evaluate, and facilitate the resolution of affected persons concerns, complaints, and social and environmental grievances/issues related to the project in a time bound manner. GRM will be accessible, inclusive, gender-sensitive and culturally appropriate for receiving and facilitating the resolution of affected persons' grievances. The project GRM will be integrated with the existing public grievance redressal system of GCC.

123. The GRM will be disclosed to the affected communities and households prior to the mobilization of contractors for the project. The PIU safeguard officers will be responsible for registration of grievances, disclosure and communication and timely resolution of grievances. A complaint register will be maintained at field unit and PIU level with details of complaint lodged, date, action taken and date of communication sent to complainant. Contact details and the process of grievance redressal will be disclosed to the communities through leaflets. Sample grievance registration form is given in the Appendix 5.

124. Affected persons will have the flexibility of conveying grievances/suggestions by submitting the grievance/suggestion in writing, through telephone call to Executive Engineer, PIU safeguards officer, or by writing in the complaints register at the Division Office or by submitting grievance/suggestion by email to GCC. Further, affected persons and/or persons can convey their grievances/suggestions through the public grievance and redressal system of GCC either through internet or by calling the telephone number ‘1913” or by writing to the Commissioner.

B. Grievance Redressal Process

125. In case of grievances that are immediate and urgent in the perception of the complainant, the Executive Engineer on-site will provide the most easily accessible or first level of contact for quick resolution of grievances. Contact phone numbers and names of the concerned Executive Engineer, PIU safeguard officers, contractors and that of the public grievance redressal system will be displayed at all construction sites at visible locations. The second level will be a four-member committee with the Superintending Engineer (SWD), GCC, acting as its convenor. Third level will be the appellate level with the Chief Engineer (General) and Deputy Commissioner (Works).

(i) **1st Level Grievance.** The phone number of the site in charge Executive Engineer and of the public grievance redressal system should be made available at the construction site signboards. The contractors and field unit staff can immediately resolve grievances onsite and seek the advice of the Executive Engineer as required and resolve grievances within seven days of receipt of a complaint/grievance.

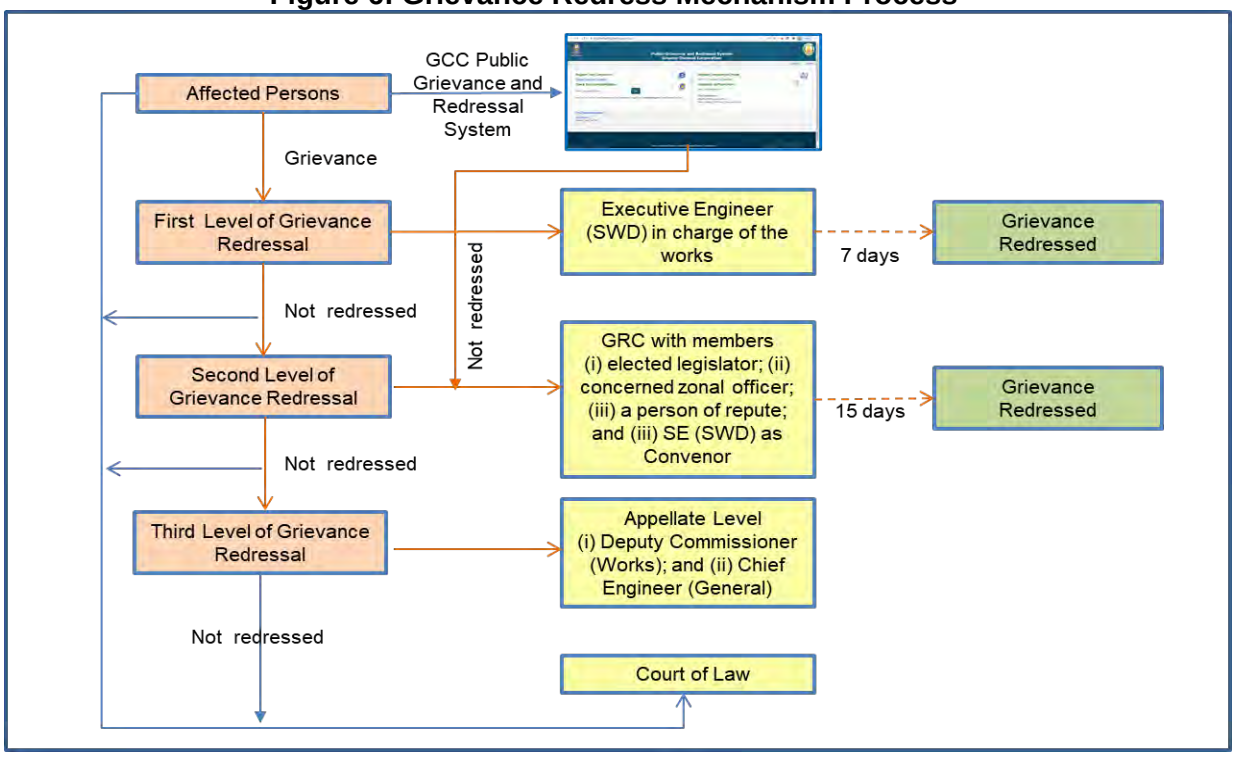
(ii) **2nd Level Grievance.** All grievances that cannot be redressed within seven days at field level will be reviewed by the GRC at PMU level comprising of 4-members,

[3] https://erp.chennaicorporation.gov.in/pgr/

with preferably one member being a woman. The committee will have any one elected member of the legislature, concerned zonal officer, a person of repute and standing in locality, nominated by the Commissioner, GCC and the Superintending Engineer (SWD) acting as its convenor.

(iii) **3rd Level Grievance**. All grievances that cannot be redressed within 15 days at PMU level, will be placed before the Chief Engineer (General), who will consult the Deputy Commissioner (Works) in grievance resolution.

Figure 6: Grievance Redress Mechanism Process



Source: Project Administration Manual; Integrated Urban Flood Management for the Chennai-Kosasthalaiyar Basin Project

126. **Court of Law**: Despite the project GRM, an aggrieved person shall have access to the country's legal system at any stage and accessing the country's legal system can run parallel to accessing the GRM and is not dependent on the negative outcome of the GRM.

127. **ADB Accountability Mechanism**: In the event that the established GRM is not in a position to resolve the issue, the affected person also can use the ADB Accountability Mechanism through directly contacting (in writing) the Complaint Receiving Officer (CRO) at ADB headquarters or the ADB India Resident Mission (INRM). The complaint can be submitted in any of the official languages of ADB's developing member countries.

VIII. ENVIRONMENTAL MANAGEMENT PLAN

A. Environmental Management Plan

128. An Environmental Management Plan (EMP) has been developed to provide mitigation measures to reduce negative impacts to acceptable levels.

129. The EMP will guide the environmentally-sound construction of the project and ensure efficient lines of communication between GCC and the Contractor. The EMP will (i) ensure that the activities are undertaken in a responsible non-detrimental manner; (i) provide a pro-active, feasible and practical working tool to enable the measurement and monitoring of environmental performance on-site; (ii) guide and control the implementation of findings and recommendations of the environmental assessment conducted for the project; (iii) detail specific actions deemed necessary to assist in mitigating the environmental impact of the project; and (iv) ensure that safety recommendations are complied with. The EMP includes a monitoring program to measure the environmental condition and effectiveness of the implementation of the mitigation measures. It will include observations on- and off-site, document checks and interviews with workers and beneficiaries.

130. The Contractor will be required to submit to GCC, for review and approval, a Site Environmental Management Plan (SEMP) including (i) proposed sites/locations for construction work camps, storage areas, hauling roads, laydown areas, disposal areas for solid and hazardous wastes; (ii) specific mitigation measures following the approved EMP; and (iii) monitoring program as per SEMP. No works are allowed to commence prior to the approval of SEMP.

131. The Contractors shall undertake a COVID risk assessment of project area and prepare a COVID Response and Management Plan (C-R&MP) and submit to GCC for approval. A brief guidance on “To Do” List prepared from these documents is provided in **Appendix 4.**

132. A copy of the EMP/approved SEMP will be kept on-site during the construction period at all times. The EMP included in the bid and contract documents. Non-compliance with, or any deviation from, the conditions set out in this document constitutes a failure in compliance.

133. For civil works, the contractors will be required to (i) carry out all of the mitigation and monitoring measures outlined in the approved SEMP; and (ii) implement any corrective or preventive actions set out in safeguards monitoring reports that the employer will prepare from time to time to monitor implementation of the SEMP. The contractors shall allocate budget for compliance with these SEMP measures, requirements and actions.

134. The potential environmental impacts proposed mitigation measures, and responsible agencies for implementation and monitoring are furnished in the following Tables.

Table 30: Environmental Management Plan

Sl.no	Environmental Issues	Mitigation Measures	Indicators and Targets	Responsibility for implementation	Responsibility for Supervision
1.	**Pre-Construction**				
1.1	Assessment of Environmental Parameters Rapid surveys of flora and fauna prior to start of works Works planning to avoid birds breeding season	• Baseline parameters for ambient air and noise, water quality and soil quality have to be assessed prior to commencement of work. • Contractor to conduct lake bottom soil/sediment testing during the desilting works to check the physical, chemical, heavy metal, and biological quality parameters • Scheduling the clearance and desilting works during the summers and non-monsoon season (March-October); • Conduct a rapid survey of the lake area for presence of nest; and isolate the area without disturbing them until they hatch • Workers has to be trained and made aware if nest noticed during the restoration activity should report to the monitoring team and should isolate the place. • Do not remove or harm existing vegetation except those required under proposed contract.	• Water and soil quality parameters	Contractor	GCC
1.2	Consent, NOCs, Permissions and SEMP	• Contractor should obtain permissions/ NOC from the TNPCB for the desilting material, which is equal to or greater than 20 tons per day or 300 tons per project in a month • Before the disposal of the desilting materials/ silt waste, make an agreement with the GCC and concerned agencies to dispose the debris. • Obtain labour insurance and labour licence • Submission and approval of SEMP, based on updated IEE including EMP, prior to starting of work to the GCC • Operation and maintenance plan should also be prepared prior to completion of construction.	• Estimated quantity of the C and D Waste • Operation and maintenance plan • Written agreement on disposal of construction and demolition waste • approved SEMP by GCC	Contractor	GCC

Sl.no	Environmental Issues	Mitigation Measures	Indicators and Targets	Responsibility for implementation	Responsibility for Supervision
1.3	Workers camp / labours accommodation	• Provide water and sanitation facilities (separately for men and women); regular cleaning and disinfection of site • Provide adequate electricity / lighting • Provide potable water / storage tanks • Conduct regular health check-up / provide access to medical care • First aid room shall be provided in the project area during the entire construction and operation phases of the project; The antivenom/antivenin drug should be available for emergency purposes of snake bites • The proponent shall provide the dispenser for the disposal of sanitary napkins • Provide solid waste bins and collection; no final disposal on-site or burning of wastes is allowed in the workers camp / labours accommodation • Comply with the ban on single use plastics under Tamil Nadu Government Order • Discharge construction / workers camp sewage / wastewater into onsite septic tanks or connect to local public sewer system	• Location of construction camp approved by GCC • Construction camp having all the basic amenities with proper sanitary conditions drainage and watery supply • Contractor health and waste disposal records	Contractor	GCC
1.4	Lack of sufficient design and planning to ensure long term sustainability and protection of assets created	• Develop and implement Lake regeneration master plan following sustainable design measures, , including: o Clearance and fencing o Re-greening / re-vegetation of banks / land along water bodies and channels o New plantations with native species o Implement site specific plans in close coordination with GCC e.g. waste management plan o Preference should be given to low GHG embedded materials.	• Detailed design/ master plan for regeneration works	Contractor	GCC

Sl.no	Environmental Issues	Mitigation Measures	Indicators and Targets	Responsibility for implementation	Responsibility for Supervision
		o The possibilities of using local materials or recycled materials should be explored.			
1.5	COVID-19 response - spread of infection which causes serious symptoms like difficulty in breathing, chest pain and loss of speech or movement. If not treated it will lead to death	• Taking cognizance of situation at time of mobilization, the Contractor shall undertake a COVID risk assessment of project area and prepare a COVID Response and Management Plan (C-R&MP) and submit to GCC and PSC for approval. • The preparation of C-R&MP shall consider guidance of Government of India, World Health Organization, International Labour Organization, International Financial Corporation and World Bank's interim guidance note etc. • GCC should also encourage staff and workers engaged in project to get vaccinated • The contractor shall submit a weekly monitoring and progress report to GCC and PSC.	COVID Response and Management Plan	Contractor	GCC
1.6	Damage to utilities and service interruptions	• Identify and include locations and operators of these utilities in the DPR to prevent unnecessary disruption of services during the construction phase. • Require contractor to prepare a contingency plan to include actions to be done in case of unintentional interruption of services. • Require contractor to obtain from the GCC/ concerned department the list of affected utilities and operators; • If relocations are necessary, contractors along with GCC will coordinate with the providers/line agencies to relocate the utility. • Consult with the local communities if there is a need for interruption of services • Immediately inform local communalities of any accidental service interruptions that may occur due to works	Utility shifting plan	Contractor	GCC

Sl.no	Environmental Issues	Mitigation Measures	Indicators and Targets	Responsibility for implementation	Responsibility for Supervision
1.9		•			
2.	**Construction stage**				
2.1	Permissions from various departments	• During construction, the permits obtained by the contractor shall be periodically examined and validity be ensured. This includes the Consent for the batching plants from where the contractor sources the concrete, labour License, insurances etc.	• Maintain record for Validity information with respect to the permissions/ NoC's	Contractor	GCC
2.2	i. De-silting of the Lake a. Increase in turbidity b. Change in lake water quality due to aqueous discharges (oil and grease/ fuel waste) from excavator, and workboats c. Decrease in DO levels d. Removal of benthic communities e. ii. Construction of diversion drains iii. Strengthening of Bunds.	• Conduct works during dry season • Check water turbidity levels with baseline levels as reference during entire monitoring programme • Discharge of wastewater into lake will be prohibited • Oil Spill control measures will be adopted • Conduct water quality monitoring as per Environmental Monitoring Plan • The desilted excess earth should be disposed in an designated area in consultation with the GCC (preferably Kodungaiyur dumping yard) • The Contractor should make sure that no appreciable change to the drainage course shall occur due to the construction of diversion channel. • Wetting of soil before trench excavation, wetting of brick, metal and sand before handling • Construction residues such as metal cuttings/ shavings, wood, packing materials and containers should be disposed as per applicable legal requirements (please refer **Table 6**)	• Maintain record of de-silted soil quantity • Record for solid waste management at site	Contractor	GCC
2.3	Transportation of Construction materials and excess soil	• Traffic congestion near the entry and exit points from the roads adjoining the proposed project area must be avoided • Excess soil shall be handled, transported to dumping yard properly; before loading it shall be ensured that it is dried so no water spills during	• Maintain records of housekeeping • records of water sprinkling • covered vehicles carrying	Contractor	GCC

Sl.no	Environmental Issues	Mitigation Measures	Indicators and Targets	Responsibility for implementation	Responsibility for Supervision
		transport, and material also should be covered during transport to avoid spillage and dust. • Vehicles transporting construction materials prone to fugitive dust emissions should be covered • clean the undercarriage and wheels of construction vehicles to avoid dust generation • Idling of delivery trucks or other equipment should be avoided during loading and unloading operations (maximum idling time 3-5 minutes) • Sprinkling of water (for materials such as blue metal, sand and brick) before unloading to suppress dust generation • Adequate care should be taken to prevent spillage of earth or construction materials offsite and in haul routes. Any such spillage should be removed immediately, and the area cleaned	Construction materials		
2.4	Storage of construction materials/ Stockpiling of materials	• Construction materials should be stored within the project area, without affecting the traffic and other common utilities. • Storage of materials for regeneration works confined to work sites, such as there is no obstruction to natural drainage pattern at site; covered to reduce dust generation	• Maintain register for construction materials	Contractor	GCC
2.5	i. Management of Excavated silt ii. Construction debris and excavated materials.	• The excavated silt should be used for the bund strengthening and formation of bird island purposes; the quantum of silt required for this purpose shall be stored at the site, and [the excess silt shall be transported in covered trucks to disposal site and register should be maintained at the site. • Excess silt should be removed from the site as soon as possible, preferably daily, minimizing on-site storage	• Maintain records of excavated soil • records of reuse and disposal of excavated soil • disposal site identified and approved	Contractor	GCC

Sl.no	Environmental Issues	Mitigation Measures	Indicators and Targets	Responsibility for implementation	Responsibility for Supervision
		• Location for disposal of excess silt should be identified in consultation with the GCC (preferably Kodungaiyur dumping yard shall be used) • Floating materials like plastics, weeds should be sent to the SWM (composting and plastic segregation) facility of the GCC (Kodungaiyur dumping yard). • The Contractor should ensure that silt is dry during transportation to the disposal site and dripping shall not be permitted.			
2.6	Traffic Management	• Traffic management should be in place by the Contractor with adequate placement of traffic signals and traffic control personnel, when the vehicles are passing through the local roads and near the project area. Transportation of the construction materials to project area and excess silt/ wastes for disposal covered trucks shall be during non-peak hours	• Temporary Traffic Management Plan	Contractor	GCC
2.7	Nuisance to neighbourhood community	• Minimize disturbance to the neighbourhood community during material transport; conduct training sessions to the drivers on safe and good driving practices and ensure regular monitoring • Safety hard barricading should be provided while construction works near the small temples on bund and signage's should be placed; unrestricted and safe access should be provided • Work site lighting during night wherever required should be provided during the implementation. • Adequate slope gradient should be maintained while strengthening the bund while working in the boundary of the site • Storage of materials should be within the earmarked areas of project area, without disturbing the nearby community	• maintenance record of construction vehicles and equipment • records of noise monitoring as per EMP • contractor consultation records	Contractor	GCC

Sl.no	Environmental Issues	Mitigation Measures	Indicators and Targets	Responsibility for implementation	Responsibility for Supervision
		• Control dust; sprinkle water regularly • Erect barricading or wind breakers as required to reduce effect of high winds that would disturb loose soils and generate dust • the proposed construction activities should be implemented in a controlled manner minimizing the noise levels. The dB(A) levels for residential area (day time noise level 55 dB(A) and night time noise level 45 dB(A)) should be maintained. In work locations, close to the existing roads where noise levels are exceeding the threshold limit the project should not result in an increase of more than 3 dB(A) over existing ambient noise levels at the nearest receptor location off-site. • Conduct consultation with the local communities and provide detail in the language that is understandable to the local community about project activities and the anticipated impacts as part of the project information dissemination (prior to the start of the demolition activity) • Display the project related information including the GRM details in the project (demolishing) site. • Demolition activity (if any) should not be carried out at night (as per the labour law and 8 hours working time should be adopted)			
2.8	Operation of construction machinery	• All construction vehicles should comply with emission standards and be maintained properly Wind shields or Install barriers (GI sheets, geo-net) should be installed all along the site boundary to abate the dust carried over to the neighbouring areas. • Use of ready-mix concrete wherever possible shall be explored. In the case of use of concrete	• PUC available for all vehicles • maintenance record of construction vehicles and equipment • records of water sprinkling	Contractor	GCC

Sl.no	Environmental Issues	Mitigation Measures	Indicators and Targets	Responsibility for implementation	Responsibility for Supervision
		mixer, it should be mounted on shelter with top and sides closed. • Sprinkling of water on metal & sand should be carried out before handling			
2.9	Dust Pollution near settlements	• All earth work should be protected/ covered to minimize generation of dust. • Area under construction should be covered & equipped will dust collector. • Construction material should be covered or stored in such a manner so as to avoid being affected by wind direction. • Unpaved haul roads near / passing through residential and commercial areas to be watered thrice a day. • Trucks carrying construction material to be adequately covered to avoid the dust pollution and to avoid the material spillage.	• Maintain records of housekeeping • maintenance record of construction vehicles and equipment • exhaust silencers working properly • records of water sprinkling at site • covered vehicles carrying excavated soil • records of Air Quality monitoring as per EMP	Contractor	GCC
2.10	Vehicular noise pollution at residential / neighbouring settlements.	• Maintenance of vehicles, equipment and machinery should be regular to keep noise from these at a minimum. • All vehicles and equipment used for construction should be fitted with exhaust silencers. During routine servicing operations, the effectiveness of exhaust silencers should be checked and if found to be defective, it should be replaced. • Notwithstanding any other conditions of contract, noise level from any item of plant(s) will comply with the noise standards specified by CPCB. • If specific noise complaints are received during construction, the Contractor may be required to implement one or more of the following noise	• Maintenance record of construction vehicles and equipment • Exhaust silencers working properly • Records of noise monitoring as per EMP	Contractor	GCC

Sl.no	Environmental Issues	Mitigation Measures	Indicators and Targets	Responsibility for implementation	Responsibility for Supervision
		mitigation measures, as directed by the Engineer: • Shut off idling equipment. • Reschedule construction operations to avoid periods of noise annoyance identified in the complaint. • Notify nearby residents whenever extremely noisy work will be occurring.			
2.11	Socio cultural resources and chance finds	• Ensure the ADB SPS, 2009 requirements are met while dealing with physical cultural resources • The existing three temples should not be disturbed during the lake restoration works • Construction contractors to follow these measures in conducting the excavation work o All fossils, coins, articles of value of antiquity, structures and other remains or things of geological or archaeological interest discovered on the site shall be the property of the Government and shall be dealt with as per provisions of the relevant legislation. o The contractor will take reasonable precautions to prevent his workmen or any other persons from removing and damaging any such article or thing. He will, immediately upon discovery thereof and before removal acquaint the local authority of such discovery and carry out the instructions for dealing with the same. o Stop work immediately to allow further investigation if any finds are suspected; o Create awareness among the workers, supervisors and engineers about the chance finds during excavation work The local authority will inform State Archaeological	• Maintain record for the Chance find	Contractor	GCC

Sl.no	Environmental Issues	Mitigation Measures	Indicators and Targets	Responsibility for implementation	Responsibility for Supervision
		Department if a find is suspected and seek direction from ASI prior to recommencing the work. o Develop a protocol for use by the construction contractors in conducting any excavation work, to ensure that any chance finds are recognized and measures are taken to ensure they are protected and conserved			
2.12	Pollution from fuel and lubricants	• Contractor shall ensure that all vehicle/machinery and equipment operation, maintenance and refuelling will be carried out in such a fashion that spillage of fuels and lubricants does not contaminate the ground. • Contractor will arrange for collection, storing and disposal of oily wastes to the pre-identified disposal sites	• Proper storage of fuel and lubricants • Impermeable membrane used in flooring of storage yard to prevent soil and water pollution	Contractor	GCC
2.13	Site clearance/ levelling	• Sprinkling of water to reduce dust generation. • All vehicles, equipment and machinery to be procured for construction shall confirm to the relevant Bureau of Indian Standards (BIS) Norms and relevant emission/safety norms and/or standards	• Maintain record for water sprinkling and • Records of PUC's for construction vehicles and equipment's	Contractor	GCC
2.14	Identification and selection of Quarries	• The Contractor will identify materials from existing licensed quarries	• Maintain record of MoU/ NOC's/ Consent from TNPCB for the quarries	Contractor	GCC
2.15	Labour requirements and facilities	• The contractor should engage local labours to avoid conflict with local communities • The contractor has to adopt a Code of Conduct for the migrant labours to sort out any issues with the locals • Labour camp (if any) should be provided with water and sanitation facilities.	• Maintain labour register	Contractor	GCC

Sl.no	Environmental Issues	Mitigation Measures	Indicators and Targets	Responsibility for implementation	Responsibility for Supervision
		• All the basic amenities as mentioned in the Factory Act, BOCW Act and Safety, Health & Welfare at Work (Construction) Regulation 2013, should be provided by the contractor			
2.16	Occupational health and Safety	• Prepare H&S plan and include the measures such as (i) type of hazards during demolishing works; (ii) corresponding personal protective equipment for each identified hazard; (iii) H&S training for all site personnel; (iv) procedures to be followed for all site activities; and (v) documentation of work-related accidents • An environment, health and safety site officer should also be nominated by the contractor. • Workers should be provided with necessary occupational health and safety equipment such as protective face mask, head gear, eye shields / protective goggles and safety gloves etc. • Emergency contact numbers including Ambulance should be displayed at the project area and labour accommodation. First aid (along with antivenom/antivenin drug) will be made available at site. • Health check-up for the labourers should be carried out periodically due to exposure to slushy soil. • Elevated platforms should be equipped with handrails, toe boards and non-slip surfaces Personal Floatation devices (life vests), First Aid Kits (along with antivenom/antivenin drug), Fire Extinguisher, Tow rope, etc. shall be provided on vehicles / floats while working near water filled portions of the water body	• Maintain records on accidents, near misses	Contractor	GCC
2.17	Safety Measures During Construction	• Personal Protective Equipment (PPE) for workers on the project and adequate safety	• use of PPEs	Contractor	GCC

Sl.no	Environmental Issues	Mitigation Measures	Indicators and Targets	Responsibility for implementation	Responsibility for Supervision
		measures for workers during handling of materials at site will be taken up. • Adequate strutting should be provided to avoid collapse of soil. • The contractor has to comply with all regulations regarding safe scaffolding, ladders, working platforms, gangway, stairwells, excavations, trenches and safe means of entry and egress. • The used construction materials including nails, wooden pieces and other waste generated should be immediately removed from the work site after completing the construction work • Wherever required, signage's, reflectors and work site lighting should be provided	• records of PPEs procured and issued for use • compliance of all regulations regarding scaffolding, ladders and work at height		
2.18	Barricading site	• The construction site should be barricaded with adequate marking, flags, reflectors etc. for safety of general traffic movement, neighbouring settlements and pedestrians • No unauthorized persons shall be allowed to enter lake area during the works; desilting works in of lake bottom with wet soil conditions may pose considerable risk	• Maintain record and to replace the damaged / broken reflector/ barricade tapes	Contractor	GCC
2.19	Clearing of site and restoration	• On completion of the works, the left-over construction materials should be removed by the contractor from project area for reuse/ proper disposal. • All temporary structures will be cleared away, all rubbish cleared, excreta or other disposal pits or trenches filled in and effectively sealed off and the site left clean and tidy, at the contractor's expenses, to the entire satisfaction of the GCC.	• Site photographs, before and after completion of the works • Site inspection report	Contractor	GCC
3.	**Post Construction stage**				
3.1	Solid waste (debris, excavated soils, etc.)	• Backfill any excavation and trenches, preferably with excess excavation material generated during the construction phase.	• Pre-existing condition	GCC	GCC

Sl.no	Environmental Issues	Mitigation Measures	Indicators and Targets	Responsibility for implementation	Responsibility for Supervision
		• Re-establish the original grade and drainage pattern to the extent practicable. • Restore access roads, staging areas, and temporary work areas. • Remove all tools, equipment, barricades, signs, surplus materials, debris, and rubbish. Demolish buildings/structures not required for O&M. Dispose in designated disposal sites.	• Construction zone has been restored		
4	Operation	•	•		
4.1	Operation of restored lake and recreational activities	• Increased vehicular movement along the roads - speed restrictions, vehicle entry restrictions, provision of appropriate road signage and well-located rest points for pedestrians shall minimize impacts on safety of the visitors • Increase demands for services – line agency to provide adequate public facilities • Increase solid waste generation – GCC with help of local authority to put in place solid waste management programs in the affected areas. • Provide and maintain adequate number of washrooms, toilets, and create awareness and ensure that there is no open defecation; • Ensure that septic tanks are bottom and sides sealed, and septic tanks should be maintained properly and contents shall be sent to treatment plants for treatment and disposal • Cleaning and desludging operation of septic tanks shall not be conducted manually. • Implement COVID-19 prevention and control measures following applicable government guidelines and advisories issued by agencies like WHO and ILO. • Ensure availability of antivenom/antivenin drug with the First aid kit. Information on drug shall be displayed prominently, and awareness shall be	•		

Sl.no	Environmental Issues	Mitigation Measures	Indicators and Targets	Responsibility for implementation	Responsibility for Supervision
		created so that both reptiles and humans are not harmed			

B. Site and Activity-Specific Plans as per EMP

135. Table 31 summarizes site and activity-specific plans to be prepared as per EMP.

Table 31: Site- and Activity-Specific Plans/Programs as per EMP

To be Prepared During	Specific Plan/Program	Purpose	Responsible for Preparation and implementation	Responsible for Supervision
Detailed Design Phase	Environmental monitoring program as per detailed design	Indicate sampling locations, methodology and parameters	DPR Consultant	GCC
Pre-Construction Phase	List of pre-approved sites for stockpiling and disposal of materials	Locations for stockpile, storage and disposal	Contractor	GCC
Pre-Construction Phase	Waste Management Plan	Mitigate impacts due to waste generation	Contractor	GCC
Pre-Construction Plan	H&S plan	Occupational health and safety	Contractor	GCC
Construction Stage	EHS Training to the Labourers and staff	To made the staff aware about the risks and impacts of works and their mitigation	Contractor	GCC
Construction Stage	Workers awareness program	To make the workers aware about the Occupation H&S risks	Contractor	GCC

C. Environmental Monitoring Program

136. Through integration of mitigation measures in project design, the anticipated impacts are not significant, and mostly temporary in nature and can be avoided, minimized or mitigated by following the proposed mitigation measures given in the EMP.

137. Table 32 provides environmental monitoring plan which includes relevant environmental parameters, with a description of the sampling stations, frequency of monitoring and responsibility.

Table 32: Environmental Monitoring Plan (Pre construction and Construction stage)

	Field	Phase	Parameters	Locations	Frequency	Responsibility
1.	Air quality	Pre-Construction to establish baseline	Particulate matter (PM_{10} & $PM_{2.5}$), SOx, NOx, CO	5 locations (Sensitive locations, commercial areas especially in the downwind direction);	24 hours (Once before start of the construction)	Contractor

	Field	Phase	Parameters	Locations	Frequency	Responsibility
		Construction	Same as above	5 locations (similar to pre-construction locations)	24 hours (yearly 3-times during the construction period for 2 years)	Contractor
2.	Noise	Pre-Construction to establish baseline	Day time dB(A)	5 locations (Wherever the contractor decides to locate the equipment yard and at sensitive locations such as school, hospitals, etc)	24 hours (Once before start of the construction)	Contractor
		Construction	Day time dB(A)	5 locations (similar to pre-construction locations)	24 hours (yearly 4 - times during the construction period for 2 years)	Contractor
3	Surface water quality	Pre-Construction to establish baseline	pH, DO, BOD, COD, Chloride, TDS, TSS, Calcium, Zn, Cr^{+6}, Magnesium, Copper, Manganese, Sulphate, Cyanide, Nitrate, Sodium, Potassium, Fluoride, Cadmium, Arsenic, Lead, Boron, Selenium, Aluminium, Total residual Chlorine	3 sampling locations (inlet to the lake, middle section and outlet to the lake) representing water quality of the lake	Once before start of construction works	Contractor
		Construction	Same as above	3 locations (similar to pre-construction locations)	Quarterly except monsoon for 2 years	Contractor
4	Silt/ Sediment quality	Pre-Construction to establish baseline	Pb, SAR and Oil & Grease, monitoring silt for the presence of toxic metals	3 sampling locations (inlet to the lake, middle section and outlet to the lake) representing sediment quality of the lake	Once before start of construction works	Contractor
		Construction	Same as above	3 locations (similar to pre-	Quarterly except	Contractor

	Field	Phase	Parameters	Locations	Frequency	Responsibility
				construction locations)	monsoon for 2 years	
5	COVID - 19	Construction	Construction camps/ labour camps and working areas	Common symptoms including Fever, Dry cough and Tiredness	Daily	Contractor

Table 33: Indicative Environmental Monitoring Program (Operation stage)

	Field	Phase	Parameters	Locations	Frequency	Responsibility
1	Surface water quality	Operation Stage	Parameters for Surface water quality standards (IS; 2296). Water pH, TDS, Total hardness, Sulphate, Fluorides, Chloride, Fe, Pb for groundwater.	3 sampling locations (inlet to the lake, middle section and outlet to the lake) representing water quality of the lake	Yearly once during the Defect Liability Period (DLP) for 2 years	Contractor
2	Silt quality	Operation Stage	Pb, SAR and Oil & Grease, monitoring silt for the presence of toxic metals	3 sampling locations (inlet to the lake, middle section and outlet to the lake) representing sediment quality of the lake	Yearly once during the Defect Liability Period (DLP) for 2 years	Contractor

D. Implementation arrangement

138. The following agencies will be responsible for EMP Implementation:

(i) Greater Chennai Corporation (GCC) will act as the Implementing agency, responsible for coordinating procurement and construction of the project.

(ii) The Project Management Consultant (PMC) cum Independent Engineer (IE) assists GCC in managing the project including procurement and assures technical quality of design and construction. IE carries out construction supervision during project implementation. The responsibility will also include EMP implementation/supervision. Environmental specialist of PMC will update the IEE and monitoring the implementation of EMP. A biodiversity expert engaged under GEF component will support PMC and GCC.

(iii) The Contractor will be responsible for execution of all construction works. The contractor will work under the guidance of the Independent Engineer (IE) and GCC. The environmental related mitigation measures will also be implemented by the contractor. Contractor staff will also include Forestry expert with experience in Miyawaki method.

139. The detailed roles and responsibilities are as follows:

(i) **Greater Chennai Corporation (GCC)**. Being the Implementing Agency (IA), along with other key roles in executing the project, the roles pertaining to the Implementation of EMP includes.

(a) Review the IEE document and ensure adequacy under Safeguard Policy Statement, 2009 and identify any areas for improvement.
(b) Ensure that the project design and specification adequately reflect the IEE, co-ordinate the obtaining of requisite environmental clearances/ NoCs/ Permissions for the project
(c) Monitor construction activities to ensure that identified and appropriate control measures are effective and in compliance with the IEE
(d) Review and approve the Contractor's Implementation Plan for the environmental measures, as per IEE.
(e) Ensure that contractors and their subcontractors/suppliers comply with labour legislations ADB's SPS Prohibited list requirements; ensure that workers are paid and treated according to the labour legislations
(f) Liaise with the Contractor and Project Management Consultant cum Independent Engineer on the implementation of the Environmental management measures proposed in the IEE
(g) Liaise with the various Government agencies on environmental and other regulatory matters
(h) Establish dialogue with the affected communities (if any) and ensure that the environmental concerns and suggestions are incorporated and implemented in the project.
(i) Review the environmental performance of the project through an assessment of the periodic environmental monitoring reports submitted by the PMC cum IE; and initiate necessary follow-up actions
(j) Provide support and assistance to the Government Agencies and the ADB to supervise the implementation of the IEE during the construction as well as operation stage of the project
(k) Document the good practices in the project on incorporation and integration of environmental issues into engineering design and on implementing measures in the construction, and dissemination of the same.

(ii) Project Management Consultant (PMC) cum Independent Engineer (IE). The roles and responsibility includes:

(a) Oversight of implementation of environmental standards and safeguards as part of project implementation
(b) Interact on a regular basis with the Contractor and integrate environmentally sound practices into the detailed design of project components.
(c) Advise GCC for compliance with statutory clearances.
(d) Work out the site-specific mitigation measures for components as required and integrate the same into contractual provisions.
(e) Develop, organise and deliver environmental training programmes and workshops for the staff of the GCC and Contractor and in accordance to the Capacity Building Programme as specified in the IEE.
(f) Ensure that baseline surveys, environmental monitoring plans and programs as may be required are carried out.

(g) Preparation of Activity Plans as identified in IEE (these include Site Management Plan, Waste Management Plan, Occupational, Health and Safety Plan etc.).
(h) Supervise the implementation of the Environmental provisions by the Contractor.
(i) Review and approve site specific environmental enhancement/mitigation designs worked out by the Contractor. Hold regular consultation meetings with the GCC
(j) Review the Contractors Environmental Implementation Plans to ensure compliance with the IEE.
(k) Monitoring the Contractor environmental performance on day to day basis
(l) Conduct regular monitoring and ensure that contractors and their subcontractors/suppliers comply with labour legislations and ADB SPS Prohibited list requirements; ensure that workers are paid and treated according to the labor legislations
(m) Develop good practice construction guidelines to assist the Contractor in implementing the provisions of IEE.
(n) Prepare and submit regular environmental monitoring and implementation progress reports.

(iii) Construction Contractor. EMP will be included in the bidding and contract document and verified by the PMC cum IE. The Contractor will ensure Environment, Health and Safety (EHS) requirements are adequately implemented as per the EMP during civil works. Contractor is to carry out all environmental mitigation and monitoring measures outlined in their contract. The Contractor will be required to submit to PMC cum IE, for review and approval, a Site Environmental Management Plan (SEMP) including:

(a) Proposed sites/locations for construction work camps, storage areas, hauling roads, lay down areas, disposal areas for solid and hazardous wastes;
(b) Specific mitigation measures following the approved SEMP;
(c) Monitoring program as per SEMP;
(d) Site specific OHS plan in accordance with the Health and Safety Plan (COVID 19) and
(e) Budget for SEMP implementation. No works are allowed to commence prior to approval of SEMP.
(f) Comply with labour legislations, and ensure that subcontractors/suppliers also implement labor legislations requirements, through cascading of requirements to subcontractors—HR policy, labor management requirements, any worksite specific grievance redress mechanism.

(iv) Responsibility for Reporting. PMC cum IE in coordination with Contractor will submit quarterly and semi-annually monitoring report to GCC. On the basis of it GCC will submit to ADB semi-annual monitoring reports on implementation of the EMP. Any major accidents having serious environmental consequences will be reported immediately. PMC cum IE will help in preparation and finalization of quarterly, semi-annual and annual progress reports. The sample environmental monitoring template, summary monitoring table and sample environmental site inspection report format is attached as Appendix 5 to 7.

(v) Lake Management Committee (LMC). An empowerment council has to be constituted for carrying out the management and maintenance activities of the lake. The Committee shall be headed by the person not lesser than the rank of an Executive Engineer and consist of representatives from various stake holding agencies such as:

(a) Greater Chennai Corporation (GCC)
(b) PWD, WRO
(c) CRRT
(d) Agriculture Department
(e) TNPCB
(f) Reputed NGO's

(vi) Roles & Responsibilities of the LMC. The committee shall meet once in every three months to review the maintenance works undertaken and address the issues raised so far. The key roles includes:

(a) To review the maintenance works undertaken so far and address the issues pertaining to the day-to-day operations.
(b) To coordinate the various stake holding agencies involved and resolve the issues pertaining to the implementation of the lake development works.
(c) The committee shall have its own website to invite suggestions from public.
(d) The committee will ensure the riparian rights of nearby farmers demarcation clearly as per existing rules and amendments.
(e) To train the field level and administrative level of employees of the lake including Government stakeholders and NGO's to improve the administrative capacity so as to maintain the water bodies from pollution problems. Local residents can also be included in the training programmes.
(f) Water & Environmental quality monitoring, LMC shall associate with GCC for monitoring the lake environment and its surroundings, their water quality and take up the issues to the corresponding department contract it's for seeking the solution.
(g) Develop the working nomenclature and schedule for each of the worker to be involved in the lake development & lake maintenance works.

E. Capacity Building Programme

140. The following Table presents the outline of the capacity building program to ensure EMP implementation. These capacity building and training will be conducted by the PMC cum IE, which are part of project implementation set-up, and therefore no separate or additional costs are envisaged. The detailed program and specific modules will be customized for the available skillset after assessing the capabilities of the target participants and the requirements of the project by the GCC. The capacity building program will be participatory to the extent possible and will employ variety approaches to be more effective (such as learning by doing, role playing, group exercises, on-the-job training, etc). A pre- and post-training assessment will be undertaken to measure the effectiveness of the program

Table 34: Outline Capacity Building Program on EMP Implementation

Description	Suggested Training Method	Target Participants and Venue	Cost and Source of Funds
1. Introduction and Sensitization to Environmental Issues (1 day) • ADB Safeguards Policy Statement • Government of India and Tamil Nadu applicable safeguard laws, regulations and policies including but not limited to core labour standards, OH and S, etc. • Incorporation of EMP into the project design and contracts • Monitoring, reporting and corrective action planning	Lecture and group activities	All staffs (GCC and Contactor) involved in the project At GCC office	Included in the overall program cost
2. EMP implementation (1/2 day) • EMP mitigation and monitoring measures • Roles and responsibilities • Public relations, - Consultations • Grievance redress • Monitoring and corrective action planning • Reporting and disclosure • Construction site standard operating procedures (SOP) • Traffic management plan Site clean-up and restoration	Group activities, role play and case studies	All staffs (GCC and Contactor) involved in the project. At GCC Office	Part of project implementation cost
3. Contractors Orientation to Workers (1/2 day) • Environment, health, and safety in project construction	Orientation via audio visual presentations, and on-job training	• Once before initiation of work, and thereafter regular briefing every month once. • A daily briefing on safety prior to the start of work • All workers (including unskilled laborers)	Contractor to conduct the program, with the guidance of PMC cum IE

F. EMP Implementation Cost

141. Most of the mitigation measures require the contractors to adopt good site practices, which should be part of their normal procedures already, so there are unlikely to be major costs associated with compliance. The costs which are specific to EMP implementation and are not covered elsewhere in the projects are given below.

Table 35: Cost Estimates to Implement the EMP

Sl.no	Management Activities	Qty	Rate (Rs.)	Cost (Rs.)	Remarks
A	**During Pre-Construction Phase**				
1	Monitoring of Baseline parameters				Refer Environmental Monitoring Plan - Pre construction Stage
	Ambient air quality	5	5,000	25,000	
	Ambient noise levels	5	3,000	15,000	
	water quality	3	5,000	15,000	
	Sediment quality	3	5,000	15,000	
	Sub Total-A			**70,000**	
B	**During Construction Phase**				
2	Monitoring of Baseline parameters				Refer Environmental Monitoring Plan - construction Stage
	Ambient air quality	30	5,000	150,000	
	Ambient noise levels	30	3,000	90,000	
	water quality	18	5,000	90,000	
	Sediment quality	18	5,000	90,000	
	Sub Total-B			**420,000**	
C	**During the Operational Phase**				
3	Monitoring of Baseline parameters				Refer Environmental Monitoring Plan - Operation Stage
	water quality	2	5,000	10,000	
	Sediment quality	2	5,000	10,000	
	Sub Total-C			**20,000**	
D	**Capacity Building**				
4	Orientation workshop for officials involved in the project implementation on ADB Safeguards Policy Statement and environmental assessment process and Public Awareness Programs	LS		5,00,000	
5	Induction course to contractor, preparing them for environmental management plan (EMP) implementation and environmental monitoring requirements related to mitigation measures; and taking immediate action to remedy unexpected adverse impacts or ineffective mitigation measures found during implementation	LS		5,00,000	
	Sub Total-D			**10,00,000**	
	Total Cost for Environmental Monitoring during pre- construction, construction and operation stages and Capacity Building			**5,10,000**	

IX. CONCLUSION AND RECOMMENDATIONS

142. The environmental impacts of all the proposed project interventions of the Kadapakkam lake restoration project have been assessed. Based on the assessment outcome, and as per the ADB SPS 2009 requirements, this project has been categorized as “B”. The proposed Kadapakkam lake restoration project components does not fall under the ambit of the EIA Notification 2006, and therefore EIA Study or EC is not required for the project.

143. Baseline environmental monitoring conducted for ambient air quality shows the concentration of all the key parameters (PM_{10} & $PM_{2.5}$, SO_x and NO_x) are well within the stipulated standards. However, the monitored ambient noise levels are observed to be high for residential zone/ silent zone, the increase in noise levels may be due to the movement of cargo trucks/ lorries used for transporting the materials to the warehouses located surrounding the Kadapakkam Lake. The surface water quality meets the Class A as per the IS:2296-1982 (Class of Surface Water). The sediment analysis shows the quality of the sediment/ silt can be utilised for agriculture purposes as it contains no heavy metal.

144. There is no natural habitat of forest, grassland of significant size within the restoration area that support a high diversity of terrestrial wildlife, which will be disturbed during restoration. There was no rare, protected or endangered wildlife species in the project area based on literature and survey except the Near Threatened (NT) species Spot-Billed Pelican (*Pelecanus philippensis*), and this species will be benefited after the completion of the restoration. Kadapakkam lake restoration will have positive impacts to biological resources, ecology and biodiversity. Rehabilitated Kadapakkam lake will provide resting, feeding, nesting and nursery habitats for wildlife. The restoration activity should use native plant species of local provenance.

145. Based on the project design and the existing baseline environmental conditions, all potential impacts were identified in relation to pre-construction, construction, and operation phases. Planning principles and design considerations have been reviewed and incorporated into the site planning and design process wherever possible; thus, environmental impacts as being due to the project design or location were not significant.

146. Another fact is that being a small construction works, significant adverse environmental impacts are not anticipated. The major issues identified during the restoration of the lake is the disposal of the excavated silt, however, as per the sediment analysis, the silt is suitable for construction works and hence nearly 80% of the silt (1,14,056 cu.m) shall be utilised for bund formation and remaining 20% (28,514 cu.m) shall be disposed in the Kodungaiyur solid waste dumping area (owned by GCC). Construction related minimal impacts like disturbance to local biodiversity (flora and fauna), dust pollution, loading and unloading operation, will have impact to the surrounding which may also have impacts on the labours (causing health hazard). Accordingly, the EMP has been provided with mitigation measures to take care of the labourer’s safety during construction.

147. The EMP has been designed to address the impacts that are likely to arise during the pre-construction, construction and post construction stages of the project with appropriate mitigation and monitoring mechanism with responsibilities. The effective implementation of the proposed environmental management measures will be ensured through capacity building and monitoring.

148. Mitigation will be assured by a program of environmental monitoring conducted during construction to ensure that all measures are implemented, and to determine whether the environment is protected as intended. This will include observations on- and off-site, document

checks, and interviews with workers and beneficiaries, and any requirements for remedial action will be reported to the GCC.

149. The implementation of the project will have positive impacts to the local people during the project construction stage by generating employment opportunity for skilled and unskilled labourers for short time (construction stage) and during operation stage there are potential for more shops/ commercial activities to be benefited through business generated due to the arrival of more/ increased visitors thus it will have direct positive impact in the livelihood of the local people.

150. One on one consultation have been conducted (with the locals residing surrounding the lake area) following COVID19 protocals throughout the IEE process and their view have been examined and included in the project design/ planning and development of the project. Local people were also consulted during the biodiversity study. Further consultations will be conducted once the situation becomes conducive. The outcome/ feedback from consultations will be appropriately considered in project design, construction, and operation.

151. The prepared IEE will be disclosed to a wider audience via the GCC and ADB websites. The consultation process will be continued and expanded during project implementation to ensure that stakeholders are fully engaged in the project and have the opportunity to participate in its development and implementation.

152. The IEE carried out for the Kadapakkam lake restoration project shows that the proposed interventions/ components will result in net environmental benefits and that any likely environmental impact can be easily addressed through proper location, planning and design of the proposed project; control of construction activity and mitigation measures. The EMP provides for mitigation of all identified impacts and the Contract clauses for the environmental provisions will be part of the civil works contracts. Further, the proposed designs have been consulted with the stakeholders and no significant issues requiring redressal in terms of environmental safeguards are known to exist at present.

153. Based on the findings of the IEE, there are no significant impacts and the classification of the project as Category “B” is confirmed. No further study or detailed Environmental Impact Assessment (EIA) needs to be undertaken to comply with ADB SPS (2009).

Appendix 1A : UNEP Checklist (Safeguard Risk Identification Form [SRIF])

Safeguard Risk Identification Form (SRIF)

Section 1: Project Overview

Identification	*Insert Project ID# from Programme Framework Table*
Project Title	Restoration of Biodiversity and Ecosystem services in Kadapakkam Lake in Chennai - Kosathalaiyar Basin.
Managing Division	Greater Chennai Corporation (GCC), Chennai
Type/Location	KadapakkamVillage, Madhavaram, Chennai
Region	Asia Pacific
List Countries	India
Project Description	The proposed project is to rejunuvate the Kadapakkam Lake, which is located in the Kadapakkam Village, Chennai. The total area of the lake is 134.8 acres. It has an inlet for receiving surplus water from Vichoor lake which is located in the upstream and an outlet for releasing surplus water to Ariyalur lake which is located in the downstream. The present condition of the lake was observed to be undisturbed, however, due to siltation, mainly through the runoff from nearby agriculture field, the lake has lost its actual water holding capacity. Further site investigations also suggests the lake is free of sewage pollution, but it is susceptible for agriculture waste dumping and the water quality is getting deteriorated due to the cleaning of vehicles using the lake water. In order to restore the lake capacity and to restore the lost biodiversity, the project on “the Restoration of Biodiversity and Ecosystem services in Kadapakkam Lake in Chennai - Kosathalaiyar Basin” has been proposed. The key objective of the project is to increase the capacity of the lake by deepening the water spread area and to provide amenities, which shall be utilized by the communities to make the lake area livelier. Some of the project interventions includes 1. De-silting for a depth of 2 m average. 2. Strengthening and Widening of bund around the lake 3. Development of walking track, Cycling track, Hedge rows and Tree plantation on the bund 4. Construction of Shallow ponds at inlets and formation of Bird Island with Miyawaki Forest 5. Restrict of cart & vehicle washing and bathing activities 6. Removal of water plants and weeds from the water spread areas and Lake foreshore bund 7. Restrict open defecation

	Positive benefits of the project includes, the lake will act as flood water reservoir during monsoon and ensures water availability in the summer for sustaining agricultural activity in the command area and recreation activities within the lake. In addition to this, continuous storage of water will improve the ground water level in adjoining areas and sustains aquatic biodiversity. Using Green materials as a preferred choice will also be pioneer in this type of development and will become bench mark for the future projects in positive earth development. Concept of fore bay pond plays a major role in filtering the inlet water and It is the pioneer in this type of development, thereby it reaches the main lake in secondary with filtered water.
Relevant Sub programmes	
Estimated duration of project	19.5 Months
Estimated cost of the project	8.318 Million USD (55.34 crore)
Name of the UNEP project manager responsible	
Funding Source(s)	ADB (Asian Development Bank)
Executing/Implementing partner(s)	Greater Chennai Corporation (GCC)
SRIF submission version	*If it is not the first time, mark the time of your previous submission* *Concept Review [ ]* ***During Project development [✓]*** *PRC [ ]* *Other _____*
Safeguard-related reports prepared so far *(Please attach the documents or provide the hyperlinks)*	• *Feasibility report [ ]* • *Gender Action Plan [ ]* • *Stakeholder Engagement Plan [ ]* • *Safeguard risk assessment or impact assessment [ ]* • *ES Management Plan or Framework [ ]* • *Indigenous Peoples Plan [ ]* • *Cultural Heritage Plan [ ]* • *Others* ***Initial Environmental Examination (IEE)***

Section 2: Safeguards Risk Summary

A. Summary of the Safeguards Risk Triggered

Safeguard Standards Triggered by the Project	Impact of Risk [4] (1-5)	Probability of Risk (1-5)	Significance of Risk (L, M, H) *Please refer to the matrix below*
SS 1: Biodiversity, Ecosystems and Sustainable Natural Resource Management	4	3	M
SS 2: Climate Change and Disaster Risks	3	3	L
SS 3: Pollution Prevention and Resource Efficiency	2	2	L
SS 4: Community Health, Safety and Security	2	2	L
SS 5: Cultural Heritage	1	1	L
SS 6: Displacement and Involuntary Resettlement	1	1	L
SS 7: Indigenous Peoples	1	1	L
SS 8: Labor and working conditions	3	3	M

B. **ESS Risk Level[5] -**

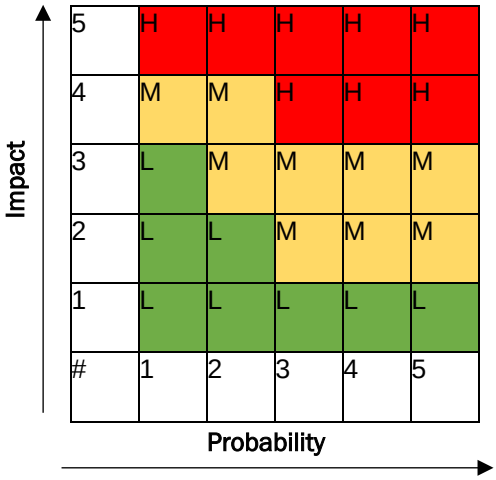
Refer to the UNEP ESSF (Chapter IV) and the UNEP's ESSF Guidelines.

Low risk ☐

Moderate risk ☒

High risk ☐

Additional information required ☐



[4] Refer to UNEP Environmental and Social Sustainability Framework (ESSF): Implementation Guidance Note to assign values to the Impact of Risk and the Probability of Risk to determine the overall significance of Risk (Low, Moderate or High).

[5] **Low risk**: Negative impacts minimal or negligible: no further study or impact management required.
Moderate risk: Potential negative impacts, but limited in scale, not unprecedented or irreversible and generally limited to programme/project area; impacts amenable to management using standard mitigation measures; limited environmental or social analysis may be required to develop a Environmental and Social Management Plan (ESMP). Straightforward application of good practice may be sufficient without additional study.
High risk: Potential for significant negative impacts (e.g., irreversible, unprecedented, cumulative, significant stakeholder concerns); Environmental and Social Impact Assessment (ESIA) (or Strategic Environmental and Social Assessment (SESA)) including a full impact assessment may be required, followed by an effective comprehensive safeguard management plan.

C. Development of ESS Review Note and Screening Decision

Prepared by

Name: TA Consultants, Date: 15/08/2021

Screening review by

Name: _____ Date: _____

Cleared[6]

Signature

D. Safeguard Review Summary (by the safeguard team)

The proposed Kadapakkam Restoration Project is to increase the capacity of the lake by deepening the water spread area and to provide amenities, which shall be utilized by the communities to make the lake area livelier. The impacts associated with the proposed interventions are short term impacts related to construction activities, by adopting the EMP measures the anticipated impacts shall be mitigated hence no further assessment needed.

E. Safeguard Recommendations (by the safeguard team)

- No specific safeguard action required ☐
- Take Good Practice approach[7] ☒
- Carry out further assessments (e.g., site visits, experts' inputs, consult affected communities, etc.) ☐
- Carry out impact assessments (by relevant experts) in the risk areas and develop management framework/plan ☐
- Consult Safeguards Advisor early during the full project development phase ☐
- Other_____

Section 3: Safeguard Risk Checklist

Screening checklist	Y/N/ Maybe	Justification for the response (please provide answers to each question)
Guiding Principles (these questions should be considered during the project development phase)		

[6] This is signed only for the full projects latest by the PRC time.

[7] Good practice approach: For most low-moderate risk projects, good practice approachmay be sufficient. In that case, no separate management plan is necessary. Instead, the project document demonstrates safeguard management approach in theproject activities, budget, risks management, stakeholder engagement or/and monitoring segments of the project document to avoid or minimize the identified potential risks without preparing a separate safeguard management plan.

GP1	Has the project analyzed and stated those who are interested and may be affected positively or negatively around the project activities, approaches or results?	Yes	It does affect positively large extent and negative results weighed very minor and does affect negatively for the users who either abuse the lake or use it against the rules such as taking out illegal water using diesel pumps.
GP2	Has the project identified and engaged vulnerable, marginalized people, including disabled people, through the informed, inclusive, transparent and equal manner on potential positive or negative implication of the proposed approach and their roles in the project implementation?	No	Not envisaged
GP3	Have local communities or individuals raised human rights or gender equality concerns regarding the project (e.g. during the stakeholder engagement process, grievance processes, public statements)?	No	No human rights or gender equality related concerns in this project
GP4	Does the proposed project consider gender-balanced representation in the design and implementation?	Yes	The project is designed to have ample safety measures for the visitors and also separate toilet facilities, lighting facilities for the walkway, parking area are provided to make the project area more secure for women and children's
GP5	Did the proposed project analyze relevant gender issues and develop a gender responsive project approach?	Yes	Appropriate Gender Based Violence has been assessed and accordingly the design has been formulated
GP6	Does the project include a project-specific grievance redress mechanism? If yes, state the specific location of such information.	Yes	The existing GRM (head by the GCC) will play the vital role in this project. The information about the GRM including the contact numbers will be displayed near the project area
GP7	Will or did the project disclose project information, including the safeguard documents? If yes, please list all the webpages where the information is (or will be) disclosed.	Yes	As per the ADB safeguard Policy all the safeguard documents (IEE and RP) will be disclosed in the GCC and ADB website.
GP8	Were the stakeholders (including affected communities) informed of the projects and grievance redress mechanism? If yes, describe how they were informed.	Yes	Project related Information has been shared through the Public consultation and disclosed in the local newspapers (in both regional and English languages).
GP9	Does the project consider potential negative impacts from short-term net gain to the local communities or countries at the risk of generating long-term social or economic burden?[8]	No	During the project construction, short term pollution impacts are anticipated, which is common for any construction activities. However, during operation phase of the lake (after rejuvenation), it helps recharging the groundwater, which will have a long-term positive impact to the surrounding communities

[8] For example, a project may consider investing incommercial shrimp farm by clearing the nearby mangrove forest to improve the livelihood of the coastal community. However, long term economic benefit from theshrip farm may be significantly lower than the mangroves if we consider full costs factoring safety from storms, soil protection,water quality, biodiversity and so on.

GP10	Does the project consider potential partial economic benefits while excluding marginalized or vulnerable groups, including women in poverty?	Yes	During the operation stage of the project (after rejuvenation), there are potential positive benefits through commercial activities for the visitors.
Safeguard Standard 1: Biodiversity, Ecosystems and Sustainable Natural Resource Management			
Would the project potentially involve or lead to:			
1.1	conversion or degradation of habitats (including modified habitat, natural habitat and critical natural habitat), or losses and threats to biodiversity and/or ecosystems and ecosystem services?	Yes	The proposed restoration activities are to conserve the aquatic and terrestrial biodiversity in the project area.
1.2	adverse impacts specifically to habitats that are legally protected, officially proposed for protection, or recognized as protected by traditional local communities and/or authoritative sources (e.g., National Park, Nature Conservancy, Indigenous Community Conserved Area, (ICCA); etc.)?	No	The proposed site (Kadapakkam Lake) for restoration is not legally protected site under Wildlife Protection Act, 1972
1.3	conversion or degradation of habitats that are identified by authoritative sources for their high conservation and biodiversity value?	No	The proposed restoration activities are to conserve the aquatic and terrestrial biodiversity.
1.4	activities that are not legally permitted or are inconsistent with any officially recognized management plans for the area?	No	There is no specific management plan available for this area. Necessary regulatory clearances under Water and Air act shall be obtained from Tamil Nadu Pollution Control Board.
1.5	risks to endangered species (e.g., reduction, encroachment on habitat)?	No	The proposed restoration measures improve the aquatic habitat.
1.6	activities that may result in soil erosion, deterioration and/or land degradation?	No	Excavated earth will be used to Strengthen the Bund and slope. In order to prevent soil erosion fibrous rooted trees like Palm species and Grasses are proposed on the berm to hold the soil promptly.
1.7	reduced quality or quantity of ground water or water in rivers, ponds, lakes, other wetlands?	No	The proposed deepening activity doubles the water storage capacity of lake and improve the surface as well as ground water quality.
1.8	reforestation, plantation development and/or forest harvesting?	Yes	Proposed Bird Island (5 acres) in the water spread areas shall be planted with native tree species following the Miyawaki planting method. It is also proposed to plant trees and Hedges along lake bund.
1.9	support for agricultural production, animal/fish production and harvesting	Yes	The purpose of the project is to increase the capacity of the lake by deepening the water spread area, From climate change impact perspective, the lake will act as flood water reservoir during monsoon (prevents crops from inundation) and ensures water availabity in the summer for sustaining agricultural activity in the command area

			Proposed to repair the exiting Sluice Gate to release water from lake upto 3m storage level for irrigation Purpose.
1.10	introduction or utilization of any invasive alien species of flora and fauna, whether accidental or intentional?	No	The propose project aims to use native flora for planting. The existing invasive species such as Water hyacinth, Prosopis and Ipomoea in few pockets shall be removed during deepening
1.11	handling or utilization of genetically modified organisms?	No	There are no such activities in the proposed restoration plan.
1.12	collection and utilization of genetic resources?	No	There are no such activities in the proposed restoration plan.
Safeguard Standard 2: Climate Change and Disaster Risks			
Would the project potentially involve or lead to:			
2.1	improving resilience against potential climate change impact beyond the project intervention period?	Yes	The purpose of the project is to increase the capacity of the lake by deepening the water spread area, From climate change impact perspective, the lake will act as flood water reservoir during monsoon (prevents crops from inundation) and ensures water availabity in the summer for sustaining agricultural activity in the command area
2.2	areas that are now or are projected to be subject to natural hazards such as extreme temperatures, earthquakes, extreme precipitation and flooding, landslides, droughts, severe winds, sea level rise, storm surges, tsunami or volcanic eruptions in the next 30 years?	Yes	Project location is close to Bay of Bengal, frequent and intense cyclonic storms, extreme precipitation and flooding are projected
2.3	outputs and outcomes sensitive or vulnerable to potential impacts of climate change (e.g. changes in precipitation, temperature, salinity, extreme events)?	Yes	i. Excess precipitation and runoff may cause breaching. ii. Project location is close to Bay of Bengal, frequent and intense cyclonic storms and its resultant wind action may cause damages to trees and shrubs. iii. Increase of surface temperature may result is evaporation loss and also increases water temperature. Increase in water temperature may affect the metabolic activities of aquatic organisms
2.4	local communities vulnerable to the impacts of climate change and disaster risks (e.g. considering level of exposure and adaptive capacity)?	Yes	The purpose of the project is to increase the capacity of the lake by deepening the water spread area, From climate change impact perspective, the lake will act as flood water reservoir during monsoon (prevents crops from inundation) and ensures water availabity in the

			summer for sustaining agricultural activity in the command area
2.5	increases of greenhouse gas emissions, black carbon emissions or other drivers of climate change?	No	The proposed project has been designed to use energy efficient LED light and solar powered street lights in the project area
2.6	Carbon sequestration and reduction of greenhouse emissions, resource-efficient and low carbon development, other measures for mitigating climate change	Yes	Proposed Bird Island (5 acres) in the water spread areas shall be planted with native tree species following the Miyawaki planting method. It is also proposed to plant trees and Hedges along lake bund. It is also proposed to use energy efficient LED light and solar powered street lights in the project area
Safeguard Standard 3: Pollution Prevention and Resource Efficiency			
Would the project potentially involve or lead to:			
3.1	the release of pollutants to the environment due to routine or non-routine circumstances with the potential for adverse local, regional, and/or transboundary impacts?	No	There are no polluting sources in the proposed project activities. During construction the key area of impact is the solid waste management, which shall be mitigated through following the measures suggested in the EMP. During project operation, the given infrastructure facilities like toilets, waste water management and solid waste management shall be well maintained. The wastewater from toilets blocks shall be stored in septic tanks and disposed-off at treatment facilities available with Chennai Metropolitan Water Supply and Sewerage Board. Solid waste generated at site shall be segregated. Degradable wastes shall be sent to compost facility proposed in the project. Non degradable waste shall be sent to Greater Chennai Corporation treatment facility.
3.2	the generation of waste (both hazardous and non-hazardous)?	Yes	Similar to the measures as discussed earlier (refer Sl.no 3.1)
3.3	the manufacture, trade, release, and/or use of hazardous materials and/or chemicals?	No	Not envisaged in this project
3.4	the use of chemicals or materials subject to international bans or phase-outs? (e.g. DDT, PCBs and other chemicals listed in international conventions such as the Montreal Protocol, Minamata Convention, Basel Convention, Rotterdam Convention, Stockholm Convention)	No	Not envisaged in this project
3.5	the application of pesticides or fertilizers that may have a negative effect on the environment	No	Not envisaged in this project

	(including non-target species) or human health?		
3.6	significant consumption of energy, water, or other material inputs?	Yes	During the project construction, there is a requirement for the water, energy and construction materials (including sand, stone, cement etc.). However, during the operation, no such consumptions of energy, water, or other material are envisaged. It is proposed to use energy efficient LED light and solar powered street lights in the project area
Safeguard Standard 4: Community Health, Safety and Security			
Would the project potentially involve or lead to:			
4.1	the design, construction, operation and/or decommissioning of structural elements such as new buildings or structures (including those accessed by the public)?	No	Decommissioning of structural elements are not envisaged in this project
4.2	air pollution, noise, vibration, traffic, physical hazards, water runoff?	Yes	It is expected to be site specific and short term (only during construction phase)
4.3	exposure to water-borne or other vector-borne diseases (e.g. temporary breeding habitats), communicable or no communicable diseases?	No	The proposed project is to improve the water quality and aquatic biodiversity. Larvae of vectors will be fed by small fishes. Necessary training will be given to construction workers related to HIV and COVID-19 Protection measures (Mask, Sanitizers) shall be made available at construction site.
4.4	adverse impacts on natural resources and/or ecosystem services relevant to the communities' health and safety (e.g. food, surface water purification, natural buffers from flooding)?	No	No such impacts are anticipated, the proposed project is to improve the water quality and aquatic biodiversity of the lake.
4.5	transport, storage use and/or disposal of hazardous or dangerous materials (e.g. fuel, explosives, other chemicals that may cause an emergency event)?	No	There is no use of explosives or chemicals at project area. Fuel for construction vehicles shall not be stored at site.
4.6	engagement of security personnel to support project activities (e.g. protection of property or personnel, patrolling of protected areas)?	Yes	Contractor shall appoint security personnel to protect the project area during construction phase.
4.7	an influx of workers to the project area or security personnel (e.g. police, military, other)?	Yes	Significant number of workers will be involved during construction phase
Safeguard Standard 5: Cultural Heritage			
Would the project potentially involve or lead to:			
5.1	activities adjacent to or within a Cultural Heritage site?	Yes	There are three small religious structures located in the project area. However, those structures will not be disturbed as per the proposed design and hence there will be no adverse impacts anticipated due to project activity.

5.2	adverse impacts to sites, structures or objects with historical, cultural, artistic, traditional or religious values or to intangible forms of cultural heritage (e.g. knowledge, innovations, practices)?	No	As indicated earlier (refer sl.no 5.1), the existing temples will be retained as per the proposed design and hence, there is no adverse impacts anticipated due to the project activity.
5.3	utilization of Cultural Heritage for commercial or other purposes (e.g. use of objects, practices, traditional knowledge, tourism)?	No	Not envisaged
5.4	alterations to landscapes and natural features with cultural significance?	No	Not envisaged
5.5	significant land clearing, demolitions, excavations, flooding?	No	Not envisaged
5.6	identification and protection of cultural heritage sites or intangible forms of cultural heritage	No	Not envisaged
Safeguard Standard 6: Displacement and Involuntary Resettlement			
Would the project potentially involve or lead to:			
6.1	full or partial physical displacement or relocation of people (whether temporary or permanent)?	No	The project area belongs to the GCC and there are no encroachment in the site and hence there are no full or partial physical displacement or relocation of people involved.
6.2	economic displacement (e.g. loss of assets or access to assets affecting for example crops, businesses, income generation sources)?	No	The involuntary resettlement due diligence report confirms that there are no encroachments. Hence, no economic displacement is envisaged
6.2	involuntary restrictions on land/water use that deny a community the use of resources to which they have traditional or recognizable use rights?	No	The purpose of the project is to increase the capacity of the lake by deepening the water spread area, From climate change impact perspective, the lake will act as flood water reservoir during monsoon (prevents crops from inundation) and ensures water availabity in the summer for sustaining agricultural activity in the command area Proposed to repair the exiting Sluice Gate to release water from lake upto 3m storage level for irrigation Purpose.
6.3	risk of forced evictions?	No	The involuntary resettlement due diligence report confirms that there are no encroachments. Hence, no risk of forced evictions is assessed.
6.4	changes in land tenure arrangements, including communal and/or customary/traditional land tenure patterns (including temporary/permanent loss of land)?	No	Not envisaged
Safeguard Standard 7: Indigenous Peoples			
Would the project potentially involve or lead to:			
7.1	areas where indigenous peoples are present or uncontacted or isolated indigenous peoples inhabit or where it is believed these peoples may inhabit?	No	Not envisaged. The project site is free of indigenous people / community

7.2	activities located on lands and territories claimed by indigenous peoples?	No	
7.3	impacts to the human rights of indigenous peoples or to the lands, territories and resources claimed by them?	No	
7.4	the utilization and/or commercial development of natural resources on lands and territories claimed by indigenous peoples?	No	
7.5	adverse effectson the development priorities, decision making mechanisms, and forms of self-government of indigenous peoples as defined by them?	No	
7.6	risks to the traditional livelihoods, physical and cultural survival of indigenous peoples?	No	
7.7	impacts on the Cultural Heritage of indigenous peoples, including through the commercialization or use of their traditional knowledge and practices?	No	
Safeguard Standard 8: Labor and working conditions			
8.1	Will the proposed project involve hiring or contracting project staff?	Yes	The Greater Chennai Corporation will select a contractor to implement the proposed project activity, expected project duration is 19.5 Months
If the answer to 8.1 is yes, would the project potentially involve or lead to:			
8.2	working conditions that do not meet national labour laws or international commitments (e.g. ILO conventions)?	No	Necessary national labour laws or international commitments shall be included in the contract agreement and hence it is mandatory for the Contractor to adopt the same. Which will be monitored by the PMC cum IE and GCC.
8.3	the use of forced labor and child labor?	No	As per the labour act the use of child labour is prohibited, which shall be closely monitored by the PMC cum IE and GCC.
8.4	occupational health and safety risks (including violence and harassment)?	No	All safety measures shall be followed by contractor at project area, which shall be closely monitored by the PMC cum IE and GCC.
8.5	the increase of local or regional unemployment?	No	The expected project duration is short term 19.5 Months, Contractor shall use local work force based on work experience, which will give a boost to the local socio economy, however it is a short term positive impact.
8.6	suppliers of goods and services who may have high risk of significant safety issues related to their own workers?	No	Conditions shall be provided in the tender document to reject such suppliers
8.7	unequal working opportunities and conditions for women and men	No	The appointment of the labour force (men and women) will be decided by the Contractor and the PMC cum IE and it shall be based on the nature of the activity. Men labours will be

		utilized for construction related works and women labours will be employed for landscaping works cum maintenance works.

Appendix 1B : Rapid Environmental Assessment (REA) Checklist

Urban Development

Instructions:
(i) The project team completes this checklist to support the environmental classification of a project. It is to be attached to the environmental categorization form and submitted to the Environment and Safeguards Division (RSES) for endorsement by the Director, RSES and for approval by the Chief Compliance Officer.
(ii) This checklist focuses on environmental issues and concerns. To ensure that social dimensions are adequately considered, refer also to ADB's (a) checklists on involuntary resettlement and Indigenous Peoples; (b) poverty reduction handbook; (c) staff guide to consultation and participation; and (d) gender checklists.
(iii) Answer the questions assuming the "without mitigation" case. The purpose is to identify potential impacts. Use the "remarks" section to discuss any anticipated mitigation measures.

Country /Project Title:	IND: Restoration of Biodiversity and Eco-system Services in Kadapakkam Lake in Chennai – Kosathalaiyar Basin
Sector Division:	Urban Development and Water Division

Screening Questions	Yes	No	Remarks
A. Project Siting			
Is the project area…			
□ Densely populated?		X	Kadapakkam lake is located in peri urban area in north Chennai, and not densely populated. This is part of the areas that was added to Greater Chennai Corporation (GCC) in 2011. The lake is surrounded by mixed landuse pattern comprising mostly of agriculture, followed by residential and industrial areas (mostly warehouses/ godowns)
□ Heavy with development activities?		X	There are no notable development activities in and around the lake
□ Adjacent to or within any environmentally sensitive areas?			
□ Cultural heritage site	X		There are three small temples on the lake bund worshipped by local people. Potential impacts will be mitigated by consulting with local people and ensuring that they won't be disturbed through project design and implementation.
□ Protected Area		X	There are no protected areas like national parks or wildlife sanctuaries in or within 10 km boundary of project area. The closest protected areas are Guindy National Park, and Pulicate Bird Sanctuary, located about 20 km away in south and north of the lake respectively
□ Wetland		X	No
□ Mangrove		X	No

Screening Questions	Yes	No	Remarks
			Nearest mangrove area is at about 8-10 km from the lake. Lake has no direct outlet to the sea.
□ Estuarine		X	No Ennore creek on Bay of Bengal Coast is about 8-10 km from the lake. Lake has no direct outlet to the sea
□ Buffer zone of protected area		X	Project area is not part of buffer zone of any protected area. There are no protected areas within 10 km of project boundary
□ Special area for protecting Biodiversity		X	No
□ Bay		X	No
B. Potential Environmental Impacts Will the Project cause…			
impacts on the sustainability of associated sanitation and solid waste disposal systems and their interactions with other urban services.	X		Anticipated, but not notable, and manageable Restored lake and recreational activities will attract people, and will raise demand for sanitation facilities. Necessary facilities like toilets, wastewater management and solid waste management will be well developed as part of the project. The wastewater from toilets blocks will be connected to septic tanks, and septage will be sent to existing STPs available with Chennai Metropolitan Water Supply and Sewerage Board for further treatment and disposal. Solid waste generated at site will be segregated. Biodegradable wastes will be composted at site and used as manure. Other wastes will be managed via existing solid waste management system of Greater Chennai Corporation
deterioration of surrounding environmental conditions due to rapid urban population growth, commercial and industrial activity, and increased waste generation to the point that both manmade and natural systems are overloaded and the capacities to manage these systems are overwhelmed?		X	Project is related to restoration of lake, and will not directly contribute to increase in population. Unplanned and haphazard growth may lead to deterioration of environmental conditions. Project area is part of Greater Chennai City Corporation area, and the development is guided by the City's Master Plan. Basic urban services like solid waste management, sewerage etc., are being planned/implemented by GCC in the area. Planned development is needed to avoid deterioration of environmental conditions, and GCC will ensure that.
degradation of land and ecosystems (e.g. loss of wetlands and wild lands, coastal zones, watersheds and forests)?		X	**No.** Project is not envisaged to cause degradation of land or ecosystems. Project in fact will prevent degradation of Kadapakkam lake by ecorestoration and capacity enhancement
dislocation or involuntary resettlement of people?		X	Not anticipated. Works are to be conducted within the existing lake footprint

Screening Questions	Yes	No	Remarks
disproportionate impacts on the poor, women and children, Indigenous Peoples, or other vulnerable group?		X	**No** Project will not disproportionately impact any vulnerable groups
degradation of cultural property, and loss of cultural heritage and tourism revenues?	X		**Anticipated but can be mitigated.** There are small temples worshipped by local people. Potential impacts will be mitigated by consulting with local people and ensuring that they won't be disturbed through project design and implementation
occupation of low-lying lands, floodplains, and steep hillsides by squatters and low-income groups, and their exposure to increased health hazards and risks due to pollutive industries?		X	**Not anticipated** Project is related to restoration of a lake, will not lead to / encourage / promote occupation such sensitive lands
water resource problems (e.g. depletion/degradation of available water supply, deterioration for surface and ground water quality, and pollution of receiving waters?		X	**Not anticipated** Project will not lead deplete or degrade available water resources. On the contrary, project by way of restoring and capacity enhancement of lake, will improve water resources in the project area
air pollution due to urban emissions?		X	**Not anticipate** Project will not directly result in air emissions
risks and vulnerabilities related to occupational health and safety due to physical, chemical, and biological hazards during project construction and operation?	X		**Anticipated but can be mitigated** Construction works present occupational risk unless proper safety workplace environment and procedures, including wearing of personal protection equipment (PPE), are in place and are ensured by proper supervision and monitoring. Use of *ad hoc*, substandard methods and materials, non-use of PPE, lack of proper supervisory control etc., will increase the risk EMP will include proper measures, and contract includes provision of environmental, health and safety Officer with the contractor. Submission of occupation health and safety plan including COVID19 health and safety management plan is mandatory prior to start of works
road blocking and temporary flooding due to land excavation during rainy season?		X	**Not anticipated** Proposed works will be located in Kadapakkam lake area, and within the lake footprint. No road blocking or temporary flooding anticipated
noise and dust from construction activities?	X		**Anticipated but can be mitigated** Construction works are likely to generate noise and dust. These are anticipated impacts of construction, and are temporary, and localized.

Screening Questions	Yes	No	Remarks
			EMP will include various measures to control dust and noise during construction
traffic disturbances due to construction material transport and wastes?	X		**Anticipated but can be mitigated** Due to proposed nature based solutions, the requirement of construction material will be minimal. Soil generated from desilting activity will mostly be reused in construction within the lake However, there will be some traffic generated due to requirement of materials, and movement of workers, machinery etc These are anticipated impacts of construction, and are temporary, and localized. EMP will include various measures such as the following: proper scheduling of transport activities avoiding peak times, and avoiding and heavy traffic roads etc., will be considered in the traffic management in coordination with local traffic police
temporary silt runoff due to construction?	X		**Anticipated but temporary during construction and can be mitigated** This impact will be mitigated by mostly scheduling excavation activities in dry season. There will also be measures included in EMP to contain silt runoff from sites
hazards to public health due to ambient, household and occupational pollution, thermal inversion, and smog formation?		X	**Not anticipated**
water depletion and/or degradation?		X	**Not anticipated**
overpaying of ground water, leading to land subsidence, lowered ground water table, and salinization?		X	**Not anticipated** On the contrary project will improve the groundwater resource by enhancing groundwater recharge by enhancing lake storage capacity, and by retaining water in the currently seasonal lake

A Checklist for Preliminary Climate Risk Screening

Country/Project Title	**:**	**IND: Restoration of Biodiversity and Eco-system Services in Kadapakkam Lake in Chennai – Kosathalaiyar Basin**
Sector	**:**	**SAUW**
Subsector	**:**	**Urban Development and Water Division**
Division/ Department		

Screening Questions		Score	Remarks[9]
Location and Design of project	Is siting and/or routing of the project (or its components) likely to be affected by climate conditions including extreme weather-related events such as floods, droughts, storms, landslides?	2	Flooding (heavy rainfall): High Risk. Increase in North East Monsoon rainfall and daily rainfall intensity. Sea level rise (long-term): Medium Risk of coastal flooding.
	Would the project design (e.g., the clearance for bridges) need to consider any hydro-meteorological parameters (e.g., sea-level, peak river flow, reliable water level, peak wind speed etc)?	2	Yes. Project design would need to consider projected increase and spatial variation in rainfall intensity and climate change linked sea level rise.
Materials and Maintenance	Would weather, current and likely future climate conditions (e.g., prevailing humidity level, temperature contrast between hot summer days and cold winter days, exposure to wind and humidity hydro-meteorological parameters likely affect the selection of project inputs over the life of project outputs (e.g. construction material)?	0	Not applicable
	Would weather, current and likely future climate conditions, and related extreme events likely affect the maintenance (scheduling and cost) of project output(s) ?	1	Yes, weather and current and future climate conditions is likely to affect the maintenance of Kadapakkam Lake.
Performance of project outputs	Would weather/climate conditions, and related extreme events likely affect the performance (e.g., annual power production) of project output(s) (e.g. hydro-power generation facilities) throughout their design life time?	1	Yes, changing climate conditions are likely to affect the performance of project outputs such as storage potential of water bodies connected to drainage network.

Options for answers and corresponding score are provided below:

Response	Score
Not Likely	0
Likely	1
Very Likely	2

Responses when added that provide a score of 0 will be considered low risk project. If adding all responses will result to a score of 1-4 and that no score of 2 was given to any single response, the project will be

[9] If possible, provide details on the sensitivity of project components to climate conditions, such as how climate parameters are considered in design standards for infrastructure components, how changes in key climate parameters and sea level might affect the siting/routing of project, the selection of construction material and/or scheduling, performances and/or the maintenance cost/scheduling of project outputs.

assigned a medium risk category. A total score of 5 or more (which include providing a score of 1 in all responses) or a 2 in any single response, will be categorized as high risk project.

Result **of Initial Screening (Low, Medium, High): High**

Other Comments: The proposed Kadapakkam Lake restoration project is aimed in protecting the available water spread area, increasing the storage capacity and support water retention during floods.

Prepared by: Greater Chennai Corporation (GCC)

Appendix 2: Salient Features of Major Labor Laws Applicable to Establishments Engaged in Construction of Civil Works

(i) Workmen Compensation Act, 1923 - The Act provides for compensation in case of injury by accident arising out of and during employment.

(ii) Payment of Gratuity Act, 1972 - Gratuity is payable to an employee under the Act on the satisfaction of certain conditions on separation if an employee has completed 5 years' service or more or on death at the rate of 15 days wages for every completed year of service. The Act applies to all establishments employing 10 or more employees.

(iii) Employees' PF and Miscellaneous Provisions Act, 1952 - The Act provides for monthly contributions by the employer plus workers @10 % or 8.33 %. The benefits payable under the Act are: (a) Pension or family pension on retirement or death as the case may be; (b) deposit linked insurance on the death in the harness of the worker; (c) payment of PF accumulation on retirement/death, etc.

(iv) Maternity Benefit Act, 1951 - The Act provides for leave and some other benefits to women employees in case of confinement or miscarriage, etc.

(v) Contract Labour (Regulation and Abolition) Act, 1970 - The Act provides for certain welfare measures to be provided by the Contractor to contract labor and in case the Contractor fails to provide, the same is required to be provided by the Principal Employer by Law. The principal employer is required to take a Certificate of Registration and the Contractor is required to take a License from the designated Officer. The Act applies to the establishments or Contractor of the principal employer if they employ 20 or more contract labor.

(vi) Minimum Wages Act, 1948 - The employer is supposed to pay not less than the Minimum Wages fixed by appropriate Government as per provisions of the Act if the employment is scheduled. Construction of Buildings, Roads, Runways are scheduled employment.

(vii) Payment of Wages Act, 1936 - It lays down as to by what date the wages are to be paid when it will be paid and what deductions can be made from the wages of the workers.

(viii) Equal Remuneration Act, 1979 - The Act provides for payment of equal wages for work of equal nature to Male and Female workers and not for making discrimination against Female employees in the matters of transfers, training, and promotions, etc.

(ix) Payment of Bonus Act, 1965 - The Act applies to all establishments employing 20 or more workmen. The Act provides for payments of annual bonus subject to a minimum of 8.33 % of wages and a maximum of 20 % of wages to employees drawing Rs. 3,500/- per month or less. The bonus to be paid to employees getting Rs. 2,500/- per month or above up to Rs.3, 500/- per month shall be worked out by taking wages as Rs.2, 500/- per month only. The Act does not apply to certain establishments. The newly set up establishments are exempted for five years in certain circumstances. Some of the State Governments have reduced the employment size from 20 to 10 for applicability of the Act.

(x) Industrial Disputes Act, 1947 - The Act lays down the machinery and procedure for resolution of industrial disputes, in what situations a strike or lock-out becomes illegal and what are the requirements for laying off or retrenching the employees or closing down the establishment.

(xi) Industrial Employment (Standing Orders) Act, 1946 - It applies to all establishments employing 100 or more workmen (employment size reduced by some of the States and Central Government to 50). The Act provides for laying down rules governing the conditions of employment by the employer on matters provided in the Act and get the same certified by the designated Authority.

(xii) Trade Unions Act, 1926 - The Act lays down the procedure for registration of trade unions of workmen and employees. The trade unions registered under the Act have been given certain immunities from civil and criminal liabilities.

(xiii) Child Labor (Prohibition and Regulation) Act, 1986 - The Act prohibits employment of children below 14 years of age in certain occupations and processes and provides for the regulation of employment of children in all other occupations and processes. Employment of child labor is prohibited in the Building and Construction Industry.

(xiv) Inter-State Migrant Workmen's (Regulation of Employment and Conditions of Service) Act, 1979 - The Act applies to an establishment that employs 5 or more inter-state migrant workmen through an intermediary (who has recruited workmen in one state for employment in the establishment situated in another state). The inter-state migrant workmen, in an establishment to which this Act becomes applicable, are required to be provided certain facilities such as housing, medical aid, traveling expenses from home up to the establishment and back, etc

(xv) The Building and Other Construction Workers (Regulation of Employment and Conditions of Service) Act, 1996 and the Cess Act of 1996 - All the establishments who carry on any building or other construction work and employ 10 or more workers are covered under this Act. All such establishments are required to pay Cess at a rate not exceeding 2% of the cost of construction as may be notified by the Government. The employer of the establishment is required to provide safety measures at the building or construction work and other welfare measures, such as canteens, first-aid facilities, ambulance, housing accommodation for workers near the workplace, etc. The employer to whom the Act applies has to obtain a registration certificate from the Registering Officer appointed by the Government.

Appendix 3: Environmental Monitoring Results

Ambient Air Quality

Hubert Enviro Care Systems (P) Ltd.
 # 18, 92nd Street, Ashok Nagar,
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Laboratory Services Division
(Chemical & Biological Testing)
Recognized by MoEF, BIS
FSSAI Notified Laboratory
ISO 9001, 14001 & OHSAS 18001 Certified.

TEST REPORT

Name of the Client : **M/s. Landtech AEPC Private Limited**
Address of the Client : **No. 173, 1st Main Road, Nehru Nagar,OMR, Perungudi, Chennai - 600 096**

Report No. : **HECSL/AA/006/101220**
Report Date : **15/12/2020**

Sample Description : **Ambient Air Quality**
Sampling Location : **Near Temple(Veerathi Kadaliyamman)**
Sample Drawn By : **Hubert Enviro Care Systems (P) Ltd**
Sampling/received Date : **10/12/2020 -10/12/2020**
Analysis Commenced On : **10/12/2020**
Completed On : **14/12/2020**

S.No.	Parameters	Units	Results Obtained	Test Method	NAAQ Standards : 2009	
1	Sulphur Dioxide	µg/m³	8.34	CPCB guide lines Volume 1:2012	80 (24 hours)	50 (Annual)
2	Nitrogen Dioxide	µg/m³	19.46	IS: 5182 (Part - 6):2006	80 (24 hours)	40 (Annual)
3	Particulate Matter Size Less than 10 µm	µg/m³	45.36	IS: 5182 (Part - 23):2006	100 (24 hours)	60 (Annual)
4	Particulate Matter Size Less than 2.5 µm	µg/m³	18.51	IS: 5182 (Part - 24):2019	60 (24 hours)	40 (Annual)
5	Carbon Monoxide	mg/m³	BLQ(LOQ 0.05)	IS : 5182 (Part - 10) 1999	4 (1 hours)	2 (8 hours)
6	Lead	µg/m³	BLQ(LOQ 0.05)	IS: 5182 (Part - 22): 2004	1 (24 hours)	0.5 (Annual)
7	Ozone	µg/m³	10.24	HECS/AIR/AMBIENT/SOP/007 :2013	180 (1 hours)	100 (8 hours)
8	Ammonia	µg/m³	5.62	HECS/AIR/AMBIENT/SOP/006 :2013	400 (24 hours)	100 (Annual)
9	Benzene	µg/m³	BLQ(LOQ 1)	IS: 5182 (Part - 11):2006	5 (Annual)	5 (Annual)
10	Benzo(a)pyrene	ng/m³	BLQ(LOQ 1)	IS: 5182 (Part - 12): 2004	1 (Annual)	1 (Annual)
11	Arsenic	ng/m³	BLQ(LOQ 2)	HECS/AIR/AMBIENT/009:2013	6 (Annual)	6 (Annual)
12	Nickel	ng/m³	BLQ(LOQ 10)	HECS/AIR/AMBIENT/009:2013	20 (Annual)	20 (Annual)

Note:- BLQ - Below the Limit of Quantification, LOQ- Limit of Quantification, µg/m³- Micrograms per cubic meter, mg/m³- Milligrams per cubic meter, ng/m³- Nanograms per cubic meter.

Remarks: The Tested Parameters as above are within the Limits of NAAQ Standards 2009.

End of Report

HUBERT ENVIRO CARE SYSTEMS (P) LTD. Chennai 600 083

Authorized Signatory
S. Ravi
Vice President (Labs)

Ambient Noise Monitoring

Hubert Enviro Care Systems (P) Ltd.
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TEST REPORT

Name of the Client : **M/s. Landtech AEPC Private Limited**
Address of the Client : **No. 173, 1st Main Road, Nehru Nagar,OMR, Perungudi, Chennai - 600 096**

Report No. : **HECSL/AN/003/101220**
Report Date : **15/12/2020**

Sample Description : **Noise Monitoring**
Sample Drawn By : **Hubert Enviro Care Systems (P) Ltd**

Sampling/received Date : **10/12/2020 -10/12/2020**

S.No	Time (Hrs)	Location	Noise Level in dB(A)
1	11:00	Near Temple(Veerathi Kadaliyamman)	73.2

Limits set by CPCB:

i. Industrial Area : Day Time-75 dB (A); Night Time-70 dB (A).
ii. Commercial Area : Day Time-65 dB (A); Night Time-55 dB (A).
iii. Residential Area : Day Time-55 dB (A); Night Time-45 dB (A).
iv. Silence Zone : Day Time-50 dB (A); Night Time-40 dB (A).

Note :- Day time-06.00AM to 10.00PM, Night time-10.00PM to 06.00AM

End of Report

HUBERT ENVIRO CARE SYSTEMS (P) LTD. Chennai 600 083

Authorized Signatory
S. Ravi
Vice President (Labs)

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TEST REPORT

Report No. : **HECSL/AN/001-002/050521**
Report Date : **10/05/2021**

Name of the Client : **M/s. LandTech AEPC Private Limited**
Address of the Client : **No. 173, 1st Main Road, Nehru Nagar,OMR, Kottivakkam, Perungudi, Chennai - 600 096**

Sample Description : **Noise Monitoring**
Sample Drawn By : **Hubert Enviro Care Systems (P) Ltd**
Sampling/received Date : **05/05/2021 -05/05/2021**

S.No	Time (Hrs)	Location	Day Noise Level in dB(A)
1	11.30	Near Karumariyamman Temple – Ammankulam - Kadapakkam (Mr. Damodaran House)	58.1
2	12.40	Near Perumal Temple –Kanniyamman Pettai Kadapakkam (Mr. Jeevam House)	60.2

Limits set by CPCB:

i.	Industrial Area	: Day Time-75 dB (A);	Night Time-70 dB (A).
ii.	Commercial Area	: Day Time-65 dB (A);	Night Time-55 dB (A).
iii.	Residential Area	: Day Time-55 dB (A);	Night Time-45 dB (A).
iv.	Silence Zone	: Day Time-50 dB (A);	Night Time-40 dB (A).

Note :- Day time-06.00AM to 10.00PM, Night time-10.00PM to 06.00AM

Remarks:- The noise level meets the requirement of CPCB Limits.

End of Report

HUBERT ENVIRO CARE SYSTEMS (P) LTD. Chennai 600 083

Authorized Signatory

Dr. P. ELAIYARAJU
Assistant Manager

Surface Water Quality

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TEST REPORT

Name of the Client : **M/s. Landtech AEPC Private Limited**
Address of the Client : **No. 173, 1st Main Road, Nehru Nagar,OMR, Perungudi, Chennai - 600 096**

Report No. : **HECSL/WT/004/101220**
Report Date : **15/12/2020**

Sample Description : **WATER**
Sample Mark : **Surface Water(Kadapakkam)**
Sample Drawn By : **Hubert Enviro Care Systems (P) Ltd**
Sampling/received Date : **10/12/2020 -10/12/2020**
Analysis Commenced On : **10/12/2020**

Completed On : **14/12/2020**

S.No.	Parameters	Units	Results	Test Method
1	pH (at 25 °C)	-	7.50	IS 3025 (Part - 11):1983
2	Electrical conductivity	µS/cm	260.0	IS 3025 (Part - 14):1983
3	Chloride as Cl	mg/l	36.25	4500 Cl -– B APHA 23rd Edn: 2017
4	Total Dissolved Solids	mg/l	142.0	IS 3025(Part -16):1984
5	Sulphate as SO4	mg/l	14.50	IS 3025(Part - 24):1986
6	Fluoride	mg/l	BLQ(LOQ;0.2)	IS 3025 (Part - 60):1986
7	Nitrate as NO3	mg/l	3.7	IS 3025 (Part 34): 1988
8	Iron as Fe	mg/l	0.34	IS 3025 (Part - 53):2003
9	Boron as B #	mg/l	BLQ(LOQ;0.1)	IS:3025 (Part - 57):2005
10	Phenolic compounds as C6H5OH	mg/l	BLQ(LOQ;0.001)	APHA 23rd edition (Method 5530C): 2017
11	Hexavalent Chromium as Cr6+ #	mg/l	BLQ(LOQ;0.01)	IS 3025 (Part - 52):2003
12	Zinc as Zn	mg/l	BLQ(LOQ 0.1)	USEPA Method 200.8:1994
13	Copper as Cu	mg/l	BLQ(LOQ 0.01)	USEPA Method 200.8:1994
14	Manganese as Mn	mg/l	BLQ(LOQ:0.05)	USEPA Method 200.8:1994
15	Cadmium as Cd	mg/l	BLQ(LOQ 0.001)	USEPA Method 200.8:1994
16	Lead as Pb	mg/l	BLQ(LOQ 0.005)	USEPA Method 200.8:1994
17	Selenium as Se	mg/l	BLQ(LOQ 0.005)	USEPA Method 200.8:1994
18	Arsenic as As	mg/l	BLQ(LOQ 0.005)	USEPA Method 200.8:1994
19	Mercury as Hg	mg/l	BLQ(LOQ 0.0005)	USEPA Method 200.8:1994
20	Total suspended solid	mg/l	47.0	IS 3025 (Part - 17):1984
21	BOD,3 days @27°C as O2	mg/l	4.0	IS 3025 (Part - 44):1993
22	Chemical oxygen demand as O2	mg/l	36.0	IS 3025 (Part - 58):2006
23	Oil and Grease	mg/l	BLQ(LOQ;4)	IS 3025 (Part - 39):1991
24	Sulphide as S2-	mg/l	BLQ(LOQ;0.02)	IS3025 (Part - 29):1986

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Report No. : **HECSL/WT/004/101220**
Report Date : **15/12/2020**

Sample Description : **WATER**
Sample Mark : **Surface Water(Kadapakkam)**
Sample Drawn By : **Hubert Enviro Care Systems (P) Ltd**
Sampling/received Date : **10/12/2020 -10/12/2020**
Analysis Commenced On : **10/12/2020** Completed On : **14/12/2020**

S.No.	Parameters	Units	Results	Test Method
25	**Pesticides**			
	Alpha HCH	mg/l	BLQ(LOQ 0.00001)	USEPA Method 525.2:1995
	Beta HCH	mg/l	BLQ(LOQ 0.00001)	USEPA Method 525.2:1995
	Gama HCH (Lindane)	mg/l	BLQ(LOQ 0.00001)	USEPA Method 525.2:1995
	Delta HCH	mg/l	BLQ(LOQ 0.00001)	USEPA Method 525.2:1995
	O,P-DDT	mg/l	BLQ(LOQ 0.00001)	USEPA Method 525.2:1995
	P,P-DDT	mg/l	BLQ(LOQ 0.00001)	USEPA Method 525.2:1995
	O,P-DDD	mg/l	BLQ(LOQ 0.00001)	USEPA Method 525.2:1995
	P,P-DDD	mg/l	BLQ(LOQ 0.00001)	USEPA Method 525.2:1995
	O,P-DDE	mg/l	BLQ(LOQ 0.00001)	USEPA Method 525.2:1995
	P,P-DDE	mg/l	BLQ(LOQ 0.00001)	USEPA Method 525.2:1995
	Alpha Endosulfan	mg/l	BLQ(LOQ 0.00001)	USEPA Method 525.2:1995
	Beta Endosulphan	mg/l	BLQ(LOQ 0.00001)	USEPA Method 525.2:1995
	Endosulfansulphate	mg/l	BLQ(LOQ 0.00001)	USEPA Method 525.2:1995
	Chlorpyrifos	mg/l	BLQ(LOQ 0.00001)	USEPA Method 525.2:1995
	Butachlor	mg/l	BLQ(LOQ 0.00001)	USEPA Method 525.2:1995
	Alachor	mg/l	BLQ(LOQ 0.00001)	USEPA Method 525.2:1995
	Atrazine	mg/l	BLQ(LOQ 0.00001)	USEPA Method 525.2:1995
	Aldrin	mg/l	BLQ(LOQ 0.00001)	USEPA Method 525.2:1995
	Dieldrin	mg/l	BLQ(LOQ 0.00001)	USEPA Method 525.2:1995
	Monocrotophos	mg/l	BLQ(LOQ 0.00001)	USEPA Method 8321B:2007
	Ethion	mg/l	BLQ(LOQ 0.00001)	USEPA Method 525.2:1995
	Phorate	mg/l	BLQ(LOQ 0.00001)	USEPA Method 525.2:1995
	2,4-D	mg/l	BLQ(LOQ 0.00001)	USEPA Method 8321B:2007
	Isoproturon	mg/l	BLQ(LOQ 0.00001)	USEPA Method 8321B:2007
	Methyl Parathion	mg/l	BLQ(LOQ 0.00001)	USEPA Method 8321B:2007

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Report No. : **HECSL/WT/004/101220**
Report Date : **15/12/2020**

Sample Description : **WATER**
Sample Mark : **Surface Water(Kadapakkam)**
Sample Drawn By : **Hubert Enviro Care Systems (P) Ltd**
Sampling/received Date : **10/12/2020 -10/12/2020**
Analysis Commenced On : **10/12/2020**
Completed On : **14/12/2020**

S.No.	Parameters	Units	Results	Test Method
	Malathion	mg/l	BLQ(LOQ 0.00001)	USEPA Method 8321B:2007
26	Nickel	mg/l	BLQ(LOQ 0.01)	USEPA Method 200.8:1994
27	Dissolved oxygen	mg/l	6.3	IS 3025 (Part - 38):1989
28	Ammonia as NH3	mg/l	0.43	IS 3025 (Part - 34) 1982
29	Total Kjeldahl Nitrogen	mg/l	0.55	IS 3025 (Part - 34):1988
30	Ammonical Nitrogen as NH3-N	mg/l	0.36	IS 3025 (Part - 34):1988
31	Dissolved Phosphate as PO4	mg/l	0.45	IS 3025 (Part - 31) :1988
32	Total Residual Chlorine	mg/l	BLQ(LOQ;0.1)	IS 3025 (Part - 26):1986
33	Vanadium as V	mg/l	BLQ(LOQ 0.05)	USEPA Method 200.8:1994
34	Cyanide	mg/l	BLQ(LOQ;0.01)	IS 3025 (Part-27):1986

Note :- BLQ - Below the Limit of Quantification, LOQ- Limit of Quantification, NTU- Nephelometric Turbidity Unit, mg/l- Milligrams per litre.

End of Report

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TEST REPORT

Name of the Client : **M/s. LandTech AEPC Private Limited**
Address of the Client : **No. 173, 1st Main Road, Nehru Nagar,OMR, Kottivakkam, Perungudi, Chennai - 600 096**

Report No. : **HECSL/WT/001/050521**
Report Date : **12/05/2021**

Sample Description : **WATER**
Sample Mark : **Surface Water-1 –Kadapakkam Lake North Side**
Sample Drawn By : **Hubert Enviro Care Systems (P) Ltd**
Sampling/received Date : **05/05/2021 -05/05/2021**
Analysis Commenced On : **05/05/2021**
Completed On : **11/05/2021**

S.No.	Parameters	Units	Results	Test Method
1	pH (at 25 °C)	-	7.76	IS 3025 (Part - 11):1983
2	Electrical conductivity at 25 °C	µS/cm	346.0	IS 3025 (Part - 14):1983
3	Chloride as Cl	mg/l	51.46	4500 Cl — B APHA 23rd Edn: 2017
4	Cyanide as CN	mg/l	BLQ(LOQ:0.01)	IS 3025 (Part - 27):1986
5	Total Dissolved Solids	mg/l	178.0	IS 3025(Part -16):1984
6	Sulphate as SO4	mg/l	3.85	IS 3025(Part - 24):1986
7	Fluoride	mg/l	BLQ(LOQ:0.2)	IS 3025 (Part - 60):1986
8	Nitrate as NO3	mg/l	3.3	IS 3025 (Part 34): 1988
9	Iron as Fe	mg/l	0.17	IS 3025 (Part - 53):2003
10	Boron as B	mg/l	BLQ(LOQ:0.1)	IS:3025 (Part - 57):2005
11	Phenolic compounds as C6H5OH	mg/l	BLQ(LOQ:0.001)	APHA 23rd edition (Method 5530C): 2017
12	Hexavalent Chromium as Cr6+	mg/l	BLQ(LOQ:0.01)	IS 3025 (Part - 52):2003
13	Zinc as Zn	mg/l	BLQ(LOQ0.1)	USEPA Method 200.8:1994
14	Copper as Cu	mg/l	BLQ(LOQ0.01)	USEPA Method 200.8:1994
15	Manganese as Mn	mg/l	BLQ(LOQ:0.05)	USEPA Method 200.8:1994
16	Cadmium as Cd	mg/l	BLQ(LOQ0.001)	USEPA Method 200.8:1994
17	Lead as Pb	mg/l	BLQ(LOQ0.005)	USEPA Method 200.8:1994
18	Selenium as Se	mg/l	BLQ(LOQ0.005)	USEPA Method 200.8:1994
19	Arsenic as As	mg/l	BLQ(LOQ0.005)	USEPA Method 200.8:1994
20	Mercury as Hg	mg/l	BLQ(LOQ0.0005)	USEPA Method 200.8:1994
21	Total suspended solid	mg/l	48.0	IS 3025 (Part - 17):1984
22	BOD,3 days @27°C as O2	mg/l	4.0	IS 3025 (Part - 44):1993
23	Chemical oxygen demand as O2	mg/l	32.0	IS 3025 (Part - 58):2006
24	Oil and Grease	mg/l	BLQ(LOQ:4.0)	IS 3025 (Part - 39):1991

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Report No. : **HECSL/WT/001/050521**
Report Date : **12/05/2021**

Sample Description : **WATER**
Sample Mark : **Surface Water-1 –Kadapakkam Lake North Side**
Sample Drawn By : **Hubert Enviro Care Systems (P) Ltd**
Sampling/received Date : **05/05/2021 -05/05/2021**
Analysis Commenced On : **05/05/2021**
Completed On : **11/05/2021**

S.No.	Parameters	Units	Results	Test Method
25	Sulphide as S2-	mg/l	BLQ(LOQ:0.04)	IS3025 (Part - 29):1986
26	**Pesticides**			
	Alpha HCH	mg/l	BLQ(LOQ0.00001)	USEPA Method 525.2:1995
	Beta HCH	mg/l	BLQ(LOQ0.00001)	USEPA Method 525.2:1995
	Gama HCH (Lindane)	mg/l	BLQ(LOQ0.00001)	USEPA Method 525.2:1995
	Delta HCH	mg/l	BLQ(LOQ0.00001)	USEPA Method 525.2:1995
	O,P-DDT	mg/l	BLQ(LOQ0.00001)	USEPA Method 525.2:1995
	P,P-DDT	mg/l	BLQ(LOQ0.00001)	USEPA Method 525.2:1995
	O,P-DDD	mg/l	BLQ(LOQ0.00001)	USEPA Method 525.2:1995
	P,P-DDD	mg/l	BLQ(LOQ0.00001)	USEPA Method 525.2:1995
	O,P-DDE	mg/l	BLQ(LOQ0.00001)	USEPA Method 525.2:1995
	P,P-DDE	mg/l	BLQ(LOQ0.00001)	USEPA Method 525.2:1995
	Alpha Endosulfan	mg/l	BLQ(LOQ0.00001)	USEPA Method 525.2:1995
	Beta Endosulphan	mg/l	BLQ(LOQ0.00001)	USEPA Method 525.2:1995
	Endosulfansulphate	mg/l	BLQ(LOQ0.00001)	USEPA Method 525.2:1995
	Chlorpyrifos	mg/l	BLQ(LOQ0.00001)	USEPA Method 525.2:1995
	Butachlor	mg/l	BLQ(LOQ0.00001)	USEPA Method 525.2:1995
	Alachor	mg/l	BLQ(LOQ0.00001)	USEPA Method 525.2:1995
	Atrazine	mg/l	BLQ(LOQ0.00001)	USEPA Method 525.2:1995
	Aldrin	mg/l	BLQ(LOQ0.00001)	USEPA Method 525.2:1995
	Dieldrin	mg/l	BLQ(LOQ0.00001)	USEPA Method 525.2:1995
	Monocrotophos	mg/l	BLQ(LOQ0.00001)	USEPA Method 8321B:2007
	Ethion	mg/l	BLQ(LOQ0.00001)	USEPA Method 525.2:1995
	Phorate	mg/l	BLQ(LOQ0.00001)	USEPA Method 525.2:1995

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Authorized Signatory

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Assistant Manager

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Address of the Client : **No. 173, 1st Main Road, Nehru Nagar,OMR, Kottivakkam, Perungudi, Chennai - 600 096**

Report No. : **HECSL/WT/001/050521**
Report Date : **12/05/2021**

Sample Description : **WATER**
Sample Mark : **Surface Water-1 –Kadapakkam Lake North Side**
Sample Drawn By : **Hubert Enviro Care Systems (P) Ltd**
Sampling/received Date : **05/05/2021 -05/05/2021**
Analysis Commenced On : **05/05/2021**
Completed On : **11/05/2021**

S.No.	Parameters	Units	Results	Test Method
	2,4-D	mg/l	BLQ(LOQ0.00001)	USEPA Method 8321B:2007
	Isoproturon	mg/l	BLQ(LOQ0.00001)	USEPA Method 8321B:2007
	Methyl Parathion	mg/l	BLQ(LOQ0.00001)	USEPA Method 8321B:2007
	Malathion	mg/l	BLQ(LOQ0.00001)	USEPA Method 8321B:2007
27	Nickel	mg/l	BLQ(LOQ 0.01)	USEPA Method 200.8:1994
28	Dissolved oxygen	mg/l	6.4	IS 3025 (Part - 38):1989
29	Ammonia as NH3	mg/l	0.13	IS 3025 (Part - 34) 1982
30	Total Kjeldahl Nitrogen	mg/l	0.17	IS 3025 (Part - 34):1988
31	Ammonical Nitrogen as NH3-N	mg/l	0.11	IS 3025 (Part - 34):1988
32	Dissolved Phosphate as PO4	mg/l	0.18	IS 3025 (Part - 31) :1988
33	Total Residual Chlorine	mg/l	BLQ(LOQ:0.1)	IS 3025 (Part - 26):1986
34	Vanadium as V	mg/l	BLQ(LOQ0.05)	USEPA Method 200.8:1994

Note :- BLQ - Below the Limit of Quantification, LOQ- Limit of Quantification, NTU- Nephelometric Turbidity Unit, mg/l- Milligrams per litre.

End of Report

HUBERT ENVIRO CARE SYSTEMS (P) LTD. * Chennai 600 083

Authorized Signatory
Dr. P. ELAIYARAJU
Assistant Manager

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TEST REPORT

Name of the Client : **M/s. LandTech AEPC Private Limited**
Address of the Client : **No. 173, 1st Main Road, Nehru Nagar,OMR, Kottivakkam, Perungudi, Chennai - 600 096**

Report No. : **HECSL/MB/006/080521**
Report Date : **11/05/2021**

Sample Description : **WATER**
Sample Mark : **Surface Water-1 –Kadapakkam Lake North Side**
Sample Drawn By : **Hubert Enviro Care Systems (P) Ltd**
Sampling/received Date : **05/05/2021 -05/05/2021**
Analysis Commenced On : **06/05/2021**
Completed On : **10/05/2021**

S.No.	Parameters	Units	Results	Test Method
1	Total Coliforms	MPN/100ml	< 2	IS 1622

Note:- MPN - Most Probable Number, < 2 is considered as Absent.

End of Report

HUBERT ENVIRO CARE SYSTEMS (P) LTD. * Chennai 600 083

Authorized Signatory

Dr. P. ELAIYARAJU
Assistant M...

Hubert Enviro Care Systems (P) Ltd.
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Laboratory Services Division
(Chemical & Biological Testing)
Recognized by MoEF, BIS
FSSAI Notified Laboratory
ISO 9001, 14001 & OHSAS 18001 Certified.

TEST REPORT

Name of the Client : **M/s. LandTech AEPC Private Limited**
Address of the Client : **No. 173, 1st Main Road, Nehru Nagar,OMR, Kottivakkam, Perungudi, Chennai - 600 096**

Report No. : **HECSL/WT/002/050521**
Report Date : **12/05/2021**

Sample Description : **WATER**
Sample Mark : **Surface Water-2 -Kadapakkam Lake East Side**
Sample Drawn By : **Hubert Enviro Care Systems (P) Ltd**
Sampling/received Date : **05/05/2021 -05/05/2021**
Analysis Commenced On : **05/05/2021**
Completed On : **11/05/2021**

S.No.	Parameters	Units	Results	Test Method
1	pH (at 25 °C)	-	7.25	IS 3025 (Part - 11):1983
2	Electrical conductivity at 25 °C	µS/cm	467.0	IS 3025 (Part - 14):1983
3	Chloride as Cl	mg/l	74.23	4500 Cl --- B APHA 23rd Edn: 2017
4	Cyanide as CN	mg/l	BLQ(LOQ:0.01)	IS 3025 (Part - 27):1986
5	Total Dissolved Solids	mg/l	272.0	IS 3025(Part -16):1984
6	Sulphate as SO4	mg/l	31.75	IS 3025(Part - 24):1986
7	Fluoride	mg/l	0.23	IS 3025 (Part - 60):1986
8	Nitrate as NO3	mg/l	4.2	IS 3025 (Part 34): 1988
9	Iron as Fe	mg/l	0.12	IS 3025 (Part - 53):2003
10	Boron as B	mg/l	BLQ(LOQ:0.1)	IS:3025 (Part - 57):2005
11	Phenolic compounds as C6H5OH	mg/l	BLQ(LOQ:0.001)	APHA 23rd edition (Method 5530C): 2017
12	Hexavalent Chromium as Cr6+	mg/l	BLQ(LOQ:0.01)	IS 3025 (Part - 52):2003
13	Zinc as Zn	mg/l	BLQ(LOQ0.1)	USEPA Method 200.8:1994
14	Copper as Cu	mg/l	BLQ(LOQ0.01)	USEPA Method 200.8:1994
15	Manganese as Mn	mg/l	BLQ(LOQ:0.05)	USEPA Method 200.8:1994
16	Cadmium as Cd	mg/l	BLQ(LOQ0.001)	USEPA Method 200.8:1994
17	Lead as Pb	mg/l	BLQ(LOQ0.005)	USEPA Method 200.8:1994
18	Selenium as Se	mg/l	BLQ(LOQ0.005)	USEPA Method 200.8:1994
19	Arsenic as As	mg/l	BLQ(LOQ0.005)	USEPA Method 200.8:1994
20	Mercury as Hg	mg/l	BLQ(LOQ0.0005)	USEPA Method 200.8:1994
21	Total suspended solid	mg/l	1.0	IS 3025 (Part - 17):1984
22	BOD,3 days @27°C as O2	mg/l	2.0	IS 3025 (Part - 44):1993
23	Chemical oxygen demand as O2	mg/l	16.0	IS 3025 (Part - 58):2006
24	Oil and Grease	mg/l	BLQ(LOQ:4.0)	IS 3025 (Part - 39):1991

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TEST REPORT

Name of the Client : **M/s. LandTech AEPC Private Limited**
Address of the Client : **No. 173, 1st Main Road, Nehru Nagar,OMR, Kottivakkam, Perungudi, Chennai - 600 096**

Report No. : **HECSL/WT/002/050521**
Report Date : **12/05/2021**

Sample Description : **WATER**
Sample Mark : **Surface Water-2 -Kadapakkam Lake East Side**
Sample Drawn By : **Hubert Enviro Care Systems (P) Ltd**
Sampling/received Date : **05/05/2021 -05/05/2021**
Analysis Commenced On : **05/05/2021**
Completed On : **11/05/2021**

S.No.	Parameters	Units	Results	Test Method
25	Sulphide as S2-	mg/l	BLQ(LOQ:0.04)	IS3025 (Part - 29):1986
26	**Pesticides**			
	Alpha HCH	mg/l	BLQ(LOQ0.00001)	USEPA Method 525.2:1995
	Beta HCH	mg/l	BLQ(LOQ0.00001)	USEPA Method 525.2:1995
	Gama HCH (Lindane)	mg/l	BLQ(LOQ0.00001)	USEPA Method 525.2:1995
	Delta HCH	mg/l	BLQ(LOQ0.00001)	USEPA Method 525.2:1995
	O,P-DDT	mg/l	BLQ(LOQ0.00001)	USEPA Method 525.2:1995
	P,P-DDT	mg/l	BLQ(LOQ0.00001)	USEPA Method 525.2:1995
	O,P-DDD	mg/l	BLQ(LOQ0.00001)	USEPA Method 525.2:1995
	P,P-DDD	mg/l	BLQ(LOQ0.00001)	USEPA Method 525.2:1995
	O,P-DDE	mg/l	BLQ(LOQ0.00001)	USEPA Method 525.2:1995
	P,P-DDE	mg/l	BLQ(LOQ0.00001)	USEPA Method 525.2:1995
	Alpha Endosulfan	mg/l	BLQ(LOQ0.00001)	USEPA Method 525.2:1995
	Beta Endosulphan	mg/l	BLQ(LOQ0.00001)	USEPA Method 525.2:1995
	Endosulfansulphate	mg/l	BLQ(LOQ0.00001)	USEPA Method 525.2:1995
	Chlorpyrifos	mg/l	BLQ(LOQ0.00001)	USEPA Method 525.2:1995
	Butachlor	mg/l	BLQ(LOQ0.00001)	USEPA Method 525.2:1995
	Alachor	mg/l	BLQ(LOQ0.00001)	USEPA Method 525.2:1995
	Atrazine	mg/l	BLQ(LOQ0.00001)	USEPA Method 525.2:1995
	Aldrin	mg/l	BLQ(LOQ0.00001)	USEPA Method 525.2:1995
	Dieldrin	mg/l	BLQ(LOQ0.00001)	USEPA Method 525.2:1995
	Monocrotophos	mg/l	BLQ(LOQ0.00001)	USEPA Method 8321B:2007
	Ethion	mg/l	BLQ(LOQ0.00001)	USEPA Method 525.2:1995
	Phorate	mg/l	BLQ(LOQ0.00001)	USEPA Method 525.2:1995

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TEST REPORT

Name of the Client : **M/s. LandTech AEPC Private Limited**
Address of the Client : **No. 173, 1st Main Road, Nehru Nagar,OMR, Kottivakkam, Perungudi, Chennai - 600 096**

Report No. : **HECSL/WT/002/050521**
Report Date : **12/05/2021**

Sample Description : **WATER**
Sample Mark : **Surface Water-2 -Kadapakkam Lake East Side**
Sample Drawn By : **Hubert Enviro Care Systems (P) Ltd**
Sampling/received Date : **05/05/2021 -05/05/2021**
Analysis Commenced On : **05/05/2021**
Completed On : **11/05/2021**

S.No.	Parameters	Units	Results	Test Method
	2,4-D	mg/l	BLQ(LOQ0.00001)	USEPA Method 8321B:2007
	Isoproturon	mg/l	BLQ(LOQ0.00001)	USEPA Method 8321B:2007
	Methyl Parathion	mg/l	BLQ(LOQ0.00001)	USEPA Method 8321B:2007
	Malathion	mg/l	BLQ(LOQ0.00001)	USEPA Method 8321B:2007
27	Nickel	mg/l	BLQ(LOQ 0.01)	USEPA Method 200.8:1994
28	Dissolved oxygen	mg/l	6.6	IS 3025 (Part - 38):1989
29	Ammonia as NH3	mg/l	0.084	IS 3025 (Part - 34) 1982
30	Total Kjeldahl Nitrogen	mg/l	0.11	IS 3025 (Part - 34):1988
31	Ammonical Nitrogen as NH3-N	mg/l	0.07	IS 3025 (Part - 34):1988
32	Dissolved Phosphate as PO4	mg/l	0.73	IS 3025 (Part - 31) :1988
33	Total Residual Chlorine	mg/l	BLQ(LOQ:0.1)	IS 3025 (Part - 26):1986
34	Vanadium as V	mg/l	BLQ(LOQ0.05)	USEPA Method 200.8:1994

Note :- BLQ - Below the Limit of Quantification, LOQ- Limit of Quantification, NTU- Nephelometric Turbidity Unit, mg/l- Milligrams per litre.

End of Report

HUBERT ENVIRO CARE SYSTEMS (P) LTD. Chennai 600 083

Authorized Signatory
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FSSAI Notified Laboratory
ISO 9001, 14001 & OHSAS 18001 Certified.

TEST REPORT

Name of the Client : **M/s. LandTech AEPC Private Limited**
Address of the Client : **No. 173, 1st Main Road, Nehru Nagar,OMR, Kottivakkam, Perungudi, Chennai - 600 096**

Report No. : **HECSL/MB/007/080521**
Report Date : **11/05/2021**

Sample Description : **WATER**
Sample Mark : **Surface Water-2 –Kadapakkam Lake East Side**
Sample Drawn By : **Hubert Enviro Care Systems (P) Ltd**
Sampling/received Date : **05/05/2021 -05/05/2021**
Analysis Commenced On : **06/05/2021**
Completed On : **10/05/2021**

S.No.	Parameters	Units	Results	Test Method
1	Total Coliforms	MPN/100ml	< 2	IS 1622

Note:- MPN - Most Probable Number, < 2 is considered as Absent.

End of Report

HUBERT ENVIRO CARE SYSTEMS (P) LTD. Chennai 600 083

Authorized Signatory

Dr. P. ELAIYARAJU
Assistant Manager

Sediments Analysis

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TEST REPORT

Name of the Client : **M/s. Landtech AEPC Private Limited**
Address of the Client : **No. 173, 1st Main Road, Nehru Nagar,OMR, Perungudi, Chennai - 600 096**

Report No. : **HECSL/SI/001/101220**
Report Date : **15/12/2020**

Sample Description : **Sediment**
Sample Mark : **Sediment-Kadapakkam Lake**
Sample Drawn By : **Hubert Enviro Care Systems (P) Ltd**
Sampling/received Date : **10/12/2020 -10/12/2020**
Analysis Commenced On : **10/12/2020**
Completed On : **14/12/2020**

S.No.	Parameters	Units	Results	Test Method
1	pH	-	6.34	IS2720 Part – 26 :1987
2	Texture	-	Clay	IS2720 Part – 4 :1985
3	Sand	-	3.50	IS2720 Part – 4 :1985
4	Silt	-	6.48	IS2720 Part – 4 :1985
5	Clay	-	90.02	IS2720 Part – 4 :1985
6	Electrical Conductivity	-	76.4	IS14767:2000
7	Sodium	mg/kg	477.0	USEPA Method 3050 B
8	Phosphate	mg/kg	22.38	IS10158 : 1982
9	colour	-	Yellowish	Visual Examination Method
10	Nitrates	mg/kg	11.44	IS 14684 : 1999
11	Iron	mg/kg	105.47	USEPA Method 3050 B
12	Hexavalent Chromium	mg/kg	BLQ(LOQ 0.5)	USEPA Method 3050 B
13	Trivalent Chromium	mg/kg	0.70	USEPA Method 3050 B
14	Manganese	mg/kg	118.83	USEPA Method 3050 B
15	Mercury	mg/kg	BLQ(LOQ 0.1)	USEPA Method 3050 B

Note:- BLQ - Below the Limit of Quantification, LOQ- Limit of Quantification, mg/kg- Milligrams per kilogram.

End of Report

HUBERT ENVIRO CARE SYSTEMS (P) LTD. Chennai 600 083

Authorized Signatory
S. Ravi
Vice President (Labs)

Appendix 4: COVID 19 Protocol

GOVERNMENT OF TAMILNADU

DIRECTORATE OF INDUSTRIAL SAFETY AND HEALTH

Sub: Corona Virus Disease 2019 (COVID -19) – Guidelines to the Factory Managements and Construction Establishments

*****

It is mandatory on the part of the managements of the factory and the BOCW establishments to safeguard the health of their workers. Hence they should comply with the following provisions of Factories Act 1948 and Building and other Construction Workers (Regulation of Employment and Conditions of Service) Act 1996 and prevent the outbreak of COVID-19 among their workers.

1. Provide personal protective equipments like prescribed nose mask, face shield / goggles, gloves, apron etc.
2. Provide facilities for safe disposal of the soiled nose mask, gloves, apron etc.
3. Provide facilities for drying clothing
4. Promote frequent and thorough hand washing by providing workers, customers and worksite visitors with a place to wash their hands. If soap and running water are not immediately available, provide alcohol-based hand rubs containing at least 60% alcohol.
5. Encourage workers to stay home if they are sick and to call helpline number 104. Never travel directly or avail suspected of possible exposure of COVID-19.
6. Encourage respiratory etiquette, including covering coughs and sneezes.
7. Provide customers and the public with tissues and trash receptacles.
8. Employers should explore whether they can establish policies and practices, such as flexible worksites (e.g., telecommuting) and flexible work hours (e.g., staggered shifts), to increase the physical distance among employees and between the employees.
9. Discourage workers from using other worker's phone, desks, offices or other work tools and equipment, when possible.
10. Avoid grouping of the workers or staff at work site for meetings as far as possible.

11. Prompt identification and isolation of potentially infectious individuals is a critical step in protecting workers, customers, visitors, and others at worksite.
12. Employers should inform and encourage employees to self-monitor for signs and symptoms of COVID-19 if they suspect possible exposure.
13. Employers should develop policies and procedures for employees to report when they are sick or experiencing symptoms of COVID-19.
14. Where appropriate, employers should develop policies and procedures for immediately isolating people who have signs and/or symptoms of COVID-19, and train workers to implement them. Move potentially infectious people to a location away from workers, customers and other visitors. Although most worksites do not have specific isolation rooms, designate areas with closable doors may serve as isolation rooms until potentially sick people can be removed from the worksite.
15. Take steps to limit spread of the respiratory secretions of a person who may have COVID-19. Provide a face mask, and ask the person to wear it, if tolerated. Note: A face mask (also called a surgical mask, procedure mask, or other similar terms) on a patient or other sick person should not be confused with PPE for a worker; the mask acts to contain potentially infectious respiratory secretions at the source (i.e., the person's nose and mouth)
16. Do not require a Medical Certificate for employees who are sick with acute respiratory illness to validate their illness as medical facilities may be extremely busy and not able to provide such documentation in a timely way.
17. Maintain flexible policies that permit employees to stay home to care for a sick family member. Employers should be aware that more employees may need to stay at home to care for sick children or other sick family members than is usual.
18. Minimizing contact among workers, clients, and customers by replacing face-to-face meetings with telework if feasible.
19. Establishing alternating days or extra shifts that reduce the total number of employees in a facility at a given time, allowing them to maintain distance from one another while maintaining a full onsite work week.
20. Maintain regular housekeeping practices, including routine cleaning and disinfecting of surfaces, equipment, and other elements of the

work environment. When choosing cleaning chemicals, employers should consult information on labels with claims against emerging viral pathogens. Follow the manufacturer's instructions for use of all cleaning and disinfection products (e.g., concentration, application method and contact time, PPE) Handrails may be disinfected on a regular basis.

21. Maintain proper hygiene of Canteens/dining rooms. Food placed at buffet counters in canteens should be well protected from potential contamination. Staggered lunch timings may be explored to avoid all the workers gathering at a time at canteen.
22. Creches shall be specifically monitored and disinfected thoroughly in case of any doubt of contaminations. It is suggested that crèches be closed and employees availing the facility may be placed on paid additional leave till the current crisis is resolved.
23. Factories and BOCW Management having installed public address system may utilize the same for educating workers on the measures for preventing possible exposure of COVID-19.
24. Health provisions prescribed in chapter III of the Factories Act, 1948 and Chapter VII of The Building and Other Construction Workers Act, 1996 and related provisions of the Tamilnadu Factories Rules, 1950 and Tamilnadu BOCW Rules, 2006 should be strictly complied with.
25. Notwithstanding anything stated above, all factory managements and construction establishments shall ensure strict compliance of directions of the Department of Health and Family Welfare, Government of Tamilnadu Ministry of Health & Family Welfare, Government of India.

Director of Industrial Safety and Health (FAC)
Chennai

To

1. Management of all registered Factories in the State of Tamilnadu
2. Management of all registered Construction Establishments in the State of Tamilnadu
3. All the officers of this Directorate to circulate among all the factories and construction establishments in their jurisdiction

Appendix 5: Sample Quarterly Environmental Monitoring Report Template

This template must be included as an Annex in the EIA/IEE that will be prepared for the project. It can be adapted to the specific project as necessary.

INTRODUCTION

- Overall project description and objectives
- Description of sub-projects
- Environmental category of the sub-projects
- Details of site personnel and/or consultants responsible for environmental monitoring
- Overall project and sub-project progress and status

No.	Sub-Project Name	Status of Sub-Project				List of Works	Progress of Works
		Design	Pre-Construction	Construction	Operational		
		☐	☐	☐	☐		
		☐	☐	☐	☐		

COMPLIANCE STATUS WITH NATIONAL/STATE/LOCAL STATUTORY ENVIRONMENTAL REQUIREMENTS

No.	Sub-Project Name	Statutory Environmental Requirements	Status of Compliance	Action Required

COMPLIANCE STATUS WITH ENVIRONMENTAL LOAN COVENANTS

No. (List schedule and paragraph number of Loan Agreement)	Covenant	Status of Compliance	Action Required

COMPLIANCE STATUS WITH THE ENVIRONMENTAL MANAGEMENT AND MONITORING PLAN

- Provide the monitoring results as per the parameters outlined in the EMP. Append supporting documents where applicable, including Environmental Site Inspection Reports.
- There should be Reporting on the following items which can be incorporated in the checklist of routine Environmental Site Inspection Report followed with a summary in the semi-annual Report send to ADB. Visual assessment and review of relevant site documentation during routine site inspection needs to note and record the following:
- What are the dust suppression techniques followed for site and if any dust was noted to escape the site boundaries;
- If muddy water was escaping site boundaries or muddy tracks were seen on adjacent roads;
- adequacy of type of erosion and sediment control measures installed on site, condition of erosion and sediment control measures including if these were intact following heavy rain;
- Are their designated areas for concrete works, and refuelling;
- Are their spill kits on site and if there are site procedure for handling emergencies;

- Is there any chemical stored on site and what is the storage condition?
- Is there any dewatering activities if yes, where is the water being discharged;
- How are the stockpiles being managed;
- How is solid and liquid waste being handled on site;
- Review of the complaint management system;
- Checking if there are any activities being under taken out of working hours and how that is being managed.

Appendix 6: Summary Monitoring Table

Impacts (List from IEE)	Mitigation Measures (List from IEE)	Parameters Monitored (As a minimum those identified in the IEE should be monitored)	Method of Monitoring	Location of Monitoring	Date of Monitoring Conducted	Name of Person Who Conducted the Monitoring
Design Phase						
Pre-Construction Phase						
Construction Phase						
Operational Phase						

Overall Compliance with SEMP/EMP

No.	Sub-Project Name	EMP/SEMP Part of Contract Documents (Y/N)	SEMP/EMP Being Implemented (Y/N)	Status of Implementation (Excellent/ Satisfactory/ Partially Satisfactory/ Below Satisfactory)	Action Proposed & Additional Measures Required

APPROACH AND METHODOLOGY FOR ENVIRONMENTAL MONITORING OF THE PROJECT

- Brief description on the approach and methodology used for environmental monitoring of each sub-project

MONITORING OF ENVIRONMENTAL IMPACTS ON PROJECT SURROUNDINGS (AMBIENT AIR, WATER QUALITY AND NOISE LEVELS)

- Brief discussion on the basis for monitoring
- Indicate type and location of environmental parameters to be monitored
- Indicate the method of monitoring and equipment to be used
- Provide monitoring results and an analysis of results in relation to baseline data and statutory requirements

As a minimum the results should be presented as per the tables below.

Air Quality Results

Site No.	Date of Testing	Site Location	Parameters (Government Standards)		
			PM_{10} ($\mu g/m^3$)	SO_2 ($\mu g/m^3$)	NO_2 ($\mu g/m^3$)

Site No.	Date of Testing	Site Location	Parameters (Monitoring Results)		
			PM_{10} ($\mu g/m^3$)	SO_2 ($\mu g/m^3$)	NO_2 ($\mu g/m^3$)

Water Quality Results

Site No.	Date of Sampling	Site Location	Parameters (Government Standards)					
			pH	Conductivity (μ_S/cm)	BOD (mg/L)	TSS (mg/L	TN (mg/L)	TP (mg/L)

Site No.	Date of Sampling	Site Location	Parameters (Government Standards)					
			pH	Conductivity (μ_S/cm)	BOD (mg/L)	TSS (mg/L	TN (mg/L)	TP (mg/L)

Noise Quality Results

Site No.	Date of Testing	Site Location	LA_{eq} (dBA) (Government Standard)	
			Day Time	Night Time

Site No.	Date of Testing	Site Location	LA_{eq} (dBA) (Government Standard)	
			Day Time	Night Time

SUMMARY OF KEY ISSUES AND REMEDIAL ACTIONS

- Summary of follow up time-bound actions to be taken within a set timeframe.

Annexes

- Photos
- Summary of consultations
- Copies of environmental clearances and permits
- Sample of environmental site inspection Report
- Other

Appendix 7: Sample Environmental Site Inspection Report

Project Name
Contract Number

NAME: _____ DATE: _____
TITLE: _____ DMA: _____
LOCATION: _____ GROUP: _____

WEATHER:

Project Activity Stage	Survey	
	Design	
	Implementation	
	Pre-Commissioning	
	Guarantee Period	

Monitoring Items	Compliance
Compliance marked as Yes / No / Not applicable (NA) / Partially Implemented (PI)	
EHS supervisor appointed by the contractor and available on site	
Construction site management plan (spoils, safety, schedule, equipment etc.,) prepared	
Traffic management plan prepared	
Dust is under control	
Excavated soil properly placed within minimum space	
Construction area is confined; no traffic/pedestrian entry observed	
Surplus soil/debris/waste is disposed of without delay	
Construction material (sand/gravel/aggregate) brought to the site as and when required only	
Tarpaulins used to cover sand and other loose material when transported by vehicles	
After unloading, wheels and undercarriage of vehicles cleaned prior to leaving the site	
No AC pipes disturbed/removed during excavation	
No chance finds encountered during excavation	
Work is planned in consultation with traffic police	
Work is not being conducted during heavy traffic	
Work at a stretch is completed within a day (excavation, pipe laying and backfilling)	
Pipe trenches are not kept open unduly	
Road is not completely closed; work is conducted on edge; at least one line is kept open	
Road is closed; alternative route provided and the public informed, information board provided	
Pedestrian access to houses is not blocked due to pipe laying	
Spaces left in between trenches for access	
Wooden planks/metal sheets provided across trench for pedestrian	
No public/unauthorized entry observed in worksite	
Children safety measures (barricades, security) in place at works in residential areas	
Prior public information provided about the work, schedule and disturbances	
Caution/warning board provided on site	
Guards with red flag provided during work at busy roads	
Workers using appropriate PPE (boots, gloves, helmets, ear muffs, etc)	
Workers conducting or near heavy noise work is provided with ear muffs	
Contractor is following standard and safe construction practices	
Deep excavation is conducted with landslip/protection measures	
First aid (along with antivenom/antivenin drug) facilities are available on-site and workers informed	
Drinking water provided at the site	
Toilet facility provided at the site	
Separate toilet facility is provided for women workers	

Monitoring Items	Compliance
Workers camps are maintained cleanly	
Adequate toilet and bath facilities provided	
Contractor employed local workers as far as possible	
Workers camp set up with the permission of PIU	
Adequate housing provided	
Sufficient water provided for drinking/washing/bath	
No noisy work is conducted in the nights	
Local people informed of noisy work	
No blasting activity conducted	
Pneumatic drills or other equipment creating vibration is not used near old/risky buildings	

Signature

_____

Sign off

_____ _____

Name **Name**
Position **Position**

Appendix 8: Sample Grievance Redress Form

(To be available in Local Language and English)

The _____Project welcomes complaints, suggestions, queries and comments regarding project implementation. We encourage persons with grievance to provide their name and contact information to enable us to get in touch with you for clarification and feedback. Should you choose to include your personal details but want that information to remain confidential, please inform us by writing/typing *(CONFIDENTIAL)* above your name. Thank you.

Date		**Place of registration**			
Contact Information/Personal Details					
Name		**Gender**	* Male * Female	**Age**	
Home Address					
Place					
Phone no.					
E-mail					
Complaint/Suggestion/Comment/Question Please provide the details (who, what, where and how) of your grievance below: If included as attachment/note/letter, please tick here:					
How do you want us to reach you for feedback or update on your comment/grievance?					

FOR OFFICIAL USE ONLY

Registered by: (Name of Official registering grievance)	
Mode of communication: Note/Letter E-mail Verbal/Telephonic	
Reviewed by: (Names/Positions of Official(s) reviewing grievance)	
Action Taken:	
Whether Action Taken Disclosed:	Yes No
Means of Disclosure:	

Appendix 9: Kadapakkam Biodiversity Report

Summary

The biggest and the serious threats to aquatic ecosystems is the increasing expansion of human population and settlements along the wetlands and catchments. These demands for wetland resources such as water for domestic and irrigation, aesthetic values, food and many more, which will disappear in near future. Thus, quantification of existing wetland resources and its restoration for future conservation is imperative. The goals for restoration of lake ecosystems need to be realistic and should be based on the concept of expected conditions for individual eco-regions. Traditional knowledge and practices have to be explored as remedial measures.

Kadapakkam lake is located very near to Manali, Industrial hub in North Chennai, this region is also a peri-urban area and is considered as rural under Greater Chennai Corporation land use classification. The emerging landuse change along the peri-urban regions of Chennai and the changing climatic systems has intensified the wetland restoration as mitigation tool for climate change. Restoration of Kadapakkam lake would set a model for other such lakes along the city, the basic of restoration is to study and understand the biodiversity existing and its interrelations. Result of the biodiversity study revealed a total of 124 floral species belonging to 51 families were recorded, 26 families were represented by one species. Nearly 13% of the species recorded were represented by one or few numbers at scattered locations and many non-woody species such as herbs (31%) forming dense mat on the lake bund, Hydrophytes (20%) consist of submerged, emergent and floating habits, shrubs (13%) at scattered locations, climbers (10%) 12 species of fishes were recorded from Kadapakam lake, which is comparatively less than other lakes along the regions. one invasive species Tilapia or Egyptian Mouthbreeder *Oreochromis mossambicus* was encountered during the survey. 2 species of Amphibian and 8 species of Reptiles were identified. 30 species butterflies and 14 species of Odonates were identified. 46 species of birds belonging to 17 orders and 34 families were recorded. According to the IUCN Red List of threatened species, 45 of species identified were observed as Least Concern (LC) and one species are listed as Near Threatened (NT): Spot-Billed Pelican (*Pelecanus philippensis)*.

The Pulicat lake and Guindy National Park are 23.8 and 21.2 kms from the project site, both the sites are more than 20 kms away from project area, project activities are unlikely to interfere with these environmentally sensitive areas, and therefore no adverse impacts are anticipated. Short-term changes in water quality during and after project execution is excepted, it will temporarily increase the turbidity of the water and will be back to be normal. There is no natural habitat of forest, grassland of significant size within the restoration area that support a high diversity of terrestrial wildlife, which will be disturbed during restoration. There was no rare, protected or endangered wildlife species in the project area based on literature and survey except the Near Threatened (NT) species Spot-Billed Pelican (*Pelecanus philippensis),* and this species will be benefited after the completion of the restoration

1. INTRODUCTION

The Millennium Development Goals (MDGs) and Sustainable Development Goals (SDGs) recognize the fundamental role of aquatic systems, noting many other sectors also will fail without adequate water supplies. The overall water situation, is acute along the coastal cities of India and the expanding regions of these cities, which contains the greatest density of human population, as well as some of the most degraded water systems, particularly rivers, lakes and reservoirs
An aquatic ecosystem at its best condition can carry out diverse functions like production, and regulation. Ecosystem services are provisioning, regulatory, cultural and support services. Human

action and activities often disturb the structure of the biotope, and cause organic pollution. Living things are in close interdependence and with their surrounding physical environment. India and its states are facing a crisis in the loss of biodiversity, from the genetic and species level to the ecosystem level. Restoration can play a big role in addressing biodiversity loss, by helping to revive and mitigate the loss of critical habitat for threatened species and ecosystems. In most of the places during the recent times, restoration to an original state is minimal, most of the on ground actions involves a mitigation kind of approach to bring back at least some ecosystem services and reverses biodiversity loss. This kind of remediation or rehabilitation can be viewed as a positive intervention, many ecological interventions in urban and peri-urban regions come into this category. Allowing recovery by removing pressures, taking limited measures to mitigate impacts or enhance biodiversity, or actively restoring ecosystems can all be viewed as a continuum or as intersecting approaches. It is the second-best options compared with conserving near pristine habitats with their natural biodiversity and ecosystem processes. Thus, recovery and restoration are considered together here, also as remedial or mitigating activities like creation of latest habitat

Biodiversity assessment is imperative need in order to evolve restoration / conservation strategies as well as to quantify the success or failure of actions undertaken, especially where the actions alter landscapes and waterscapes. The main objective of the biodiversity survey is to explore the functional and taxonomic floral and faunal diversity and the existing status. To explain the understanding of the patterns governing communities of plant diversity by analysing the information gathered, and analysis the ecological and conservation problems and its interrelations.

2. BACKGROUND AND STUDY SITE

The Kadapakkam lake is located in Greater Chennai Corporation Limit in GCC Zone-II (Manali), Ward 16. Lake is owned by Water Resource Department, Public Works Department, Government of Tamil Nadu. This lake is located very near to Manali, Industrial hub in North Chennai, along the village Edayanchavady this region is also a peri-urban area and is considered as rural under Greater Chennai Corporation land use classification. Kadapakkam being pristine land comparatively in the GCC region which is bound to be urbanized as the development is fast paced with Industrial demand, protecting the unpolluted lake is the model for any future urban development's and this protected place will provide the necessary urban lung space for the future rising population. To fulfil the objective to combat climate change and combat urban challenges in Chennai, it is Imperative to increases the water holding capacity of the lake by desilting and rejuvenating them and enhance the ecosystem function.

Restoration Ecology approaches include the human intervention to recreate and maintain landscapes. To recover and get eco-systems back on function and enhances interconnection of ecosystems. It’s an ecological way also in an evolutionary sense can act as a source for a new species. The future of natural ecosystems will depend not on protection from humans by restricting their interference with the nature, but on the relationships of people with the ecosystems they inhabit. And thus, the restored system need to be ecologically prosperous, economically productive and psychologically rewarding. In restoration ecology people should be a part of the natural landscape, and they should be included into every design process and their needs are also to be met.

Figure 1. View of Kadapakkam lake and Emerging Industrial Zone (Source: Google Earth)

Figure 2. View of Kadapakkam lake and Emerging Industrial Zone

Figure 3. View of Kadapakkam lake at lowest water level during summer (2020) and the Industrial area adjacent to the lake

3. METHODOLOGY

The proposed lake has four different habitats such as the terrestrial ecosystem, the freshwater ecosystem, the fragmented scrub jungle ecosystem and the wetland ecosystem (agriculture) the terrestrial floral species and macro fauna were surveyed in these habitats. Primary data on Flora and Fauna (Fishes, Amphibians and Reptiles, Butterflies, Odonates and Birds) were collected by the DPR consultants during Post monsoon (North-East monsoon) December, 2020 via the walkthrough survey / visual observation and photo and videography. The Biodiversity report on Integrated Urban Flood Management for the Chennai - Kosasthalaiyar Basin was used to crosscheck the data on Flora and Fauna (Fishes, Amphibians and Reptiles, Butterflies, Odonates and Birds). Baseline data on the status of the lake and survey on Flora and Fishes, Amphibians, Butterflies, Odonates and Birds was collected by ADB consultant via Walkthrough survey / visual observation and photo during 28th to 29th December 2020 and 4th and 5th January 2021. The following objectives were considered for the studies:

- The on ground status of the habitats along the proposed lake and the interlinking areas.
- The biodiversity and associated ecosystem of the lake and its surrounding.
- Identification of Critically Endangered Species, Endemic Species; Migratory Species and Regionally unique and highly threatened habitat or ecosystems influenced by the project
- Propose measures for no or minimum damage to the biodiversity

Secondary source of information in identifying the species are obtained from the following documents/ literature

- Regional and National literatures
- Integrated Biodiversity Assessment Tool (IBAT);
- The World Database of Key Biodiversity Areas website (WPDA);
- Important Bird Areas (Birdlife International);
- Ramsar website;
- IUCN Redlist;
- UNEP-WCMC (2017) Global Critical Habitat screening layer

The proposed lake has four different habitats such as the terrestrial ecosystem, the freshwater ecosystem, the fragmented scrub jungle ecosystem and the wetland ecosystem (agriculture) the terrestrial floral species and macro fauna were surveyed in these habitats. Based on the walkthrough survey / visual observation and photo and videography evidence the species numbers and ecosystem type were estimated. The literature available on all these habitats were reviewed and included in the document.

4. RESULT

4.1. Flora

Terrestrial vegetation in the project areas typically consists of small isolated pockets of vegetation and farmland and small plantations adjacent. Terrestrial plants are restricted to the lake bund area with few tree species. Total of 124 species belonging to 51 families were recorded, intrestingly 26 families were represented by one species. A Maximum 13 species were of Fabaceae, followed by 13 of Poaceae and 8 of Asteraceae. Eubhorbiaceae and Cyperaceae familes represented by 7 species each. Good density of hydrophytes were observed species like *Spirodela polyrhiza**,** Aponogeton natans, Alternanthera sessilis, Hydrilla verticillata, Pistia stratiotes**,** Nymphaea nouchali, Nymphaea rubra* were identified and Good density of like *Nelumbo nucifera, Nymphaea pubescens* and *Nymphaea nouchal* were observed throughout the water body, Water quality was good and the presence of more number of hydrophytes are the good indicator of it. Nearly 13% of the species recorded were represented by one or few numbers at scattered locations and many non-woody species such as herbs (31%) forming dense mat on the lake bund , Hydrophytes (20%) consist of submerged, emergent and floating habits, shrubs (13%) at scattered locations, climbers (10%) Asclepiadaceae, Cucurbitaceae and Convoluvaceae members running on trees and Capparidaceae on the ground and grasses (10%). During the summer, when the water level dries up on the water spread areas, it supports temporary habitat for herbs and grasses.

Hard wood and Thorny trees like *Prospis juliflora* and *Acacia nilotica* in the water spread were found and these serve as nesting place for Herons, especially purple heron, which breeds in these trees. Very few numbers of trees like *Azardiracta indica* and *Morinda* were identified along the bund.

Figure 4. View of Aquatic vegetation dominance in the lake

Figure 5. Fragmented small patch of vegetation along the lake and less or no vegetation along the bund

Table 1. Aquatic plants in Kadapakkam Lake

S. No	Scientific name	Common Name	Local Name
1	*Alternanthera philoxeroides*	Alligator weed	Seemai Karisilangani
2	*Aponogeton natans*	Floating Lace Plant	Kottikizhangu
3	*Ceratophyllum demersum*	Hornwort	Velampasi
4	*Cyperus rotundus*	Common Nut Sedge	Koraikizhangu
5	*Eichornia crassipes*	Water Hyacinth	Venkayatamarai
6	*Hydrilla verticillata*	Water Thyme	Amiranappaci
7	*Hygrophilla auriculata*	Marsh Barbel	Neer Mulli
8	*Ipomea aquatica*	Swamp morning-glory	Nali
9	*Ipomea carnea*	Bush morning glory	Neyveli kattamanaku
10	*Kyllinga bulbosa*	Spikesedges	Koraipul
11	*Lemna minor*	Common duckweed	Vathumithavai
12	*Ludwigiaad scendens*	Water Primrose	Kattukkirampu
13	*Marsilea quadrifolia*	Water Shamrock	Neer-aarai
14	*Nelumbo nucifera*	Sacred lotus	Thamarai
15	*Nymphaea alba*	White Waterlily	Ambal
16	*Nymphaea nouchali*	Blue Water Lily	Neelaambal

S. No	Scientific name	Common Name	Local Name
17	*Nymphaea pubescens*	Pink Water Lily	Vellambal
18	*Nymphaea rubra*	Red Water Lily	Sivappuaambal
19	*Nymphoides hydrophylla*	Crested Floatingheart	Chinnambal
20	*Nymphoides indica*	Water snowflake	Chinnambal
21	*Polygonum glabra*	Dense flower knot weed	Atlaria, Atalari
22	*Salvinia molesta*	Giant salvinia	Periyasalvinia
13	*Scirpus articulates*	Pendulous bulrush	Korai
24	*Typha angustifolia*	Common cattail	Sambu
25	*Utricularia aurea*	Golden bladderwort	-

Table 2. Trees observed around Kadapakkam Lake

S.No	Scientific name	Common Name	Local Name
1	*Acacia nilotica*	Babool	Karuvel
2	*Azardiracta indica*	Neem tree	Veppamaram
3	*Borassus flabellifer*	Palm tree	Panaimaram
4	*Cassia siamea*	Siamese cassia	ManjaKondrai
5	*Ficus religiosa*	Pepul tree	Arasamaram
6	*Lannea coromandelica*	Indian Ash tree	Othiyamaram
7	*Millingtonia hortensis*	Indian cork tree	Maramalli
8	*Phoenix sylvestris*	Silver Date Palm	Eachamaram
9	*Pongamia pinnata*	Indian Beech Tree	Pungamaram
10	*Prosopis juliflora*	Mesquite	Velikaruvaimaram
11	*Tamarindus indica*	Tamarind	Puliyamaram
12	*Samanea saman*	Monkey pod tree	Thoongumunjimaram
13	*Ziziphus mauritiana*	Ber	Elandai
14	*Morinda tinctoria*	Indian mulberry	Nona chedi
15	*Ficus hispida*	Hairy fig	Pei atthi
16	*Limonia acidissima*	Elephant apple	Vila
17	*Leucaena leucocephala*	Wild Tamarind	Savundalmaram

Table 3. Shrubs observed around Kadapakkam Lake

S.No	Scientific name	Common Name	Local Name
1	*Abutilon indicum*	Indian Abutilon	Paniyarattuti
2	*Abutilon indicum guineense*	Country mallow	Thuthi
3	*Azima tetracantha*	Needle Bush	Sangumul
4	*Cadaba fruticosa*	Indian Cadaba	Vizhudhi
5	*Calotropis gigantea*	Crown flower	Erukan chedi
6	*Cassia alata*	Candle bush	Seemaiagathi
7	*Cassia obtusifolia*	Sicklepod	Chiru takarai
8	*Cassia occidentalis*	Coffee Senna	Peiavarai
9	*Cassia tora*	Foetidcassi	Senavu
10	*Chrozophorarottleri*	Rottler's Chrozophora	Purapirakkai
11	*Datura innoxia*	Recurved thorn-apple	Vellammattai
12	*Hibiscus vitifolius*	Tropical rose mallow	Siruthutthi
13	*Jatropha gossypifolia*	Cotton-leaved jatropha	Seemayamanakku

S.No	Scientific name	Common Name	Local Name
14	*Lantana camera*	Lantana	Unni chedi
15	*Phyllanthus reticulatus*	Black-Honey Shrub	Sivapupoola
16	*Ziziphus oenoplia*	Jackal Jujube	Suraimul

Table 4. Herbs observed around Kadapakkam Lake

S. No	Scientific name	Common Name	Local Name
1	*Acalypha indica*	Indian acalypha	Kuppameni
2	*Achyranthes aspera*	Prickly Chaff Flower	Naaiuruvi chedi
3	*Aerva lantana*	Mountain Knot Grass	Sirupoola poo
4	*Alternanthera sessilis*	Sessile Joyweed	Ponnanganni
5	*Alternanthera tenella*	True Yellow Calico Plant	Keeri
6	*Alysicarpus monilifer*	Alyce Clover	Kaasukkodi
7	*Blume amollis*	Soft Blumea	Narakkarandai
8	*Boerhaavia diffusa*	Hog weed	MukkarattaiKeerai
9	*Cleome viscosa*	Asian Spider Flower	Naaikadugu
10	*Coldenia procumbens*	Creeping Coldenia	Seruppadai
11	*Commelina benghalensis*	Day Flower	Kanangkozai
12	*Corchorus aestuans*	East Indian Mallow	Perumpinnakkukkirai
13	*Croton sparsiflorus*	Ban tulasi	Naimelakkai
14	*Eclipta alba*	False Daisy	Vellaikarisilankanni
15	*Euphorbia hirta*	Asthma weed	AmmaanPachcharisi
16	*Glinusoppositifolia*	Bitter cumin	Peruntiray
17	*Gomphrena serrata*	Prostrate Gomphrena	Vellaivadamalli
18	*Heliotropium indicum*	Indian heliotrope	Thelkodukku
19	*Heliotropium indicum*	Indian heliotrope	Thelkodukku
20	*Leucas aspera*	Common Leucas	Thumbai
21	*Lippianodiflora*	Frog fruit	Podutalai
22	*Mimosa pudica*	Common Sensitive Plant	Thottasinungi
23	*Parthenium hysterophorus*	Parthenium weed	Mookuthipoo
24	*Phyllanthus amarus*	Stone breaker.	Killanelli
25	*Physalis angulata*	Groundcherry	Sodakkuthakkali
26	*Ruellia tuberosa*	Minnie Root	Tapas kaai
27	*Sida acuta*	Common wireweed	Vattathirupi
28	*Sida cordifolia*	Country mallow	Sidhamooti
29	*Spermacoce articularis*	Jointed Buttonweed	Nathaichoori
30	*Stachytarpheta indica*	Indian Snakeweed	Seemainayuruvi
31	*Trianthema portulacastrum*	Black pig weed	Mookaratai
32	*Tridax procumbens*	Coat buttons	Vettukkaaya-thalai
33	*Vernonia cinerea*	Little ironweed	Neichitti
34	*Phyla nodiflora*	Frog Fruit	Poduthalai
35	*Commelina diffusa*	Climbing day flower	Kanavalai
36	*Emilia sonchifolia*	Lilac tasselflower	Muyalccevi
37	*Mollugo pentaphylla*	Carpetweed	Kuttuttiray
38	*Xanthium strumarium*	rough cocklebur	Maruloomathai
39	*Scoparia dulcis*	Sweet broom weed	Kallurukki

Table 5. Climbers observed around Kadapakkam Lake

S.No	Scientific name	Common Name	Local Name
1	*Cardiospermum halicacabum*	Heartseed	Mudakattan
2	*Cissis vitiginea*	South Indian Treebine	Kattumunthiri
3	*Clitoriaternetea*	Asian pigeonwings	Sangu Poo
4	*Coccinia grandis*	Ivy gourd	Kovakkai
5	*Oxystelma esculentum*	Rosy Milkweed Vine	Usippalai
6	*Passiflora foetida*	Fetid passionflower	Siruppunaikkalikodi
7	*Pentatropis capensis*	Ambarvel	Upilankodi
8	*Pergularia daemia*	Pergularia	Uttamani
9	*Solanum trilobatum*	Purple Fruited Pea Eggplant	Tuduvalai
10	*Wattakaka volubilis*	Sneeze Wort	Kurinjan
11	*Ipomea separia*	Purple heart glory	Senthali
12	*Rivea hypocrateriformis*	Midnapore Creeper	Musuttai
13	*Capparis zeylanica*	Ceylon caper	Aathondai
14	*Maerua oblongifolia*	Desert caper	Boomi sakkaraivallikilangu
15	*Merremia emarginata*	Kidney leaf morning glory	Elikkadhukeerai
16	*Luffa aegyptiaca*	Sponge guard	Egipthuvellari

Table 6. Grasses observed around Kadapakkam Lake

S.No	Scientific name	Common Name	Local Name
1	*Alloteropsis cimicina*	Summer grass	Kodaipul
2	*Apluda mutica*	Mauritian Grass	Moongilpul
3	*Chloris barbata*	Swollen Finger Grass	Mayilkondaipul
4	*Cynodan dactylon*	Bermuda grass	Arugampul
5	*Sporobolus coromandelianus*	Smut grass	Pul
6	*Cyperus compressus*	Poorland Flat Sedge	Korai kizhangu
7	*Cyperus exaltatus*	Tall Flat Sedge	Korai
8	*Arundo donax*	Giant Reed	Southaimoongil
9	*Dactyloctenium aegyptium*	Egyptiyan crowfoot	Kakkakalpul
10	*Kyllinga bulbosa*	Whitehead Spikehedge	Koraipul
11	*Saccharum spontaneum*	Wild Sugarcane	Peikarumbu
12	*Schoenoplectiella articulata*	Sedge grass	Korai

4.2 Fauna

4.2.1 Fishes

Kadapakkam freshwater habitat provides habitat for locally predominant fish species. The increase or decrease of fish diversity and population has a direct impact on the interpretation of the success or failure of restoration / interventions since they are the most reliable indicators where interventions in water are planned and executed. Occurrence of smaller size native fish indicates the lake is healthy and least impacted by invasive Tilapia and other anthropogenic

threats. A total of 12 species were encountered in the Kadapakam lake, which is comparatively less than other lakes along the regions.
one invasive species was encountered during the survey. The Tilapia or Egyptian Mouthbreeder *Oreochromis mossambicus* introduced from Africa as a protein substitute food fish, this species finds prominent mention in the list of “100 of the world’s worst invasive alien species”. During all fishing sessions *Oreochromis mossambicus* was caught but comparatively less in numbers, which need to be kept in control.

Figure 6. View of *Pseudetroplus maculatus* (Orange Chromid) and fishing activity at the Kadapakkam lake

Table 7. Icthyofauna observed in Kadapakkam Lake

S. No	Scientific Name	Common name	IUCN / Wildlife Protection Act 1972 -Status
1	*Channa striata*	Snake head murrel	LC
2	*Channa punctata*	Spotted snakehead	LC
3	*Oreochromis mossambicus*	Tilapia	LC
4	*Glossogobius giuris*	Tank goby	LC
5	*Mystus vittatus*	Stripped dwarf catfish	LC
6	*Puntius sophore*	Pool barb	LC
7	*Puntius chola*	Swamp barb	LC
8	*Pseudetroplus maculatus*	Orange chromid	LC
9	*Rasbora dandia*	Rasbora	LC
10	*Pethia conchonius*	Rosy barb	LC
11	*Pethiaticto*	Ticto barb	LC
12	*Xenantadon cancilla*	Freshwater garfish	LC

LC – Least Concern

4.2.2 Amphibians and Reptiles

Amphibians and reptiles are bio-indicators that provide valuable insights into the state of the ecosystem they inhabit. Marginal and suboptimal habitat patches present near human settlements often harbor a good number of biodiversity. 2 species of Amphibian and 8 species of Reptiles were identified**.**

Table 8. Amphibians observed around Kadapakkam Lake

S. No	Scientific Name	Common Name	Local name
1	*Hoplobatrachus tigerinus*	Indian bullfrog	Thavalai
2	*Duttaphrynus melanostictus*	Asian common toad	Periyatherai

Table 9. Reptiles observed around Kadapakkam Lake

S. No	Scientific Name	Common Name	IUCN / Wildlife Protection Act 1972 -Status
1	*Naja naja*	Indian cobra	LC
2	*Bungarus caeruleus*	Indian krait	LC
3	*Daboia russelii*	Russels viper	LC
4	*Ptyas mucosus*	Indian rat snake	LC
5	*Xenochrophis piscator*	Asiatic water snake	LC
6	*Ahaetulla nasuta*	Common vine snake	LC
7	*Eryx conicus*	Common sand boa	LC
8	*Melanochelys trijuga*	Indian pond terrapin	LC

4.2.3 Butterflies and Odonates

A baseline study of the Butterflies and Odonata (dragonflies and damselflies) was carried out as a part of the biodiversity survey, the study targeted in identifying the existing population of Butterflies and Odonates, which also act as the bio-indicators for the health of any eco-region and can subsequently be used to gauge the progress of the restored lake in future stages of development. Butterflies are beneficial as they serve as pollinators and indicators of environmental quality and are appreciated for their aesthetic value and are much vital for the Agriculture lands around. The variety of butterflies in an area varies in direct proportion to the diversity of the local vegetation, since butterfly species feed on different species of plants. 30 species butterflies and 14 species of Odonates were identified. Some of the butterfly host plants identified were *Amaranthus, Barleria, Calotropis, Pergularia, Tylophora, Capparis, Cleome, Ipomea, Acacia, Abutilon, Sida, Hibiscus* and species of Poaceae and Papilionoideae

Table 10. Butterflies observed around Kadapakkam Lake

S. No	Scientific Name	Common Name	IUCN / Wildlife Protection Act 1972 -Status
31.	*Calotis danae*	Crimson tip	LC
32.	*Appias libythea*	Western Striped Albatross	LC
33.	*Colotis eucharis*	Plain orange tip	LC
34.	*Ixias pyrene*	Yellow orange tip	LC
35.	*Catopsilia pomona*	Common emigrant	LC
36.	*Catopsilia pyranthe*	Molttled emigrant	LC
37.	*Cepora nerissa*	Common gul	NE
38.	*Danaus chrysippus*	Plain tiger	LC

S. No	Scientific Name	Common Name	IUCN / Wildlife Protection Act 1972 -Status
39.	*Danaus genutia*	Common tiger	LC
40.	*Euploea core*	Indian Common Crow	LC
41.	*Acraea terpsicore*	Tawny coaster	LC
42.	*Pantoporia hordonia*	Common laskar	NE
43.	*Junonia orithya*	Blue pansy	LC
44.	*Junonia lemonias*	Lemon pansy	LC
45.	*Junonia almana*	Peacock Pansy	LC
46.	*Tirumala septentrionis*	Dark blue tiger	LC
47.	*Tirumala limniace*	Blue tiger	NE
48.	*Parantica aglea*	Glassy tiger	LC
49.	*Pantoporia hordonia*	Common lascar	LC
50.	*Hypolimnas misippus*	Danid eggfly	LC
51.	*Hypolimnas bolina*	Great eggfly	LC
52.	*Junonia iphita*	Chocolate pansy	LC
53.	*Hemiargus ceraunus*	Ceraunus blue	LC
54.	*Zizeeria otis*	Lesser grass blue	LC
55.	*Zizeeria karsandra*	Dark grass blue	NE
56.	*Papilio demoleus*	Lime butterfly	LC
57.	*Papilio polytes*	Common morrnon	LC
58.	*Atrophaneura aristolochiae*	Common rose	NE
59.	*Atrophaneura hector*	Crimson rose	NE
60.	*Ampittia dioscorides*	Bush hopper	NE

LC – Least concern NE – Not Evaluated

Table 11. Dragonflies and Damselflies observed around Kadapakkam Lake

S. No	Scientific Name	Common Name	IUCN / Wildlife Protection Act 1972 -Status
1	*Rhyothemis variegata*	Common picture wing	LC
2	*Trithemis kirbyi*	Orange winged dropwing	LC
3	*Trithemis aurora*	Crimson marsh glider	**LC**
4	*Diplacodes nebulosa*	Black tipped ground skimmer	LC
5	*Brachydiplax sobrina*	Little blue marsh hawk	LC
6	*Diplacodes trivialis*	Ground skimmer	LC
7	*Orthetrum sabina*	Green marsh hawk	LC
8	*Trithemis pallidinervis*	Long legged marsh glider	LC
9	*Acisoma panorpoides*	Trumpet tail	LC
10	*Zyxomma petiolatum*	Brown dusk hawk	LC
11	*Rhodothemis rufa*	Rofous marsh glider	LC
12	*Anaciaeschna jaspidea*	Rusty darner	LC
13	*Ceriagrion cerinorubellum*	Coromandel marsh dart	LC
14	*Agriocnemis pygmaea*	Pygmy dartlet	LC

4.2.4 Birds

Totally, 46 species belonging to 17 orders and 34 families were recorded. According to the IUCN Red List of threatened species, 45 of species identified were observed as Least Concern (LC) and one species are listed as Near Threatened (NT): Spot-Billed Pelican (*Pelecanus philippensis)*. Terrestrial habitat along the lake bund provides feeding habitat for terrestrial birds,

flowers attract variety of insects (larva, bees and butterflies) which in turn attracts insectivorous birds, fruits attract frugivorous, bushy vegetation provides ideal habitat for reptiles (snakes and lizards) which in turn attracts omnivorous birds.

The areas along the project site includes some portion of fragmented scrubland with Palmyra Palm *Borassus flabellifer* and other trees like Neem *Azadirachta indica*. The area has indigenous floral species predominantly; and thus it still supports a good variety of bird species.

Figure 7. View of birds at Kadapakkam Lake and the Industrial area adjacent to the lake

Table 12. Avifaunal (Aquatic) species observed in Kadapakkam Lake

S. No	Scientific Name	Common Name	IUCN / Wildlife Protection Act 1972 -Status
1	*Alcedo atthis*	Common Kingfisher	LC
2	*Ceryle rudis*	Pied kingfisher	**LC**
3	*Halcyon smyrnensis*	White-throated kingfisher	LC
4	*Ardeola grayii*	Pond Heron	LC
5	*Bubulcus ibis*	Cattle egret	LC
6	*Egretta garzetta*	Little egret	LC
7	*Ixobrychus flavicollis*	Black bittern	LC
8	*Ardea cinerea*	Grey heron	LC
9	*Ixobrychus cinnamomeus*	Cinnamon bittern	LC
10	*Anhinga melanogaster*	Darter	NT
11	*Anastomus oscitans*	Asiatic openbill stork	LC
12	*Anas poecilorhyncha*	Spot billed duck	LC
13	*Porphyrio porphyrio*	Purple moorhen	LC
14	*Gallinula chloropus*	Common Moorhen	LC

S. No	Scientific Name	Common Name	IUCN / Wildlife Protection Act 1972 -Status
15	*Amaurornis akool*	Brown crake	LC
16	*Amaurornis phoenicurus*	White breasted waterhen	LC
17	*Fulica atra*	Common coot	LC
18	*Vanellus indicus*	Red Wattles Lapwing	LC
19	*Sterna aurantia*	River tern	LC
20	*Pelecanus philippensis*	Spot billed pelican	NT
21	*Phalocorax niger*	Little Cormorant	LC
22	*Tachybaptus ruficollis*	Little grebe	LC
23	*Actitis hypoleucos*	Common Sandpiper	LC
24	*Esacus recurvirostris*	Great thick-knee	LC
25	*Nycticorax nycticorax*	Black crowned night heron	LC

LC – Least concern NE – Not Evaluated NT – Near Threatened

Table 13. Avifaunal (Terrestrial) species observed in Kadapakkam Lake

S. No	Scientific Name	Common Name	IUCN / Wildlife Protection Act 1972 -Status
1	*Psittacula krameri*	Rose Ringed Parrot	LC
2	*Eudynamys scolopaceus*	Asian Koel	LC
3	*Centropus sinensis parroti*	Southern coucal	LC
4	*Corvus splendon*	Common Crow	LC
5	*Corvus culminatus*	Indian Jungle crow	LC
6	*Acridotheres tristis*	Common Myna	LC
7	*Argya affinis*	Yellow billed babbler	LC
8	*Coracias benghalensis*	Indian Roller	LC
9	*Pycnonotus cafer*	Red Vented Bulbul	LC
10	*Merops orientalis*	Green bee eater	LC
11	*Accipiter badius*	Shikra	LC
12	*Dicrurus macrocercus*	Drongo	LC
13	*Spilopelia chinensis*	Spotted dove	LC
14	*Columba livia*	Rock pigeon	LC
15	*Leptocoma zeylonica*	Purple rumped sunbird	LC
16	*Passer domesticus*	House sparrow	LC
17	*Copsychus fulicatus*	Indian robin	LC
18	*Motacilla alba*	White wagtail	LC
19	*Francolinus pondicerianus*	Grey francolin	LC
20	*Cypsiurus balasiensis*	Asian palm swift	LC
21	*Orthotomus sutorius*	Tailor bird	LC

5. Biodiversity of the Protected Areas within 50kms radius of the Project Area

The Integrated Biodiversity Assessment Tool (IBAT) has been utilized for identifying the critical habitat / hotspots/ areas having rich biodiversity in the project area. Screening and assessment indicated two protected areas lie within 50km radius from the project area: (i) Guindy National Park, 21.2 km southwest of project area, and (ii) Pulicate Bird Sanctuary, 23.8 km north of project area. Details are provided below. Both the protected areas location is far away from project area, project activities are unlikely to interfere with these environmentally sensitive areas, and therefore no adverse impacts are anticipated.

Figure 8. Distance of Pulicat Lake and Guindy National Park from the project area

5. 1. Pulicat Lake (Pulicat Bird Sanctuary)

The vegetation in the islands are dominated by the Tropical Dry Evergreen Forest (TDEF) species, Mangrove and Mangrove associated flora and the Halophytes. A total of 180 floral species are found in the Pulicat Lake, of which 117 species are dicotyledonous plants, 51 species are of monocotyledonous plants. 6 species of mangroves and 35 mangrove associated species are recorded. TDEF species such as *Manilkara hexandra, Albizia amara*, *Strychnos nux-vomica* and *Maba buxifolia* are found in good numbers. The sand dunes are dominated by *Ipomea pesr-carpae,* the intertidal and saline environment, salty marsh is dominated by halophytes species like *Aeluropus lagopoides, Atriplex repens, Cressa cretica, Crotalaria retusa, Cyperus haspan, Fimbristylis ferrugenea, Salichornia brachiata, Sensuvium portulacastrum, Suaeda* species. etc. Halophytes like *Salcornia, Sensuvium* and *Suaeda* grow in hypersaline areas., herbs like *Suaeda nudiflora* and *Suaeda maritima* are dominant. The sea grass species *Halophila ovalis* occurs prominently all along the margins of Buckingham canal. About ten species of mangroves were recorded from the Pulicat Lake; now it is restricted to nearly 6 species, the most dominant species was *Excoecaria agallocha* now its *Avicennia marina*. 88 species of Zooplankaton, 81 species of Benthos. 12 species of prawns, 19 species of crabs and 168 species of finfish and pulicat lake harbours several endemic, endangered and keystone species. 115 species of birds both water (aquatic) as well as land (terrestrial) were recorded in the Pulicat Bird Sanctuary. Birds are the important components in the Pulicat Lake ecosystem and this lagoon area has been announced as a RAMSAR site.

5.2. Guindy National Park.

Guindy National Park is a 2.70 km^2 (1.04 m^2) protected area of Tamil Nadu, located in Chennai, India, is the 8th smallest National Park of India and one of the very few national parks situated inside a city. The park and the diverse vegetation provides an ideal habitat for over 150 species of birds. 9 species of amphibians, 14 species of mammals, 3 species of tortoise and turtles 60 species of spiders and 60 species of butterflies. There are more than 350 species of plants and over 24 variety of trees, including the sugar-apple, *Atlantia monophylla*, wood-apple, *Annona squamosa, Atlanta monoplylla, Feronia limonia, Azadirachta indica* and many others are found in this park. The park and the diverse vegetation provides an ideal habitat for over 150 species of birds. About one-sixth of the park has been left as open grassland to preserve that habitat for blackbucks. Though both the species of blackbuck and spotted deer have their natural habitat in grassland, the spotted deer prefer bushes.

6. BIODIVERSITY ASSESSMENT

Protected habitats located within 50km radius were assessed using the Integrated Biodiversity Assessment Tool (IBAT) to identifying the critical habitat and hotspots areas having rich biodiversity, where any 1. Critically Endangered or Endangered Species, 2. Endemic or Restricted-range Species, 3. Migratory or Congregatory Species and 4. Regionally unique and highly threatened species exists. The Pulicat lake and Guindy National Park are 23.8 and 21.2 Kms from the project site. The Guindy National Park is within the urban limit well protected and managed, the Pulicat is the second largest brackish water lagoon of the countary. Spread in about 450 km^2, Pulicat Lake is ornithological rich and nominated by the Global Nature Fund as "*Threatened* Lake of the Year 2010".

Two of the above 1 and 3, Critically Endangered / Endangered Species, which are threatened with global extinction and listed in the IUCN Red List of Threatened Species face an extremely high risk of extinction in the wild. The Migratory species come to Pulicat from many habitats in India and other countries during different times of the year, due to seasonal limitations in factors such as food, sunlight, and temperature. Six species of water birds; Great Thick-knee *Esacus recurvirostris*, Black-Tailed Godwit *Limosa limosa*, Eurasian Curlew *Numenius arquata*, Painted Stork *Mycteria leucocephala*, Spot-billed Pelican *Pelecanus philippensis* and Black-headed Ibis *Threskiornis melanocephalus* were categorised as “Near Threatened” according to the International Union for Conservation of Nature (IUCN) Red List. Five species of raptors Black-winged Kite *Elanus caeruleus*, Oriental Honey Buzzard *Pernis ptilorhynchus*, Shikra *Accipiter badius*, Brahminy Kite *Haliastur indus* and Whitebellied Sea eagle *Haliaeetus leucogaster* were categorised as “Schedule I” according to the Wildlife Protection Act 1972. Though Migratory of birds are a common in Pulicat, no Congregatory of any species were reported or observed either for feeding, breeding or resting

7. ANTICIPATED ENVIRONMENTAL IMPACTS

Intervention in Kadapakkam Lakes involves removal of weeds and floating matter, desilting, bund strengthening. The activities proposed for restoration of lake are aimed in protecting the available water spread area, increasing the storage capacity and support water retention during floods. The expected impacts of the project on the environment can be in different stages from the initiation of desilting work to completion. These activities will have their own impacts at different magnitude, such impacts are localized and temporary or short term. In operation phase of the project, very less impact is predicted except siltation. The negative impacts anticipated from implementation of this project are minimal and the benefits will be considerable in long-term perspective.

- The Kadapakkam lake doesn’t have a rich biodiversity and almost all the species of both fauna and flora listed are either least concerned or not evaluated except

the Spot-billed Pelican *Pelecanus philippensis* categorised as “Near Threatened” according to the International Union for Conservation of Nature (IUCN) Red List. Even this species was recorded in very less number and very few time in a year

- In long-term view after the completion of the project, in the evolutionary processes no structural changes in the region is expected, such as change in the topography, geology, soil, temperature, and vegetation, and combinations of any of these components. This region is no biological corridor for any species of both fresh water and terrestrial species which can restrict species migration and gene flow
- Either the Pulicat Lake or the Guindy National Park is not a highly threatened ecosystems according to the criteria listed by International Union for Conservation of Nature (IUCN) 1994, 2012, 2014 (Areas representing ≥5% of the global extent of an ecosystem type meeting the criteria for IUCN status of CR or EN and areas not yet assessed by IUCN but determined to be of high priority for conservation by regional or national systematic conservation planning). Similar to the Red List for Threatened Species, IUCN has developed Red List of Ecosystems, Areas representing ≥5% of the global extent of an ecosystem type meeting the criteria for IUCN status of CR or EN and the Other areas not yet assessed by IUCN but determined to be of high priority for conservation by regional or national systematic conservation planning. And thus both the Pulicat Lake or the Guindy National park is not a Threatened ecosystem
- Both Pulicat Lake or the Guindy National Park are located more than 20kms from the project site and both the protected area is no way influenced by the project area and doesn’t fall within the ecological limit of the project site. The Kadapakkam lake is far from the catchment of the Pulicat lake and the Gunidy National Park, is restricted to the urban environment and receiving water needs from the Cooum basin catchments

8. MITIGATION MEASURES

The lake restoration project is likely to change or influence the ecology and environment of the region. The desilting and bund formation will naturally have impacts on the flora such as trees, herbs and shrubs, in the Kadapakkam lake the vegetation in the bund is very sparse and mostly occupied by *Prosopis* thus the impact of vegetation during execution is very minimal.

Figure 9. View of very less vegetation cover in the bund and domination of *Prosopis juliflora*

- Short-term changes in water quality during and after project execution is excepted it will temporarily increase the turbidity of the water and will be back to be normal.
- Physical impacts can be caused due to erosion and deposition within the lake if the execution happens during monsoon, thus restoration activity (desilting and bund formation) during monsoon seasons has to be restricted also precautionary measures (measures to prevent soil erosion) need to be implemented during pre-monsoon season
- The Agriculture landscape along the lake should remain undisturbed for the micro habitats to develop. Floods are the main ecological and human challenge of the area in the future and had one in the recent 2015. The village of Kadapakkam, is in a floodplain and hence, they are very susceptible to flooding during extreme events like 2015 monsoons. The threats are the channels reducing by encroachments and unregulated landfill, the land conversion via increasing industrial development and related activity which can act as obstacle to the natural flow of water.
- The local ecosystem the lake – the fragmented scrub – grassland – the agriculture lands has an associated flora and diversity of fauna. At the transition area between two systems, one can find species of both systems interacting and sharing (even temporarily) the same space. This limit, called “ecotone”, always presents great species diversity and richness, being “fed” from both systems. The boundary between the lake and the agriculture fields are vital and is an ecotone need to be protected for the long-term sustainability of the biodiversity of the region.

- **Bird Islands** are in natural or man-made, they always constitute a very special environment for fauna: it’s a land isolated away from other land. They are protected from land-dwelling predators that cannot or will not swim to the islands, including grazing livestock damaging the flora. Thus they are naturally increasing opportunities for installation of more diverse fauna, both in water, at the water edge, and on the island

- There are very few lakes in South India that have bird breeding areas, surrounded by water during the breeding season from November to March. Vedanthangal in Tamil Nadu, Ossudu eri in Puducherry. The nesting birds enable nutrient transfer from one habitat to another; in this case from wetlands. Fish and other aquatic prey are high on organic compounds and are consumed by aquatic birds, the birds then visit farmlands and fields were they either roost or continue feeding. The excreta they produce is especially rich in nitrogen, phosphate and potassium and hence very good for agriculture. These places are good tourist attractions and the local communities have benefited out of it.
- Environment friendly nature signage along the bunds and viewing platforms will enhance community and visitor participation. Interpretative signage concerning the different facets of the natural environment of the Kadapakkam lake and the surrounding area and in general and the lakes in particular can be an attraction if the signage is created on natural material
- Rest places with information boards along the bunds can be built near the edges of the lake in locations to be agreed by the local people.
  Environmental awareness / education programs designed for schools and local peoples should involve children, parents and teachers ensuring that different levels of the community take away the information. The programs can be designed in different ways to make sure that there is on-site learning and classes designed for in-house sessions in schools as a follow up to field sessions. Thus, helping us

strike a balance between experiential learning and theoretical understanding of various topics. The following topics need to be covered

- Biodiversity
- Watershed and wetlands
- Land and water
- Energy
- Sewage and Solid waste management
- Ecosystem services
- Climate change

- **Use of native plants:** Native plants that are indigenous to a particular region and are adapted to the local micro climate and soil conditions. native plants work well for restoration / landscaping and wildlife habitat creation, because once established, they rarely need watering, mulching and protection. It is advisable to reintroduce native plant species for resilience in the plantation areas.
- **Erosion control and other services:** Native grass like *Vetiveri zizanioides* (Vetiver), *Cymbopogon citratus* (Lemon Grass) are suitable for planting on the newly formed bunds of the lake which can prevent soil erosion, reduce flooding, detoxify the air and water, improve the local climate, and store carbon that would otherwise contribute to global climate change. Plant species such as *Barringtonia acutangula*, *Calamus rotang*, *Calophyllum inophyllum*, *Mitragyna parvifolia*, *Suregada angustifolia*, *Thespesia populnea*, and *Vitex negundo* are most suitable for plantation around water bodies and spillway areas to avoid soil erosion
- Good fruit yielding species like *Alangium salvifolium*, *Eugenia bracteata*, *Rauvolfia tetraphylla, Mimusops elengi, Phyllanthus emblica* and *Syzygium cumini* can provide food and shelter for birds and animals. The flora of the lakes, both in and around the water bodies, is already and will remain the keystone of a restored lake eco-system. Sustainable development strategies for the lake i.e All long-term strategies for the lakes will need to include a healthy, diverse and growing flora around.

9. CONCLUSION

There is no natural habitat of forest, grassland of significant size within the restoration area that support a high diversity of terrestrial wildlife, which will be disturbed during restoration. There was no rare, protected or endangered wildlife species in the project area based on literature and survey except the Near Threatened (NT) species Spot-Billed Pelican (*Pelecanus philippensis),* and this species will be benefited after the completion of the restoration

Wetland rehabilitation and construction will have positive impacts to biological resources, ecology and biodiversity. Rehabilitated and constructed wetlands will provide resting, feeding, nesting and nursery habitats for wildlife. All wetland rehabilitation activities should use native plant species for local provenance. ‗Local provenance' means that the seedlings and plants to be used for the replanting are collected from vegetation communities around the lake, and then propagated in local nurseries, before being planted in the project sites

10. REFERENCES

Henry AN, Kumarai GR, Chitra V. Flora of Tamilnadu, India,series 1: Analysis, Botanical Survey of India, Southern Circle, Coimbatore, Tamilnadu, India, 1987.

IUCN (2012) IUCN Red List Categories and Criteria: Version 3.1. Gland, Switzerland

IUCN Standards and Petitions Subcommittee (2014). Guidelines for Using the IUCN Red List Categories and Criteria. Version 11. Prepared by the Standards and Petitions Subcommittee.

Matthew, K.M. 1991. An Excursion flora of Central Tamil Nadu, India Oxford and IBH Publishing Co., New Delhi.

Sanjeeva Raj P.J. 2006. Macro Fauna of Pulicat Lake, NBA Bulletin No. 6, National Biodiversity Authority, Chennai, Tamil Nadu, India p67

Selvam V, Mohan R, Ramasubramanian R, Azariah J., 1993. Plant communities and soil properties of three mangrove stands of Madras coast. Indian Journal of Marine Science. 20,67-69.

https://www.chennaicorporation.gov.in/