PROJECT MANAGEMENT CONSULTANCY FOR IMPLEMENTATION OF SMART CITY MISSION PROJECTS FOR MANGALURU CITY

DETAILED PROJECT REPORT

IMPROVEMENT OF KAVOOR LAKE

Attachment to letter no. WTESL/2292/2019-20/ 787, dated 23.12.2019

Lalbaug, M.G. Road, Mangalore – 575003

ISSUE RECORD

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1 Introduction

1.1 Project Background

Kavoor lake is one of the major lakes located in Mangalore. The geographic location is towards the north of the city and is accessed through the Bejai-Kavoor road. The total extent of the lake is 8.37 Acres. This can be considered as one of the very few lakes still existing in the city. It presently comes under the jurisdiction of Minor Irrigation Department.

Historically Kavoor lake used to be one of the most prominent water body in the area, although over the years encroachment and neglect has led to it being dry, filled with silt and being converted into a marsh due to the lack of facilities to hold back the rainwater.

Figure 1-1 View of Kavoor lake

Source: Louis Berger Analysis

1.2 Project Purpose

The objective(s) of the project is towards:

1. Improvement and upgradation of the lake as a part of Rain water Harvesting initiative to store rainwater and increase catchment.
2. Development of recreational facilities around lake to increase the social interaction between the community.
3. Rejuvenating the lake to improve the socio-cultural value of surrounding areas and redevelopment it as a recreational area.
4. Encouraging & creating awareness in society about water conservation and lake rejuvenation

1.3 Project Brief

The Mangaluru Smart City Limited (MSCL, the Client), under the Government of Karnataka (GoK), has proposed the Improvement of Kavoor lake (the Project) with the allocation of INR 2 Crore from the Smart City Mission Fund.

The available areas of improvement are:

1. Areas falling within the boundary of the lake.
2. Immediate areas and access routes around the lake.

The salient features of the proposed improvement project are:

1. Self-sustainable, rain water harvesting development.
2. Exploring and analyzing the possibility of inclusion of following features/ conveniences as part of the improvement:
    - Public Plaza
    - Pedestrian and bicycle friendly design (walking and cycle tracks)
    - Entertainment Zones
    - Food and Beverage Kiosks
    - Public facilities
    - Recreational and leisure areas

Work Order to take on the project of 'Improvement of Kavoor lake' was issued to the PMC on 10th April 2019. This report is an amalgamation of the data collected and analyzed, the concepts developed for the proposed project, comments & suggestions received from the Client, in submission for the first deliverable of the 'Concept Report'. The comments and suggestion on concept report was received on 22nd July 2019 after detail discussion and review.

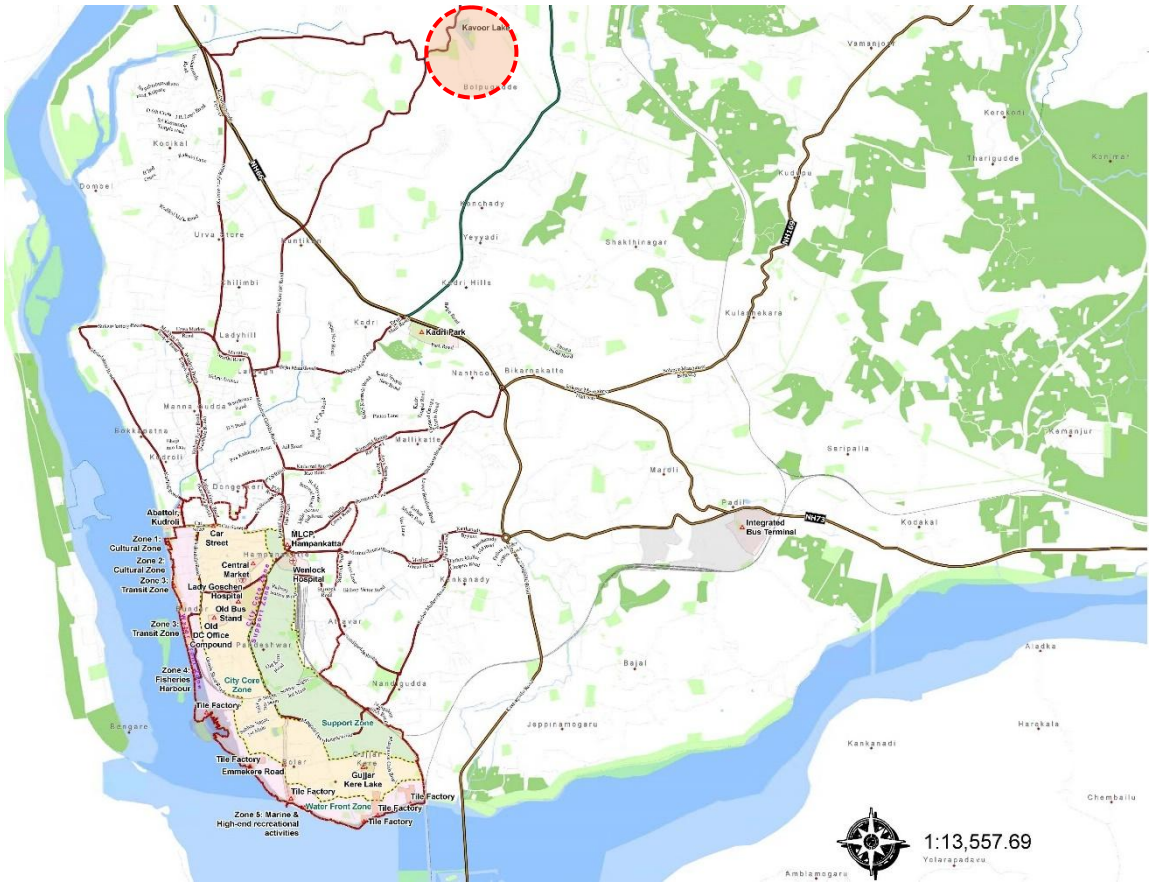
2 Existing Condition Study

2.1 City Context and Existing Connectivity

The Kavoor lake, which is located towards the northern end of Mangalore is approximately 8.37 Acres in area and is surrounded by residential built up structures and abundant greenery, providing the perfect opportunity of rejuvenating and redeveloping it as a means of significantly improving the recreation and water harvesting options for the residents of the city and beyond.

The site is in close proximity to the Gurupura river. The Railway Station, which is the nerve center of the city's transportation, is within 15 kilometers from the site, while the airport is around 5.6 kilometers. The extents of the ABD and most of the important infrastructure facilities fall within a radius of 8 to 10 kilometers towards the southwest direction.

Figure 2-1 Site location with respect to Mangalore City



Source: Louis Berger Analysis

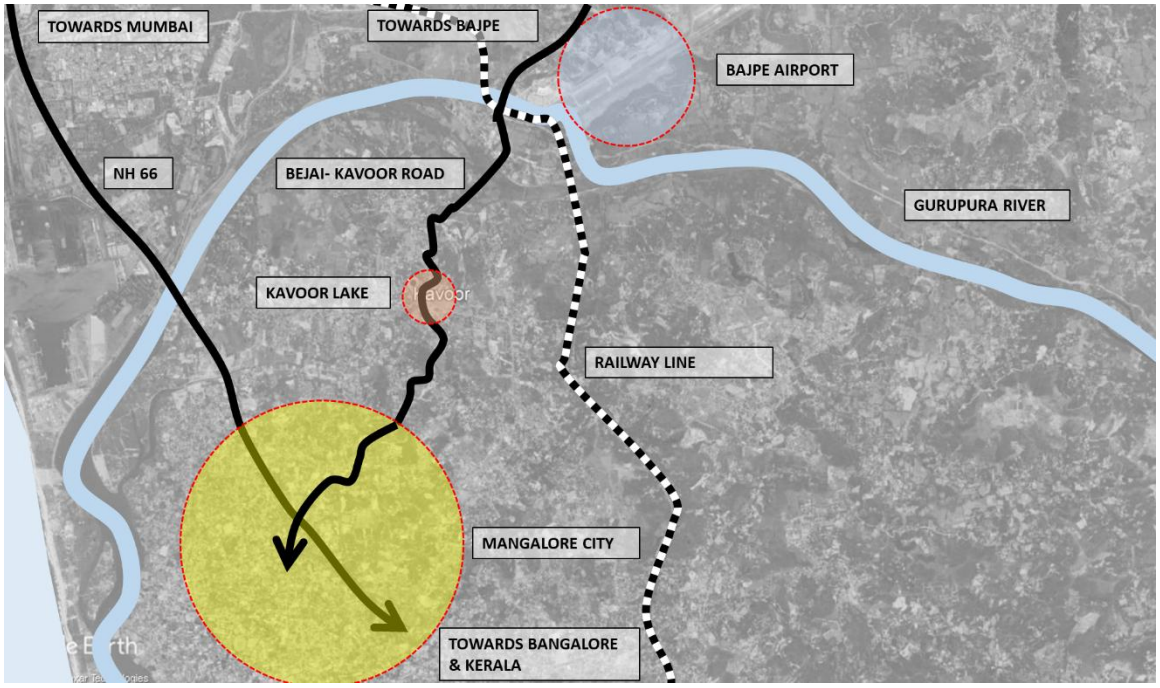
Several proposed redevelopment sites falling within the Smart city Mission in the form of proposed Redeveloped Market Complex and the Redevelopment of the Waterfront is also within a radius of 8 and 11 kilometer respectively. Other projects namely the Multi-Level Car Parking is located at a distance of 8 kilometers, while projects like redevelopment of the Car Street and the redevelopment of Old bus stand are located at a distance of 7.5 and 8.5

kilometers respectively. A comparable project falling outside the boundaries of the ABD area in the form of a New Integrated Bus Terminus at Padil is situated at a distance of 10.5 Kilometers.

2.2 Site Connectivity

The Bejai-Kavoor road (around 9 meters wide) is the major arterial road that connects the Kavoor lake to the rest of the city as well as to the airport. Sub arterial roads bound the lake towards the north and south side.

Figure 2-2 Site connectivity to the city



Source: Louis Berger Analysis

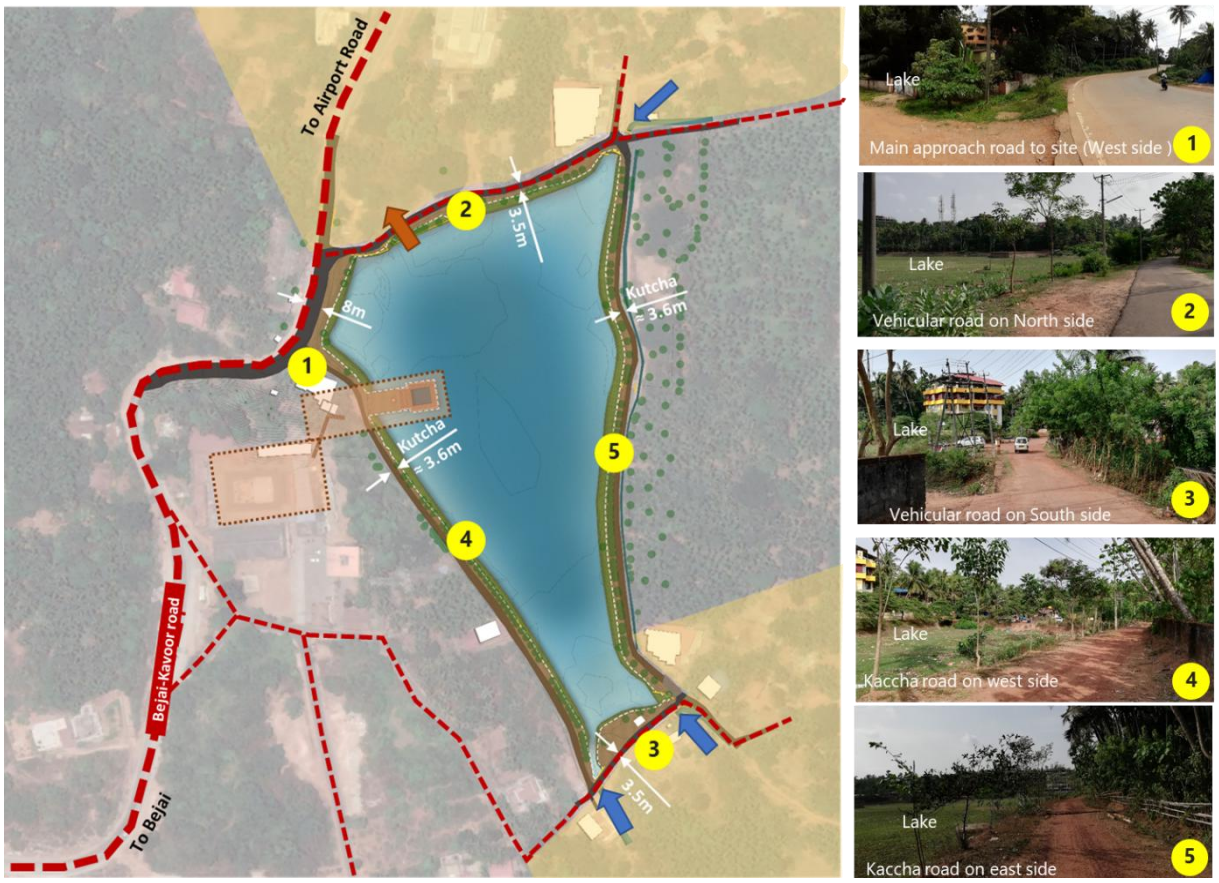
Figure 2-3 Main vehicular approach

Source: Louis Berger Analysis

2.3 Site Access

The lake is accessed through the Bejai-Kavoor road along the north western edge. The site has a vehicular access with paved roads on the northern and southern edges, while the eastern and western edges are bound by kutcha roads. The width of all roads existing around the site ranges from 4 meters to 6 meters.

Figure 2-4 Site Access and surrounding approach roads



Source: Louis Berger Analysis

2.4 *Present Site Situation*

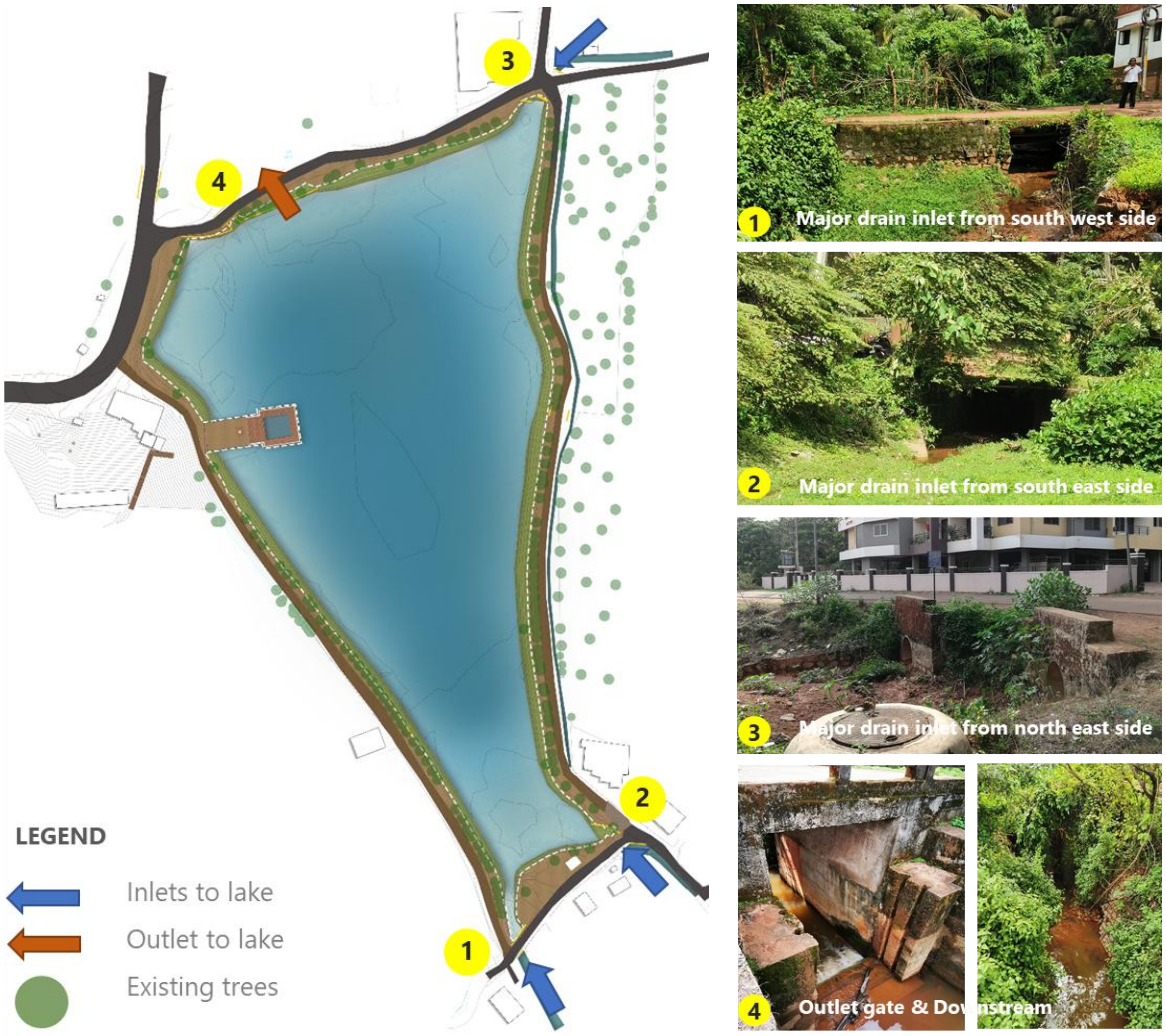
The site of the lake shows neglect as most of it is dry with no prospects of rejuvenating it at the present moment. There is a total of three inlets into the lake, through which water flows in, while there is only one outlet, through which the water flows out. Major drains are present on the north eastern side of the lake. A step well is situated on the western side of the site, jutting out into the lake. The area around the site has a substantial amount of greenery with a dense collection of coconut trees.

There are several issues present in and around the site, as noted below:

- No jali or mesh at the inlet to stop the garbage from upstream.
- Mechanical system at outlet to stop the water present. And it is operated by Minor Irrigation Department.
- No filtration system.
- Upstream channels need repair work.
- Approach area around the lake is not properly developed.
- Stepwell in the lake has become a garbage collection area due to the lack of water in the lake.

- Flora and fauna species are abundant around the lake, but presently this is completely neglected.

Figure 2-5 Context of present site situation



Source: Louis Berger Analysis

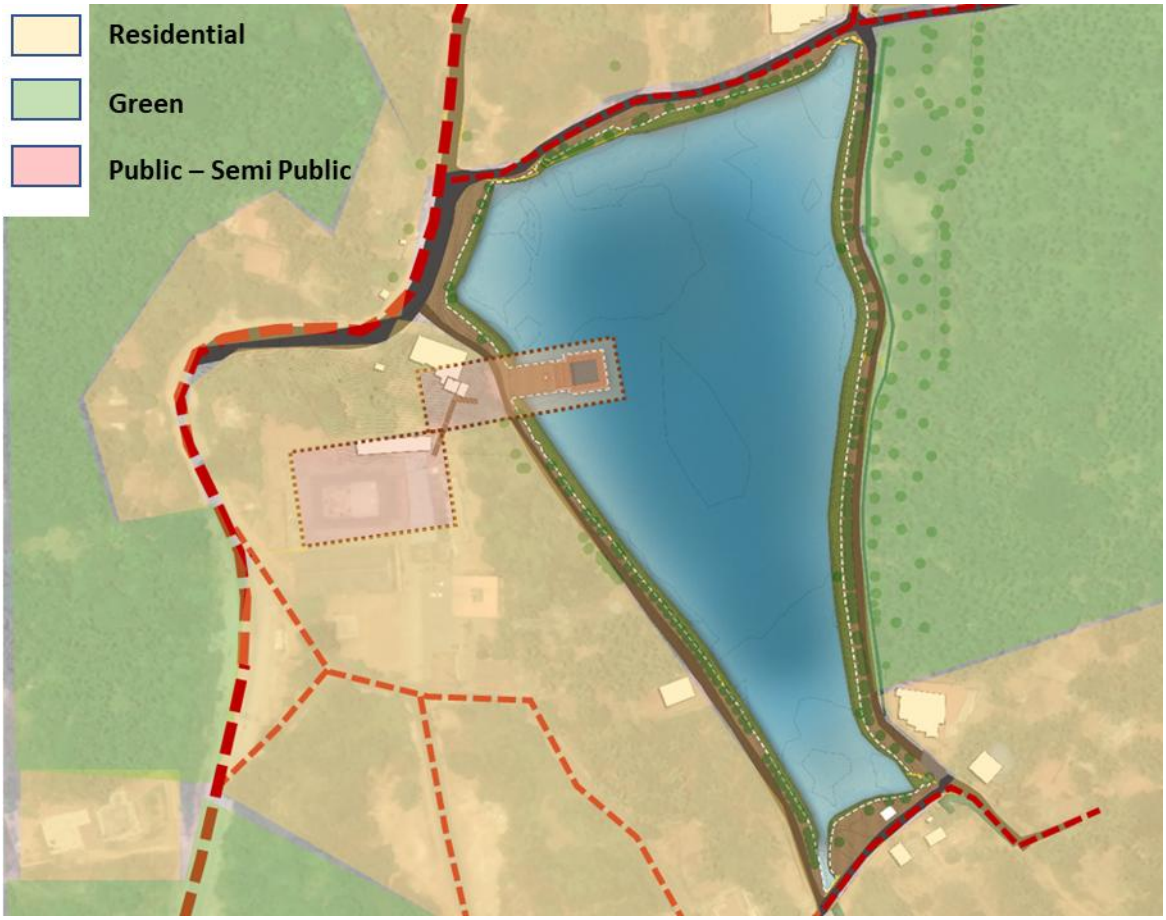
2.5 *Surrounding Land use*

The existing land use shows the principal land use around the lake to be residential. There is a semi dense cover of trees all around. A temple present on the western end forms the place of social interaction among the local people.

On the other hand, as per the proposed land use prescribed in the master plan of 2021, the predominant land use around the lake is residential, with a few pockets of commercial along the approach roads. A patch of public and semi-public space around the site has also been demarcated. It is to be noted that the immediate area surrounding the lake has been demarcated as green as it forms an integral part of the lake ecosystem.

Hence the deviation between the present and proposed land use in and around Kavoor lake is minuscule.

Figure 2-6 Existing land use



Source: Louis Berger Analysis

Figure 2-7 Proposed land use as per Master Plan 2021

Source: Mangalore Master Plan 2021

The existing and proposed land use highlights the importance of the Kavoor lake in the area. Redeveloping it would serve as a recreational area for the people.

With increased percentage allocated for residential land use in the area, the value of the rejuvenated lake in terms of socio-cultural interaction space and as a rain water harvesting reservoir, would substantially increase.

2.6 *Identified Problems & Issues*

The lake being right in the centre of urban development, mainly residential faces a lot of issues as highlighted below:

1. **Eutrophication:** It refers to excessive richness of nutrients in a lake or other body of water, frequently due to run-off from the land, which causes a dense growth of plant life. This results in depleted levels of dissolved oxygen in water leading to a situation where other aquatic life-forms cannot survive. Increased eutrophication in the Kavoor lake has resulted in reduced visual quality of the water body, problems of odor in the water, increased amount of toxins in water and loss in effective surface area and storage capacity of the lake.
2. **Anthropogenic Stress:** Due to intense residential development all around the lake, there is a considerable anthropogenic stress on Kavoor and other nearby lakes. This is further increased due to uncontrolled inflow of dissolved particulate matter. Anthropogenic stress is one of the major causes to which the character of a lake is lost.
3. **Siltation:** Inlet drains to the lake, bring a lot of silt with them and over time this tends to settle down at the lake bottom. Also, there are cases where the surface runoffs bring a considerable amount of silt with them, which ultimately find the same fate. Over time, the depth of the lake reduces, resulting in a reduced water storage volume. The lake which acts as a catchment for the whole region, now holds considerable amount of less runoff water due to reduction in the overall volume.
4. **Improper Management:** This lake, though being a part of a residential locality is neglected upon. Local people and residents are oblivious to the fact, that this lake if properly maintained would improve the social and cultural value of the area. Mismanagement of the premises has resulted in garbage dumping along the edges with uncontrolled inflow of drains.
5. **Lack of lake profiling:** There are several lakes around Mangalore which faces the same issues as the Kavoor lake faces. As different lakes have different characters, problems specific to Kavoor lake needs to be identified first and solutions to those specific issues need to be addressed. This can be achieved through physical and social surveys.
6. **Lack of Government Commitment:** Government institutions lack the knowledge about the importance of the lake in the area and essence of conservation and management, owing to constraints in finances and lack of adequate infrastructure. This is a direct impact of limited or no research on the impact of the lake on the surrounding areas.
7. **Loss of Social & Cultural Belonging:** Kavoor lake used to act as a hub for social and cultural activities. The temple complex towards the north

west of the lake used to be connected to the lake through the now abandoned step well, which added a cultural value. Over the years this has been lost and the functions completely forgotten.

2.7 Rainfall Analysis

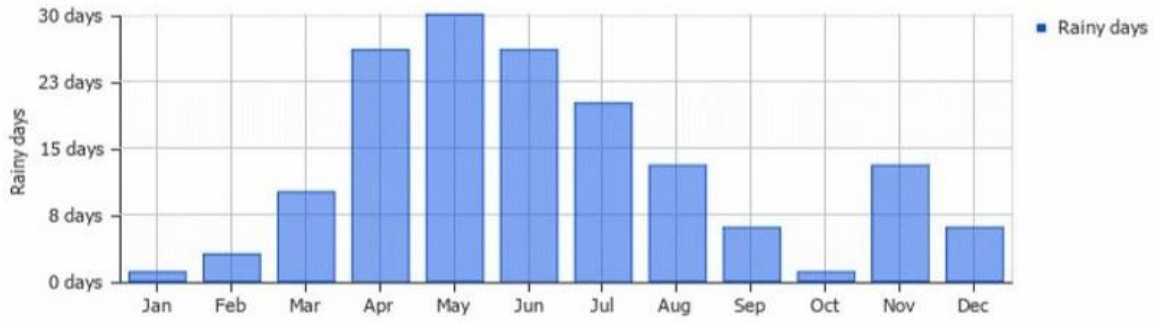
Regions in and around Mangalore witness heavy rainfall in the monsoons (June, July and August), while peak rainfall intensity is maximum in the month of October. The average yearly rainfall over a period of last 36 years come to 3395.2 mm, which is quite high as compared to the neighboring regions.

Table 2-1 Average monthly rainfall from the past 36 years

Jan	Feb	Mar	Apr	May	Jun	July	Aug	Sep	Oct	Nov	Dec	Total
3.2	1.9	12.0	34.3	179.4	943.6	916.8	698.9	291.3	215.6	89.6	8.5	3395.2
Average rainy days in a year (as per above figure)												
2	4	11	26	30	26	20	13	7	2	13	7	**161**
Average daily rainfall												
1.6	0.5	1.1	1.3	6.0	36.3	45.8	53.8	41.6	107.8	6.9	1.2	**21.1**
Average number of hours of rain occurred in a day												
2	2	2	2	3	3	3	3	3	3	2	2	
average peak rainfall intensity per hour												
0.79	0.24	0.55	0.66	1.99	12.10	15.28	17.92	13.87	**35.93**	3.45	0.61	

Source: weatherandclimate.com

Figure 2-8 Average number of rainy days per month



Source: weatherandclimate.com

2.8 Catchment Area Analysis

For the calculation of the catchment area, the water volume through the inlets and outlets have been considered along with the cross section and numbers of the same. The inlet and outlet details present on the site are as follows:

Table 2-2 Inlet and Outlet details, Hydraulic levels & Average lake bound top

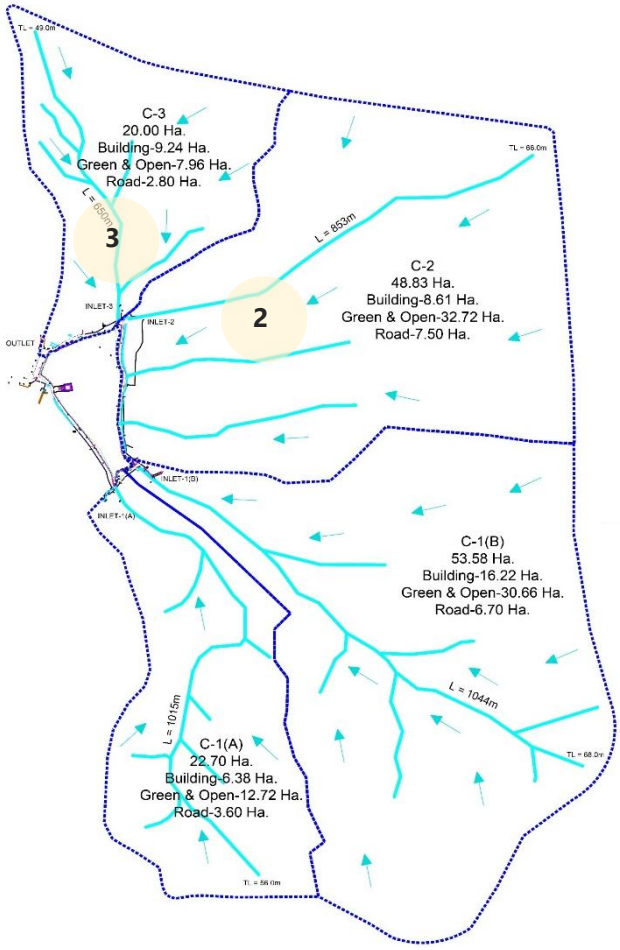
INLET 1A		INLET 1B		INLET 2		INLET 3	
IL	25.750	IL	26.020	IL	25.640	IL	25.480
Type	Box Culvert	Type	Box Culvert	Type	Pipe Culvert	Type	Pipe Culvert

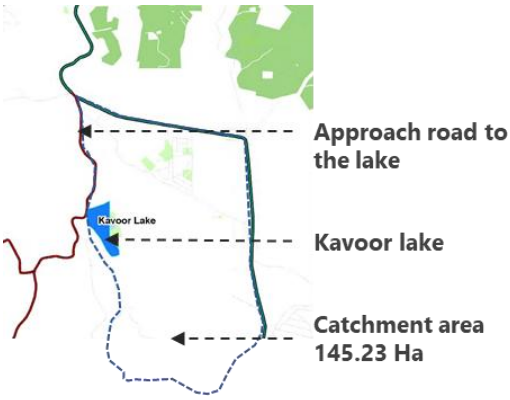
Size	1.8 x 1.88m	Size	2.5 x 1.68m	Size	1.2m dia	Size	1.2m dia
No	1	No	1	No	1	No	1

OUTLET		HYDRAULIC LEVELS OF LAKE		Avg bound top lvl (survey map)	
IL	24.301	Average Bed Level, m		East	27.800
Type	Sluice gate	Outlet IL, m	24.301	West	27.500
Size	3.5 m	Gate height, m	2.0	North	27.800
No	2	Max. Storage Level, m	26.301	South	27.500
		Freeboard, m	0.5		
		Bund level, m	26.801		

Source: Louis Berger Analysis

Figure 2-9 Catchment Area demarcation





The total catchment area of the Kavoor lake is around 145.23 Ha. 1 (A)

The catchment area has been divided into four distinct zones and the following calculation has been done based on these zones. 1 (B)

Source: Louis Berger Analysis

Table 2-3 Time of Concentration

Drain no	Length, m	U/S level, m	D/S level, m	Slope	Ti, m	Tf, m	Tc, m
1A	1008	56.000	25.750	0.030	15	0	15
1B	980	68.000	26.020	0.043	13	0	13
2	892	66.000	25.640	0.045	12	0	12

3	650	49.000	25.480	0.036	10	0	10

Source: Louis Berger Analysis

Table 2-4 Catchment area cumulative data

Catchment No.	Area, ha	Landuse, ha			Impermeability factor		
		Green	Road	Resi/Comm	Green	Road	Resi/Comm
1A	22.70	12.72	3.60	6.38	0.2	0.9	0.65
1B	53.58	30.66	6.70	16.22	0.2	0.9	0.65
2	48.83	32.72	7.50	8.61	0.2	0.9	0.65
3	20.00	7.96	2.80	9.24	0.2	0.9	0.65

Catchment No.	Weighted Average, C	Rainfall Intensity, mm/hr.	Discharge, Cumecs	Inlet location	Road Level, m
1A	0.437	36	0.99	Inlet 1A	27.830
1B	0.424	36	2.27	Inlet 1B	27.900
2	0.387	36	1.89	Inlet 2	27.730
3	0.506	36	1.01	Inlet 3	27.840

Catchment No.	Inlet type	Invert Level, m	Inlet Size, m		Assume velocity, m/s	Design Discharge, Cumecs
			Width	Depth		
1A	Box culvert	25.750	1.80	1.88	1.50	4.54
1B	Box culvert	26.020	2.50	1.68	1.50	5.55
2	Pipe culvert	25.640	1.20	1.20	1.50	1.70
3	Pipe culvert	25.480	1.20	1.20	1.50	1.70

Source: Louis Berger Analysis

2.9 *Lake Elevation Analysis*

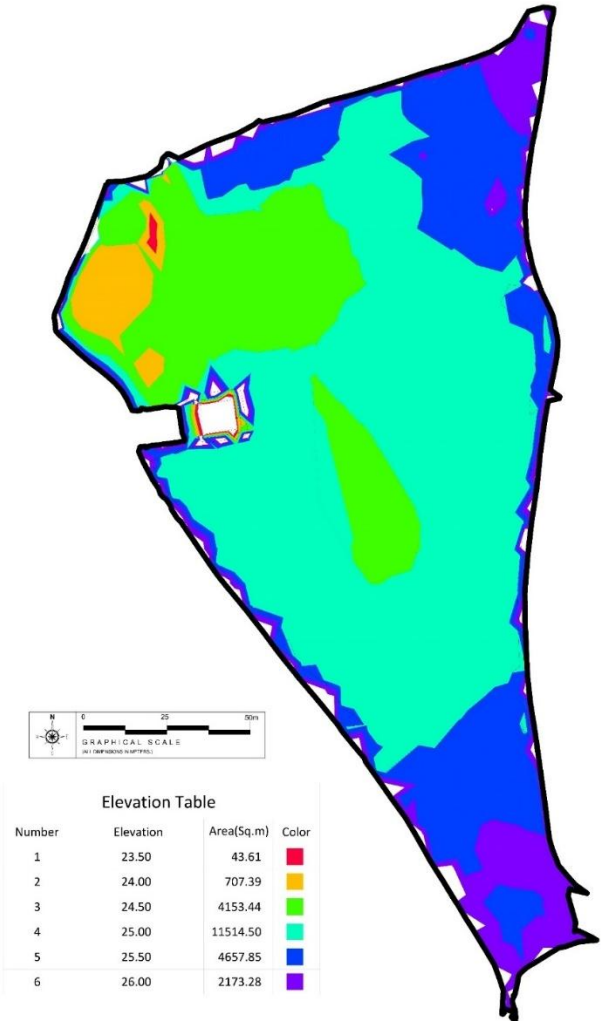
Based on the data collected from the catchment area analysis, total cumulative discharge into the lake is 6.16 cumecs. Considering the various contour levels, the storage value of the lake has been calculated.

Table 2-5 Lake Storage Capacity

Description	contour area		Cumulative. Area	Volume, cum
lake area @ 23.500	43.61	sqm	43.61	
lake area @ 24.000	707.39	sqm	751.00	198.65
lake area @ 24.500	4153.44	sqm	4904.44	1413.86
lake area @ 25.000	11514.5	sqm	16418.94	5330.85
lake area @ 25.500	4657.85	sqm	21076.79	9373.93
lake area @ 26.000	2173.28	sqm	23250.07	11081.72
Storage volume of the lake				**27399.01**
time taken to fill the lake during the peak runoff period			**4444.68 sec**	**74.08 min**

Source: Louis Berger Analysis

Figure 2-10 Lake Elevation with respect to contours



Source: Louis Berger Analysis

3 Statutory and Legal Framework

India has Policies, Acts and Laws in the Water Resources, Environment etc., which is directly or indirectly related to lake rehabilitation and revitalization. The Indian Constitution provides, in clear terms, for the State's commitment to protect the environment. Article 51-A indicates the fundamental right of citizens to protect the natural environment while Article 48-A indicates the State's role to protect and safeguard the same. The Constitution also empowers Urban local bodies with responsibilities to protect lake environments.

3.1 Initiatives by the Central Government

1. **National Lake Conservation Plan:** Ministry of Environment and Forests has been implementing the National Lake Conservation Plan for conservation and management of degraded lakes in urban and semi-urban areas. This has been in place since 2001. The main objectives of NLCP is to help State Governments sustainably manage and conserve lakes to prevent their degradation. The other objectives of NLCP is to restore the water quality and ecology of the lakes in different parts of the country, prevent point and non-point polluting sources, treating the Catchment area, desilting and weed control in and around the lake along with research & Development studies on floral and faunal activities and related ecological aspects.

2. **The Environment Protection Act, 1986 (EPA):** The Environment Protection Act, establishes an inter relationship between water, air and land, and human beings, other living creatures, plants, micro-organism and property; The purpose of the Act is to implement the decisions of the United Nations Conference on the Human Environment. They relate to the protection and improvement of the human environment and the prevention of hazards to human beings, other living creatures, plants and property. Chapter two of the Act describes general powers of Central Government, while section 3 gives the Central Government the power to take action to protect the environment. This Act also gives the government the power to give direction to closure, prohibition or regulation of industry, pollution.

3. **The water (prevention and control of pollution) act; Ministry of Environment and Forests (1974):** This Act provides for the prevention and control of water pollution and the maintenance/ restoration of the wholesomeness of water; and aids in the establishment of a board, which possesses the powers and functions of conducting activities and interventions in the context of prevention and control of water pollution. Sewage and industrial effluent discharges in the water bodies are approved or rejected by the PCBs established under the Water Act.

4. **The water (prevention and control of pollution) cess act; Ministry of Environment and Forests (1977):** The Water Cess Act provides the details for the levy and collection of a cess on water consumed by persons owning certain industries and by local authorities, with a view to augment the resources of the central board and the state boards for the prevention and control of water pollution constituted under The water (prevention and control of pollution) act, 1974. This Act was amended in 2003 with minor modifications to the original act.

5. **National Water Mission - National Action Plan on Climate Change; Ministry of Water Resources (2009,2008):** This comprehensive mission document by the Ministry of Water Resources (MoWR) highlights the objective of the National Water Mission, which is to conserve water through minimizing wastage and ensuring equitable distribution of water across and within states through integrated water resources development and management.

6. **Guidelines for repair, renovation and restoration of water bodies with external assistance and domestic support - Ministry of Water Resources (2009):** These two documents by the Government of India, Ministry of Water Resources (MoWR) provide information and details on the 'Repair, Renovation and Restoration (RRR) of Water Bodies' scheme that has been launched by the Ministry under the state sector, one with domestic budgetary support and the other with external assistance.

3.2 Initiatives by the Karnataka State Government

1. **Karnataka Lake Conservation and Development Authority Act 2014:** Guidelines has been constituted vide Gazette Notification No. SAMVYASHAE 07 SHASANA 2012, Bangalore dated 07.03.2015 for Lake Conservation and Development. The Karnataka Lake Conservation and Development Authority Rules has come into existence on 05.03.2016. As per the Karnataka Lake Conservation and Development Authority Act 2014, the jurisdiction of authority applies to all the lakes in the Karnataka State located within the limits of all Municipal Corporations and Bangalore Development Authority or any other water bodies or lakes notified by the Government from time to time.

   The main aim of the act is to:

   - Restore lakes and wetlands in quality and importance to their pristine status as reflected in the pages of history of the State.
   - To establish a strong system of well linked lakes and tanks free from organic and chemical pollutants, and
   - To intensify official concern and motivate community vigilance to the extent where pollution and encroachment of Lakelands would become impossible.

In Conclusion, there are several applicable policies from both the Central and State Governments which highlight the importance of conservation of lakes and water bodies. These act, policies and laws would act as a guideline in the preparation of concept proposal.

4 Social, Economic & Environmental Impacts

To rejuvenate and conserve a lake, a detailed understanding of the environmental, economic and social impacts is necessary. Several aspects of a lake, in the form of its development over time, change of surrounding land use pattern, watershed area, estimated monetary investments among others must be considered at the time of planning. These can only be understood through a detailed socio-economic and environmental impact study.

4.1 Lake Rejuvenation: Social Impacts

1. **Creation of Social Interaction Spaces:** Rejuvination of a lake, not only results in the improvement of stored water, but also results in the development and beautification of the adjoining land to the lake. Through this development a socially interactive space is created for the neighboring residential community, thereby increasing its social value.
2. **Creation of a Micro Climate:** Proper lake redevelopment results in creation of micro climate in the area. Water present in the lake throughout the year results in a considerable decrease in the temperature in the neighboring area along with creation of local winds, which creates a soothing atmosphere.
3. **Development of Recreational Facilities:** Added design elements in the form of jogging and cycling tracks, open gyms, play area create more value to the space and make it more attractive for the locals. Urban design in and around the lake results in improving the aesthetics and make it more appealing.

4.2 Lake Rejuvination: Economic Impacts

1. **Better property value:** With the rejuvenation of a lake, value of surrounding properties increases, and a better property tax can be estimated on these buildings. This will improve the local tax base.
2. **Entry fee:** In future, we can plan for small amount of entry fee which goes towards the maintenance of the premises.

4.3 Lake Rejuvination: Environmental Impacts

1. **Improved Flora and Fauna:** A water body attracts several species of birds and leads to the growth of different plant species. With the rejuvenation of a lake, one of the first visible effects seen is the spread of flora and fauna.
2. **Rain Water Harvesting:** In places like Karnataka where the summers are harsh with limited rainfall, there are instances of water shortages. To counter this problem, during months of monsoon with high rainfall, the water can be stored within the lake limits and used later. This should be done for all lakes in the region and should be a mandatory practice.
3. **Control of Water Quality:** As a part of redevelopment, all surrounding sewage lines are usually treated to control the flow of sewage into the lake. The water that enters the lake is a part of runoffs, which further gets purified through the soil on the lake bed, resulting in settling down of silt and better quality

5 Benchmarking

5.1 Kankaria Lake, Ahmedabad, Gujarat

The historical Kankaria Lake is situated nearly at the centre of Ahmedabad city. It is having a periphery of about 2.5 Km and has been the symbol of Ahmadabad's identity since almost 500 years. The historic lake around an island garden called Naginawadi has been an evergreen outing place for the people of Ahmedabad. Along with the adjoining Zoo, Aquarium and surrounding hill gardens, it offers a complete entertainment centre. With an expanse of around 4 sq. km of water body, it has acted as the lungs for the south-eastern part of the city.

Figure 5-1 Panoramic View of Kankaria Lake

Source: Ahmedabad Municipal Corporation

BEFORE THE INITIATIVE

Kankaria was visited by hundreds of visitors and was an urban chaos characterized by unclean Ghats, traffic chaos on the 2.4 miles periphery road, unorganized street life including a congested eating area on one corner thriving with street food vendors. The periphery wall was in a dilapidated state, and lake precincts presented somewhat unclean 40 and disorganized environment. Vehicle parking along the periphery walls often blocked the view, and visiting children had a hard time amidst the noise, traffic and resultant chaos. Kankaria had also gained notoriety as a suicide point. The water in the lake was unhygienic due to drainage run offs and dumping of waste.

Figure 5-2 Informal functions & Development before initiative

Source: Re-Envisioning the Indian City: Informality and Temporality

AIM OF THE PROJECT

Initiated by the Ahmedabad Municipal Corporation, the primary objective of the Kankaria Lakefront Development was to transform this city-scale public space with efficient and robust infrastructure. The strategies to implement this transformation included creating complete pedestrian zones encircling the lake's edge, developing an outer ring road by strengthening the existing road network, creating approximately 6 km of access streets as well as new access points to the lakefront, enhancing recreational potential by improving public facilities, preserving historic buildings and encouraging development within the precinct.

Figure 5-3 Master Plan of Kankaria Lake & Development over time

Source: HCP and Google Earth

MAIN PROJECT COMPONENTS

- The development of the lakefront was planned with facilities like food courts, walkways, linear gardens and landscapes and musical fountains.
- The entire lakefront areas have been pedestrianized with access to lakefront area through three entrance plazas and two other entrances.
- A 2.25 km long continuous pedestrian promenade made of grey granite was constructed around the periphery of the lake.
- A 2 m wide bicycle track along the periphery was also added.
- The highlight of the development was provision of a 42 m long mini toy train. The train operates around the periphery giving a joyride.
- Provision was made for creation of a handicrafts market to provide experience of shopping for traditional items of Gujarat to visitors.
- Green space was enhanced by creation of two linear parks 200 m wide one on each side. This provided the open space for recreational activities.
- The project also included construction of new public toilets supported by overhead tanks. Clean water treated by an in-house reverse osmosis plant supplied drinking water to visitors free of cost.

Figure 5-4 Developed Kankaria Lakefront after implementation

ioning the Indian City: Informality and Temporality

PROJECT DURATION & COST

- Project Initiated in: 2006 & Completed in: 2009
- Total Project Cost: Rs. 360 Million

POST REDEVELOPMENT

The lake was transformed into a Complete Entertainment Centre. The response from the citizens was overwhelming. During last one year more than 1.18 crore visitors have enjoyed the ambience of the transformed Kankaria Lake Front. Festivals, small gatherings, educational tours, jogging, informal meetings,

picnics etc. have become new face of Kankaria to attract young generation in a meaningful way. Further, the Lake is emerging as a platform for creative expressions of different communities of artists. As a result of the project, a chaotic spot has been converted into a well-organized recreational zone through a planned and think through approach despite many challenges. Further the project demonstrated a useful model for incorporation of project affected people like the food vendors into the project. Moreover, because of the clean environment, the ecology of the place has attracted many new species of birds.

5.2 *Kaikondrahalli Lake, Karnataka*

Kaikondrahalli lake is located in the south east of Bangalore, on Sarjapur road. The area surrounding the lake has experienced a multifold increase in real estate value in the past decade. Sarjapur road, which runs past one edge of the lake, is congested with traffic, while the lake itself is surrounded by all the dystopic elements of modern Indian cities - malls, apartments, and IT companies along with shanties and tented slums. The lake is around 48 Acres in area.

Figure 5-5 View of Kaikondrahalli Lake

Source: India Water Portal

BEFORE THE REDEVELOPMENT

Older residents around the lake describe a much different landscape. As recently as 2000, the lake was filled with fresh water, surrounded by groves of fruiting trees, and frequented by birds, foxes, and snakes. By 2003 the lake had begun to dry up, with the incoming channels to the lake blocked by construction and the dumping of debris and garbage. By 2007, the lake bed was a slushy malarial bed of sewage and waste. Over the years the lake started to be used for an eclectic mix of undesirable activities and misuse of the ecology and environment around.

Figure 5-6 View of dried up Kaikondrahalli Lake


Source: Lake Restoration: Two successful Models, NITI Aayog

Various problems faced by this lake over the years are:

- Severe Inflow of sewage
- Silting and settled deposits
- Dumping of debris
- Land formation owing to eutrophication
- Encroachments

REDEVELOPMENT PROCESS

The BBMP used a phased approach for lake restoration, primarily because it did not have access to adequate funds to begin with.

Phase I, which lasted from December 2009 to March 2011, underwent the following steps:

- The process began with demarcation of the lake's boundaries to stop any encroachment. The mapping was done in coordination with the revenue department, which is the custodian of land records.
- Lake encroachers were then served notice and ultimately evicted.
- With the lake administratively secured and cleared of encroachments, the next step was to stop pollution. As the inflow of sewage was a major reason for the lake's degradation, the inflow was diverted through a pipeline.
- The next step was aimed at de-silting of the lake. The unruly vegetation growth in the lake was cleared before de-weeding and de-silting of the lakebed. These efforts increased the lake's depth by an additional meter and increased its storage capacity from 1,85,000 Cum. to 2,85,000 Cum and increased tank depth from 1.5m to 2.5m.

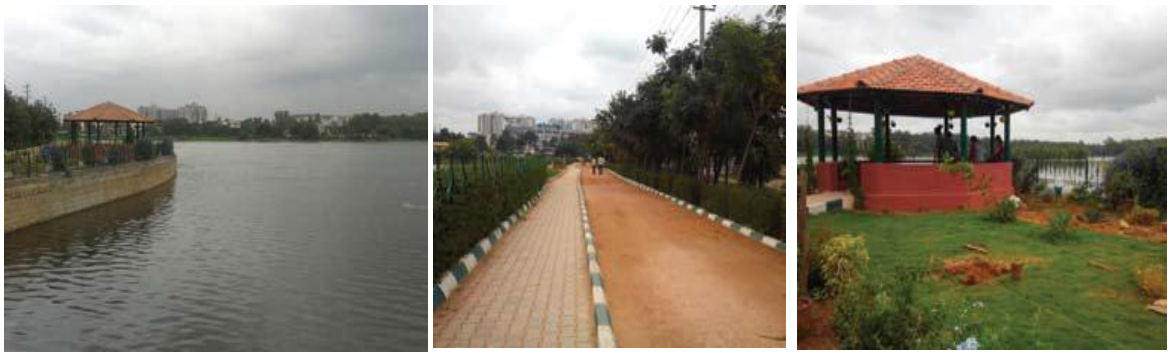
In Phase II, which lasted from September 2011 to March 2012, the following steps were followed:

- a fence was constructed around the lake to demarcate the boundary.
- Thereafter, the lake periphery was afforested to improve water quality and prevent soil erosion.
- As the dumping of items such as flowers and idols during religious festivals was also a major source of pollution in the lake, separate ponds

were constructed for these activities, enabling citizens to continue with their cultural and religious practices without harming the lake.

Kaikondrahalli was then developed into an aesthetic and recreational urban space, with facilities like walking/ jogging pathway around the lake perimeter, a 2.5-km cycling track, an amphitheater for cultural performances, and pergolas and toilets.

Figure 5-7 Developed Kaikondrahalli Lakefront after implementation



Source: Lake Restoration: Two successful Models, NITI Aayog

PROJECT DURATION & COST

- Project Initiated in: 2009 & Completed in: 2012
- Total Project Cost: Rs. 7.5 Crores

POST REDEVELOPMENT

Post redevelopment, the lake has become an urban recreational space which is frequented by people. In the case of Kaikondrahalli, the local community is enjoying the new facilities, evident from the approximately 1,200 visitors the lake site receives every day. Also, the local ecology has been revived and this attract a large variety of birds including pelicans, ducks, black cormorants and many others. Moreover, to maintain the lake in the present form, there is constant coordination between PWD, Pollution Control Board and the local government to control the incoming of pollutants into the lake.

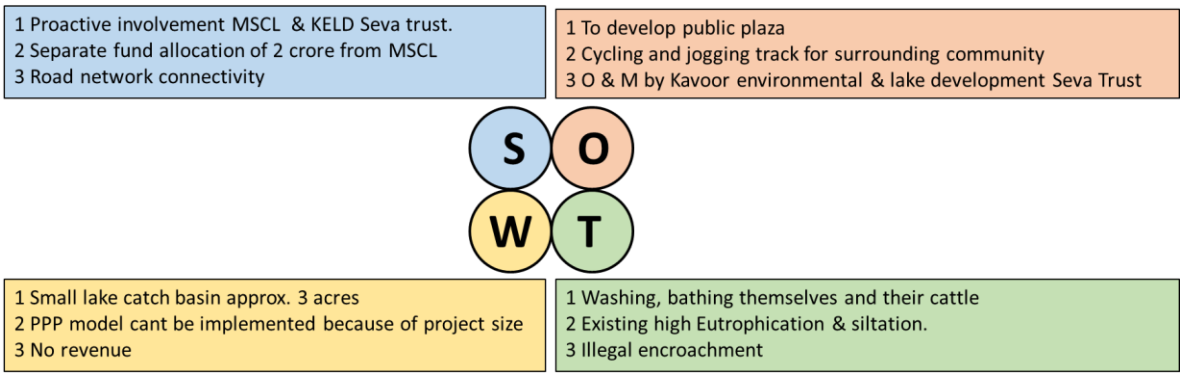
6 Concept Plan for Kavoor Lake

6.1 Vision and Goal

The vision of the development is to revitalize the Kavoor Lake and give the city of Mangalore an open public space that is cherished by the community. The objective is to re-invigorate the space, improve the water quality, provide easy access and circulation while adding a plethora of public programs that add to the usability of the space.

The lake is envisioned to be self-sustainable that adds to the idea of creating healthy communities within our city.

6.2 SWOT: Analysis for taking up lake conservation DPR.



Source: Louis Berger Analysis

The observations from the SWOT analysis has been taken into account for the creation of the proposed redevelopment plan.

6.3 Design Basis: Potential spaces

The site is approached through major roads in the north west, while a secondary road is present towards the north and south. The areas with high potential for integration with the concept design include the existing step well, the temple complex in the vicinity, and the residential community around the lake.

The concept design proposes an urban plaza to give an experience of arrival to visitors, provides a defined access between the existing temple complex and the lakefront. The development will include addition of public facilities for an enhanced visitor experience.

The proposed urban plaza is designed to enhance the entrance, to provide public utilities like toilet block, parking, eatery joints etc. The proposed temple plaza design aims to connect the temple complex with the kund (stepwell) and the kund can be used for puja offerings. The proposed temple plaza space spans to 175 Sq.m. to be used to perform temple rituals and events by the community.

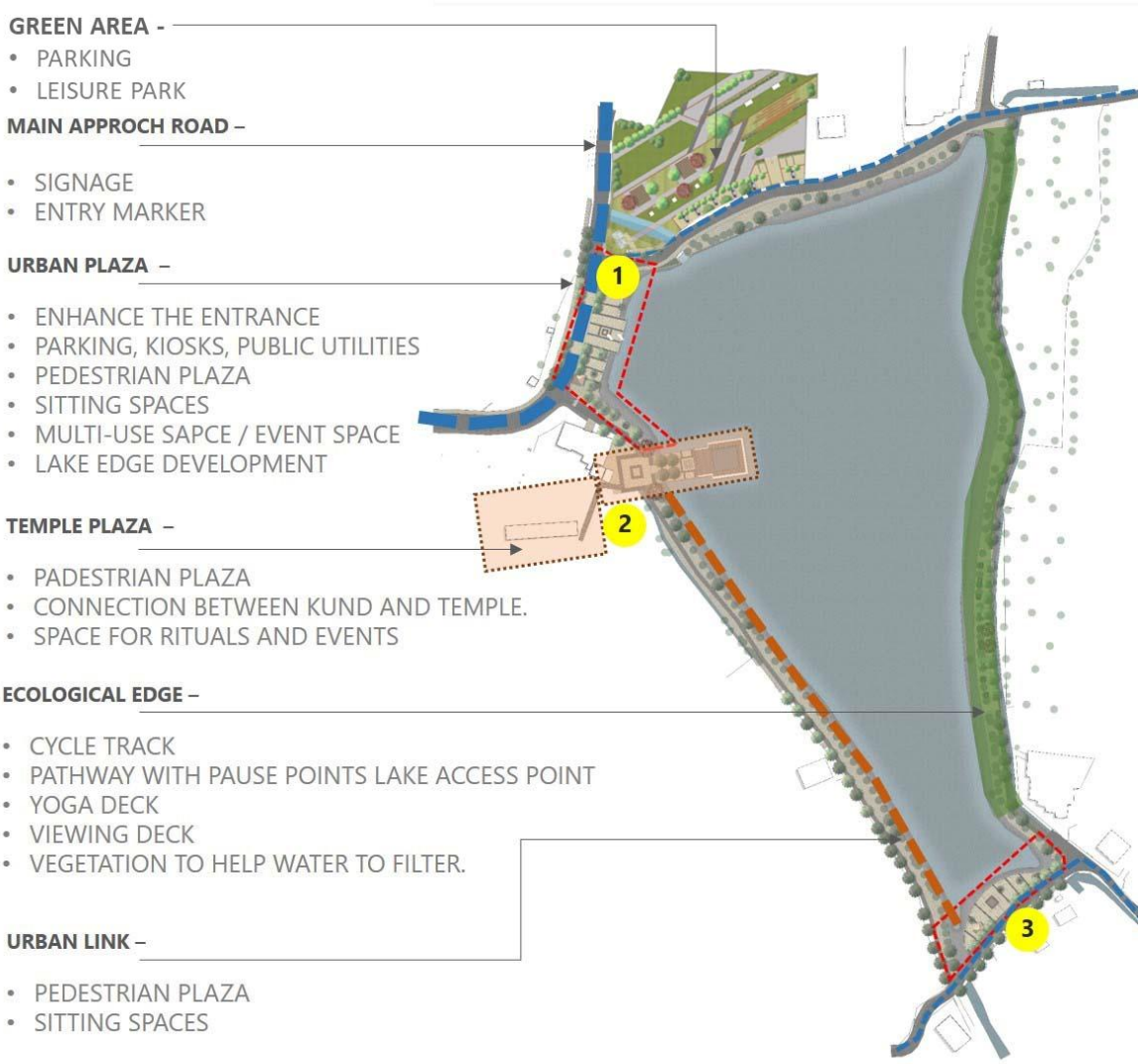
A continuous cycle and walking track will outline the entire perimeter of the lake for improved access. As part of the concept to draw in the community and

inculcate the sense of ownership of the park, we aim to add a program that includes yoga deck, open gymnasium and playgrounds that can be used by demographics of all ages. These designed spaces shall be flexible in nature, wherein the type of use can vary with times of the day as well as with varying seasons of the year.

A parcel of undulating land towards the northern edge of the lake lies unused. This space is under the jurisdiction of the Kavoor Seva Trust and has been considered in the design and made into a leisure park. This space will be used by the people for recreational purposes.

The overall design concept focusses on improving the accessibility and to reinvigorate this space that can draw the community towards it, along with focusing towards motivating the community to care and take onus of maintaining the lake. The addition of a larger variety of programs will aim to make the lake an integral part of the community's routine. Consequently, Kavoor lake will have the potential to become a model community project that catalyzes similar open public spaces in all communities around the city of Mangalore.

Figure 6-1 Potential spaces and Concept



Source: Louis Berger Analysis

6.4 *Design Components for Layout Plan*

The major components of the design incorporated in the layout plan may be summarized as follows:

- Urban plaza: A space created for public interaction.
- Kiosks: Designed for food and beverage facilities for users.
- Toilet and Drinking water block: As a part of public convenience facilities.
- Cycle track: To reduce vehicular movement around the lake.
- Pedestrian plaza: As a part of the urban plaza, for unobstructed walking.

Using the SWOT analysis as the base, two master plans have been proposed for redeveloping and rejuvenating Kavoor lake. Option 01 only covers the immediate area surrounding the lake, while option 02 takes into consideration the patch of land towards the north of the lake

6.5 Master plan: Option 01

Option 01 of the Masterplan will focus on the following main points:

- improving the condition of the main & secondary vehicular approach road
- introduction of urban plaza with utility block that houses public facilities (toilets, drinking water) at the entrance in the northwest side of the lake
- another urban plaza in the south of the lakefront that can be another place for visitors to pause their journey along the perimeter and look out towards the lake
- creation of a temple plaza that connects the stepwell/ kund to the temple complex visitors
- kiosk that provides food and beverage options
- continuous pedestrian plaza & a cycle track along the perimeter of the lake

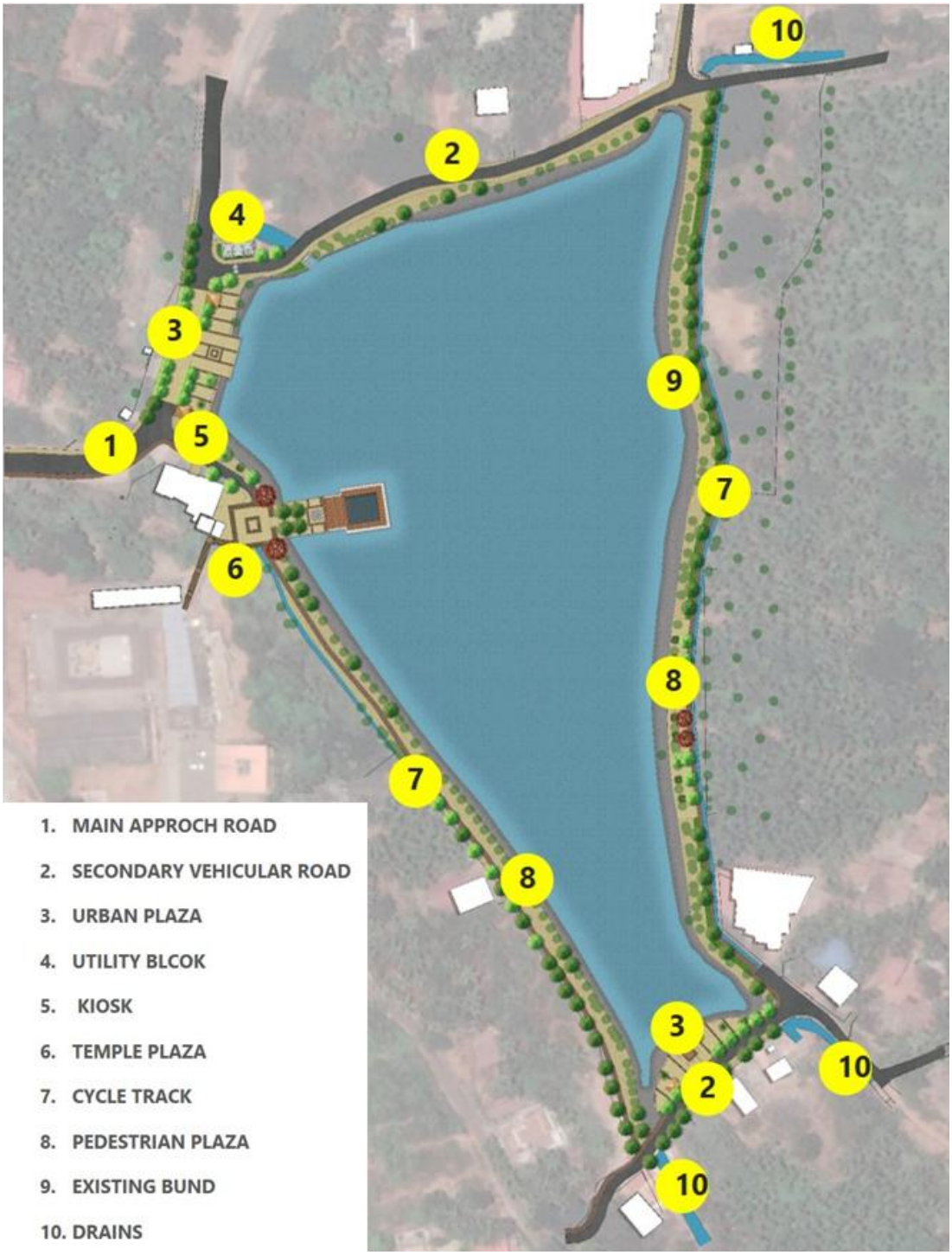
6.5.1 Key Design Features

Following are the major design features of Project

- Cycle and jogging track – Total length 588 meter
- Public Plaza with varying width – Total length 833 meter
- Cantilever projected 13-meter-wide viewing deck.
- Screen barrier & silt trap at inlet.
- Modernization/upgradation of exiting sluice gate at outlet.
- Enhancement of existing step well.
- Seating & recreational area.
- Male & Female toilet blocks.
- Railing provide to define lake periphery and access.
- Temple plaza near approach staircases & well.

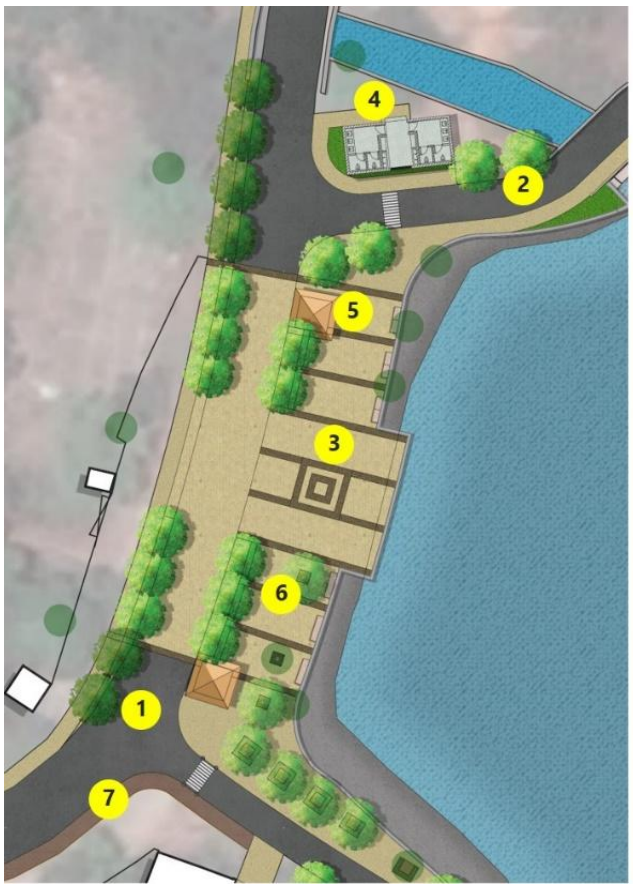
6.5.2 Master Plan

Figure 6-2 Proposed Master Plan: Option 1

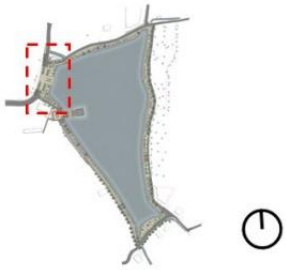


Source: Louis Berger Analysis

Figure 6-3 Detailed Entrance Urban Plaza Part Plan

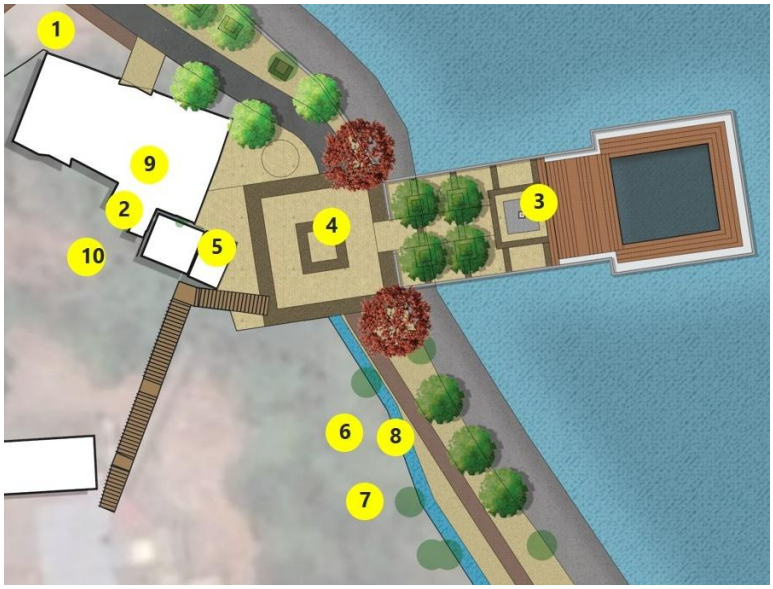


1. MAIN APPROCH ROAD
2. SECONDARY VEHICULAR ROAD
3. URBAN PLAZA
4. UTILITY BLCOK
5. KIOSK
6. BENCHES AND SITTING SPACES
7. CYCLE TRACK

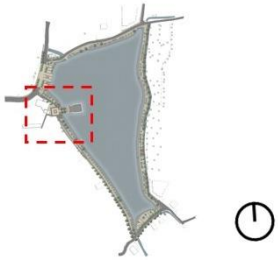


Source: Louis Berger Analysis

Figure 6-4 Detailed Temple Plaza Part Plan



1. SECONDARY VEHICULAR ROAD
2. TEMPLE PLAZA
3. KUND
4. SITTING SPACES
5. SPACE FOR EVENTS (175 SQ.M.)
6. PEDESTRIAN PLAZA
7. CYCLE TRACK
8. EXISTING BUND
9. EXISTING WELL
10. EXISTING TEMPLE STRUCTURE



Source: Louis Berger Analysis

Figure 6-5 Detailed Urban Plaza (South) Part Plan

Source: Louis Berger Analysis

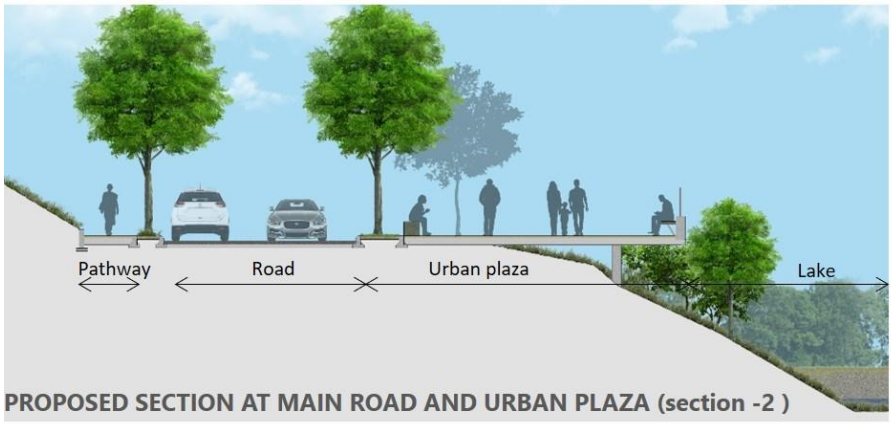
The existing edges of the lake are mostly softscape with overgrown weeds and vegetation at the edge. The plan proposes transition of the edges based on the programmatic use adjacent to the lake. At locations, while walking along the perimeter, the visitor will experience either a cantilevered lookout plaza, or a bulkhead promenade or a softscape transition from the pathway to the lake.

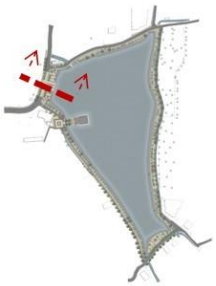
For instance, at the lakefront section along the main road, where the urban plaza is proposed, besides retaining the existing carriageway of two lanes, proper pedestrian path on either side of the carriageway are required. The pedestrian path will be separated from the carriageway through a softscape buffer zone with planters and trees. The pedestrian path on the side of the lake, will transition into a paved plaza, with cordoned edges (by railing) that will provide a lookout into the lake for the visitors.

The proposed design also incorporates the kund along with the rejuvenation of the existing well. At regular intervals, smaller plazas have been created, the spaces of which has been made interesting through the application of various urban design and landscaping techniques. Utility areas, event spaces and kiosks have been placed to make the spaces more interactive.

6.5.3 Sections

Figure 6-6 Existing and Proposed Sections along the main road

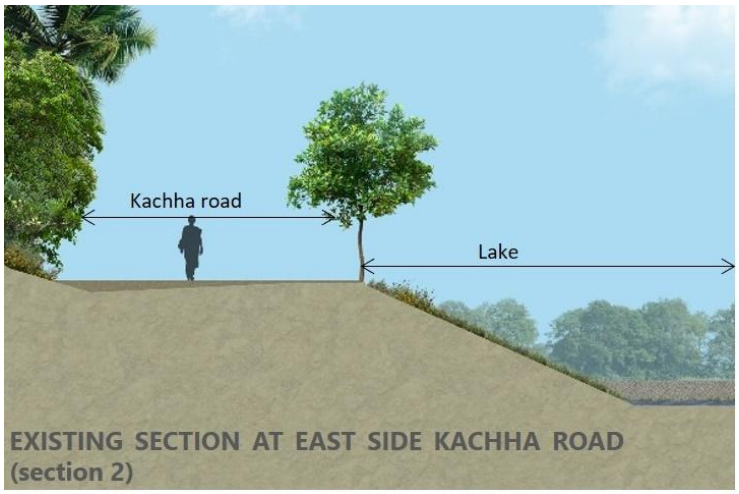




Source: Louis Berger Analysis

Along the east side of the lake, a proper channeling of the existing drain is required. A pedestrian track is segregated from the cycling track at this side of the lake by a green buffer zone. This provides safety with regards to the development being in a residential area.

Figure 6-7 Existing and Proposed Sections along the east side of lake



Source: Louis Berger Analysis

The 14m wide temple plaza adjacent to the steps (that take the visitors to the temple top), becomes the lakefront edge at this point. Seating areas and benches with adequate signage will be provided in the plaza. The plaza is segregated from the pedestrian and cycling track by a green buffer zone. It is proposed to restore the step-well / kund as part of the development at this edge.

Figure 6-8 Sections along the stepwell

Source: Louis Berger Analysis

The existing stepwell is revamped through the creation of a temple plaza, along with a dedicated sitting area. The kund is also redeveloped to create a socially viable space.

6.6 Master Plan: Option 02

Option 02 of the Master plan covers all the aspects as highlighted in the first option of the master plan. The only addendum is an area towards the northern front of the lake. This area has been proposed as a leisure park with urban design and landscaping elements. This park will be located just by the entry from the main road and will provide visual recreational support to the redeveloped lake.

Option 02 of the Masterplan will focus on the following main points:

- improving the condition of the main & secondary vehicular approach road
- introduction of urban plaza with utility block that houses public facilities (toilets, drinking water) at the entrance in the northwest side of the lake
- another urban plaza in the south of the lakefront that can be another place for visitors to pause their journey along the perimeter and look out towards the lake
- creation of a temple plaza that connects the stepwell/ kund to the temple complex visitors
- kiosk that provides food and beverage options
- continuous pedestrian plaza & a cycle track along the perimeter of the lake
- the leisure park in created in 0.87 acres land.
- Carving the usable spaces in 1:9 slope by considering feasibility of tow walls, equal ration of cutting and filling and work out the drainage.
- The park is not designed with barrier free ramps as the land terrain is steep.
- Designed is work with steep terrain to create the terrace landscape park in the direction of the contours.
- The spaces are carved are - spaces for elderly people at lower level, public conveniences, seating areas, toddlers park with EPDM flooring, play zones for 5 to 12 years and 12 to 18 years at higher levels and
- The leisure park is connected to the lake visually as well as physically.

6.6.1 Key Design Features

The major components of the design may be summarized as follows:

- Urban plaza with kiosks: A space created for public interaction.
- 18 Parking spaces provided for four wheelers
- Toilet and Drinking water block: As a part of public convenience facilities
- Continuous Cycle track overlapping with pedestrian plaza area
- Providing and Installation of Rain Gauge, Evaporimeter Notch Staff (at Inlet and Outlet) as per specification of irrigation department
- Silt traps proposed at the inlets

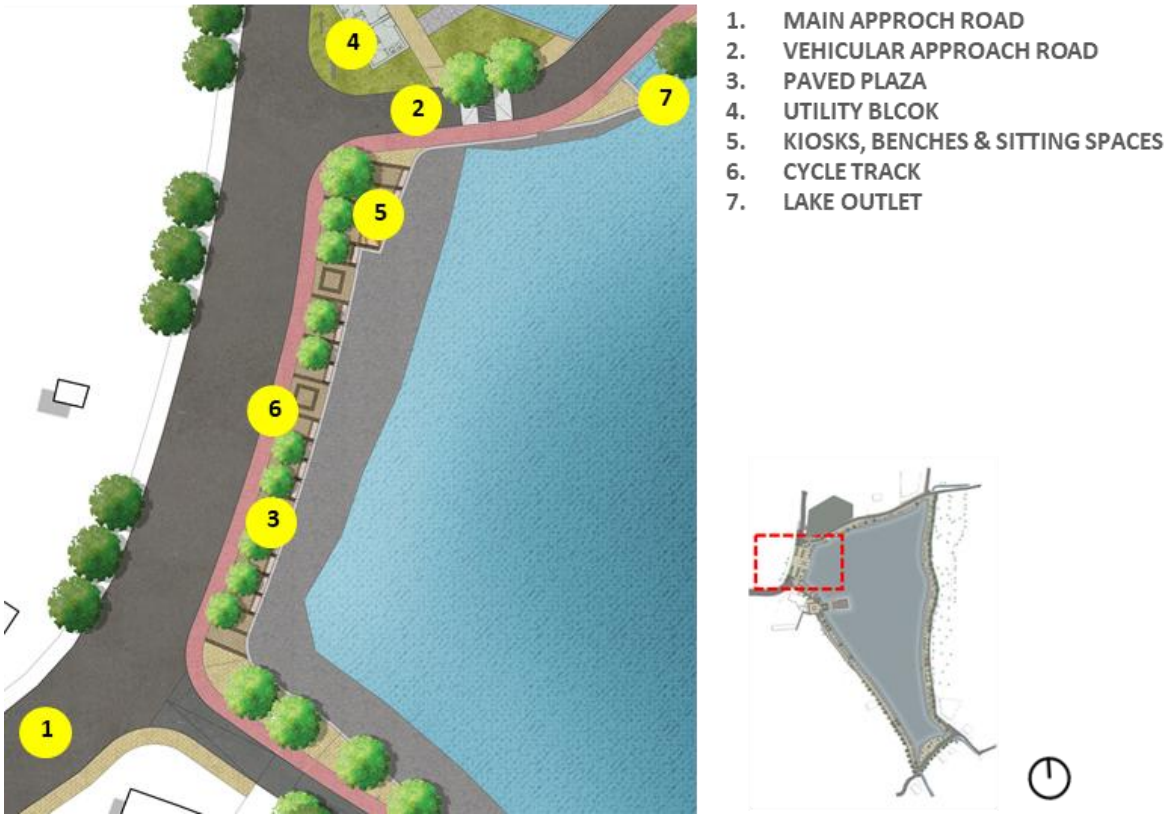
- Chain link fencing proposed all around to make the lake access controlled and prevent acess to the lake from all points.
- Boundary walls provided to separate the lake from private properties.

6.6.2 Master Plan

Figure 6-9 Proposed Master Plan: Option 2

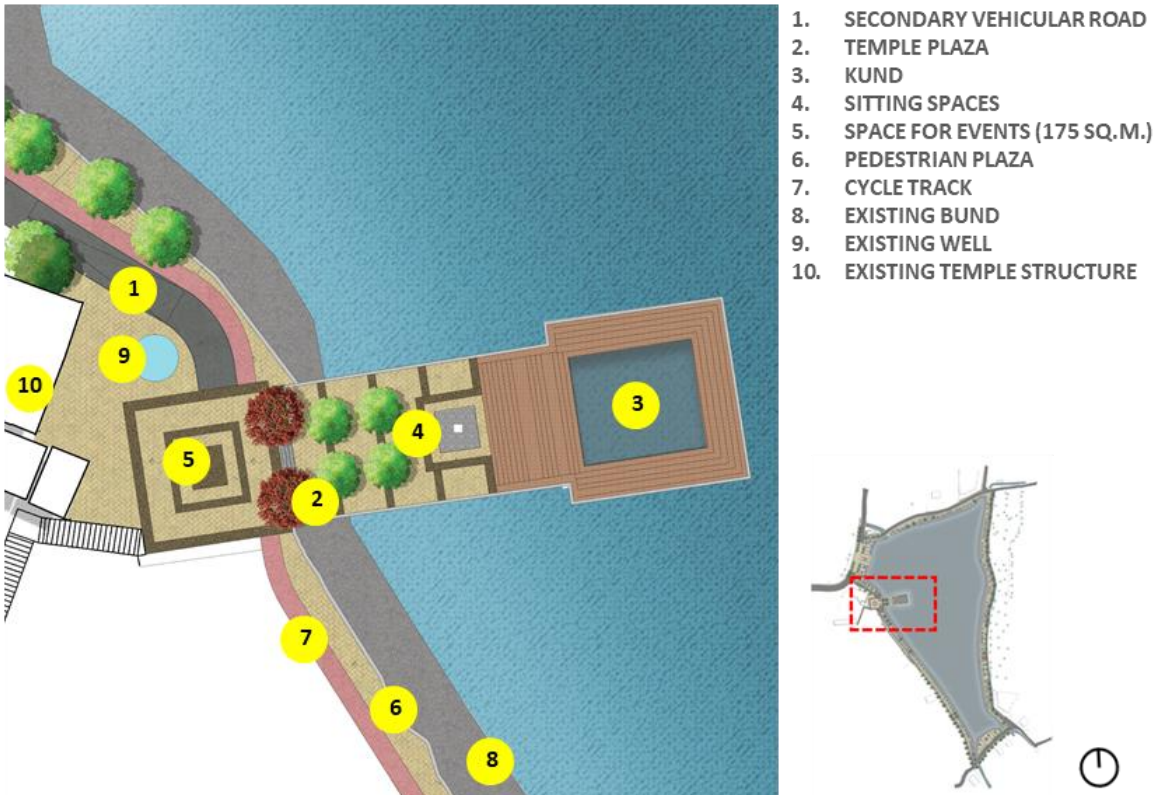
Source: Louis Berger Analysis

Figure 6-10 Option 02: Detailed Entrance Paved Plaza (West) Part Plan



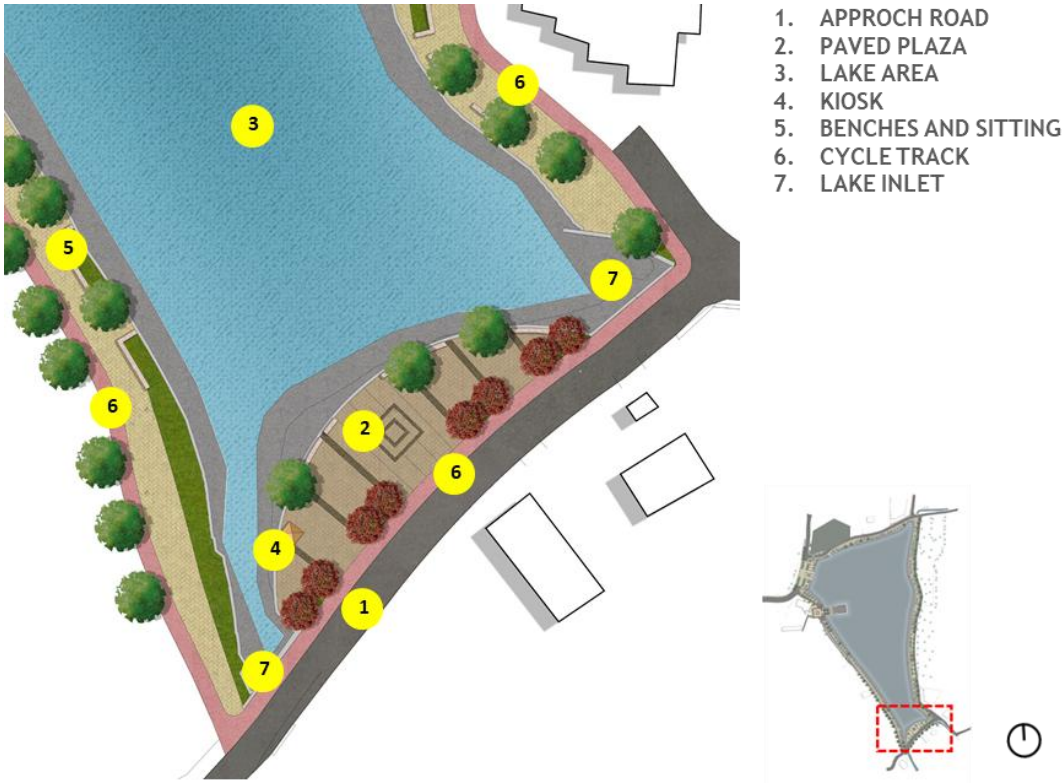
Source: Louis Berger Analysis

Figure 6-11 Option 02: Detailed Temple Plaza Part Plan



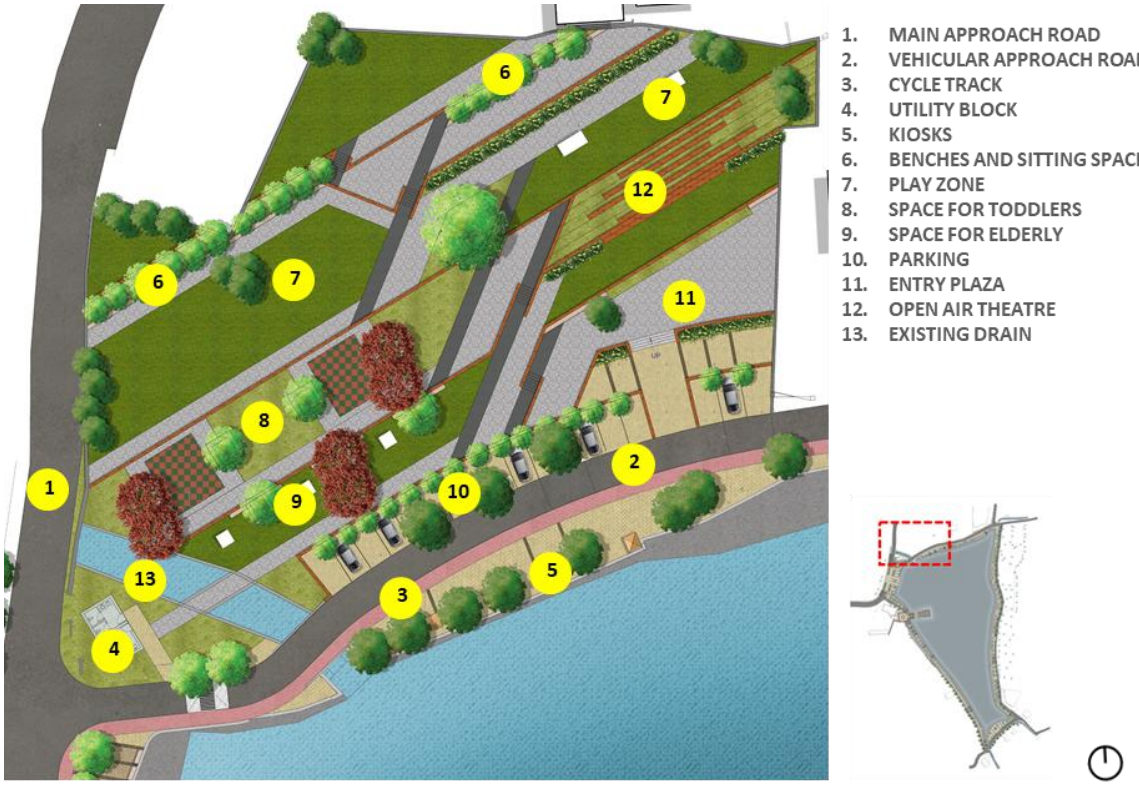
Source: Louis Berger Analysis

Figure 6-12 Option 02: Detailed Paved Plaza (South) Part Plan



Source: Louis Berger Analysis

Figure 6-13 Option 02: Detailed Plan of Leisure Park



Source: Louis Berger Analysis

The plan as proposed in the second option is very similar to what is proposed in the first option. The major difference being the modification of the paved plaza areas along with the continuous layout of the bicycle track, all along the perimeter of the lake. Another major addition is the area on the northern part of the lake, on which a leisure park is proposed. This will be used by the locals for their recreation and as a space for social interaction. Along the road, just bordering this leisure park boundary, parking for 18 cars have been provided. Though defined parking space is absent at present, it is expected that after the redevelopment, the number of cars stopping at this location will increase. Hence these parking bays have been provided.

The inlets and the outlets have been left as it is and is same as compared to the first option. To point out the similarities, the kund area will be developed on similar lines, as already proposed. The area around the lake will be protected by embankments and will be used as a pedestrian plaza. Siting areas and benches have been designed. This will make the spaces around more interesting.

6.6.3 Sections

The following sections are the proposed ones developed as a part of the second option.

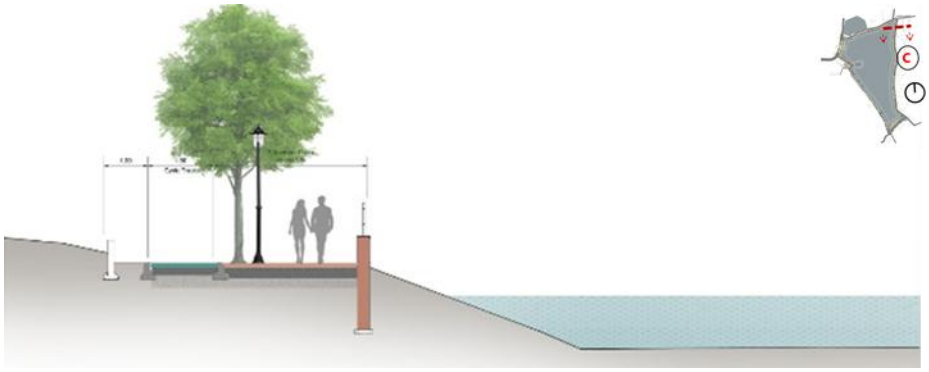
Figure 6-14 Option 02: Proposed section through west paved plaza

Source: Louis Berger Analysis

Figure 6-15 Option 02: Proposed section near north east inlet (north periphery)

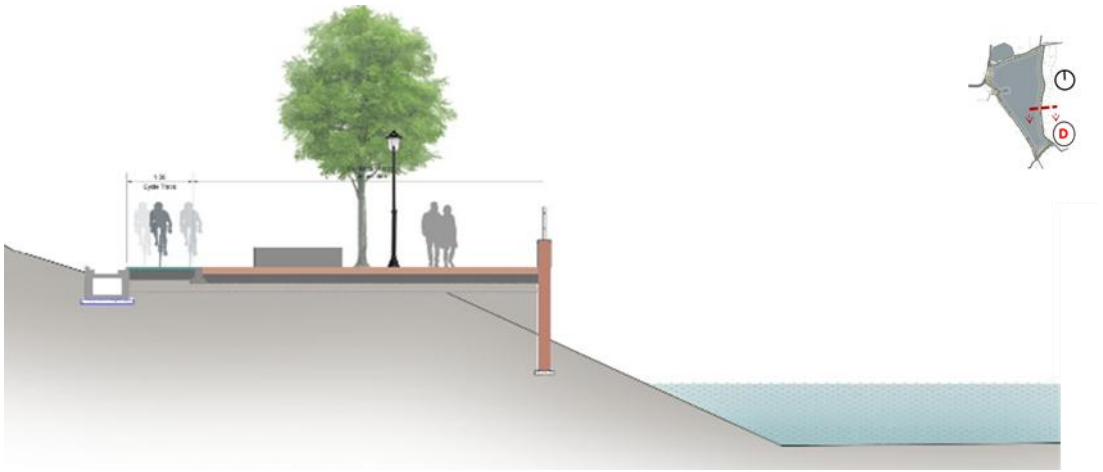
Source: Louis Berger Analysis

Figure 6-16 Option 02: Proposed section near north east inlet (east periphery)



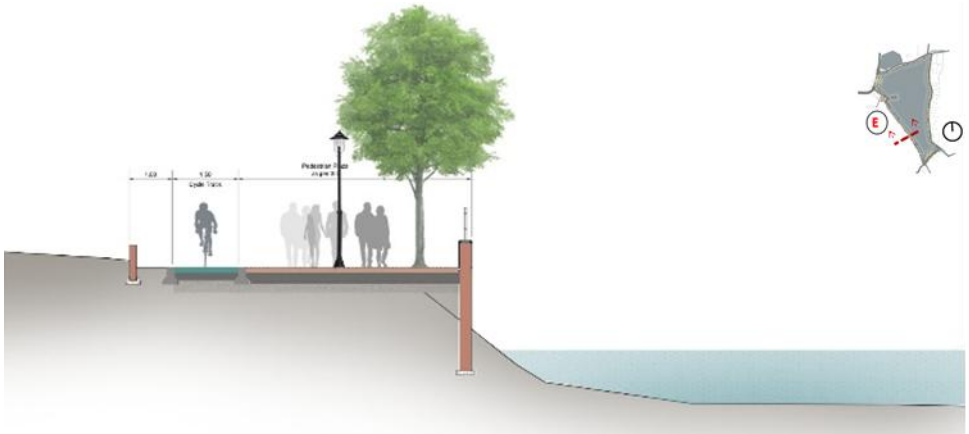
Source: Louis Berger Analysis

Figure 6-17 Option 02: Proposed section near south east inlet (east periphery)



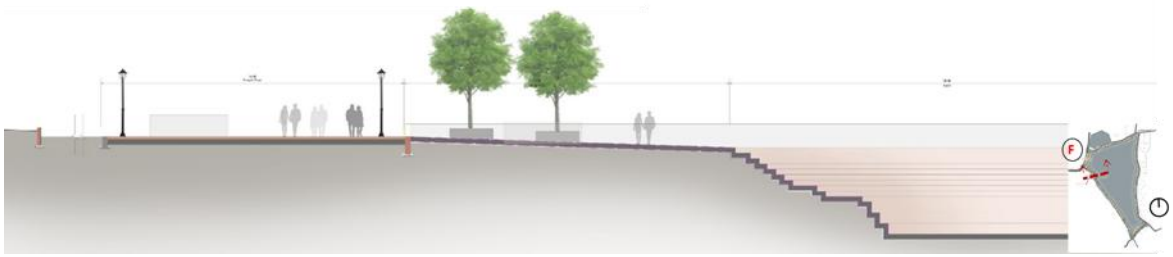
Source: Louis Berger Analysis

Figure 6-18 Option 02: Proposed section near south west inlet (west periphery)



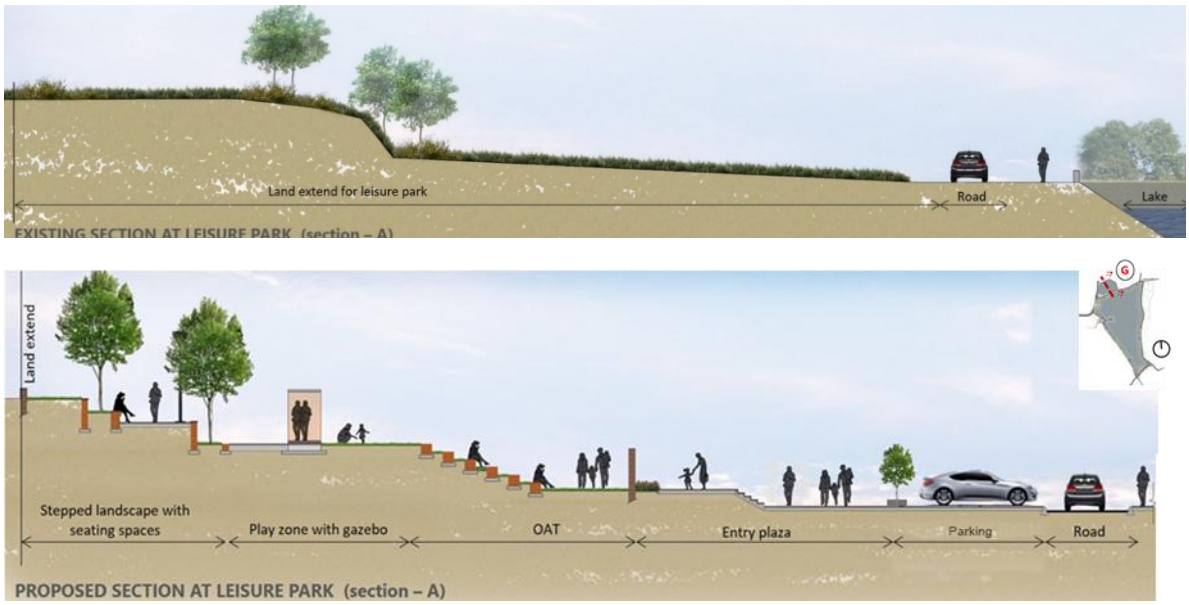
Source: Louis Berger Analysis

Figure 6-19 Option 02: Proposed section through kund and stepwell



Source: Louis Berger Analysis

Figure 6-20 Option 02: Existing and Proposed Section along Leisure Park



Source: Louis Berger Analysis

As shown in the sections, the space around the lake will be redeveloped with facilities for the people to use it for recreational purposes. As visualized from the above section, the topography of the land where the leisure park is proposed has a considerable elevation. To make the best use of this space, the design has been done taking the contours into consideration. The existing level difference allows to place an open-air theatre along with an elaborate entry plaza. Recreational spaces with essential landscaping elements have been laid out to convert this unused space into a vibrant recreational area.

6.7 *Landscaping*

As a part of the landscaping, local species of trees and shrubs have been proposed in the design. These plants are native and can withstand the natural elements, which is prevalent in the region. A combination of large, medium and small sized trees have been used along with a wide variety of shrubs and grasses. The list of plants is highlighted in the table below:

Table 6-1 List of plants proposed in the design

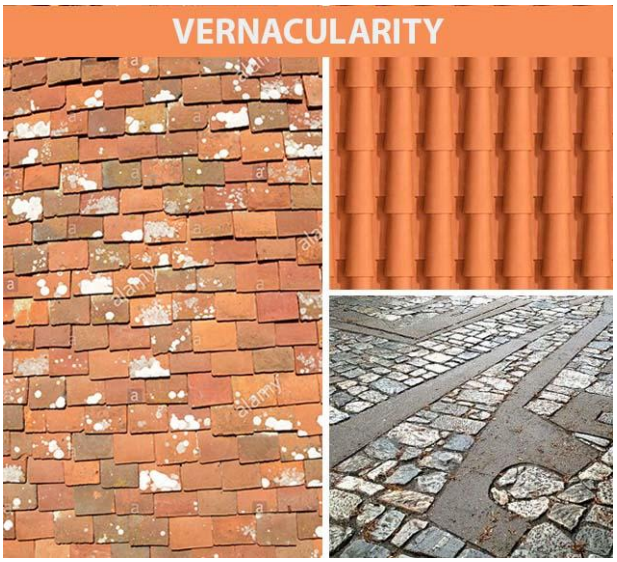
PROPOSED TREES	PROPOSED GRASSES	PROPOSED SHRUBS
Mimusops elengi	selection one grass	Golden duranta
Schleichera oleosa	Stanotaphrum secandatum	Hamelia patens
Cassia fistula		Tabernaemontana coronaria dwarf
Delonix regia		Plumbago capensis
Jacaramda mimosifolia		Bougainvillea

Source: Louis Berger Analysis

6.8 *Materiality and Streetscape*

Mangalore city in its history boasts of a thriving tile industry. The 'Mangalore tiles' earlier in time were used throughout the country by the building construction industry. Locally sourced laterite stone block was another popular construction material in the city and adjoining areas because of the strength, hardness and resistance to moisture. Lime plaster finish was also locally sourced and was abundant.

Figure 6-21 Vernacularity



Source: Louis Berger Analysis

But with the passage of time, the usability of these local materials has reduced, and it is important for us to remind the community of the rich architectural language native to Mangalore.

Material selection for the Kavoor lakefront streetscape that includes but is not limited to seating areas, paved areas, pathways, plant enclosures, railing, lighting, bollards, signage, garbage bins will be done in a responsible manner that respects the context of the city and our climate. The design materials besides playing a key role in the aesthetics, also significantly participate in the socio-cultural and climatic impact of the design.

As designers, we will choose all materials based on:

Availability	Economic Value
Durability	Sustainability

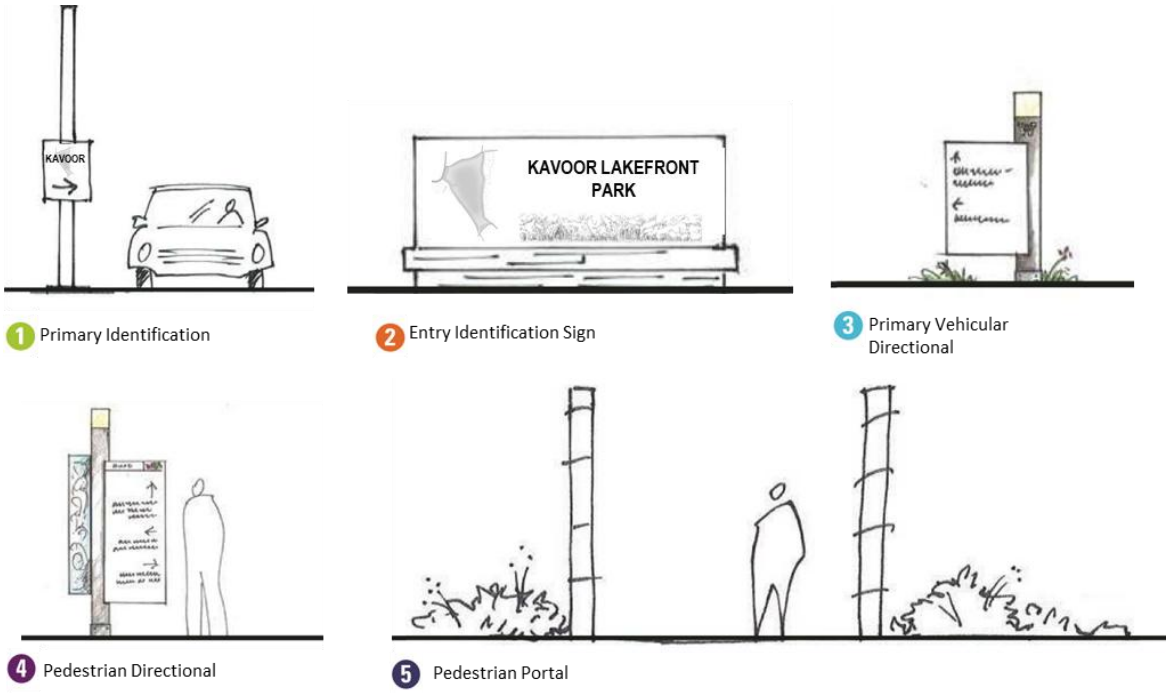
6.9 *Wayfinding and Signage*

Signage is one of the key factors in curating a great experience for all visitors. Besides the inherent use of providing necessary orienting and wayfinding information, Signage in Kavoor Lakefront development will also be employed towards:

- Building a strong vision for the community
- Attracting more visitors
- Inculcating pride and responsibility within the community
- Increasing the visibility of development

There are primarily four categories of signage – Signage for Identification, Signage for Direction, Signage for Information and Signage for Regulation. Signage for Identification will exist on the approach road in the northwestern side of the lake. An entry identification sign will be right at the entrance of the plaza zone of the lakefront. Vehicular and pedestrian directional signages (indicating suggested movement path, direction and various visitor facilities) will be required throughout the perimeter walking track along the lake. Informational signage will be designed and provided at specific points of interest created along the lake. Regulatory signage guiding visitor behavior and points of prohibition/safety will be at critical locations along the lakefront.

Figure 6-22 Forms of Wayfinding & Signage



Source: Louis Berger Analysis

Figure 6-23 Signage Instances

Source: Louis Berger Analysis

6.10 Silt Trap Design

6.10.1 Key Principles

- The key objective is to collect sediment in a location where it can be easily and permanently removed from the flow path. If however, sediment is allowed to settle within the stormwater pipe, then there is the high risk that a significant proportion of this sediment will be resuspended and washed through the outlet sediment trap during the pipe de-silting exercise.
- The key design features are usually the surface area of the settling pond, and the distance of separation of the settling pond from the stormwater outlet. This separation helps to minimize the effects of outlet 'jetting' and reduces sediment re-suspension.
- Sediment collection is primarily achieved through gravity-induced `sedimentation'; however, the process can be improved by incorporating a filtration system such as a Filter Tube Dam or Rock Filter Dam.
- The key operation issues include the appropriate management of all safety issues associated with the settling pond; and the regular de-silting of the sediment trap to minimize the risk of sediment re-suspension by subsequent storms.

6.10.2 Design Information

The design of stormwater outlet sediment traps primarily depends on the available land space and landfall that exists immediately downstream of the

outlet. In situations where land space is limited, then best use should always be made of the available land area to maximize sediment trapping potential.

If the stormwater pipe discharges into an outlet channel with very little fall, then the sediment trap will normally consist of an Excavated Sediment Trap. In circumstances where the stormwater pipe discharges at least 300mm above the receiving discharge channel, a Coarse Sediment Trap, and/or Filter Tube Dam can be incorporated into the sediment trap to improve the sediment capture process.

In circumstances where the stormwater pipe discharges at least 500mm above the receiving discharge channel, then in addition to the above options, a Rock Check Dam or Rock Filter Dam can be incorporated into the excavated sediment trap. To further improve the treatment process, Filter Tubes can be incorporated into the Rock Filter Dam.

In circumstances where the stormwater pipe discharges at least 300mm above the receiving discharge channel, a Coarse Sediment Trap can be installed within the discharge channel. If the chamber is partially confined by earth banks, then the final sediment fence can be replaced with a more elaborate filtration system.

Figure 6-24 Examples of Silt Trap Designs

Source: Catchment and Creeks private limited, Handbook Version 02, April 2010

6.11 Aeration Fountain: Application Feasibility

Water aeration is the process of increasing or maintaining the oxygen saturation of water in both natural and artificial environments. A fountain consists of a motor that powers a rotating impeller. The impeller pumps water from the first few feet of the water and expels it into the air. This process utilizes air-water contact to transfer oxygen. As the water is propelled into the air, it breaks into small droplets. Collectively, these small droplets have a large surface area through which oxygen can be transferred. Upon return, these droplets mix with the rest of the water and thus transfer their oxygen back to the ecosystem.

Fountains are a popular method of surface aerators because of the aesthetic appearance that they offer. However, most fountains are unable to produce a large area of oxygenated water. Also, running electricity through the water to the fountain can be a safety hazard.

Apart from a few positive aspects, these aeration fountains are not feasible for Kavoor lake due to the following reasons:

- Kavoor lake has a better pH value and the amount of dissolved oxygen is better as specified as per NLCP. Hence increasing the amount of oxygen in water is not necessary. The following table highlights these values.

Table 6-2 Criteria for Aeration: Between NLCP guidelines and Kavoor lake

Criteria	As Per NLCP (Box 1 by CPCB)	Test Report of Kavoor
pH	6.00 to 8.50	6.44 to 6.55
Dissolved O2	4/5 mg/litre or more	6.80 mg/litre

Source: Louis Berger Analysis

- The cost of initial purchase and setup is very high.
- The system requires high maintenance. This system requires a high AMC and each of these parts need to be replaced in case of faults.
- An aerator has the chances of killing fish and may lead to an alga bloom. This is because an overly productive lake with lots of bottom sludge can quickly become toxic due to the rapid decomposition of organic debris. It's this toxic sludge, rather than a lack of oxygen that can result in the occasional fish kill.
- The system consists of small parts and in the dry season, when there is less or no water, it is prone to theft.

Hence usage of an aeration fountain is not desirable in Kavoor lake.

6.12 Special construction work to be considered during implementation by Contractor

Table 6-3 Special Construction Work to be considered during implementation

1	Collection of the Hydrology Data to determine runs offs and water levels
2	Carrying out geo-technical investigations for silt removal
3	GPS tagging of the dump trucks to carry the silt during desilting. Also approval from MCC for determining the areas for silt dumping
4	Silt trap & grating design as per NEERI guideline to be design and get approved by Irrigation department before construction
5	Procurement of Rain gauge and Evaporimeter, Staff etc. should be done as per recommendation of metrological & irrigation department. Contractor need to approach for specification before procurement to respective department

6	Sluice gate design & drawings as per NEERI guideline to be done by contractor and get approved by Irrigation department before construction

Source: Louis Berger Analysis

7 Detailed Design of Kavoor Lake

Two options were presented at the concept stage, which included Option 01 and Option 02. Option 02 covers some extra land towards the north of the lake. Urban design and landscaping has been major tools in the shaping of the design. This chapter covers the detailed design for both the options.

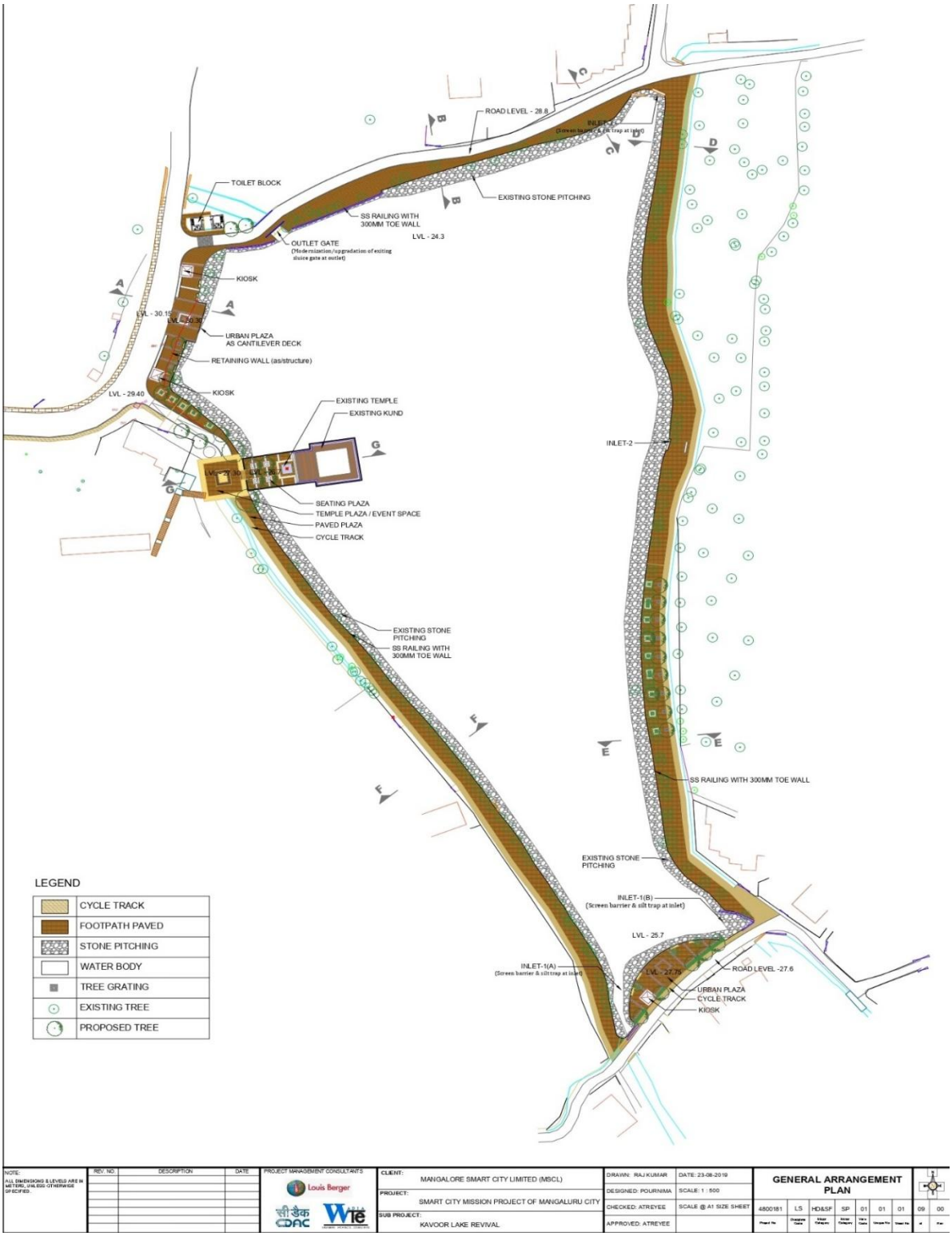
7.1 Detailed Design: Rendered Views

Figure 7-1 Detailed Design: View I (View of Stepped Well)

Source: Louis Berger Analysis

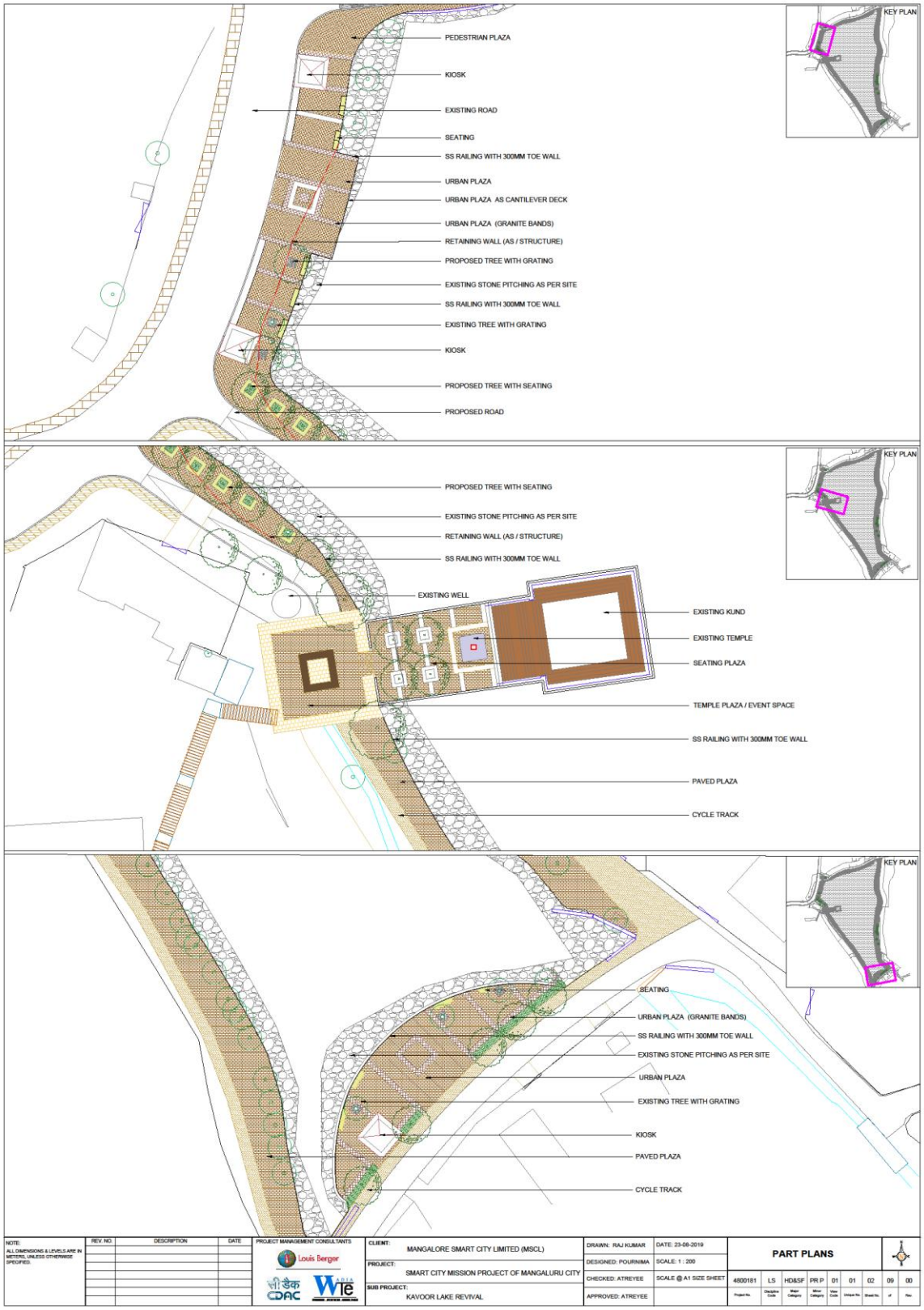
7.2 Detailed Design: Architectural Drawings: Option 01

Figure 7-2 Option 01 Detailed Design: Site Plan



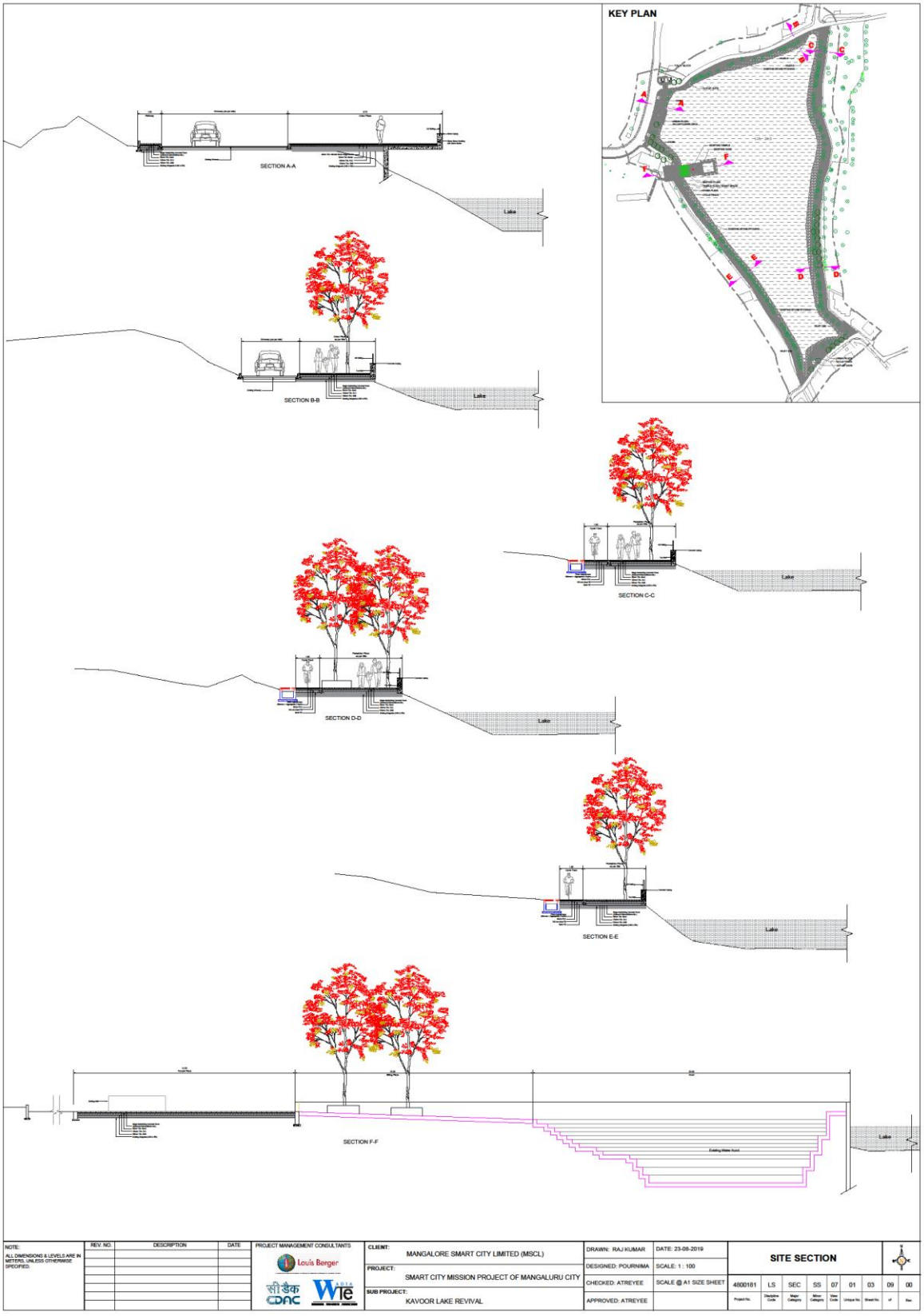
Source: Louis Berger Analysis

Figure 7-3 Option 01 Detailed Design: Part Plans



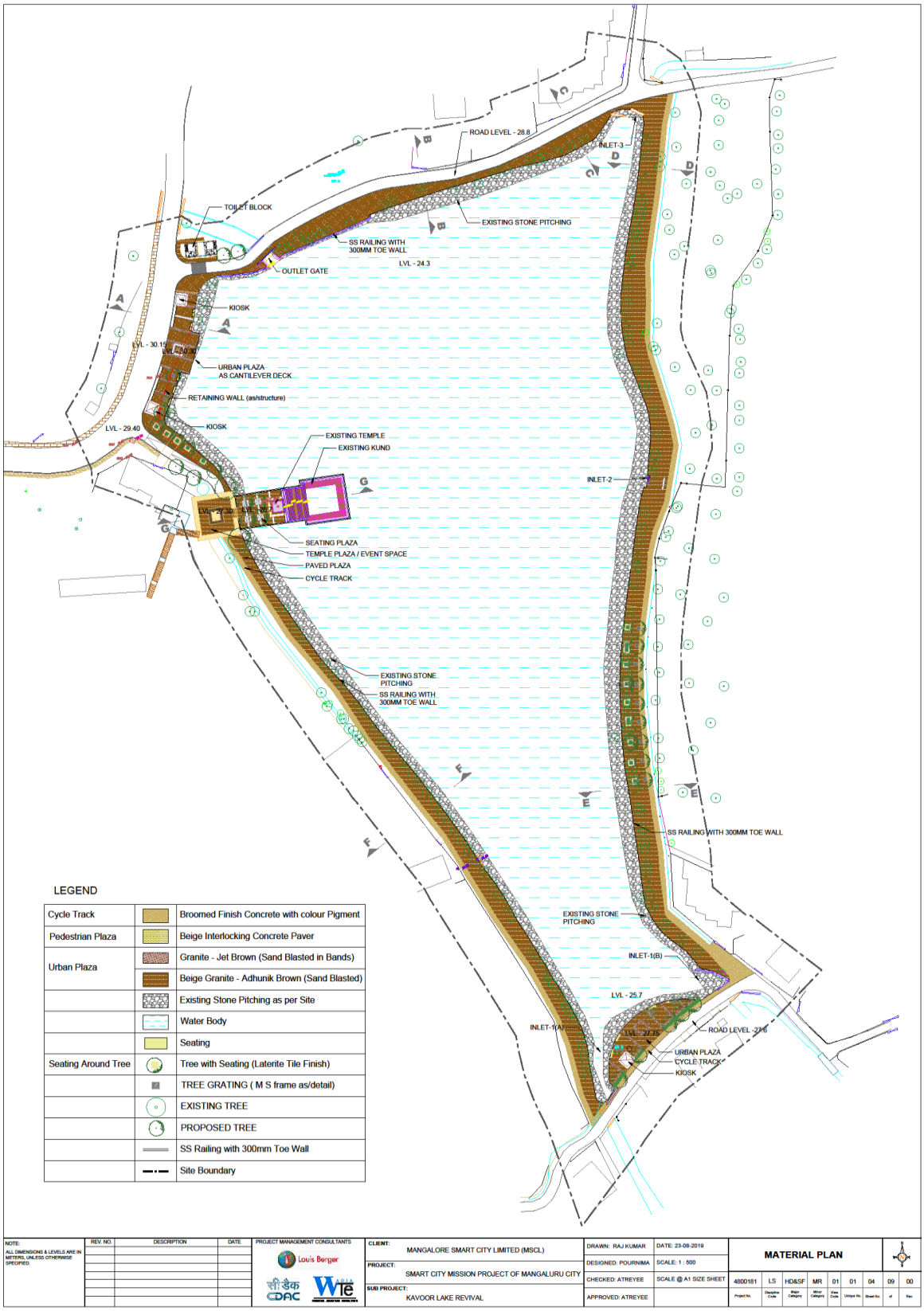
Source: Louis Berger Analysis

Figure 7-4 Option 01 Detailed Design: Site Sections



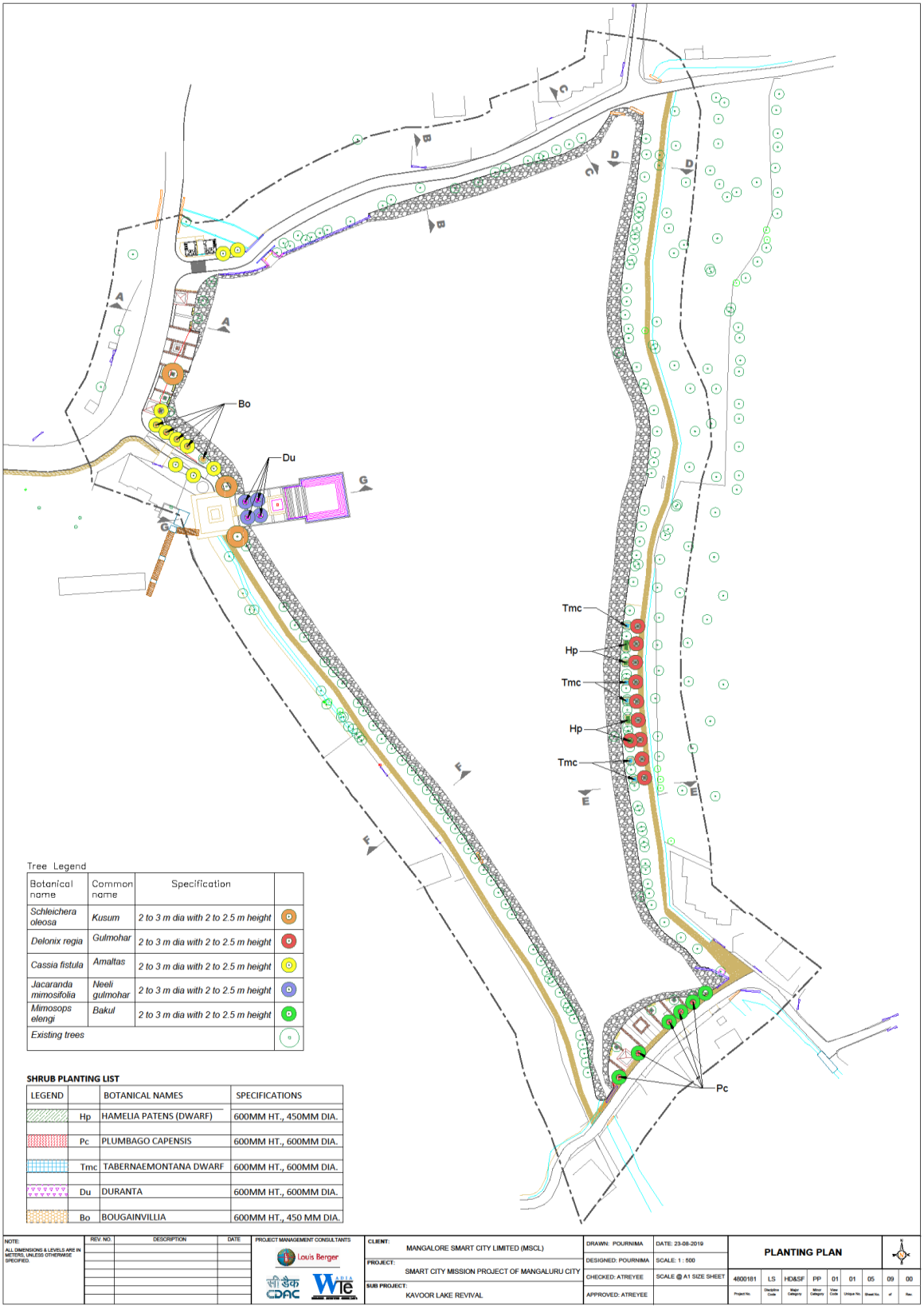
Source: Louis Berger Analysis

Figure 7-5 Option 01 Detailed Design: Material Plan



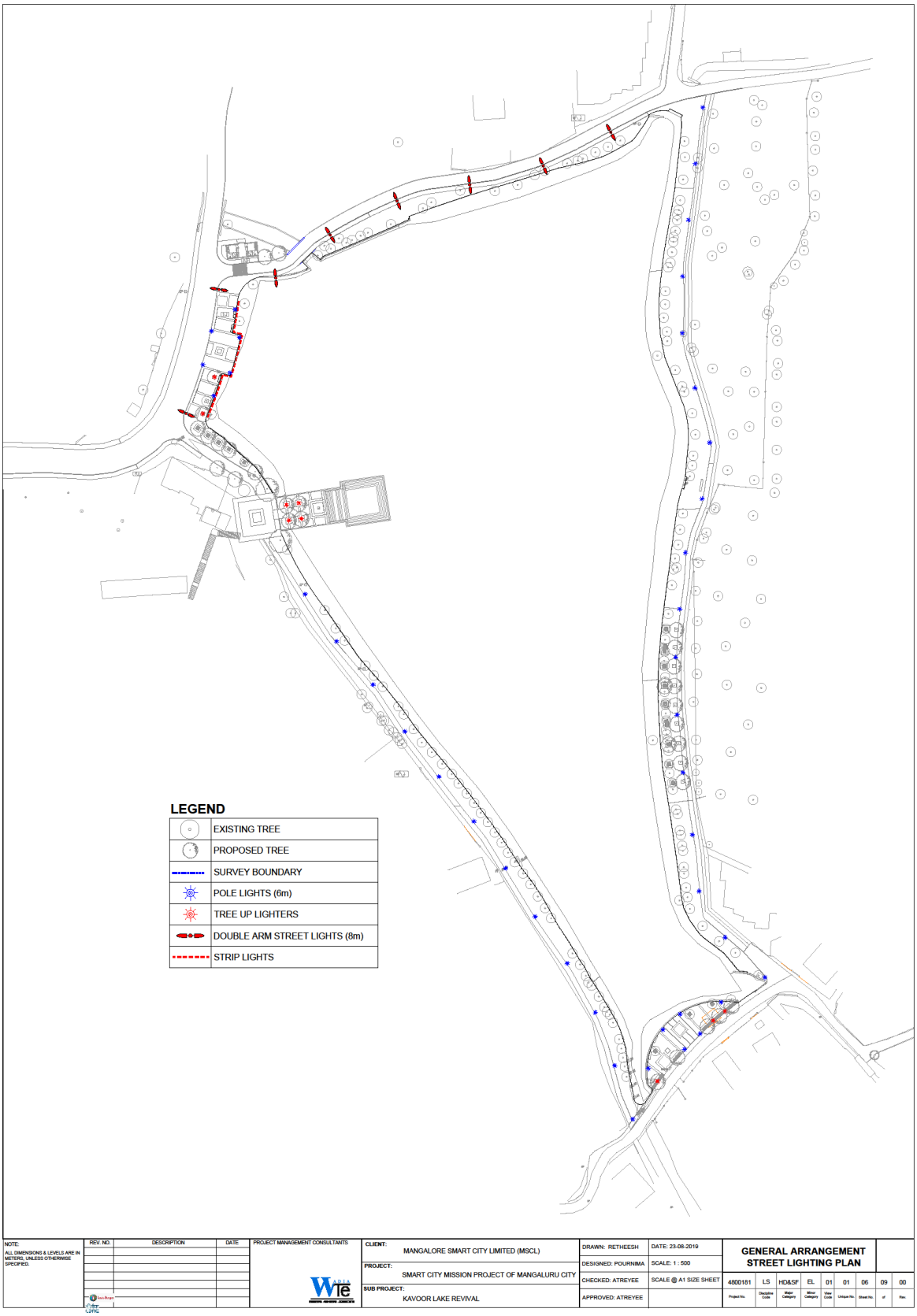
Source: Louis Berger Analysis

Figure 7-6 Option 01 Detailed Design: Planting Plan



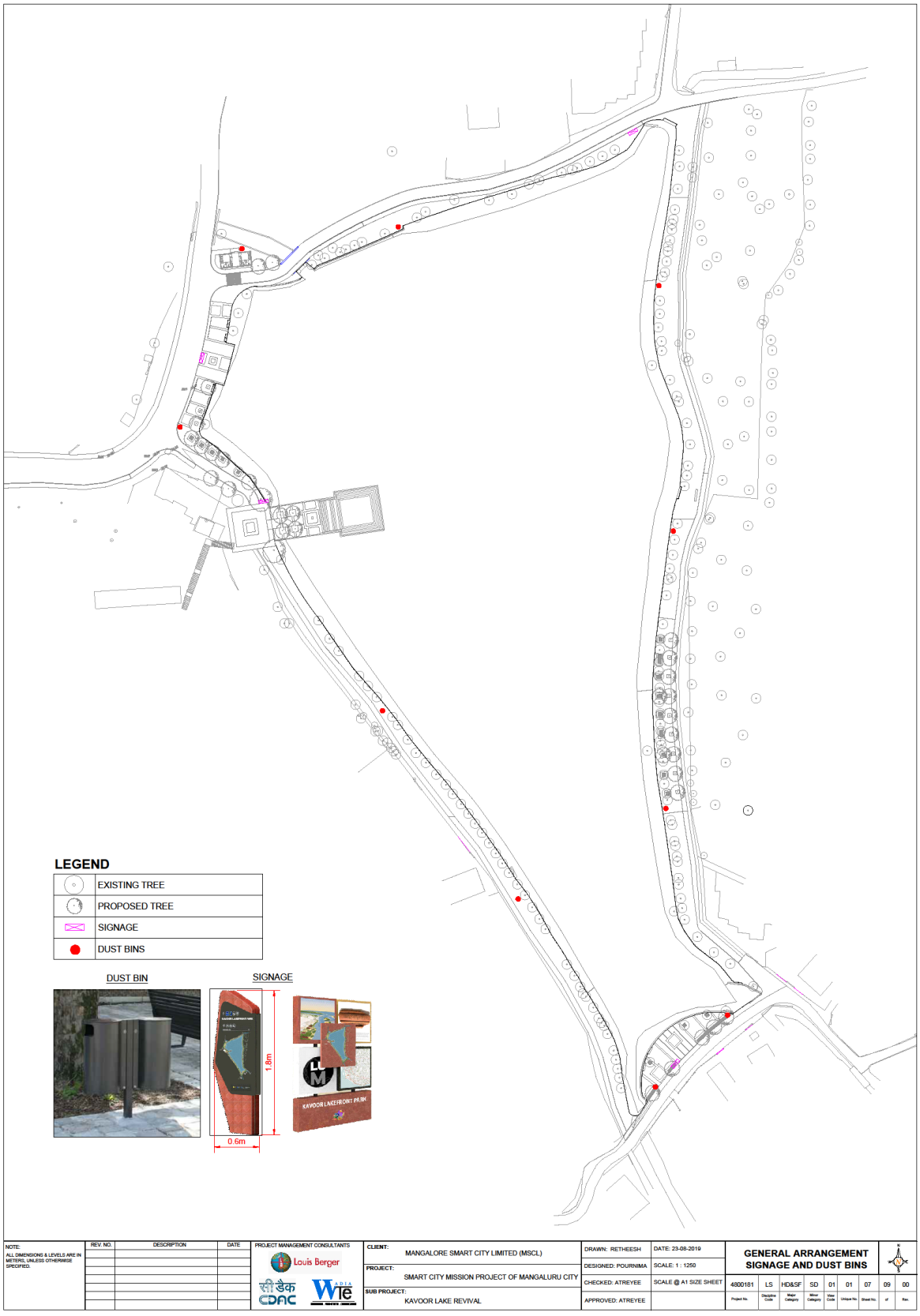
Source: Louis Berger Analysis

Figure 7-7 Option 01 Detailed Design: Lighting Plan



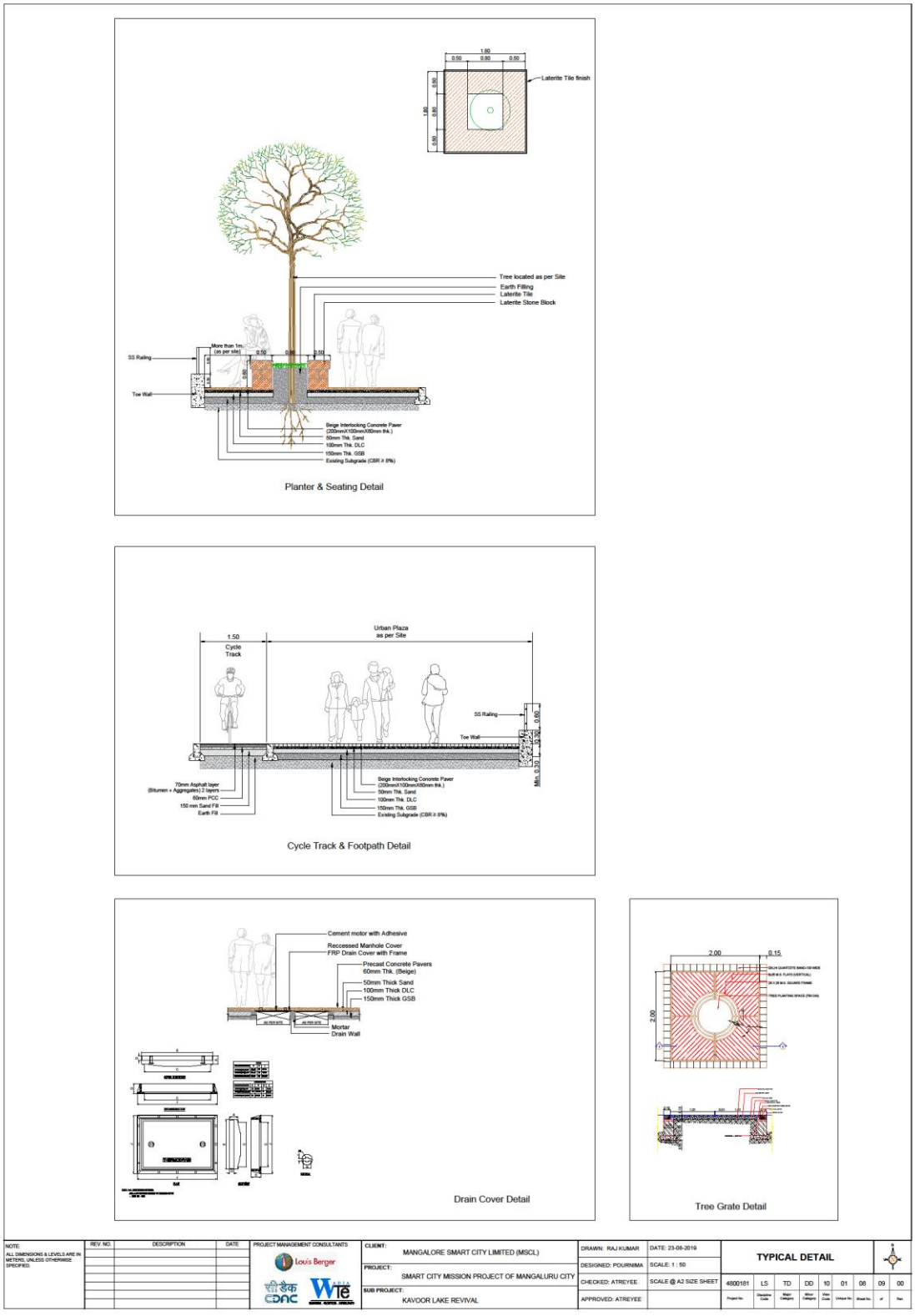
Source: Louis Berger Analysis

Figure 7-8 Option 01 Detailed Design: Signage Plan



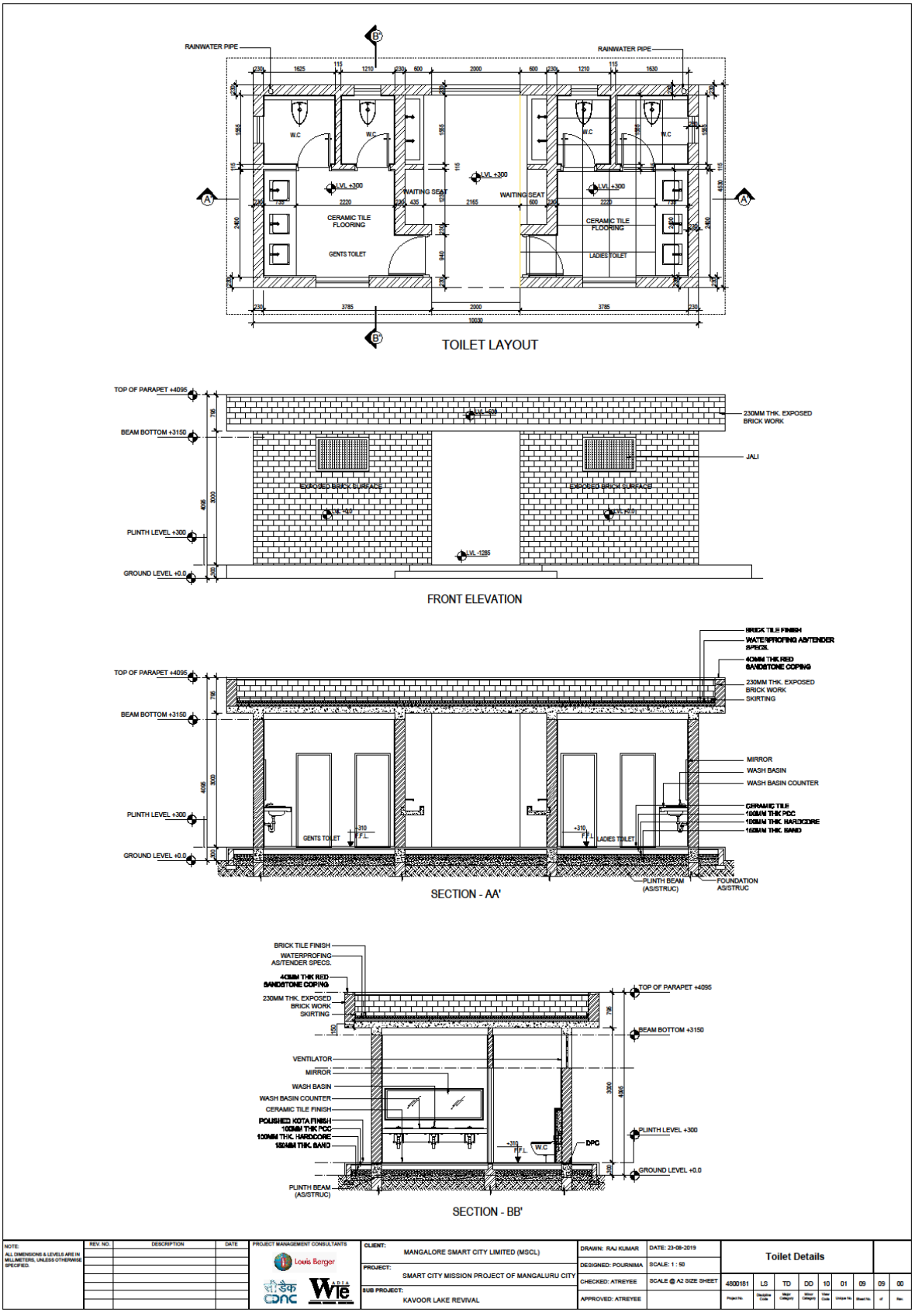
Source: Louis Berger Analysis

Figure 7-9 Option 01 Detailed Design: Typical Details



Source: Louis Berger Analysis

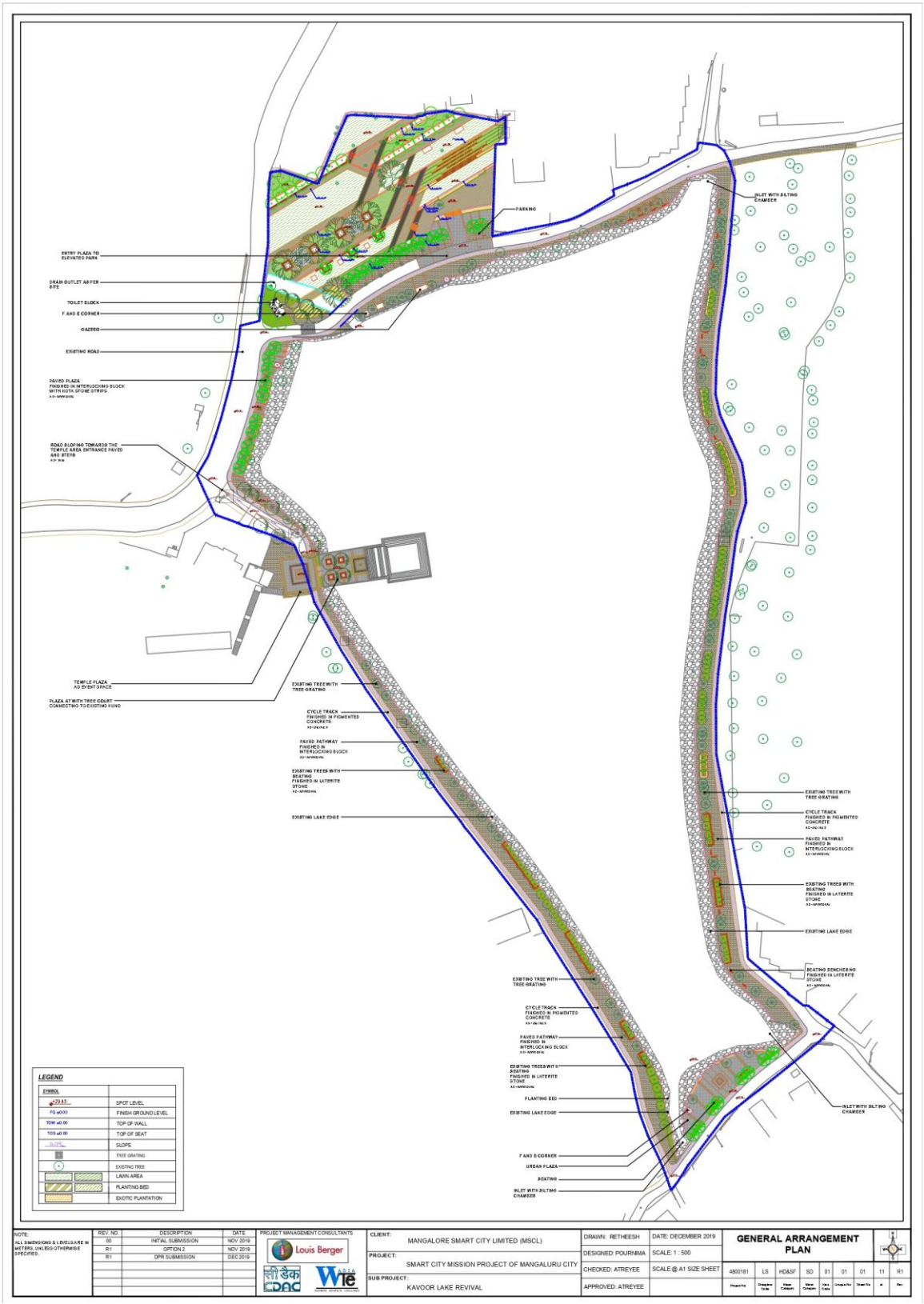
Figure 7-10 Option 01 Detailed Design: Toilet Details



Source: Louis Berger Analysis

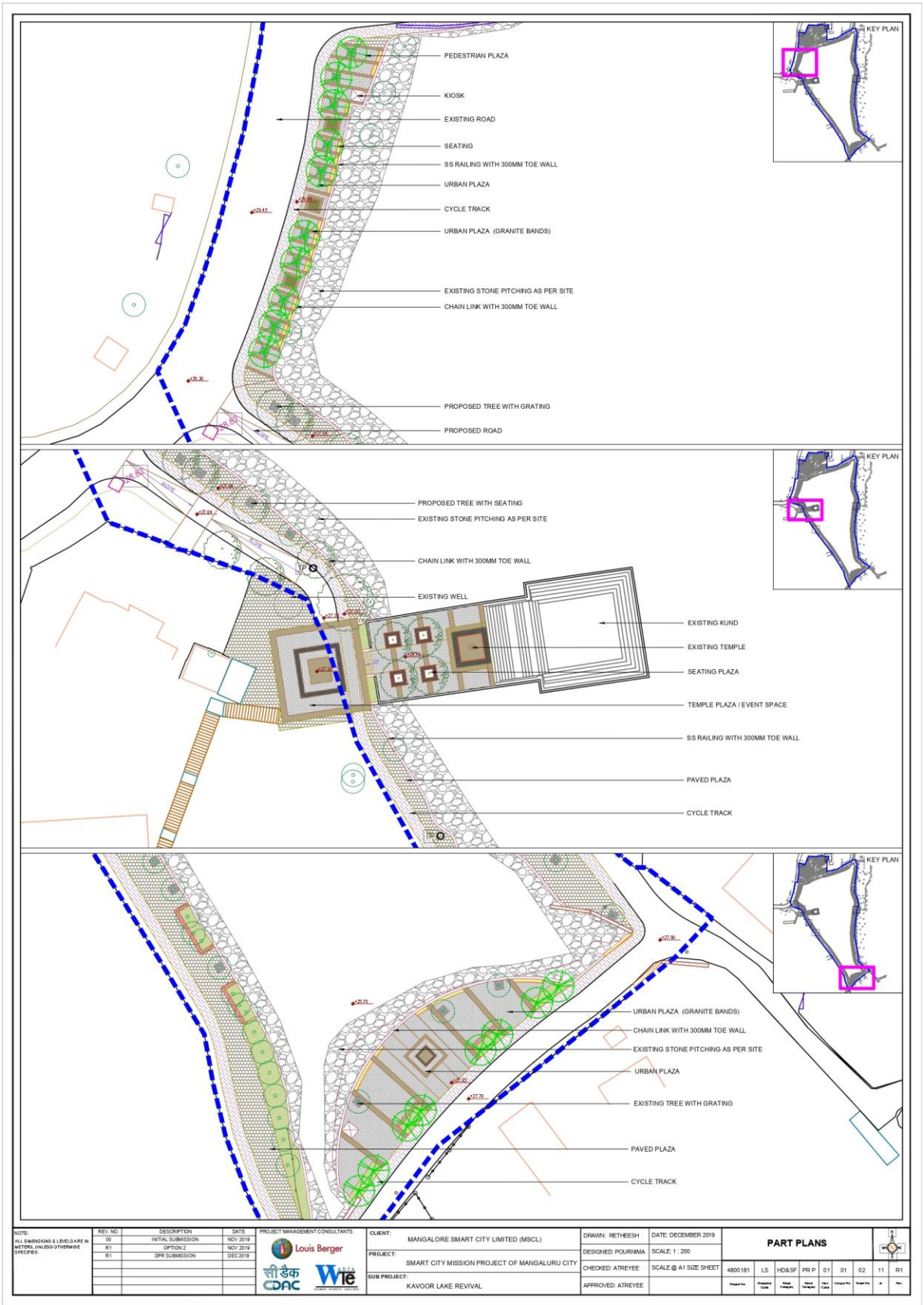
7.3 Detailed Design: Architectural Drawings: Option 02

Figure 7-11 Option 02 Detailed Design: General Arrangement Plan



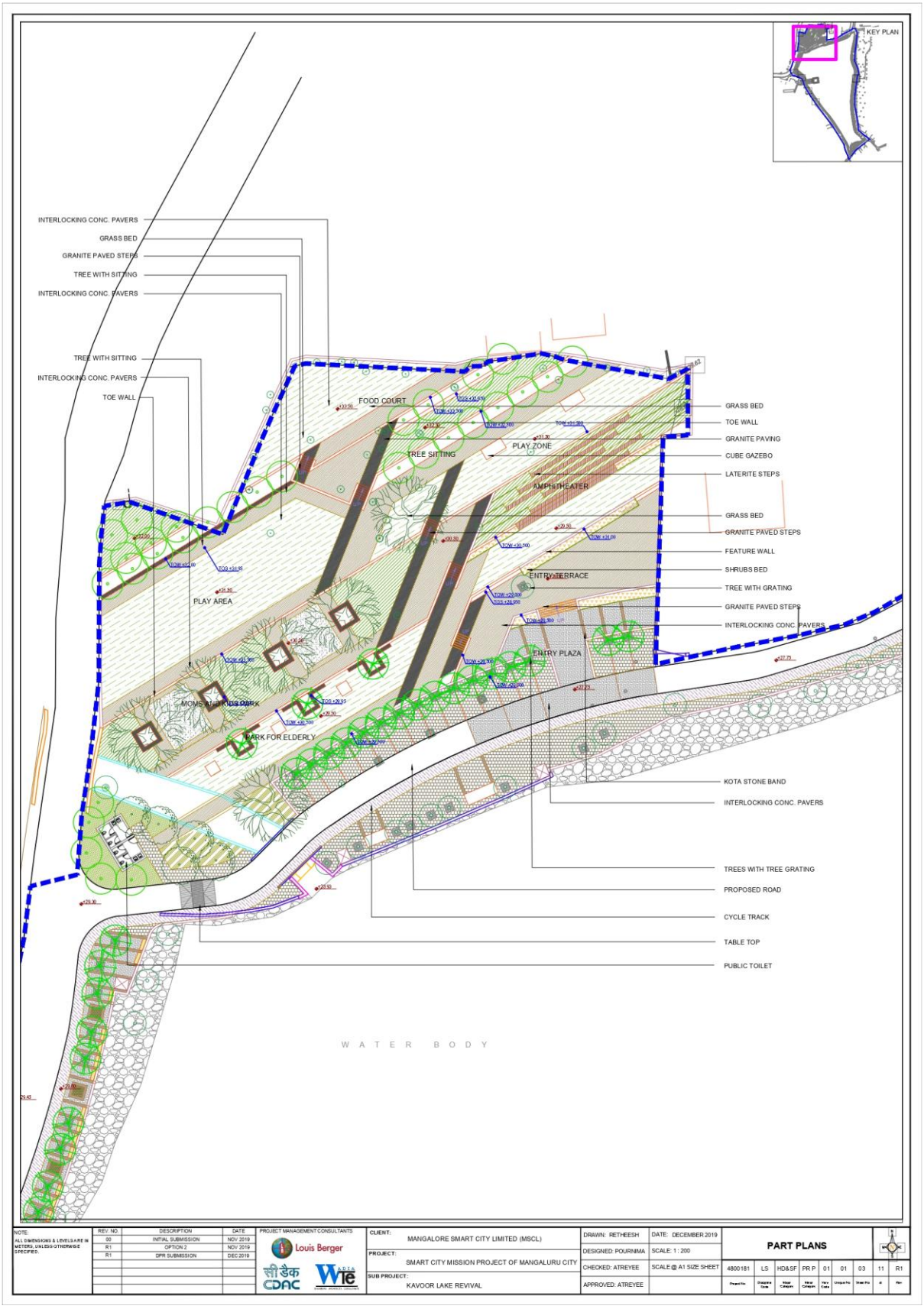
Source: Louis Berger Analysis

Figure 7-12 Option 02 Detailed Design: Part Plans



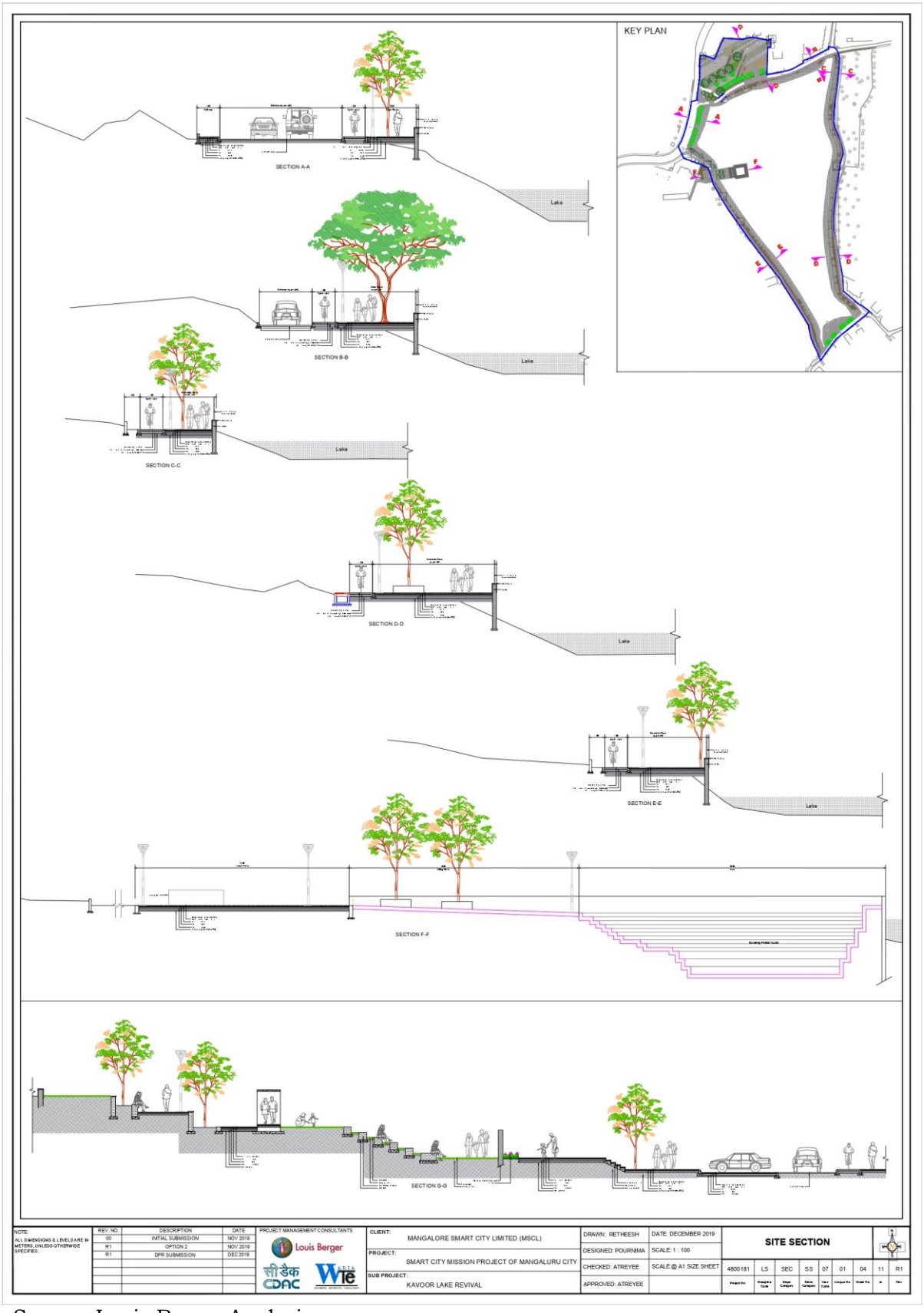
Source: Louis Berger Analysis

Figure 7-13 Option 02 Detailed Design: Detailed Part Plan of Leisure Garden



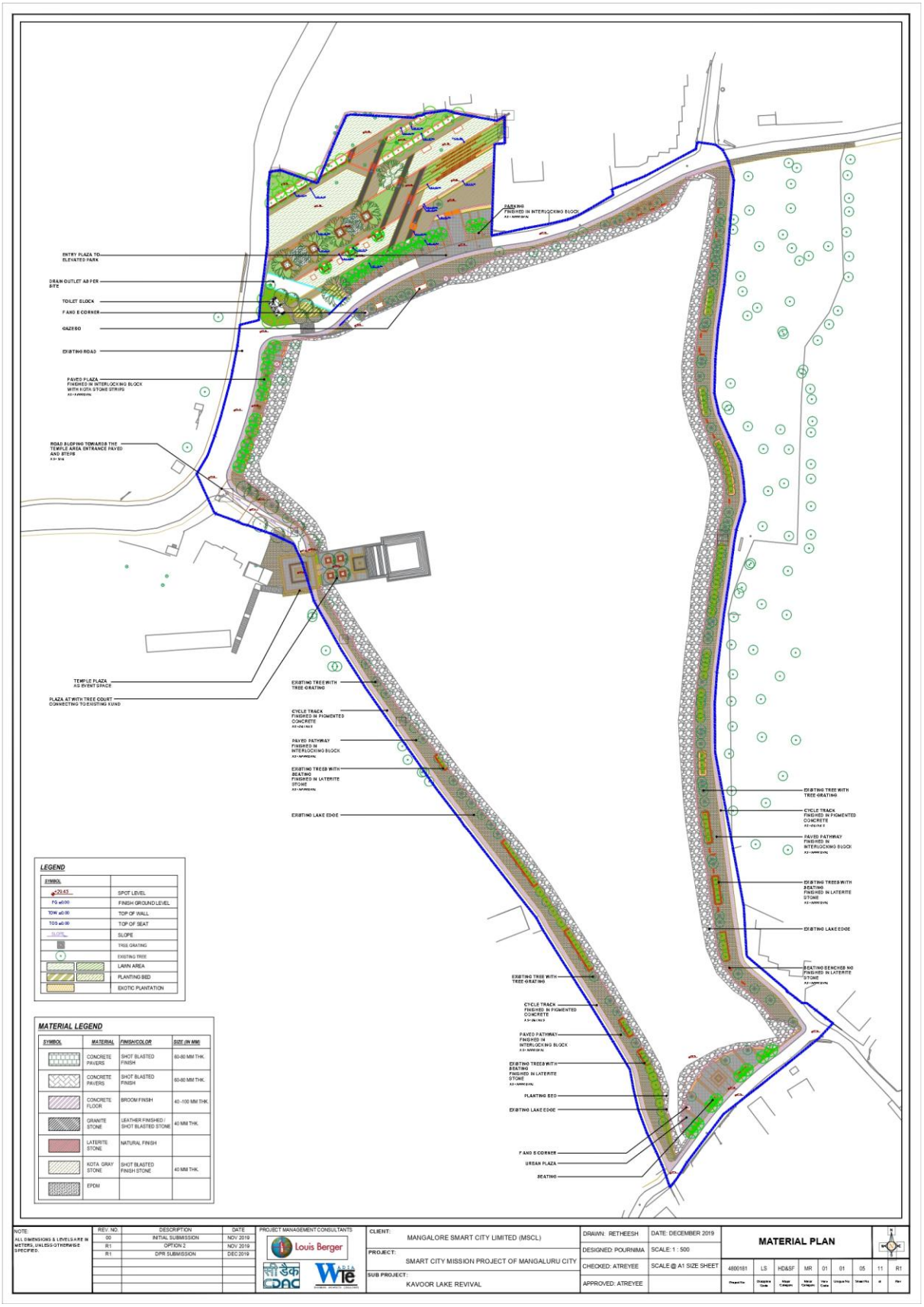
Source: Louis Berger Analysis

Figure 7-14 Option 02 Detailed Design: Site Sections



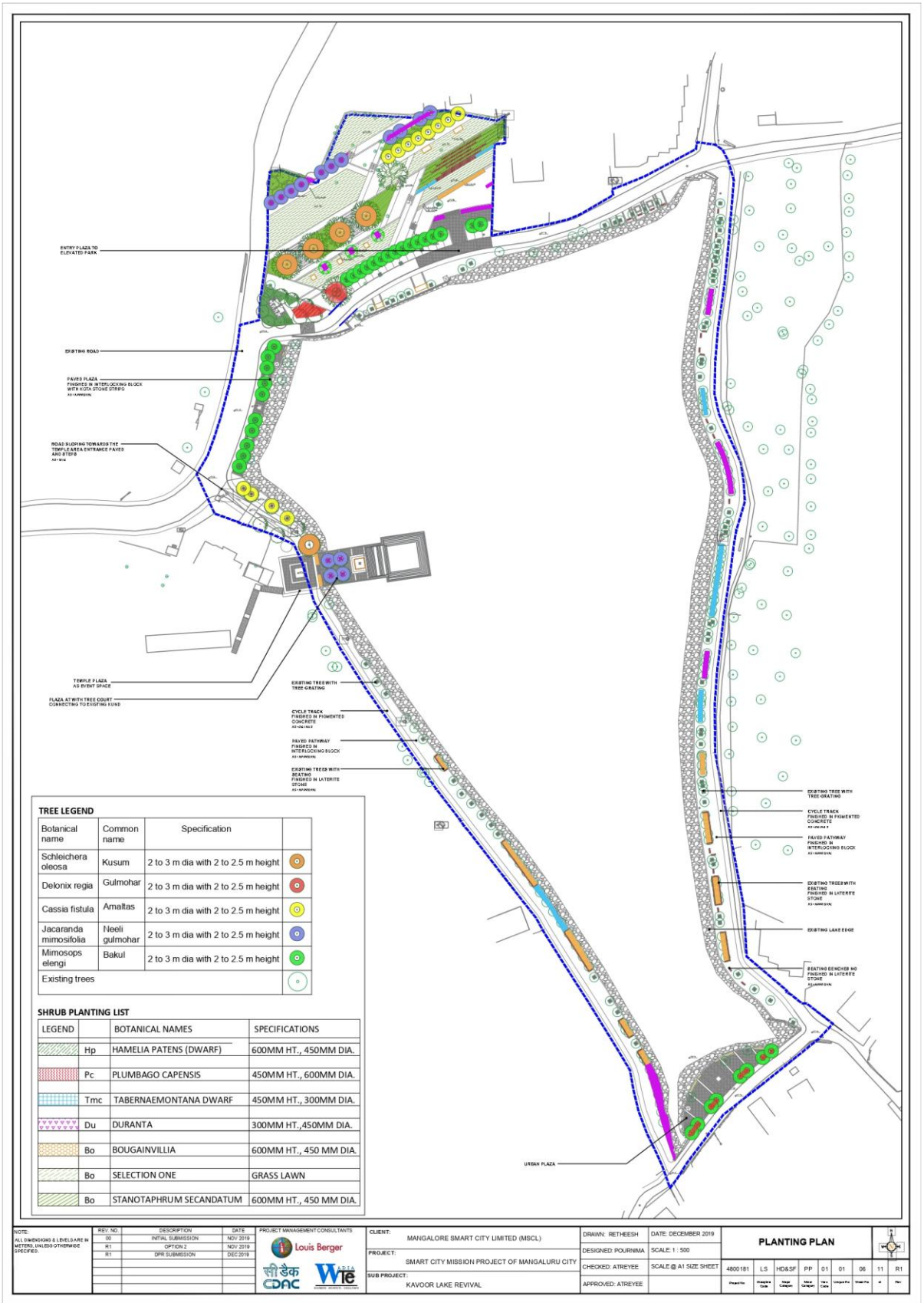
Source: Louis Berger Analysis

Figure 7-15 Option 02 Detailed Design: Material Plan



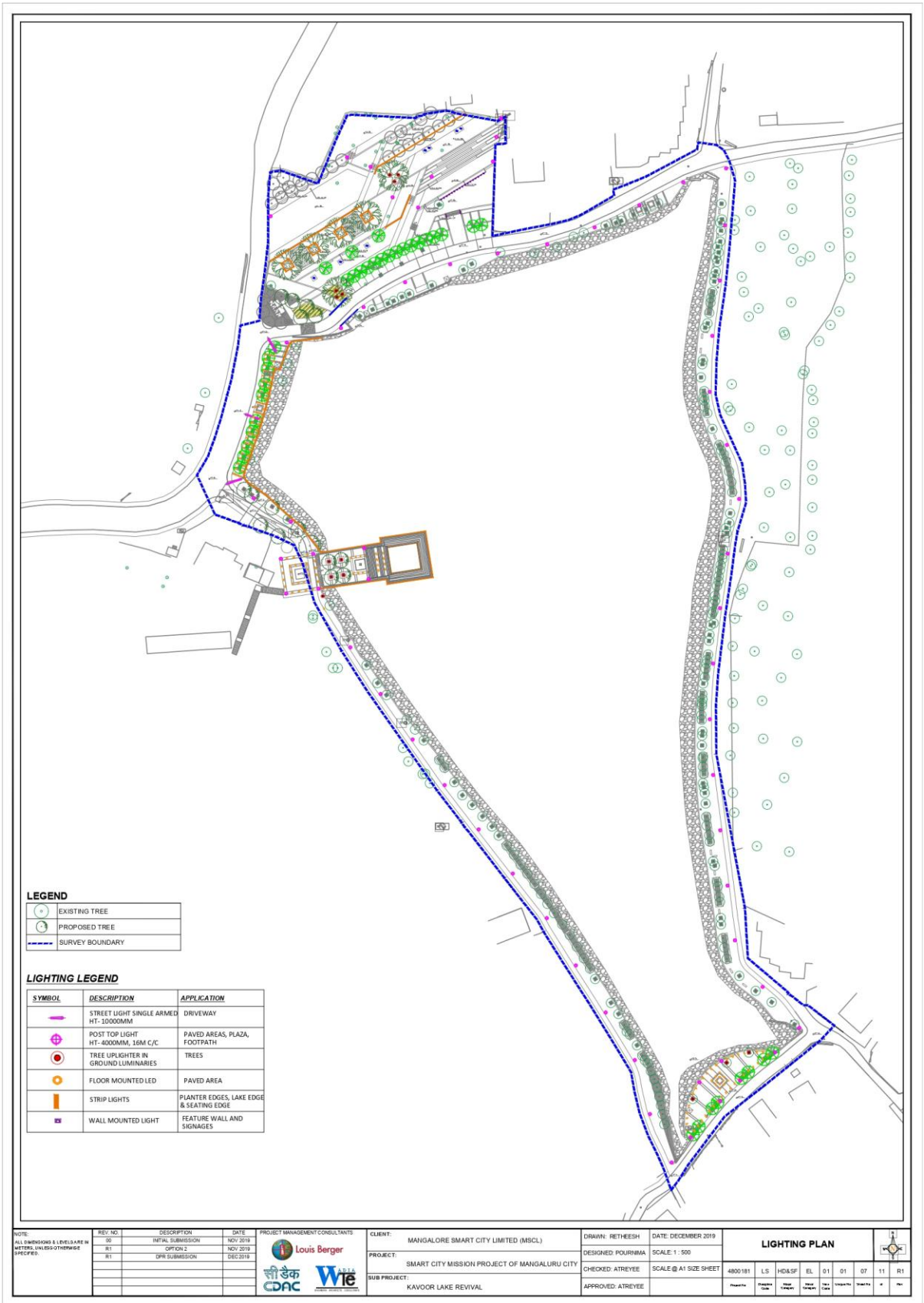
Source: Louis Berger Analysis

Figure 7-16 Option 02 Detailed Design: Planting Plan



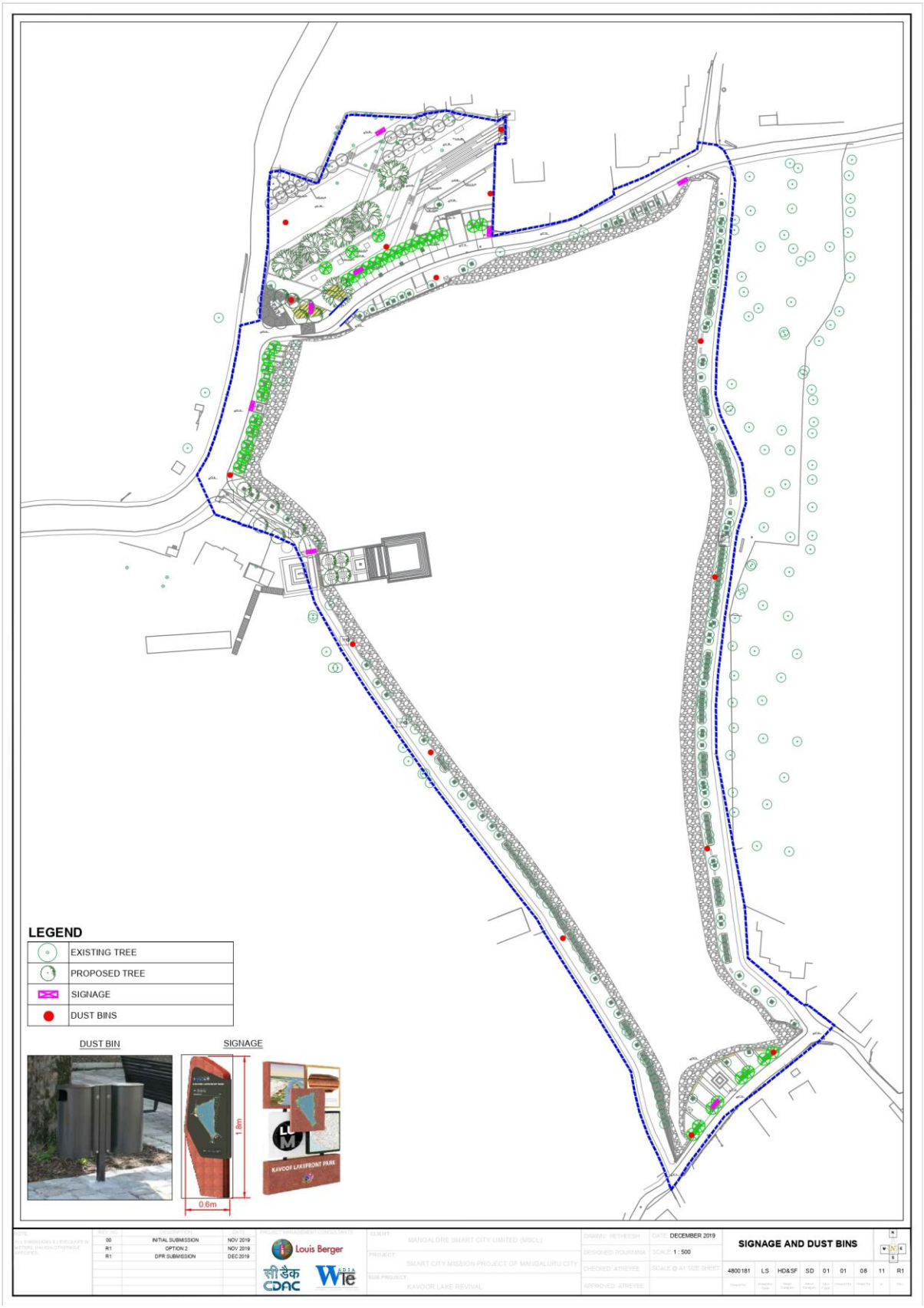
Source: Louis Berger Analysis

Figure 7-17 Option 02 Detailed Design: Lighting Plan



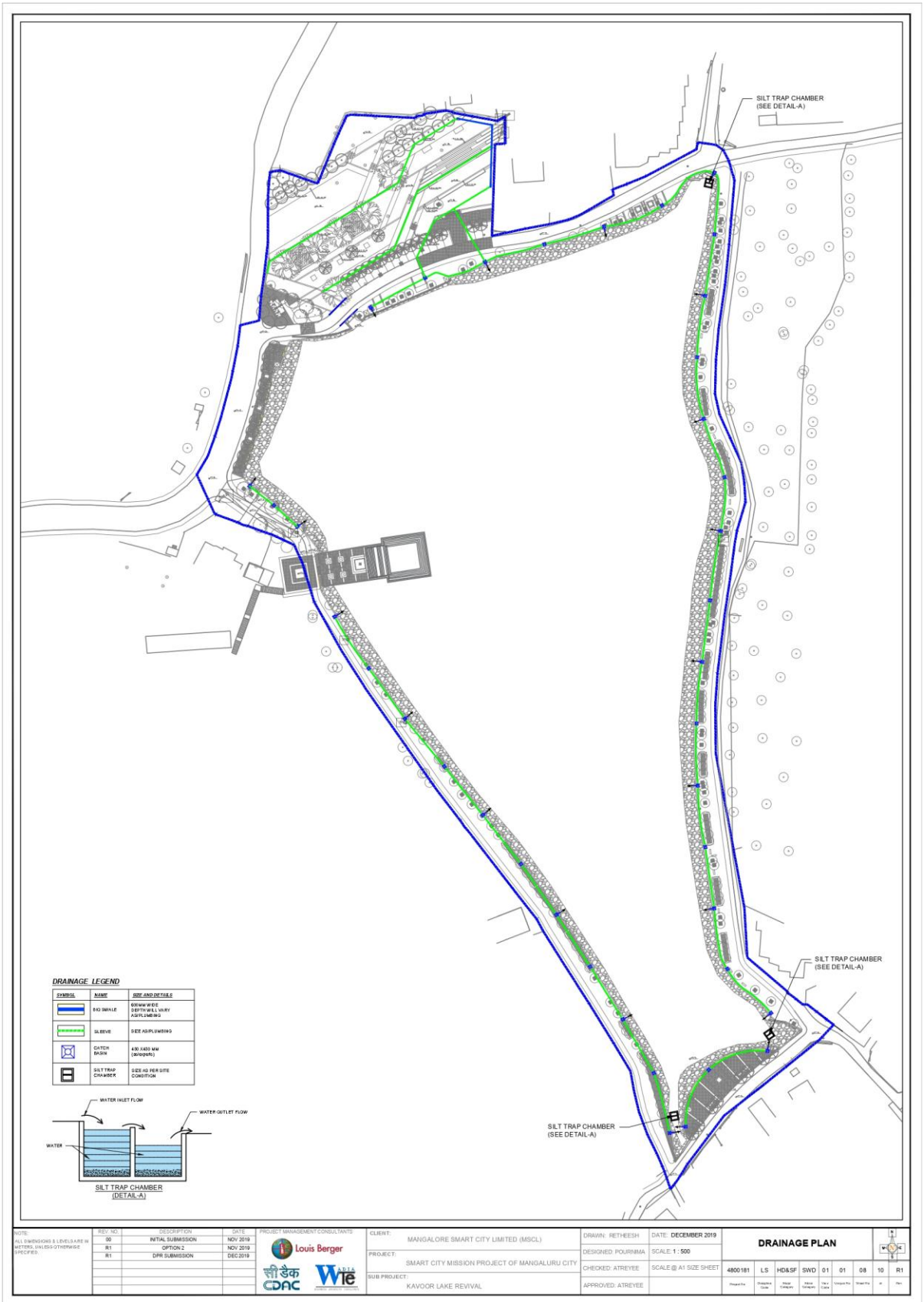
Source: Louis Berger Analysis

Figure 7-18 Option 02 Detailed Design: Signage and Dustbin Layout Plan



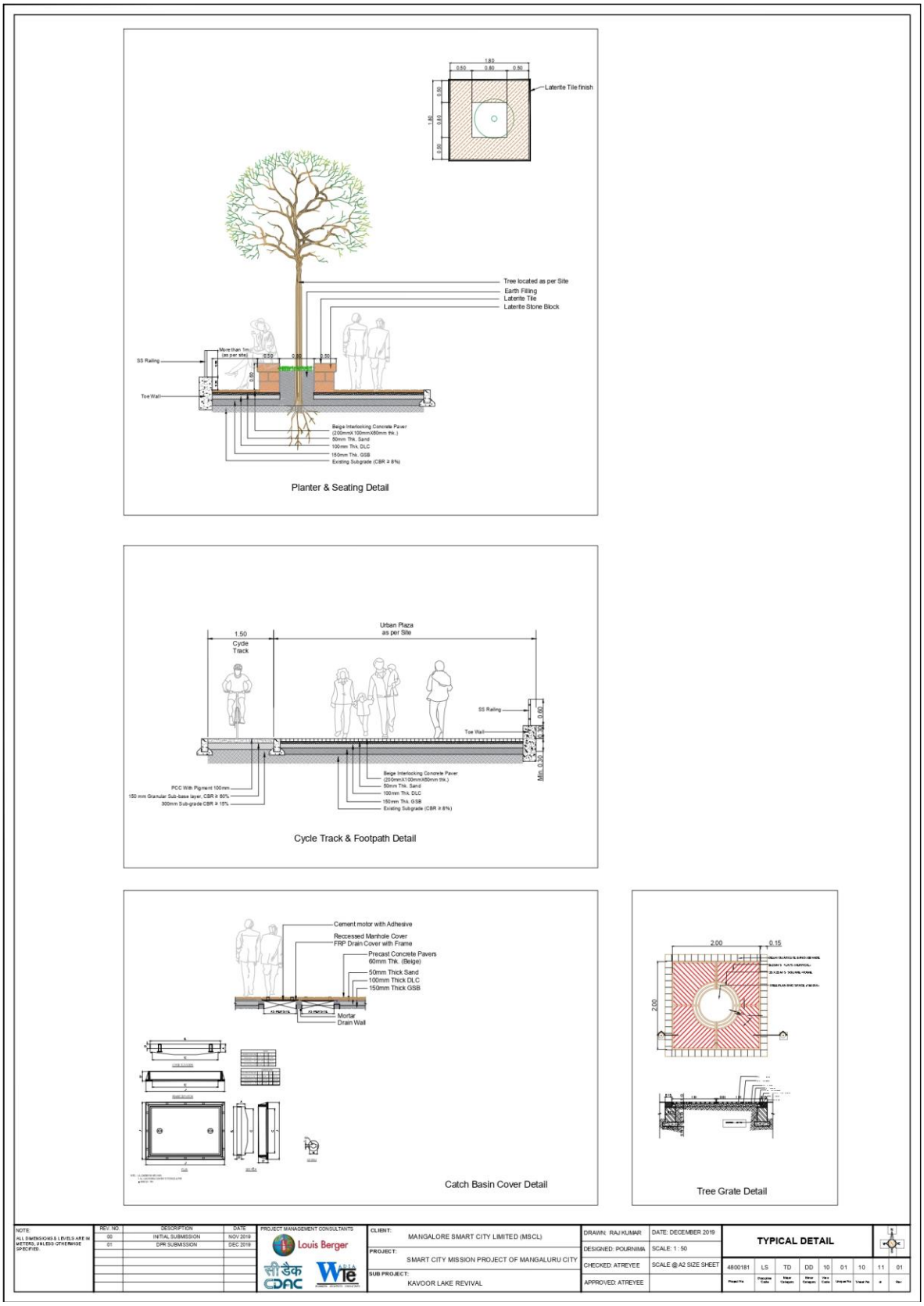
Source: Louis Berger Analysis

Figure 7-19 Option 02 Detailed Design: Drainage Plan



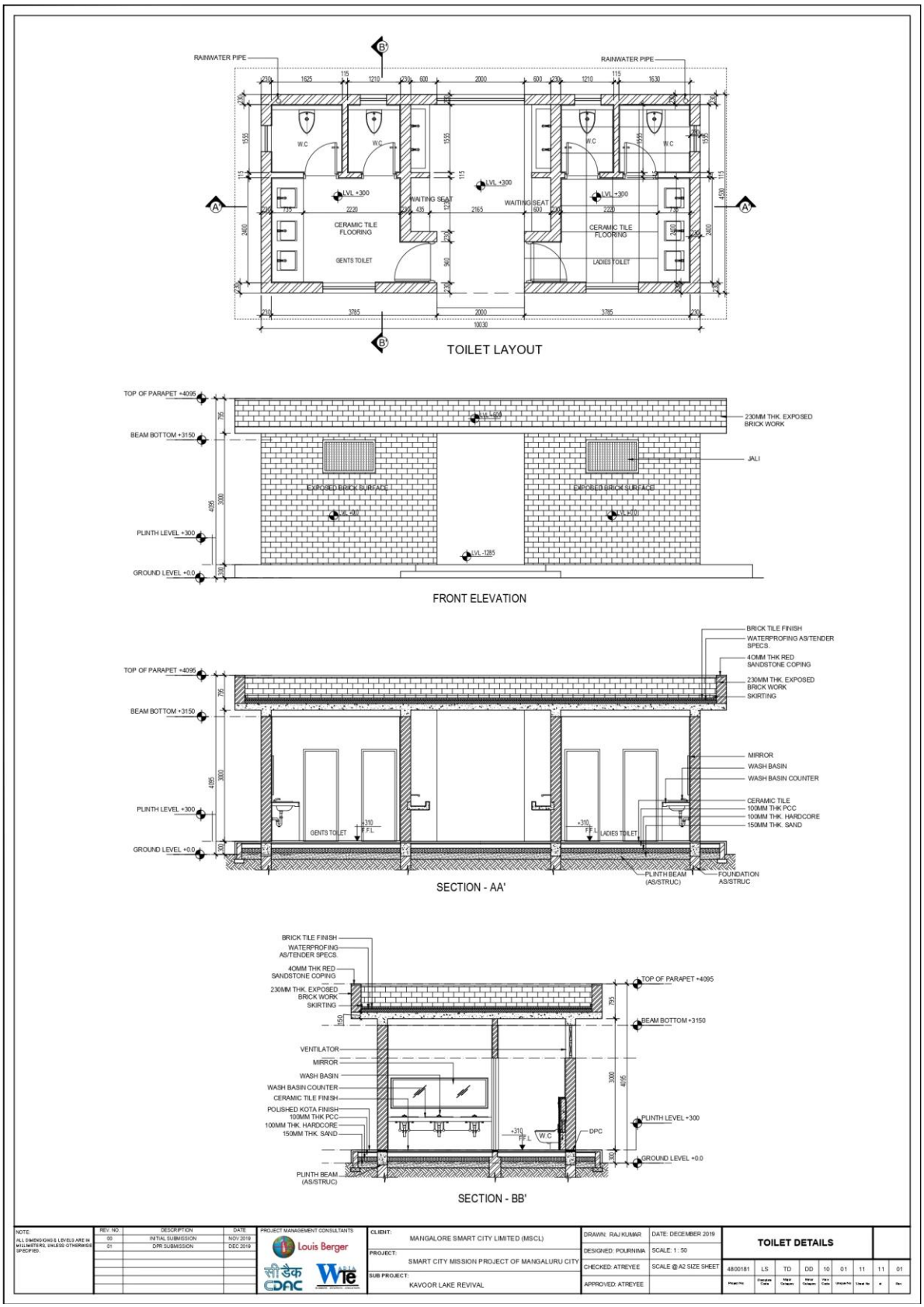
Source: Louis Berger Analysis

Figure 7-20 Option 02 Detailed Design: Typical Details



Source: Louis Berger Analysis

Figure 7-21 Option 02 Detailed Design: Toilet Details



Source: Louis Berger Analysis

8 Cost Estimation

8.1 Detail Cost Estimation

Cost estimate is an important component of the detail DPR as it provides vital input to financial evaluation. Detail cost estimate done after concept approval & detail engineering. Karnataka SOR 2018-19 items are majorly used in preparation of cost estimate. Other refer documents are CPWD DSR 2019 & market rate item. For market rate item we have done rate analysis and based on pre-approved MSCL method while referring to competitive 3 market quotation. Market quotation collected for equivalent makes and specification.

Table 8-1 Detailed Cost Estimation

Sr. No.	Description	Cost In INR
1	Civil Work including SWD, UGD, Lake Improvement and Horticulture	5,57,24,157
2	Leisure Park	60,24,637
3	Electrical Work	32,40,378
4	Plumbing Work	5,48,152
5	HVAC Work	14,000
	Construction Cost Sub Total	**6,55,51,324**
	GST @ 12% on Civil SOR Items	70,69,527
	GST @ 18% on Civil Market Rate	4,99,492
	GST @ 12% on Electrical	2,07,633
	GST @ 18% on Electrical	2,71,818
	GST @ 12% on Plumbing	23,493
	GST @ 18% on HVAC Work & Plumbing	65,948
	Escalation and Tender Premium @5%	32,77,566
	Add 3% Contengency	19,66,540
	Miscellaneous and Rounding off	10,66,659
	Grand Total	**8,00,00,000**

Source: WTE

9 General Instructions & Work Method Statement

9.1 Contractor's Superintendence

- The Contractor shall submit a Staff Organization Plan in accordance with the Client. This plan shall be updated and resubmitted whenever there are changes to the staff. The plan shall show the management structure and state clearly the duties, responsibilities & authority of each staff member.
- The site agent and his associates/supervisors shall have experience and qualification appropriate to the type and magnitude of the Works. Full details shall be submitted of the qualifications and experience of all proposed staff to the Engineer for his approval.

9.2 Checking of Contractor's Temporary Works Design

The Contractor shall, prior to commencing the construction of the Temporary Works, submit a certificate to the Engineer signed by him certifying that the Temporary Works have been properly and safely designed and checked and that the Contractor has checked the effect of the Temporary Works on the Permanent Works and has found this to be satisfactory.

9.3 The Site

Works Areas are those areas identified are to these Employer's Requirements and on the Drawings.

Use of the site

- The Site or Contractor's Equipment shall not be used by the Contractor for any purpose other than for carrying out the Works in the scope of this contract, except that, with the consent in writing of the Engineer, the Site or Contractor's Equipment such as batching/mixing plants for concrete and bituminous materials may be used for the work in connection with other contracts under the employer.
- Rock crushing plant shall not be used on the Site.
- The location and size of each stockpile of materials, including excavated materials, within the Site shall be as permitted by the Engineer. Stockpiles shall be maintained at all times in a stable condition.
- Entry to and exit from the Site shall be controlled and shall be only available at the locations for which the Engineer has given his consent.
- Contractor has to dump all the waste and unusable material at approved designated dumping site of MCC.
- All waste material should be out of the site before the start of next working day.
- Filling of soil should be done in layer only after compaction and approval.
- Filling material sample should be approved before start of filling.

Access to the site

- The Contractor shall make its own arrangements, subject to the consent of the Engineer, for any further access required to the Site.
- In addition, the Contractor shall ensure that access to every portion of the Site is continually available to the Employer and Engineer.

Access to the outside of site

- The Contractor shall be responsible for ensuring that any access or egress through the Site boundaries are controlled such that no disturbance to residents or damage to public or private property occur as a result of the use of such access or egress by its employees and sub-contractors.

Survey of the site

- A survey shall be carried out of the Site to establish its precise boundaries and the existing ground levels within it. This survey shall include a photographic survey sufficient to provide a full record of the state of the Site before commencing the work with particular attention paid to those areas where reinstatement will be carried out later on. The survey shall be carried out before the site clearance wherever possible and in any case prior to the commencement of work in any Works Area. The survey shall be carried out by the Contractor and agreed with the Engineer.

Barricades and Sign Boards

- The Contractor shall erect barricades as per Tender Drawing and gates around its areas of operations to prevent entry by unauthorized persons to his Works Areas and necessary identity cards /permits should be issued to workers and staff by the contractor. The Contractor shall submit proposal for barricades of the complete perimeter of all works areas to the Engineer. Painting of the barricades shall be carried out to the design and colors as directed by the Engineer and the Contractor shall carry out re-painting of the entire barricades on a regular basis. No work shall be commenced in any Works Area until the Engineer has been satisfied that the barricades installed by the Contractor are sufficient to prevent, within reason, unauthorized entry. The cost of all this barricade is included in quoted price.
- The types, sizes and locations of project signboards shall be agreed with the Engineer before manufacture and erection. Other advertising signs shall not be erected on the Site.
- The consent of the Engineer shall be obtained before hoardings, fences, gates or signs are removed. Hoardings, fences, gates and signs which are to be left in positions after the completion of the Works shall be repaired and repainted as instructed by the Engineer.
- Hoardings, barricades, gates and signs shall be maintained in clean and good order by the Contractor until the completion of the Works, whether

such hoardings, fences, gates and signs have been installed by the Contractor or by others and transferred to the Contractor during the period of the Works. All the fencing, hoardings, gates and signs etc. shall be mopped minimum one in a week and washed monthly.

- All hoardings, barricades, gates and signs installed by the Contractor shall be removed by the Contractor upon the completion of the Works, unless otherwise directed by the Engineer.

Clearance of Site

- All Temporary Works which are not to remain on the Site after the completion of the Works shall be removed prior to completion of the Works or at other times instructed by the Engineer. The Site shall be cleared and reinstated to the lines and levels and to the same condition as existed before the Works started except as otherwise stated in the Contract.

9.4 Survey

- The Contractor shall relate the construction of the Works to the Site Grid. To facilitate this, survey reference points have been established and the Engineer will provide benchmarks in the vicinity of the Site.
- Before the Contractor commences the setting out of the Works, the Engineer will provide a drawing showing the position of each survey reference point and bench mark, together with the co-ordinates and/or level assigned to each point. The Contractor shall satisfy itself that there are no conflicts between the data given and shall establish and provide all subsidiary setting out points which may be necessary for the proper and accurate setting out and checking of the Works.
- The Contractor shall carefully protect all the survey reference points, bench marks, setting out points, monuments, towers and the like from any damages and shall maintain them and promptly repair or replace any points damaged from any causes whatsoever. The Contractor shall regularly recheck the position of all setting out points, bench marks and the like to the satisfaction of the Engineer.
- Upon handover to the Contractor, the survey reference points will become the responsibility of the Contractor. The Contractor shall frequently review, ensure that these survey points continue to remain consistent with the bench marks.

9.5 Safety, Health and Environment Requirements

The Contractor shall comply with in the conditions stipulated in the Conditions of contracts on Safety, Health & Environment (SHE).

Training of Contractor's Employees/Staff/Workers:

Contractor shall provide a training/workshop on safety, Health & Environment (SHE) to all its workers/staff/employees/subcontractors of at least 2 weeks

(96hrs.) at the time of induction. Before postings of any his workers/ staff/ employees/ subcontractors, the contractor shall give a certificate that the said person had undergone the requisite SHE is training. Non-compliance of the above will invoke penalties as per condition of contract.

In case of any mishap/ accident causing death/ injury to public or damage to public/ private property or damage to public/ private vehicles or damage to railway property, the employer, will impose a penalty to the contractor as deemed fit and appropriate in addition to the cost of damage caused due to the accident.

9.6 Other Safety Measures

Site Safety, Health & Environment Plan:

The Contractor shall, within 7 days of the date of Notice to Proceed, prepare and submit to the Engineer for review his proposed safety, Health and Environment plan which shall contain as a minimum those items set out in Conditions of Contract on Safety, Health & Environment Plan.

Fire Regulations and Safety:

- The Contractor shall provide and maintain all necessary temporary fire protection and firefighting facilities on the Site during the construction of the Works and shall comply with all requirements of the Mangalore Fire Services Department. These facilities may include, without limitation, sprinkler systems and fire hose reels in temporary site buildings, raw water storage tanks and portable fire extinguishers suitable for the conditions on the Site and potential hazards.
- The Contractor shall submit details of these facilities to the Engineer for review prior to commencement of work on the Site.
- If, in the Engineer's opinion, the use of naked lights may cause a fire hazard, the Contractor shall take such additional precautions and provide such additional firefighting equipment (including breathing apparatus) as the Engineer considers necessary. The term "naked light" shall be deemed to include electric arcs and oxyacetylene or other flames used in welding or cutting metals.
- Oxyacetylene burning equipment will not be permitted in any confined space. Burning equipment of the oxypropane type shall be used.

Hazard and Risk Assessments:

- The Contractor shall, prior to the commencement of any operation carry out a detailed hazard & risk assessment. The results of such assessments shall be recorded, and the records kept for inspection by the Engineer.
- The Contractor shall produce detailed method statements for all medium and high-risk operations and shall submit them to the Engineer for his consent prior to commencement of any task to which they relate.

- The Contractor shall produce and implement a Permit to Work system for all high-risk operations. The Permit to Work system shall be submitted to the Engineer for consent before application.

Launching Girder

- No Launching Girder to be used without prior written consent of Engineer.
- The Contractor shall prepare a detailed specification for the operation of Launching Girder and submit it to the Engineer for review.

Standby Equipment

The Contractor shall provide adequate stand-by equipment to ensure the safety of personnel, the Works and the public. These measures shall include as a minimum the following:

- stand-by pumping and generating equipment for the control of water;
- stand-by equipment and spares for illumination of the Works; and
- Stand-by generating equipment and equipment for lighting for works.

Co-operation

The Contractor shall provide full co-operation and assistance in all safety surveillance carried out by the Engineer or the Employer. Any breaches of the Site Safety Plan or the statutory regulations or others disregard for the safety of any persons may be the reason for the Engineer to exercise his authority to require the site agent's removal from the Site.

9.7 Care of Works

- Unless otherwise permitted by the Engineer all work shall be carried out in dry conditions.
- The Works, including materials for use in the Works, shall be protected from damage due to water. Water on the Site and water entering the Site shall be promptly removed by temporary drainage or pumping systems or by other methods capable of keeping the Works free of water. Silt and debris shall be removed by traps before the water is discharged and shall be disposed of at locations to which the Engineer has given his consent.
- The discharge points of the temporary systems shall be as per the consent of the Engineer. The Contractor shall make all arrangements with and obtain the necessary approval from the relevant authorities for discharging water to drains, watercourses etc. The relevant work shall not be commenced until the approved arrangements for disposal of the water have been implemented.
- The methods used for keeping the Works free of water shall be such that settlement of, or damage to, new and existing structures do not occur.
- Measures shall be taken to prevent flotation of new and existing structures.

Protection of the works from weather

- Work shall not be carried out in weather conditions that may adversely affect the Works unless proper protection is provided to the satisfaction of the Engineer.
- Permanent Works, including materials for such Works, shall be protected from exposures of weather conditions that may adversely affect such Permanent Works or materials.
- During construction of the Works storm restraint systems shall be provided where appropriate. These systems shall ensure the security of the partially completed and ongoing stages of construction and in all weather conditions. Such storm restraint systems shall be installed as soon as practicable and shall be compatible with the right of way, or other access around or through- out the Site.
- The Contractor shall at all times programme and order progress of the work and make all protective arrangements such that the Works can be made safe in the event of storms.

Protection of the work

The finished works shall be protected from any damage that could arise from any activities on the adjacent site/ works.

9.8 Damage and Interference

- Work shall be carried out in such a manner that there is no damage to or interference with:
  a) watercourses or drainage systems;
  b) utilities;
  c) structures (including foundations), roads, including street furniture, or other properties;
  d) public or private vehicular or pedestrian access;
  e) monuments trees, graves or burial grounds other than to the extent that is necessary for them to be removed or diverted to permit the execution of the Works. Heritage structures shall not be damaged or disfigured on any account. The Contractor shall inform the Engineer as soon as practicable of any items which are not stated in the Contract to be removed or diverted but which the Contractor considers need to be removed or diverted to enable the Works to be carried out. Such items shall not be removed or diverted until the consent of the Engineer to such removal or diversion has been obtained.
- Items which are damaged or interfered with as a result of the Works and items which are removed to enable work to be carried out shall be reinstated to the satisfaction of the Engineer and to at least the same condition as existed before the work started. Any claims by Utility Agencies due to damage of utilities by the Contractor shall be borne by Contractor.

Utilities

Please refer Employer's Requirement - Functional

Structures, roads and other properties

The Contractor shall immediately inform the Engineer of any damage to structures, roads or other properties.

Access

Alternative access shall be provided to all premises if interference with the existing access, public or private, is necessary to enable the Works to be carried out. The arrangements for the alternative access shall be as agreed by the Engineer and the concerned agency. Unless agreed otherwise, the permanent access shall be reinstated as soon as practicable after the work is complete and the alternative access shall be removed immediately as it is no longer required, and the ground surfaces reinstated to the satisfaction of the Engineer. Proper signage and guidance shall be provided for the traffic / users regarding diversions.

Removal of Graves and Other Obstructions

If any graves and other obstructions are required to be removed in order to execute the Works and such removal has not already been arranged for, the Contractor shall draw the Engineer's attention to them in good time to allow all necessary arrangements and authorizations for such removal, and it shall not itself remove them unless the Engineer has given consent.

Protection of the adjacent structures and works

The Contractor shall take all necessary precautions to protect the structures or works being carried out by others adjacent to and, for the time being, within the Site from the effects of vibrations, undermining and any other earth movements or diversion of water flow arising from its work.

9.9 Work on Roads

Traffic Management Plan

The Contractor shall develop a detailed Traffic Management Plan for the work under the contract. The purpose is to develop a Traffic Management Plan to cope with the traffic disruption as a result of construction activities by identifying strategies for traffic management on the roads and neighborhoods impacted by the construction activities. The Contractor shall implement the Traffic Management Plan throughout the whole period of the Contract.

Principles for Traffic Management

The basis for the Plan shall take into consideration four principles:

- to minimize the inconvenience of road users and the interruption to surface traffic through the area impacted by the construction activities;

- to ensure the safety of road users in the impacted area;
- to facilitate access to the construction site, and to maintain reasonable construction progress.
- to ensure traffic safety at each construction site.

9.10 Site Establishment

Site laboratories

The Contractor shall provide, erect and maintain in a clean, stable and secure condition a laboratory, equipped for the routine testing of concrete, soil and rock samples and for the storage and curing of concrete cubes or cylinders only. This laboratory shall be located at the Contractor's principal work site or at a location agreed to by the Engineer. Detailed requirements for this laboratory are set out in to Employer's Requirements.

Contractor's site accommodation

The Contractor shall provide and maintain its own site accommodation at locations consented to by the Engineer. Offices, sheds, stores, mess rooms, garages, workshops, latrines and other accommodation on the Site shall be maintained in a clean, stable and secure condition. Living accommodation shall not be provided on the Site. The Contractor shall comply with the requirements of Appendix 8 to the Employer's Requirement.

Latrines and wash places

The Contractor shall provide latrines and wash places for the use of its personnel and all persons who will be on the Site. The size and disposition of latrines and wash places shall accord with the numbers and dispositions of persons entitled to be on the Site, which may necessitate their location on structures and, where necessary there shall be separate facilities for males and females. The capacities and layout shall be subject to approval of the Engineer. The Contractor shall arrange regular disposal of effluent and sludge in a manner that shall be in accordance with local laws/ regulations.

The Contractor shall be responsible for maintaining all latrines and wash places on the Site in a clean and sanitary condition and for ensuring that they do not pose a nuisance or a health threat. The Contractor shall also take such steps and make such provisions as may be necessary or directed by the Engineer to ensure that vermin, mosquito breeding etc. are at all times controlled.

Site utilities and access

- The Contractor shall be responsible for providing water, electricity, telephone, sewerage and drainage facilities for contractors site offices, structures and buildings and for all site laboratories in accordance to the Employer's Requirements and all such services that are necessary for satisfactory performance of the Works. The Contractor shall make all

arrangements with and obtain the necessary approval from the relevant civil and utility authorities for the facilities.

The contractor shall be responsible for provision of power supply for his works including for launching girder and the like. The Employer cannot guaranty provision of adequate, continuous power supply however assistance will be given in obtaining the necessary permissions for site generators and the like.

- Access roads and parking areas shall be provided within the Site as required and shall be maintained in a clean, acceptable & stable condition.

Submission of particulars

- The following particulars shall be submitted to the Engineer for his consent not more than ten days after the date of commencement of the Works:
  a) drawings showing the formation works and the layout within earmarked area for the Contractor's offices, project signboards, principal access and other major facilities required early in the Contract, together with all service utilities;
  b) drawings showing the details to be included on the project signboards and diversion boards.
- Drawings showing location of stores, storage areas, concrete batching plants and other major facilities +and their access roads/paths shall be submitted to the Engineer for his consent as early as possible.

9.11 Security

The Contractor shall be responsible for the security of the Site for the full time the Site is in its possession, except for the specific case. The Contractor shall maintain all site boundary fences in first class condition and shall so arrange site boundary fences at all access drainage points of work areas that it's use of such access points etc., are not restricted by the system or method of achieving the required security measures. Notices shall be displayed at intervals around the Site to warn the public of the dangers of entering the Site.

9.12 Testing

General

- The Contractor shall provide and perform all forms of testing procedures applicable to the Works and various components and the interfacing of the Works with the other Contract works and shall conduct all necessary factory, site and acceptance tests.
- All testing procedures shall be submitted at asap prior to conducting any Test. The Testing procedures shall show unambiguously the extent of testing covered by each submission, the method of testing, the Acceptance Criteria, the relevant drawing (or modification) status and the location.

- The testing Procedures shall be submitted, as required, by the Contractor during the duration of the contract to reflect changes for the identification of additional testing requirements.
- The Engineer shall have the facilities for monitoring all tests and have access to all testing records. Ample time shall be allowed within the testing Programmes for necessary alterations to equipment, systems to be undertaken, together with re-testing prior to final commissioning.
- The Contractor is reminded that at some point, the High Voltage Power Supply system will be energized and the additional precautions for the safety of staff and co-ordination of activities after power-on shall be anticipated in its testing and commissioning Programmes.
- All costs associated with the Testing shall be borne by the Contractor, unless otherwise specified, including the services of any specialized personnel or independent assessors. The Contractor shall also bear any expenses incurred due to resetting caused by defects or failure of equipment to meet the requirements of the Contract in the first instance.
- Unless agreed in writing by the Engineer, the personnel engaged on testing shall be independent of those engaged for installing same equipment.
- All testing equipment shall carry an appropriate & valid calibration label.

Batches, samples and specimens

- A batch of material is a specified quantity of the material that satisfies the specified conditions. If one of the specified conditions is that the material is delivered to the Site at the same time, then material delivered to the Site over a period of a few days may be considered as part of the same batch if in the opinion of the Engineer there is sufficient proof that the other specified conditions applying to the batch apply to all of the material delivered over the period.
- A sample is a specified quantity of material that is taken from a batch for testing and which consists of a specified amount, or a specified number of pieces or units, of the material.
- A specimen is the portion of a sample that is to be tested.

Samples for testing

- Samples shall be of sufficient size and in accordance with relevant Standards to carry out all specified tests.
- Samples taken on the Site shall be selected by, and taken in the presence of, the Engineer and shall be suitably marked for their identification. An identification marking system should be evolved at the start of works in consultation with the Engineer.
- Samples shall be protected, handled and stored in such a manner that they are not damaged or contaminated and such that the properties of the sample do not change.

- Samples shall be delivered by the Contractor, under the supervision of the Engineer, to the specified place of testing. Samples on which non-destructive tests have been carried out shall be collected from the place of testing after testing and delivered to the Site or other locations instructed by the Engineer.
- Samples which have been tested may be incorporated in the Permanent Works provided that:
    a) the sample complies with the specified requirements;
    b) the sample is not damaged; and
    c) the sample is not required to be retained under any other provision of the Contract.
- Additional samples shall be provided for testing if in opinion of Engineer:
    a) material previously tested no longer complies with the specified requirements; or
    b) material has been handled or stored in such a manner that it may not comply with the specified requirements.

Testing

- The Contractor shall be responsible for all on-site and off-site testing and for all in-situ testing. All appropriate laboratory tests shall be carried out in the Contractor's laboratory, unless otherwise permitted or required by the Engineer. Where the laboratory is not appropriately equipped and/or staffed for some tests, or if agreed to by the Engineer, tests may be carried out in other laboratories provided that:
    a) they are accredited for the relevant work to a standard acceptable to the Engineer; and
    b) particulars of the proposed laboratory are submitted to the Engineer for his consent.
- In-situ tests shall be done in the presence of the Engineer.
- Equipment, apparatus and materials for in-situ tests and laboratory compliance tests carried out by the Contractor shall be provided by the Contractor. The equipment and apparatus shall be maintained by the Contractor and shall be calibrated before the testing starts and at regular intervals as permitted by the Engineer. The equipment, apparatus and materials for in-the situ tests shall be removed by the Contractor as soon as practicable after the testing is complete.
- The Contractor shall be entitled in all cases to attend the testing carried out in the Employer's or other laboratories, to inspect the calibration certificates of the testing machines & to undertake the testing on counterpart samples.
- Attendance on tests, including that by the Engineer, Contractor, shall be as laid down in the Quality Assurance procedures.

9.13 Records

Drawings produced by the contractor

Drawings produced by the Contractor including drawings of site layouts, Temporary Works, etc. for submission to the Engineer shall generally be to ISO A1 size. They shall display a title block with the information as detailed to these Employer's Requirements. The number of copies to be submitted to the Engineer shall be as stated in the Contract, or as required by Engineer.

Progress photographs

The Contractor shall provide weekly progress photographs which have been properly recorded to show the progress of the works to the Engineer.

The Contractor shall ensure that no photography is permitted on the Site without the agreement of the Engineer. Contractor should be aware of the local regulations and conditions with regard to Photography in some "RESTRICTED AREA' in Mangalore.

Records of wage rates

The Contractor shall keep monthly records of the average, high and low wage rates for each trade/tradesman employed on the Site and records shall be made available to the Engineer during inspection.

9.14 Provision and Disposal of Earthwork Materials

The Contractor shall be responsible for the provision of all classes of earthworks material required for the Works, whether sourced from the excavations within the Contract or obtained from any other sources, which are located outside the Site, for which the Engineer has given the consent.

For fill or dumping sites, the Contractor shall prepare a land plan with details of surface drainage requirements, final formation levels, spreading and compaction of the fill during dumping acceptable to the Engineer. The Contractor shall also provide security for such sites. The dumping sites to be used by the Contractor shall be as directed by the Engineer.

All excavated material, excluding waste material, bentonite fluid and bentonite contaminated material shall be disposed of at the appointed site only. This material shall be placed and compacted in accordance with the Construction Specification for Earth Works or as otherwise directed by the Engineer's Representative. The disposal of waste material, bentonite fluid and material contaminated with bentonite shall be the full responsibility of the Contractor and these materials shall be disposed of by the Contractor at an approved location. The dumping sites provided by the Employer shall not be used for disposal of waste material, bentonite fluid or material contaminated with bentonite.

Rock deposited as fill material at the dumpsites shall be capable of compaction with single pieces no larger than 300mm.

9.15 Restoration of Areas Disturbed by Construction

Unless otherwise directed by the Engineer, any areas disturbed by the construction activity, either inside or outside the Project Right of Way, shall be reinstated as follows:

All areas affected by the construction work shall be reinstated to their original condition, with new materials, including but not necessarily limited to, sidewalks, parking lots, access roads, adjacent roads properties and landscaping. Grass cover shall be provided for any bare earth surface areas, along with proper provisions for surface drainage.

9.16 Landscaping

Landscaping must be submitted to the relevant authorities and match the remaining areas. In addition, the Contractor shall carry out the construction of landscaping for all works areas and will submit his proposals to the relevant authorities for approval before commencement of landscaping works.

9.17 Timeline

Base timeline for the completion of after work order

10 Summary and Conclusion

10.1 Why there is need for rejuvenation of lakes?

- Rejuvenation of lakes will help in rain water harvest and extend water security during non-rainy seasons.
- The beds of lakes and tanks over the period of time deposits soil rich in nutrient and humus due to the decomposition of organic matters, fishes and other water organisms. Such soils, having high water retention capacity, if used as top soil helps farmers also by reducing cost of fertilizers.
- Lake & water bodies recharge ground water aquifers & help in tube well irrigation.
- Social cohesion - Lakes exist as Common Property Resources.

10.2 Benefit to Nature?

- Top soil of the dried lakes, ponds and tanks are rich in organic content (humus). Thus, dredged soil can be supplied to farmers which will give immense benefits like requirement of less or no nutrient inputs, high yield & good quality production
- This soil can also be used to cover less fertility soils like red laterite soil for making them fertile and drought proof as this soil has good water retention capacity
- Rejuvenation of lakes leads to groundwater replenishment with more percolation of water, and also increases water holding capacity: increases availability of water.
- It helps in development of biodiversity.
- Water bodies triggers birds migration.

10.3 What are the impacts of polluted lakes?

- The microbes feeding on the rotting organic matter consume all the oxygen in the water, disturbing the ecology for the survival of fish life.
- When such organic matter naturally breaks down, it releases fatty acids that float to the surface.
- These act as natural surfactants, which allow minute bubbles to form which often persist for a long time. This is how foam is formed and turns into froth.
- Phosphorus in detergents entered into wastewater which hugely promotes the growth of water plants.

10.4 What are the measures adopted by government?

- Dredging of dried lake beds and tank beds in the drought affected areas

- Implementation of Wetland Conservation measures as per Ramsar Convention
- Digging deep trenches surrounding the lakes to avoid waste dumping, especially in urban areas
- Exclusive missions of various state governments like Mission Kakatiya of Telangana for rejuvenating lakes, ponds and tanks.
- Rejuvenation works taken up under MGNREGA, PMKSY etc.
- New Municipal and Solid Waste Management Rules mandates segregation, recycling and reuse of waste & emphasis on waste treatment before discharging.

10.5 Conclusion

Rejuvenation of lakes and tanks is an important step in recharging groundwater and fighting drought, especially in India. Therefore, it is high time that the government should initiate strong steps to protect and rejuvenate all lakes and other existing water bodies.

Prevailing laws are ineffective as far as the protection or conservation of aquatic ecosystems is concerned as most of them indirectly touch wetland protection (fragmented approach);

- Wildlife (Protection) Act - 1972
- Water (Prevention and Control of Pollution) Act - 1974
- Territorial Water, Continental Shelf, Exclusive Economic Zone and other Marine Zones Act - 1976
- Water (Prevention and Control of Pollution) Amendment Act - 1977
- Maritime Zone of India (Regulation & fishing by foreign vessels) Act - 1980
- Forest (Conservation) Act - 1980
- Environmental (Protection) Act - 1986
- The Indian Fisheries Act - 1857
- The Indian Forest Act - 1927
- Coastal Zone Regulation Notification - 1991
- Wildlife (Protection) Amendment Act - 1991
- National Conservation Strategy and Policy Statement on Environment and Development - 1992

India, in spite of being a signatory to the Ramsar Convention on Wetlands and the Convention of Biological Diversity, there is no significant development towards sustaining these ecosystems, either due to lack of coordination among agencies involved or lack of awareness of the values of wetlands among the policy makers and implementation agencies. The effective management of these wetlands requires a thorough appraisal of the existing laws, institutions and practices. The involvement of various people from different sectors is essential in the sustainable management of these wetlands.

A clear understanding of limnology and geographic information systems (GIS) will help in devising better monitoring mechanisms of the physical, chemical and biological characteristics along with spatial and temporal aspects of wetland resources. Management based on accurate knowledge and increased awareness of wetland issues involving all stakeholders and components of ecosystem help in long-term conservation of these fragile ecosystems. This also would enhance the function and value of the system in terms of natural and socioeconomic factors to satisfy critical resource needs of the human population.

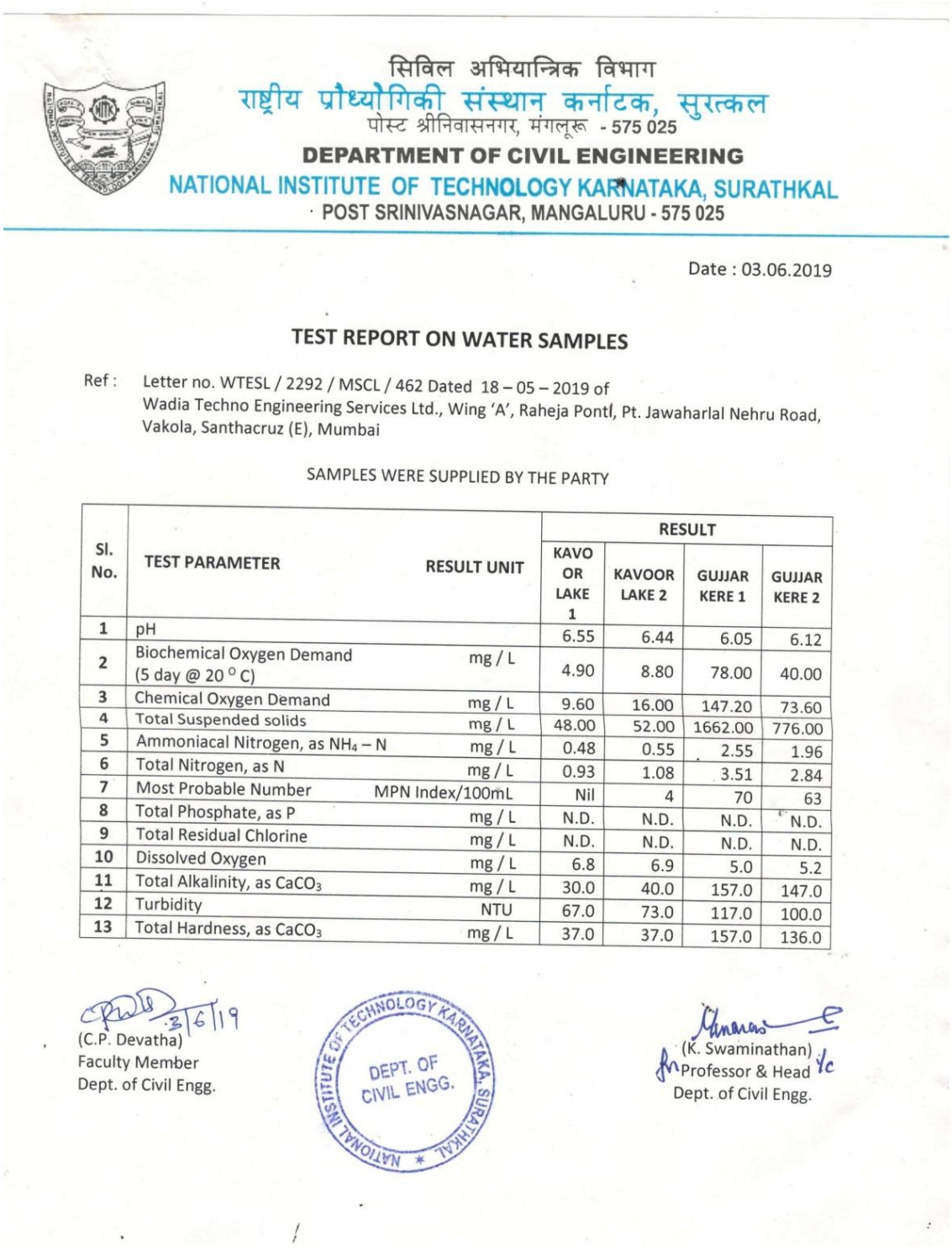
"Lakes are important ecosystems that, when respected and cared for, can sustain a healthy balance of aquatic life, provide us with much enjoyment, and help support our socio-economic needs"

11 Annexures

11.1 Annexure 01: Water Sample test Report

BOD and COD tested in the samples of water collected from the lake shows it to be within the permissible limits.

Figure 11-1 Water Sample Test Report



सिविल अभियान्त्रिक विभाग
राष्ट्रीय प्रौध्योगिकी संस्थान कर्नाटक, सुरत्कल
पोस्ट श्रीनिवासनगर, मंगलूरू - 575 025
DEPARTMENT OF CIVIL ENGINEERING
NATIONAL INSTITUTE OF TECHNOLOGY KARNATAKA, SURATHKAL
POST SRINIVASNAGAR, MANGALURU - 575 025

Date : 03.06.2019

TEST REPORT ON WATER SAMPLES

Ref : Letter no. WTESL / 2292 / MSCL / 462 Dated 18 – 05 – 2019 of Wadia Techno Engineering Services Ltd., Wing 'A', Raheja Pontl, Pt. Jawaharlal Nehru Road, Vakola, Santhacruz (E), Mumbai

SAMPLES WERE SUPPLIED BY THE PARTY

Sl. No.	TEST PARAMETER	RESULT UNIT	RESULT			
			KAVOOR LAKE 1	KAVOOR LAKE 2	GUJJAR KERE 1	GUJJAR KERE 2
1	pH		6.55	6.44	6.05	6.12
2	Biochemical Oxygen Demand (5 day @ 20 ^{O} C)	mg / L	4.90	8.80	78.00	40.00
3	Chemical Oxygen Demand	mg / L	9.60	16.00	147.20	73.60
4	Total Suspended solids	mg / L	48.00	52.00	1662.00	776.00
5	Ammoniacal Nitrogen, as NH_4 – N	mg / L	0.48	0.55	2.55	1.96
6	Total Nitrogen, as N	mg / L	0.93	1.08	3.51	2.84
7	Most Probable Number	MPN Index/100mL	Nil	4	70	63
8	Total Phosphate, as P	mg / L	N.D.	N.D.	N.D.	N.D.
9	Total Residual Chlorine	mg / L	N.D.	N.D.	N.D.	N.D.
10	Dissolved Oxygen	mg / L	6.8	6.9	5.0	5.2
11	Total Alkalinity, as $CaCO_3$	mg / L	30.0	40.0	157.0	147.0
12	Turbidity	NTU	67.0	73.0	117.0	100.0
13	Total Hardness, as $CaCO_3$	mg / L	37.0	37.0	157.0	136.0

3/6/19
(C.P. Devatha)
Faculty Member
Dept. of Civil Engg.

NATIONAL INSTITUTE OF TECHNOLOGY KARNATAKA, SURATHKAL
DEPT. OF CIVIL ENGG.

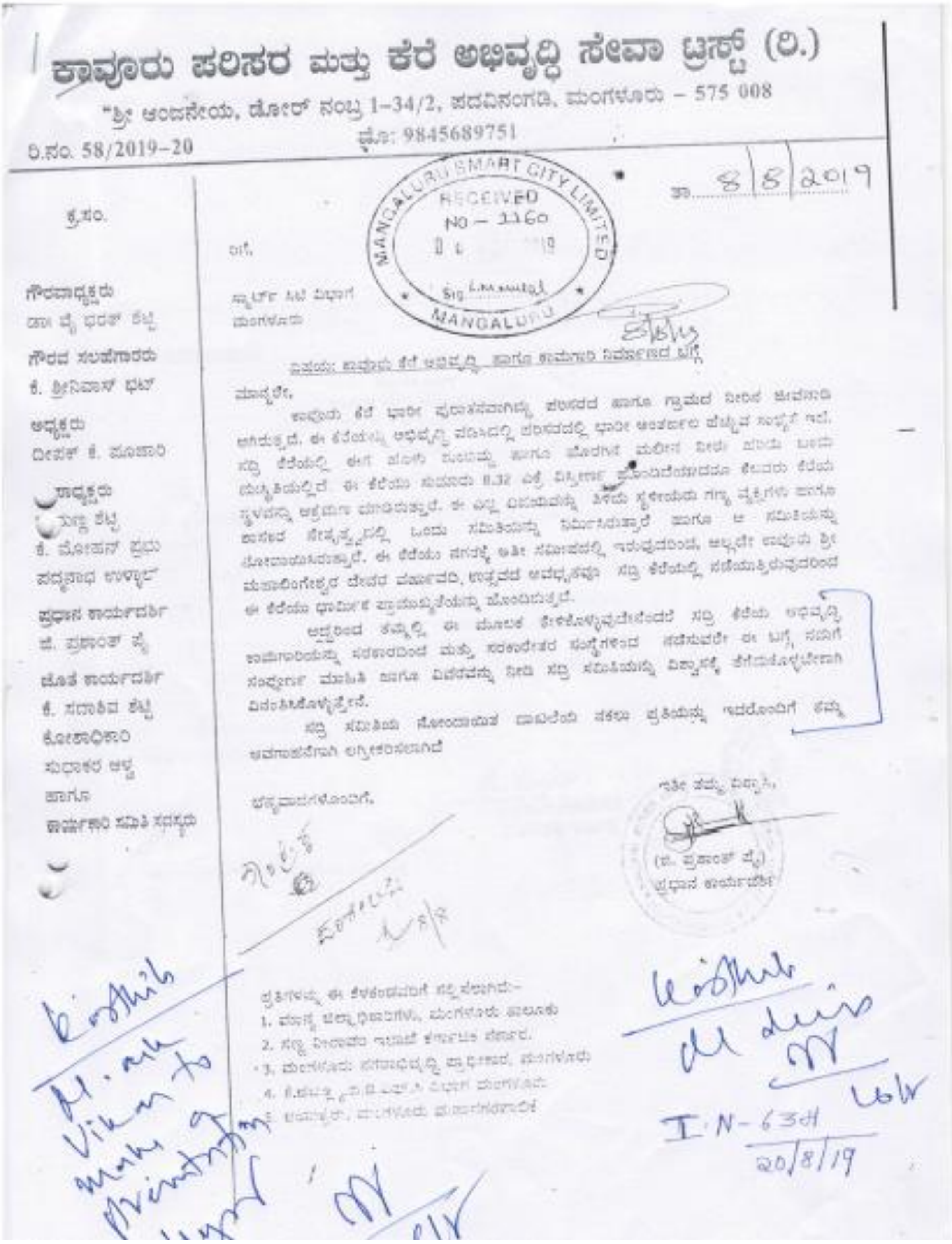
(K. Swaminathan)
Professor & Head
Dept. of Civil Engg.

Source: National Institute of Technology Surathkal

11.2 *Annexure 02: Stakeholder's Involvement*

Suggestions received from Kavoor Environmental and Lake development Seva Trust as a part of the stakeholder's involvement.

Figure 11-2 Suggestion Letter from Stakeholders


ಕಾವೂರು ಪರಿಸರ ಮತ್ತು ಕೆರೆ ಅಭಿವೃದ್ಧಿ ಸೇವಾ ಟ್ರಸ್ಟ್ (ರಿ.)

"ಶ್ರೀ ಆಂಜನೇಯ, ಡೋರ್ ನಂಬ್ರ 1–34/2, ಪದವಿನಂಗಡಿ, ಮಂಗಳೂರು – 575 008

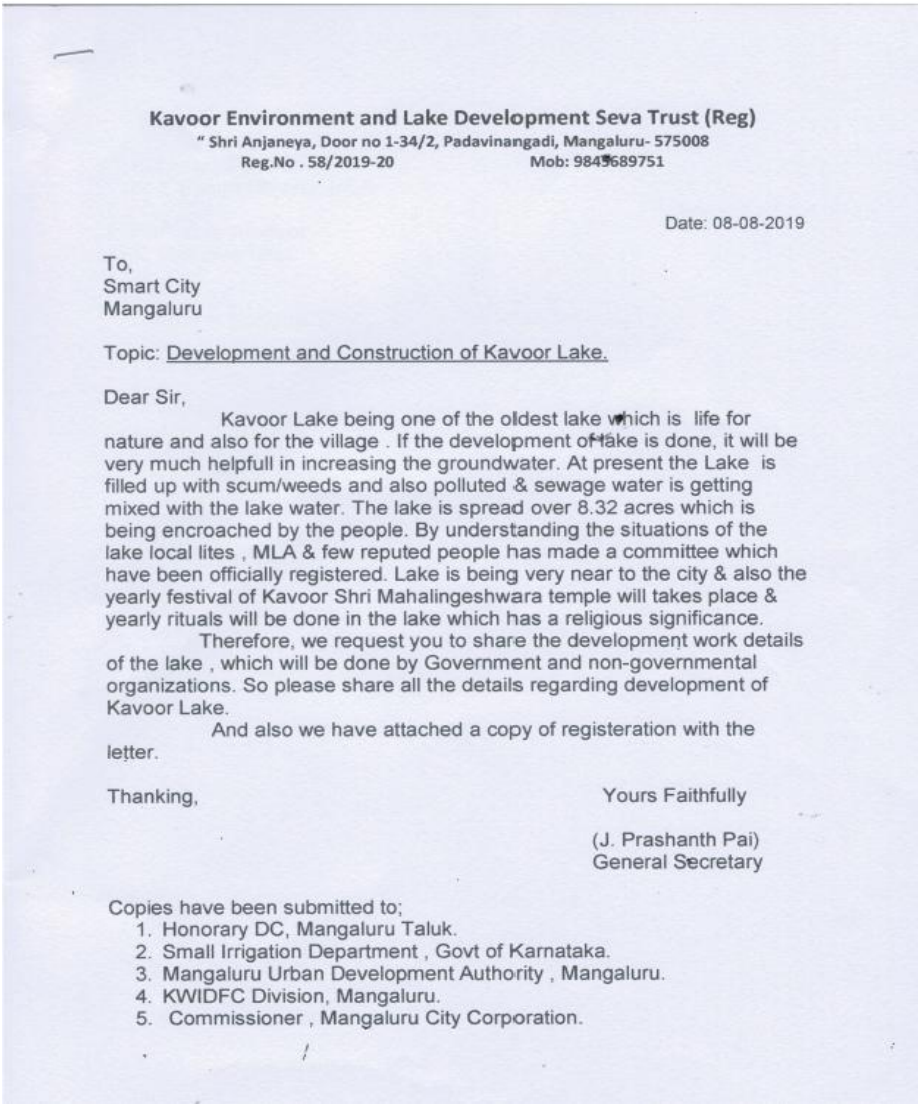
ಫೋ: 9845689751

ರಿ.ನಂ. 58/2019–20

ತಾ. 8/8/2019

11.3 Annexure 03: Kavoor Seva Trust Consensus Letter

Figure 11-3 Consensus letter from Kavoor Seva Trust



Kavoor Environment and Lake Development Seva Trust (Reg)
" Shri Anjaneya, Door no 1-34/2, Padavinangadi, Mangaluru- 575008
Reg.No . 58/2019-20 Mob: 9845689751

Date: 08-08-2019

To,
Smart City
Mangaluru

Topic: Development and Construction of Kavoor Lake.

Dear Sir,

Kavoor Lake being one of the oldest lake which is life for nature and also for the village . If the development of lake is done, it will be very much helpfull in increasing the groundwater. At present the Lake is filled up with scum/weeds and also polluted & sewage water is getting mixed with the lake water. The lake is spread over 8.32 acres which is being encroached by the people. By understanding the situations of the lake local lites , MLA & few reputed people has made a committee which have been officially registered. Lake is being very near to the city & also the yearly festival of Kavoor Shri Mahalingeshwara temple will takes place & yearly rituals will be done in the lake which has a religious significance.

Therefore, we request you to share the development work details of the lake , which will be done by Government and non-governmental organizations. So please share all the details regarding development of Kavoor Lake.

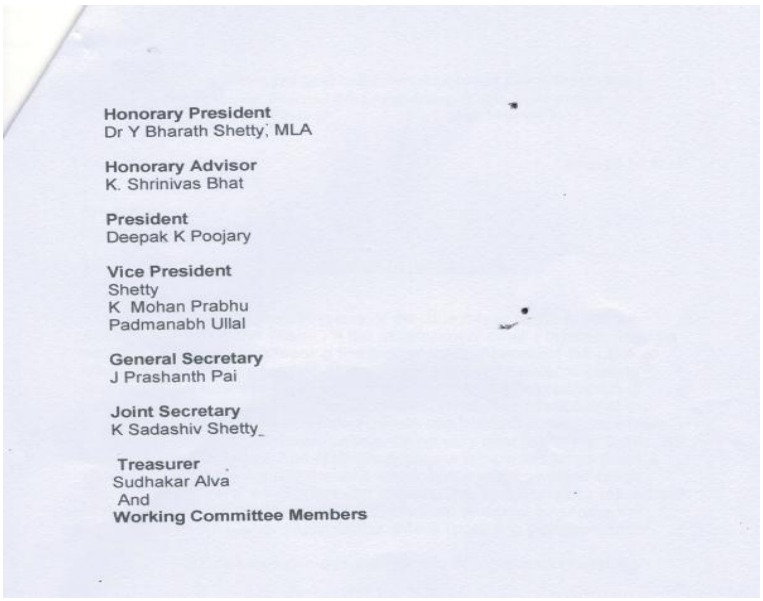
And also we have attached a copy of registeration with the letter.

Thanking,

Yours Faithfully

(J. Prashanth Pai)
General Secretary

Copies have been submitted to;
1. Honorary DC, Mangaluru Taluk.
2. Small Irrigation Department , Govt of Karnataka.
3. Mangaluru Urban Development Authority , Mangaluru.
4. KWIDFC Division, Mangaluru.
5. Commissioner , Mangaluru City Corporation.



Honorary President
Dr Y Bharath Shetty, MLA

Honorary Advisor
K. Shrinivas Bhat

President
Deepak K Poojary

Vice President
Shetty
K Mohan Prabhu
Padmanabh Ullal

General Secretary
J Prashanth Pai

Joint Secretary
K Sadashiv Shetty

Treasurer
Sudhakar Alva
And
Working Committee Members

11.4 Annexure 04: News Article

Figure 11-4 News article on Kavoor lake in national newspapers

THE NEW INDIAN EXPRESS

MANGALU

02 MANGALURU FRIDAY 10.05.2019

Kavoor Lake set to get a facelift, residents rejoice

DIVYA CUTINHA @ MANGALURU

If everything goes as planned, then Kavoor Lake in the city which is crying for attention due to encroachments, will bounce back to life very soon.

Smart City Managing director Narayanappa speaking to TNIE said that a survey of the lake has been completed to take up rejuvenation works. "A report on the survey conducted during May first week will be out soon and based on it, we will chalk out plans. The project is at its initial stage," he said.

This development comes as a big relief to Kavoor residents. Under Kavoor Kere Abhivrudhi Mandali they have been undertaking cleanliness drive at the lake from past 20 years. Mandali's vice-president Oswald Lewis who grew up playing around the lake recalls locals beating the summer heat at this pristine water body.

He said authorities should take immediate action to stop the sewage water from the nearby Maryhill, Padavinangady and other elevated areas entering the lake, besides putting an end to the dumping of meat and other waste into the water body.

Narayana Murthy, an activist said that several pleas to authorities to revive water wells, ponds and lakes around the city have fallen on deaf ears. "When Krishna Palemar was the district minister, he had got ₹1 crore and when Mohiuddin Bava was MLA he had got ₹10 lakh for laying embankment. However, nothing concrete has been done so far to rejuvenate the lake. The lake's boundary should be marked to prevent further encroachments. The lake which was about 8 acres has reduced to 5 acres due to land grabbing. Drainage flowing into the lake from surrounding apartments and houses should be stopped. Else, it will soon become another Bellandur."

Kavoor lake bed in Mangaluru is crying for revival | Rajesh Shetty Ballalbagh

> More than ₹3 crore fund is required to develop the lake. There are plans to introduce water boats, fishing and also to beautify the lake. The public should join hands to keep the lake clean.
> MLA Bharat Shetty

MLA Bharat Shetty said: "Work on desilting, underground drains and other works will be started soon. More than ₹3 crore fund is required to develop the lake. There are plans to introduce water boats, fishing and also to beautify the lake. The public should join hands to keep the lake clean. We are trying to avail funds from MUDA, CRZ, MRPL and NMPT. After election code of conduct comes to an end, we will look into allegations of encroachments. We do not want this to be another city like Bengaluru. We will draw a full-fledged action plan to revive the lake after May 23."

TIMES

Kavoor lake is left in a pathetic state

Was On 15 Acres Which Is Now Down To 5 Acres

Chethan.Misquith
@timesgroup.com

Mangaluru: The Kavoor lake, which was supposed to provide respite to scores of people from stressful urban life some years ago, is now in a pathetic state with one-third of its original area being encroached upon, and the remaining being used as a drainage disposal area.

The lake, one of the biggest lung spaces in the city, now stinks of drainage in its corners. Waste, mainly plastic products, are seen floating on the surface across the lake. Narayan Kalyanthaya, an activist and former officer at BSNL, told TOI that despite a huge amount of money being sanctioned with the view of developing the lake, nothing concrete had been achieved so far, except its boundaries being marked.

Numerous memorandums submitted at various government offices and to political leaders have fetched little or no response.

"While on the one hand the lake hasn't been desilted since years, on the other, drainage from most of the neighbouring apartment complexes is let into the lake. If the lake is maintained properly, it certainly will turn out to be a good source of water. If left unattended, the underground water will get contaminated," he said.

FAILED PLAN: In 2011, the then Mangaluru City North MLA J Krishna Palemar had announced a revival project for the lake. He had chalked out a rejuvenation plan at a cost of Rs 1 crore, which didn't materialise

In the second half of 2011, the then Mangaluru City North MLA J Krishna Palemar had announced revival of the lake, and to make it a picnic spot. He had chalked out a rejuvenation plan at a cost of Rs 1 crore, which included desilting, diversion of sewer lines leading to the lake, and construction of a bund. However, the project did not see the light of the day. According to Palemar, the lake was on an area of 15 acres several decades ago, but around 40% of it had been encroached over the years. In the recent past, the lake has been subject to further encroachments, reducing it to only around five acres.

Dr Y Bharath Shetty, MLA, Mangaluru City North, told TOI that the Mangalore Refinery Petrochemicals Limited (MRPL) has assured to rejuvenate the lake under its corporate social responsibility activity.

He said a committee involving locals has been formed, and this committee will monitor the work.

He said though a proposal seeking funds was placed before the government, he was yet to receive a response in this connection.

Source: The Indian Express and The Times of India

11.5 Annexure 05: Public Awareness

Figure 11-5 Photographs of public awareness campaigns done for Kavoor lake

Source: Louis Berger Analysis