REVIVING THE VAIGAI A VIBRANT CULTURAL AND SOCIAL RIVERFRONT FOR TEMPLE CITY

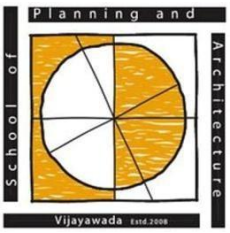
Thesis Submitted

in the partial fulfilment of the requirements for
the award of the degree of

Master of Architecture
(Landscape Architecture)

By
Kargi S
Reg. No.1230700095

Supervisor:
Ar. Kapil Natawadkar
Assistant Professor



Department of Planning/Architecture
School of Planning and Architecture, Vijayawada

MAY 2025

U N D E R T A K I N G

I, Ms. **Kargi s**, hereby declare that the thesis titled "**Reviving The Vaigai A Vibrant Cultural And Social Riverfront For Temple City**" is a record of original research work undertaken by me towards partial fulfilment of the requirements for the award of the Master of Architecture in the Department of Architecture, School of Planning and Architecture, Vijayawada. The work has not been submitted to any other organization/ institution for the award of any Degree/Diploma.

I hereby confirm the originality of the work and that there is no plagiarism in any part of the Thesis.

Name: Kargi S
Reg. No. 1230700095
2023-25
Master of Architecture
Department of Architecture

Date: 20-05-2025

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BONAFIDE CERTIFICATE

Certified that this thesis titled **"Reviving The Vaigai A Vibrant Cultural And Social Riverfront For Temple City"** is a bonafide work of **Kargi. S**, who carried out the research under my/our supervision. Certified further, that to the best of my knowledge the work reported herein does not form part of any other thesis or dissertation on the basis of which a degree or award was conferred on an earlier occasion on this or any other scholar.

Place: Vijayawada
Date: 20-05-2025

Signature of the Supervisor
Ar. Kapil Natawadkar
Assistant Professor
Department of Architecture

योजना तथा वास्तुकला विद्यालय, विजयवाड़ा
School of Planning and Architecture, Vijayawada
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CERTIFICATE

This is to certify that the thesis titled **"Reviving The Vaigai A Vibrant Cultural And Social Riverfront For Temple City"** has been submitted by **Kargi.S** (Reg. No. **1230700095**) at the Department of Architecture, towards partial fulfilment of the requirements for the award of Master of Architecture. This is a bonafide work of the student.

RECOMMENDED

Signature of the Supervisor
Ar. Kapil Natawadkar
Assistant Professor
Department of Architecture

ACCEPTED

Signature of the Head,
Department of Architecture
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The content produced in the dissertation report is an original piece of work and takes due acknowledgement of referred content, wherever applicable. The thoughts expressed herein remain the responsibility of the undersigned author and have no bearing on or does not represent those of School of Planning and Architecture, Vijayawada.

Name: Kargi S
Reg. No. 1230700095
2023-25
Master of Landscape Architecture
Department of Architecture

Date: 20-05-2025

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ACKNOWLEDGEMENTS

Develop an attitude of gratitude, and give thanks for everything that happens to you, knowing that every step forward is a step towards achieving something bigger and better than your current situation.

--Brian Tracy

I would like to express my gratitude to Ar. Kapil Natawadkar for offering guidance and immense support during this entire thesis and helping me in various stages of the design. I am thankful to External Panel Member for enriching me with his knowledge and guiding me with his valuable experience during the various stages of my thesis review sessions. I thank all the faculty members of the Department of Architecture for the encouragement and inspiration.

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ABSTRACT

This project focuses on revitalizing a 4-km stretch of the Vaigai River in Madurai, addressing environmental degradation and community detachment from the river. The river once sustained vibrant cultural and ecological networks but is now clogged by waste, with encroachment and poor management exacerbating flooding risks. The proposal integrates cultural and social strategies to create a vibrant riverfront thereby drawing on the city's unique water systems and rich heritage. Key interventions include ecological NMT corridors, public Ghats for bathing and recreation. Adding Public amenities such as pedestrian pathways, cycle tracks, and open-air plazas will encourage recreation and community interaction. Landscaped gardens, shaded seating areas, and performance spaces will celebrate Madurai's rich cultural heritage, providing a platform for local artists and festivals. The channel which connects the Vadiyur lake to the Vaigai river was also revive the traditional water connection. The design incorporates seasonal adaptability, ensuring the river remains a vibrant public space year-round. The project seeks to reconnect Madurai's residents with their river, fostering sustainable urban development while preserving the Vaigai's cultural legacy.

CHAPTER 1: INTRODUCTION

The Vaigai River has long been the lifeline of southern Tamil Nadu, shaping the growth and sustenance of the region's civilization. Flowing through the heart of Madurai—one of the oldest inhabited cities in India—the Vaigai has historically played a crucial role in supporting agriculture, enabling trade, and nurturing cultural and spiritual life in the region. The river has not only provided water for drinking and irrigation but also formed the backdrop for countless traditions, festivals, and rituals unique to Tamil culture. The Vaigai is deeply embedded in the literature, mythology, and collective memory of the Tamil people, symbolizing both physical nourishment and cultural continuity.

However, in recent times, the Vaigai faces mounting pressures from over-extraction of water, pollution from urban and agricultural runoff, and erratic flow patterns driven by climate variability. Once a central element of community life, the river is now often overlooked—reduced to a seasonal stream in many stretches, heavily burdened with waste, and disconnected from the cities it once sustained. The decline of the Vaigai mirrors the broader challenges faced by rivers across India, underscoring the urgent need for environmentally sensitive, climate-resilient, and culturally inclusive riverfront planning and restoration efforts.

1.1 Understanding riverfront:

Riverfronts can be seen as the origin of human culture and economy. In fact, most of the earliest settlements developed on the banks of rivers. They serve as an excellent opportunity for recreational spaces within a city, intra and inter-city navigation along the water channels, livelihood generation in the form of fishing/ agriculture/ and other activities, spaces for religious/ cultural/ historical connect with the city, generating avenues for promoting tourism, and most importantly saving open areas to serve as a lung-space within the city's built-up fabric. (URBAN RIVER MANAGEMENT PLAN).

1.2 Evolution of Waterfronts Development:

Living besides and building along riverfronts has various challenges Such as the risk of loss of life and property and spread of insects and disease due to contaminated water. In India and other developing countries, such risks are

disproportionately borne by economically weaker sections of society who reside in such areas due to the lower costs of land in these unimproved areas. Urban riverfront development projects frequently overlook the socio-economic consequences of displacing existing communities. These initiatives tend to emphasize physical infrastructure such as construction, landscaping, and beautification, along with the anticipated economic gains. However, they often pay insufficient attention to crucial aspects like social equity, hydrology, environmental sustainability, and ecological balance. Ignoring these factors has repeatedly resulted in serious issues, including ecological degradation, water-related disasters such as urban flooding, and damage to life and property. Riverine ecosystems, when preserved, offer essential services like groundwater recharge, flood regulation, biodiversity enhancement, and microclimate stabilization. Moreover, well-maintained urban rivers can foster livelihoods through fishing, recreational activities, and water-based tourism. (Guidance Note for Environmentally Sensitive, Climate Adaptive and Socially Inclusive Urban Riverfront Planning and Development).

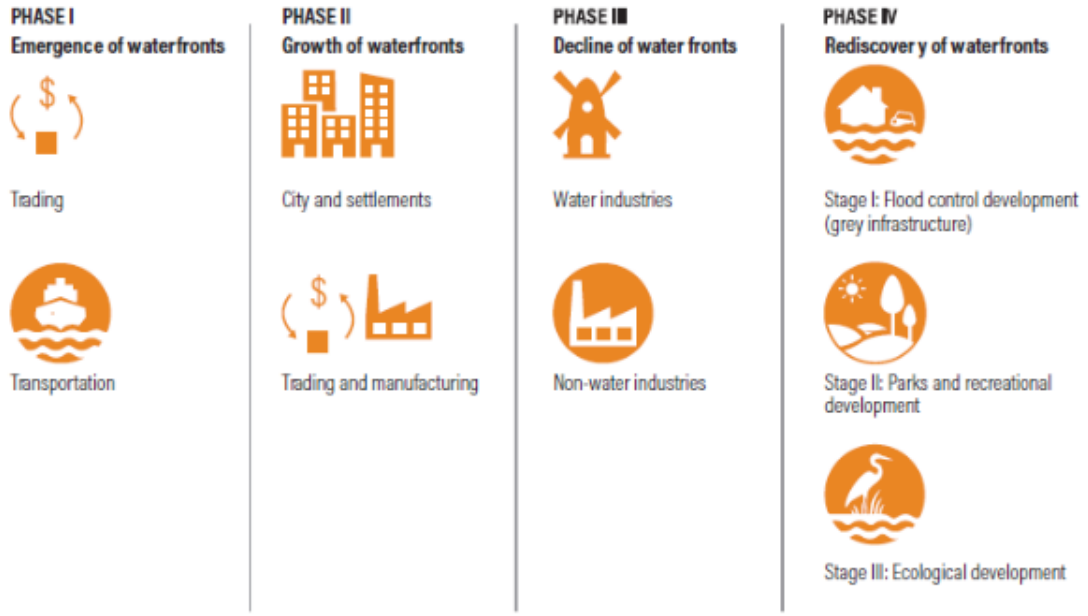


Figure 1- Evolution of Waterfronts Development (Guidance Note for Environmentally Sensitive, Climate Adaptive and Socially Inclusive Urban Riverfront Planning and Development)

1.3 Purpose of the study:

The purpose of this study is to assess the current condition of the Vaigai Riverfront, particularly within urban areas such as Madurai, and to explore opportunities for its environmentally sensitive and socially inclusive rejuvenation. The study aims to:

- Understand the environmental, cultural, and economic roles the Vaigai River has played historically and continues to play today.
- Identify key issues affecting the riverfront, including pollution, encroachment, water scarcity, and loss of public access.
- Evaluate the potential for ecological restoration, climate adaptation, and sustainable urban development along the river.
- Propose strategies and design guidelines for the revitalization of the Vaigai Riverfront that reconnect communities to the river, enhance biodiversity, and improve resilience to future climate challenges.

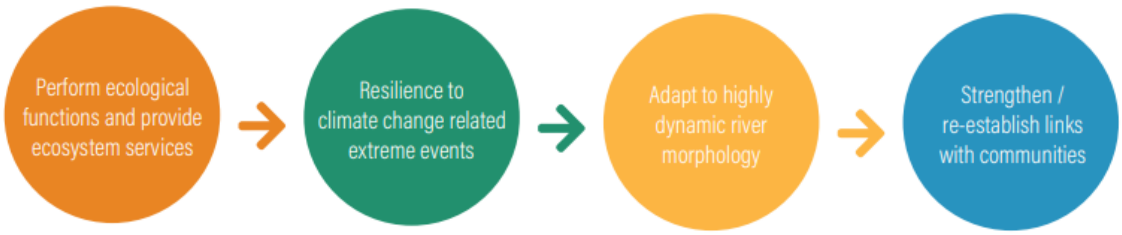


Figure 2 Guidelines for Riverfront (Guidance Note for Environmentally Sensitive, Climate Adaptive and Socially Inclusive Urban Riverfront Planning and Development)

CHAPTER 2: SYNOPSIS

2.1 Aim:

The aim of this thesis is to rejuvenate the Vaigai River as a vibrant cultural, ecological, and social corridor, transforming a 4-kilometer stretch in Madurai into a sustainable and inclusive riverfront. The project seeks to restore the river's environmental health, reconnect the community with its rich cultural heritage, and create multifunctional spaces that integrate recreation, tradition, and ecological balance.

2.2 Objective:

- To restore the Vaigai River as a vibrant and sustainable cultural, and recreational corridor in Madurai, the temple city.
- To activate the river edges through multifunctional zones by enhancing accessibility and connectivity
- To create a cultural corridor that facilitate the temple precision and festivals
- To Mitigate Urbanization Impacts through instilling a sense of belonging in citizens.

2.3 Scope:

- The design will address the restoration of ecosystems around the river, focusing on channels, livelihoods, habitat creation, and the promotion of biodiversity
- Creating public Ghats, open-air plazas, and landscaped gardens for recreation and community interaction.
- Ecological strategies focus on water filtration, Seasonal flood management.
- Seasonal adaptability to ensure year-round functionality.
- Historical structures such as old mandapam, padithurai, these can be restored and integrated into the landscape design.

2.4 Methodology:

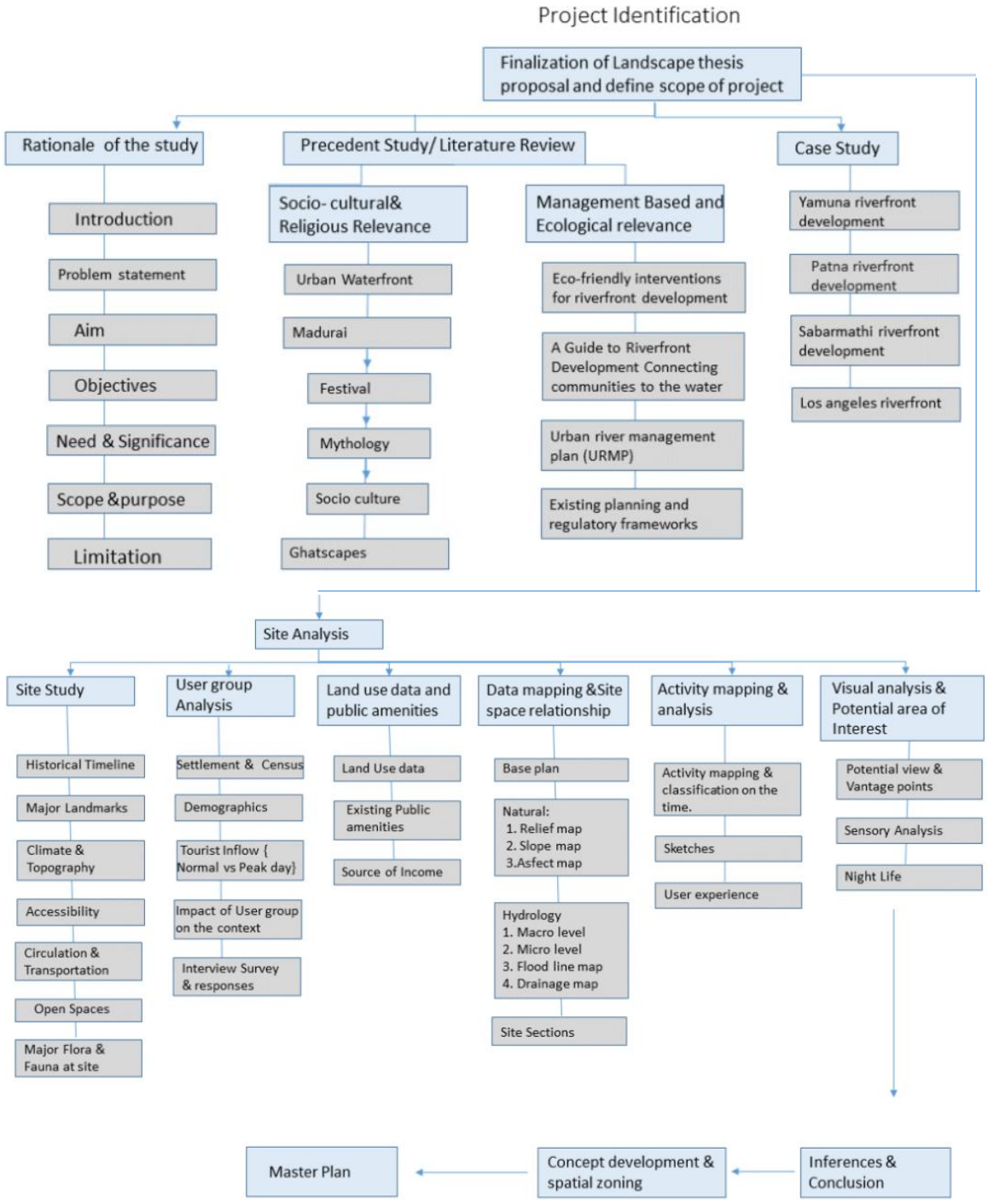


Figure 3 Methodology
Source: Author

2.5 Limitation:

The study is limited to a particular stretch of 4 km of Vaigai river

CHAPTER 3: LITERATURE REVIEW

The literature review anchors the thesis in a theoretical and precedent-based framework, helping guide the revitalization of the Vaigai Riverfront through tested principles, policies, and comparative studies. This section investigates the relationship between rivers and urban settlements, the evolving nature of riverfronts in Indian cities, principles of ecological design, and participatory frameworks for sustainable development.

3.1 Rivers and Urbanity: Historical Role

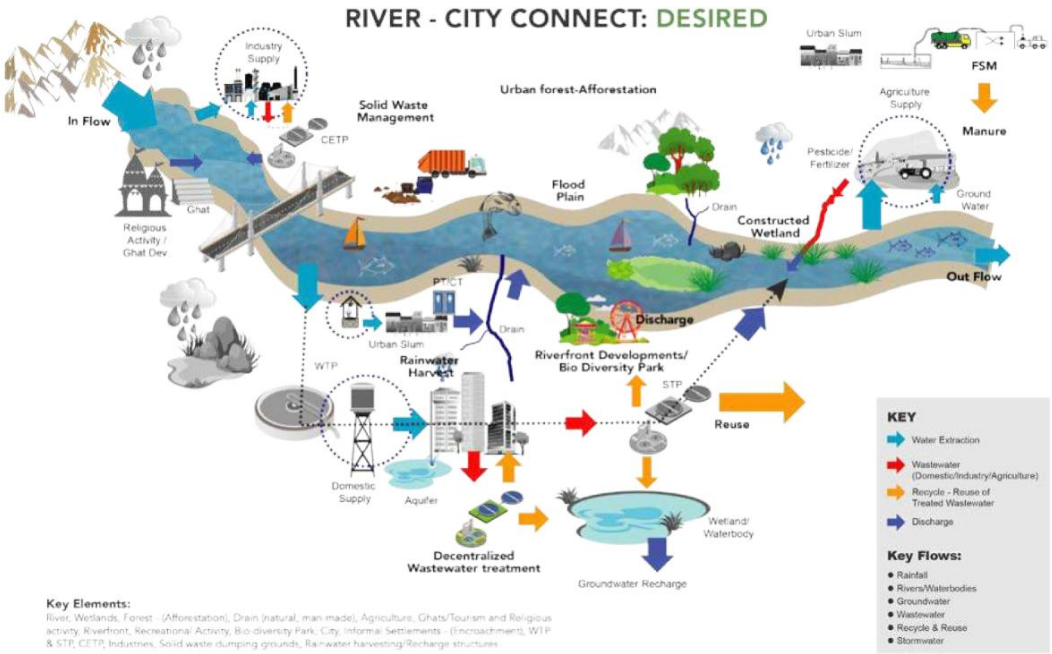


Figure 4 Existing situation of the river and city interaction (URBAN RIVER MANAGEMENT PLAN (URMP))

Historically, rivers served not only as sources of water and transportation but as focal points for spiritual, cultural, and civic life. (URBAN RIVER MANAGEMENT PLAN (URMP))Civilizations developed along rivers the Nile, Tigris-Euphrates, Indus, and Ganga — establishing settlements where rivers functioned as extensions of sacred landscapes. Riverfronts were ritual spaces, marketplaces, and venues for social interaction. Over time, however, urbanization, industrialization, and disconnection from nature led to their decline as civic spaces. In the Indian context, rivers have profound spiritual associations. Ghats in Varanasi, Haridwar, and Madurai exemplify how ritual and water interface with urban form. The architecture of temples, mandapams, and tanks was often

oriented toward the river. The erosion of this linkage forms the cultural basis for many contemporary riverfront revitalization projects.

3.2 The decline of Urban River:

The 20th and 21st centuries have witnessed a systematic decline in urban rivers globally. Studies show that urbanization leads to encroachment, pollution, habitat fragmentation, and altered hydrology. The concept of the "urban stream syndrome" explains how urban rivers suffer from increased peak flows, reduced base flows, and degraded water quality due to impervious surfaces and unregulated development. In India, rivers like Yamuna (Delhi) (Kanoi, 2022), Mithi (Mumbai),

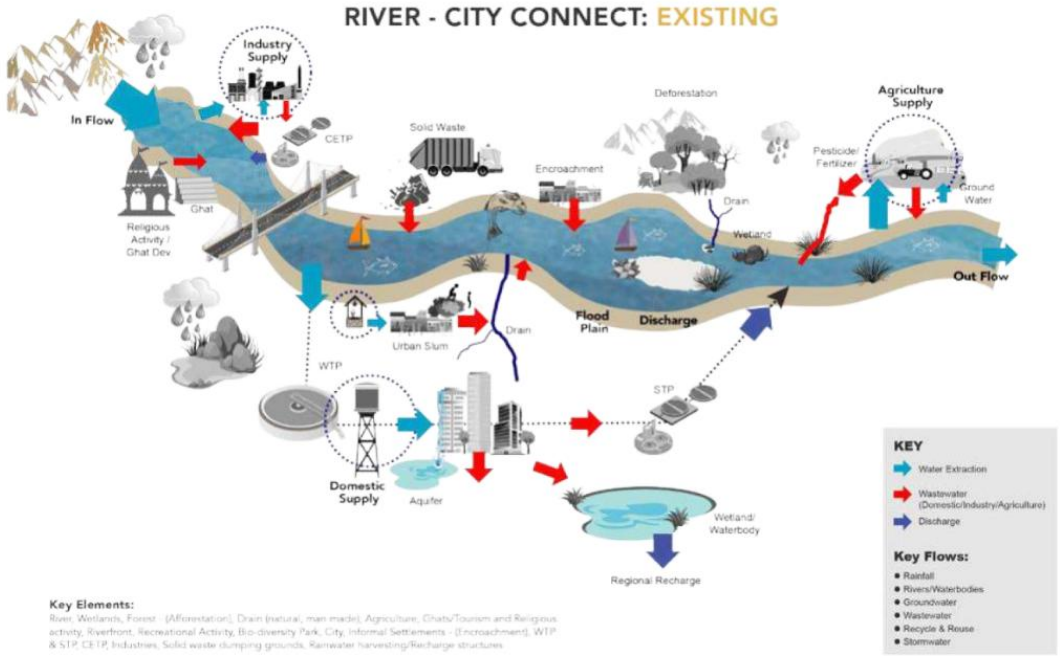


Figure 5 Desired situation of the river and city interaction (URBAN RIVER MANAGEMENT PLAN (URMP))

and Adyar (Chennai) have become highly polluted, disconnected from public use, and seen as waste carriers. In most cases, the riverfront is either privatized, inaccessible, or neglected (Kanoi, 2022). This growing disconnect has led to a revaluation of rivers as potential public landscapes.

3.3 Urban Riverfront Development(URD)

Urban riverfront development refers to the transformation of river edges into vibrant public spaces through integrated design and planning. These projects attempt to

balance ecological restoration with civic engagement, often incorporating parks, promenades, cultural nodes, and eco-sensitive infrastructure.

Examples of URD include:

- **Sabarmati Riverfront (Ahmedabad):** A mix of promenades, parks, and commercial spaces built on reclaimed land. (Patel)
- **Patna Ganga Riverfront:** Preserved historic ghats with public gathering spaces and lighting.
- **Cheonggyecheon Stream Restoration (Seoul):** Removal of an elevated highway to restore the urban stream with biodiversity corridors.

Key principles of URD include:

I. Continuity of river access

II. Cultural and ecological integration

III. Adaptive reuse of heritage

IV. Floodplain management

V. Public-private partnerships for funding

3.4 Urban River Management Plan (URMP)

The Ministry of Housing and Urban Affairs (MoHUA), Government of India, proposed the URMP framework in 2022 to support Indian cities in managing their rivers.

The guidelines include seven categories of recommendations as follows:

1. Removal of encroachments
2. Restriction/banning of certain activities on the riverbank
3. Development/restoration of the riverbank area
4. Prevention of the discharge of untreated sewage
5. Pumping and other infrastructure
6. Reuse of tertiary treated sewage

7. Disposal of sludge generated due to sewage treatment. (URBAN RIVER MANAGEMENT PLAN (URMP))

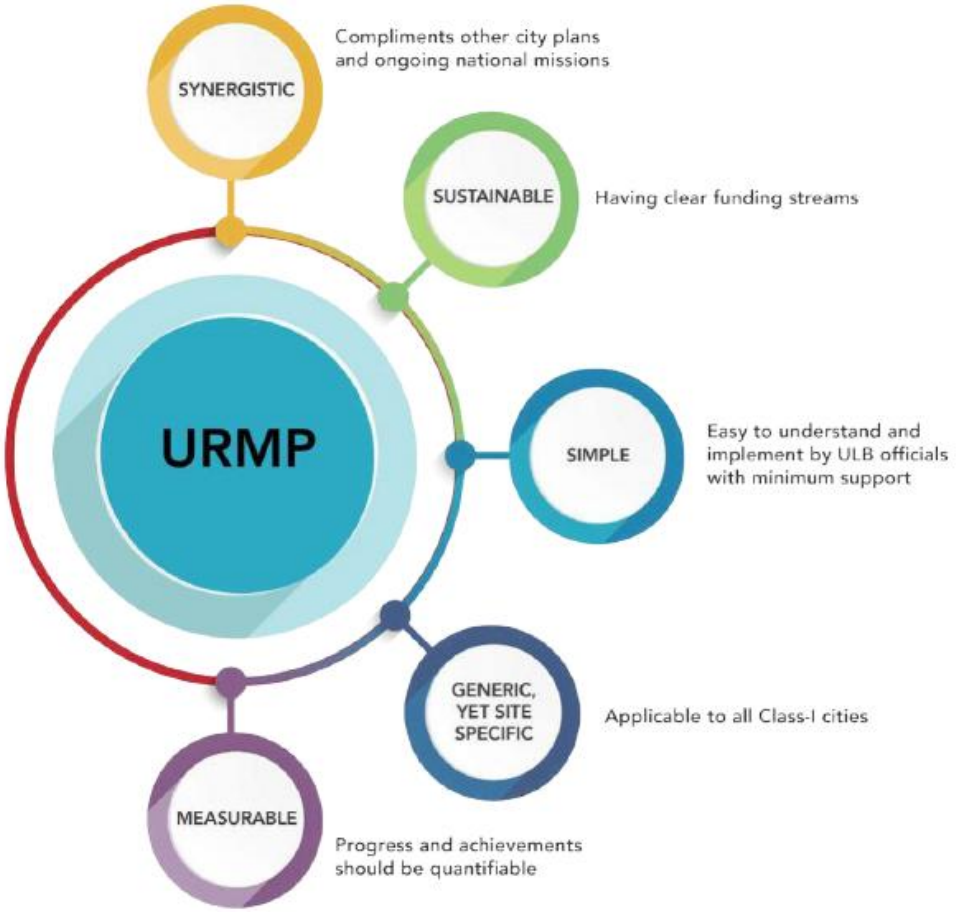


Figure 6 Design principles of the Urban River Management Plan framework (URBAN RIVER MANAGEMENT PLAN (URMP))

3.5 Water-Sensitive Urban Design (WSUD)

WSUD is an approach that integrates water management into urban design to reduce runoff, improve infiltration, and enhance amenity. Elements include bioswales, rain gardens, constructed wetlands, and green roofs. The goal is to align ecological processes with human infrastructure, a key strategy in this thesis. WSUD strategies are now being adapted to Indian contexts, especially where combined sewer-stormwater systems fail, and open drains carry untreated effluents. Incorporating WSUD principles into riverfront design enhances climate resilience, water quality, and biodiversity. (Guidance Note for Environmentally Sensitive, Climate Adaptive and Socially Inclusive Urban Riverfront Planning and Development)

3.6 Cultural Landscape Theory

The thesis also draws on the theory of **cultural landscapes**, as defined by UNESCO, where tangible and intangible cultural elements are woven into a landscape setting. In Madurai, the Vaigai is a cultural landscape where temples, festivals, water rituals, and traditional architecture coalesce. (VISWANATH, 2021)

- Revitalization must therefore retain symbolic and spiritual meanings while improving usability and ecological integrity. This requires:
- Respecting ritual spaces and movement paths
- Restoring original spatial hierarchies
- Enabling new uses without erasing memory

3.7 Livelihood and Equity Considerations

One critique of many riverfront projects in India is the exclusion of marginalized stakeholders, particularly informal settlers, washermen, and vendors. Livelihood integration is essential to avoid gentrification and displacement. Design must include:

- Spaces for dhobi ghats with storage and shelter
- Informal vending plazas
- Cattle ramps and watering zones
- Access for all age groups, genders, and mobility levels
- Successful models show that inclusive design enhances usage, respect, and protection of public spaces. (Guidance Note for Environmentally Sensitive, Climate Adaptive and Socially Inclusive Urban Riverfront Planning and Development)

3.8 Nature-Based Solutions (NBS)

NbS refers to the use of natural systems for addressing urban challenges. In riverfront contexts, this includes:

- Floodplain restoration
- Riparian buffer planting
- Bio-remediation through wetlands
- Urban forests and native groves

Such interventions not only improve ecology but also reduce infrastructure costs and contribute to mental well-being. NbS is increasingly recognized in national programs like AMRUT 2.0 and Smart Cities Mission (URBAN RIVER MANAGEMENT PLAN (URMP))

3.9 Existing Planning and Regulatory Frameworks

Table 1 Existing Planning and Regulatory Frameworks (URBAN RIVER MANAGEMENT PLAN (URMP))

Act/ Rules	Purpose	Applicability	Authority
Environment (Protection) Act, 1986	To protect and improve overall environment.	As all environmental notifications, rules and schedules are issued under this umbrella act.	Ministry of Environment, Forests and Climate Change, DoE, State Govt. Central Pollution Control Board, State Pollution Control Boards
Coastal Regulation Zone (CRZ) Notification 1991 (2011)	Protection of fragile coastal belts.	If project location is located along coastal belt.	
Land Acquisition Act, 1894 (as amended)	Sets out rules for acquisition of land by government.	Applicable in case of acquisition of land.	Revenue Department, State Government
Environmental Impact Assessment Notification 14th Sep-2006 (as amended)	Mandatory environmental clearance to a certain category of new development activities following environmental impact assessment.	Applicable in case built up area of the project is more than 20,000 sq.m and the total construction area is more than 1,50,000 sq.m	State Pollution Control Boards, State Environment Impact Assessment Authority
Wildlife (Protection) Act, 1972	To protect wildlife in sanctuaries and national parks.	This act is applicable if any sanctuary/ national park exists within 10 km radius of project site. This act will be applicable, if there are any points of protected wildlife crossings in proximity to project locations like River Dolphin, which is a schedule-I animal.	Chief Conservator Wildlife, Wildlife Wing, State Forest Department, Ministry of Environment, Forests and Climate Change

Table 2 Existing Planning and Regulatory Frameworks (URBAN RIVER MANAGEMENT PLAN (URMP))

Act/ Rules	Purpose	Applicability	Authority
Jal Jeevan Mission (URBAN), 2021	This mission's primary objective is to provide universal coverage of water supply across 4,378 statutory towns in accordance with United Nations Sustainable Development Goal 6. This mission takes an integrated approach and recognizes that rejuvenation of water bodies and sustainable aquifer management will be critical to augment sustainable fresh water supply.	Urban green spaces and sponge cities will mitigate flood impact and support development of urban water assets (surface and groundwater) through circular practices for recycle and recharge of treated wastewaters.	Ministry of Housing and Urban Affairs, urban local bodies
River Ganga (Rejuvenation, Protection and Management) Authorities Order, 2016	This order is for the purpose of effective abatement of pollution and rejuvenation, protection and management of the River Ganga, maintain ecological flows through its entire length, impose restrictions as required on industries and processes abutting River Ganga and to make provision for inspection of premises, plants, machinery, etc., to assess their impact on the river.	This Order shall apply to the states comprising the River Ganga Basin and its tributary rivers and streams and will guide during plan, implementation and evaluation phases.	Ministry of Jal Shakti, State Ganga Basin Authorities
National Water Policy, 2012	The National Water Policy, 2012 is envisioned as a framework law that can support essential legislation on water governance at State and Union level. This law enshrines the value that water be considered as element that sustains life and ecology and not merely as a scarce resource that has to be divided among various competing uses.	Section 8 about 'Conservation of River Corridors, Water Bodies and Infrastructure' details the value of urban rivers. Section 8.2 elaborates: Encroachments and diversion of water bodies (like rivers, lakes, tanks, ponds, etc.) and drainage channels (irrigated area as well as urban area drainage) must not be allowed. Wherever encroachment has occurred, restoration to the extent feasible should be undertaken and maintained properly.	Government of India, State governments, Ministry of Jal Shakti, Ministry of Housing and Urban Affairs
Air (Prevention and Control of Pollution) Act, 1981	To control air pollution by controlling emission of air pollutants as per the prescribed standards.	This act will be applicable during construction phase and may be applicable during operational phase (for e.g., if the project has any diesel generator set of more than 15 kVa capacity or a crematorium).	State Pollution Control Boards
Water Prevention and Control of Pollution) Act, 1974	To control water pollution by controlling discharge of pollutants as per the prescribed standards.	This act will be applicable during construction phase and may be applicable during operational phase.	State Pollution Control Boards
The Noise Pollution (Regulation and Control) Rules, 2000	The standards for noise for day and night have been promulgated by the MoEF&CC for various land uses.	This act will be applicable during construction phase.	State Pollution Control Boards
Central Motor Vehicle Act, 1988	To check vehicular air and noise pollution.	This act will be applicable during construction phase and may be applicable during operational phase.	Motor Vehicle Department
National Forest Policy, 1988	To maintain ecological stability through preservation and restoration of biological diversity.	This policy will be applicable if any eco-sensitive feature exists in and around the project.	Forest Department, State Government and Ministry of Environment, Forests and Climate Change

The literature reviewed highlights that riverfront revitalization is no longer just about aesthetics or beautification. It is a socio-ecological and cultural project that requires sensitivity to place, people, and process.

CHAPTER 4: BASIN STUDY

4.1 River Basins of Tamil Nadu:

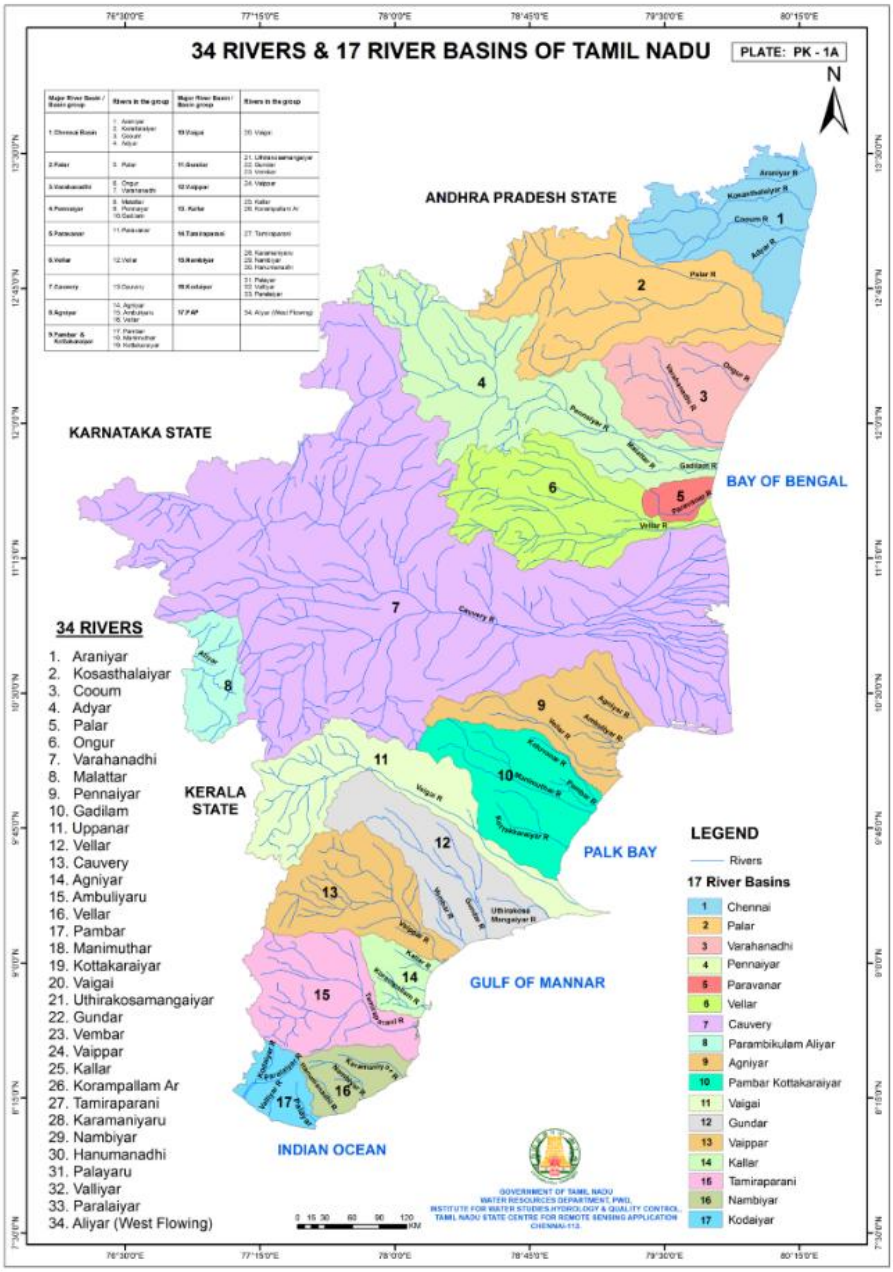


Figure 7 Basins of Tamil nadu
Source: Tnenvis

Tamil Nadu has a total of 34 river basins, which are consolidated into 17 groups for hydrological analysis. Among these is the Vaigai River basin, encompassing an area of approximately 7009.13 square kilometers, including around 2,101.68 square kilometers of hilly terrain. This basin spans across the districts of Theni, Dindigul, Madurai, Sivaganga, and Ramanathapuram. The Vaigai River, originating from the Varushanadu valley, along with its tributaries, forms a distinct and compact drainage system.

4.2 Vaigai river Basin:

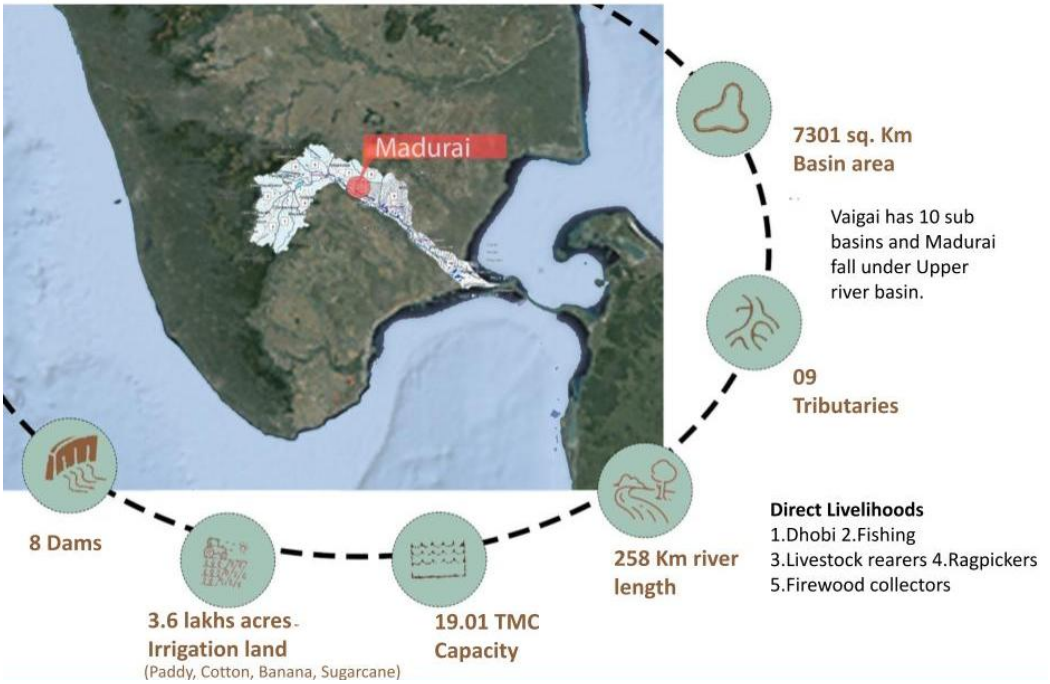


Figure 8 Vaigai Basin
Source: Author

The river Vaigai originates in the eastern slope of the Western ghat mountainous offshoot in the Varushanad area and drains into the Palk Bay of the Bay of Bengal. The length of the basin is about 258.59 km and the width varies from 15 to 55 km.

4.2.1 Vaigai river Sub Basin:

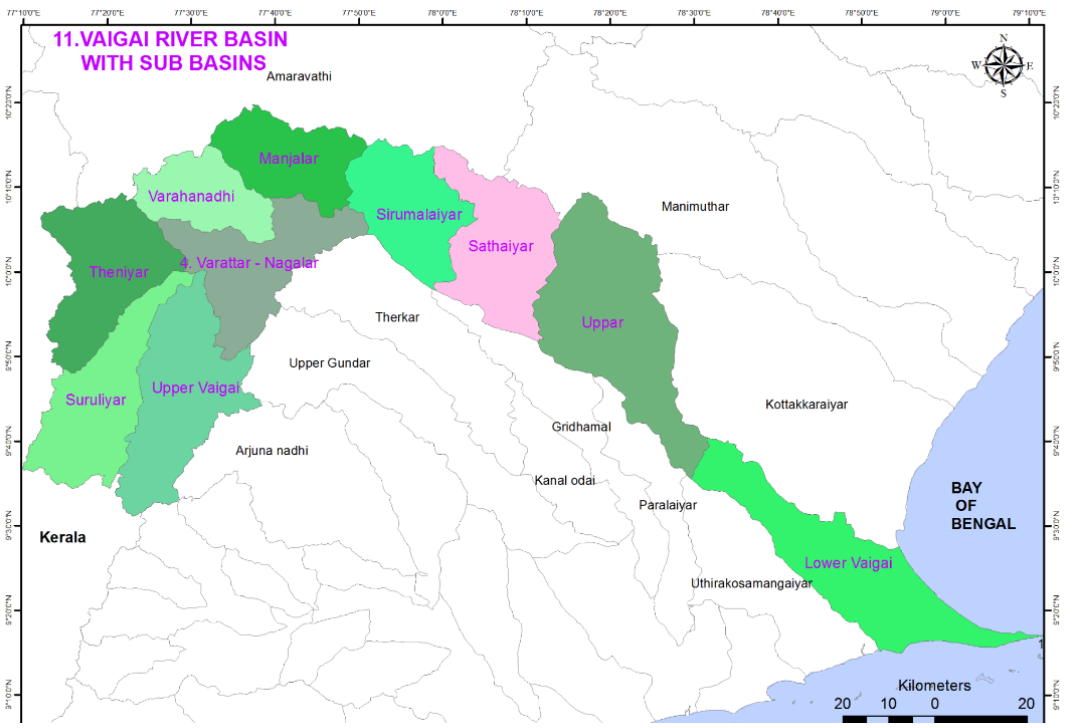


Figure 9 Vaigai Sub Basin (India WRIS)

The Vaigai basin is geographically bordered by the Cauvery and Pambar-Kottakaraiyar basins to the north, the Gundar basin to the south, the Periyar basin to the west, and the Bay of Bengal to the east. It stretches approximately 289.59 kilometers in length, with its width ranging between 15 and 55 kilometers. Major urban centers within this basin include Madurai, Cumbum, Uthamapalayam, Bodinayakkanur, Theni, Periyakulam, Nilakottai, Melur, Manamadurai, Paramakudi, and Ramanathapuram. (India WRIS)

4.2.2 Relief Map of Vaigai river Basin:

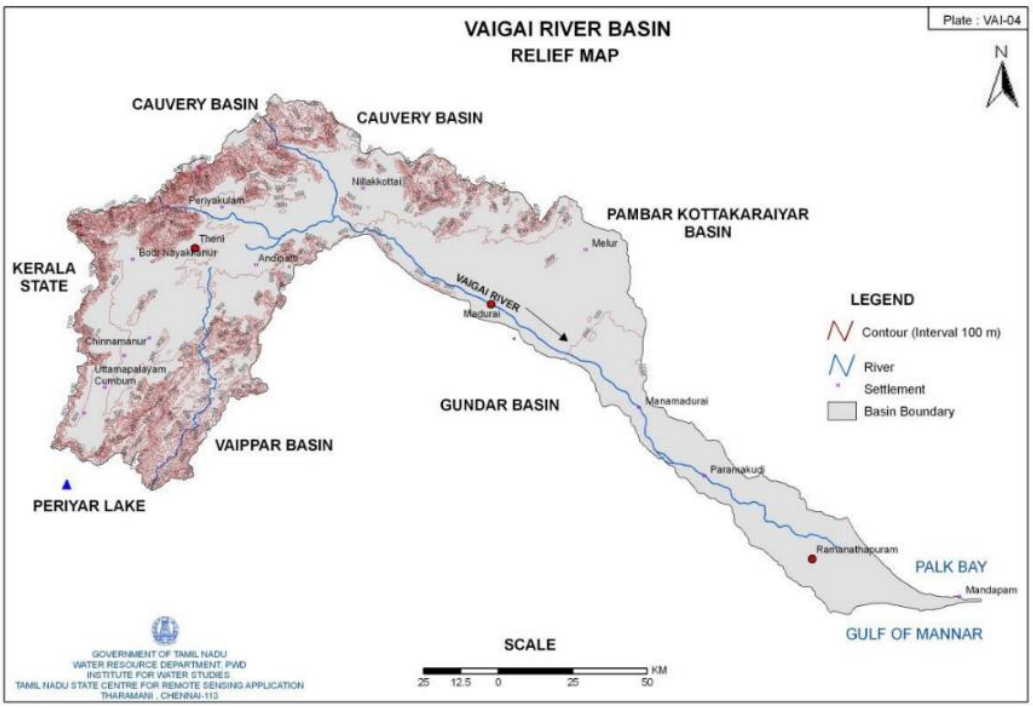


Figure 10 Relief Map of Vaigai Basin (India WRIS)

Physiographic perspective, the Vaigai basin can be broadly divided into three distinct zones:

1. The western region characterized by mountainous terrain and complex valleys,
2. A centrally located elevated landform, and
3. The eastern coastal plains. (India WRIS)

4.2.3 Vaigai river Basin Drainage:

The Vaigai River originates on the eastern slopes of the Western Ghats in the Varushanad hills and initially flows northward through Gandamanayakkanur. Near Kottapatti, it is joined by the Suriliyar and Theniar rivers. From this confluence, the

river changes direction, flowing eastward and southeastward before eventually emptying into the Bay of Bengal. Several important tributaries—including Varattar, Nagalar, Varahanadhi, Manjalar, Marudhanadhi, Sirumaliar, and Sathaiyar—rise in the Palani and Sirumalai hills and feed into the Vaigai along its course. Additionally, the Uppar River, originating from the Alagar hills, joins the Vaigai near Manamadurai. Before reaching the sea, the river passes through the Ramnad Big Tank, with only the surplus water continuing on to the ocean.

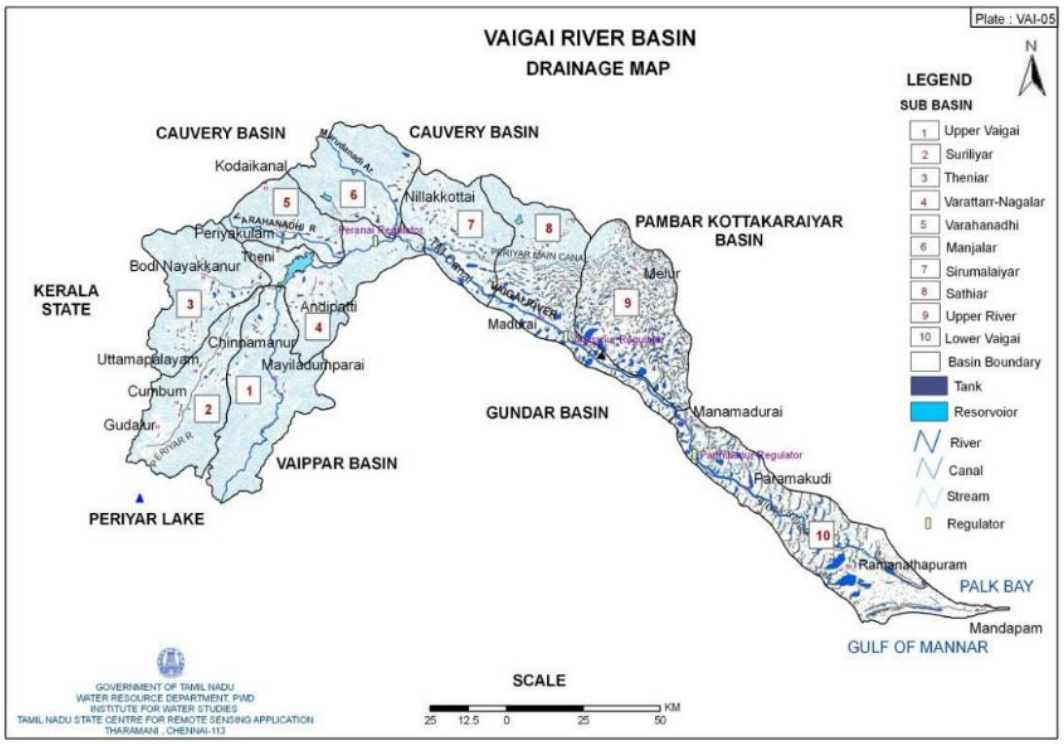


Figure 11 Vaigai Basin Drainage (India WRIS)

Table 3 Vaigai Sub Basin Area (India WRIS)

Sl. No.	Name of the sub basin	Total area in Ha.	Hilly area in Ha.	Percentage	Plain area in Ha.	Percentage
1	Upper vaigai	822.02	558.97	67.99	263.05	32.01
2	Suriliyar	640.10	217.95	34.05	422.15	65.95
3	Theniyar	651.65	310.84	47.69	340.81	52.31
4	VarattarNagalar	631.82	231.31	36.62	400.51	63.38
5	Varahanadhi	380.28	200.65	52.75	179.65	47.25
6	Manjalar	612.74	309.68	50.54	303.06	49.46
7	Surumalaiyar	541.59	131.66	24.30	409.91	75.70
8	Sathiyar	782.76	119.29	15.24	663.45	84.76
9	Uppar	882.29	21.35	2.42	860.94	97.58
10	Lower Vaigai	1063.88	-	-	1063.88	100.00
	TOTAL	**7009.13**	**2101.68**	-	**4907.43**	-

Based on its natural drainage characteristics, the Vaigai basin is divided into ten distinct sub-basins: Upper Vaigai, Suriliyar, Theniar, Varattar-Nagalar, Varahanadhi, Manjalar-Marudhanadhi, Sirumalaiar, Sathaiyar, Uppar, and the Lower Vaigai. Each sub-basin comprises unique combinations of hilly and plain landscapes. (India WRIS)

4.2.4 Vaigai river Basin Geology:

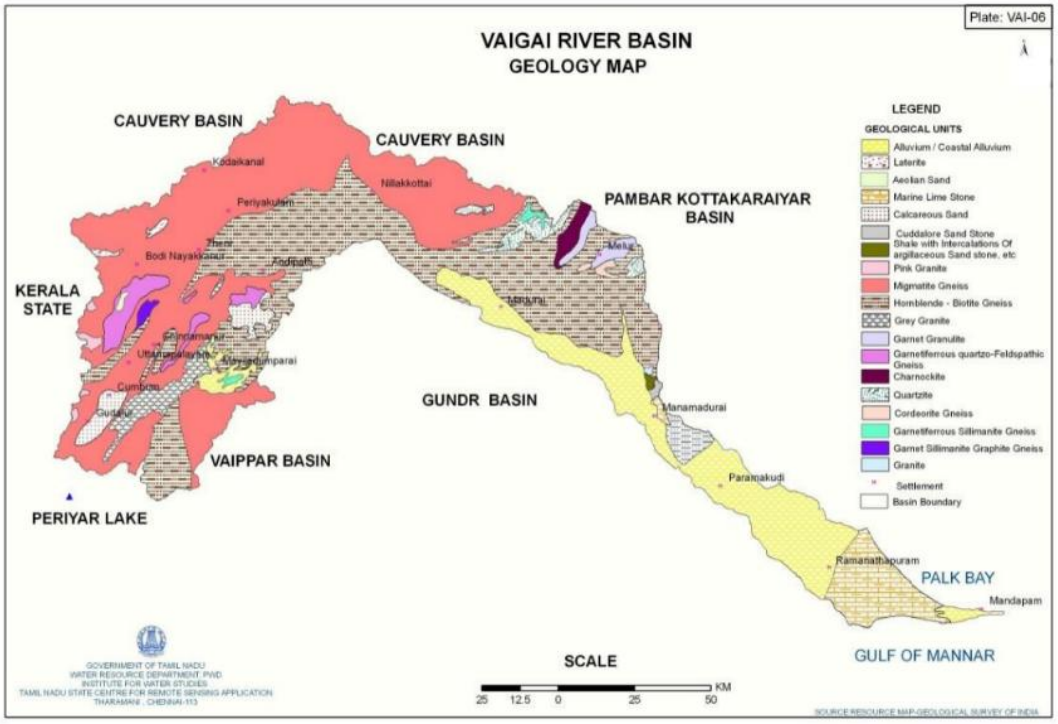


Figure 12 Vaigai Basin Geology (India WRIS)

Hard crystalline rock masses of Archaean age was foiund on the western portion; nearly 74% are sedimentary rocks of Upper Gondwana, Tertiary and quaternary age are on the eastern portion (26%). From Manamadurai to the Bay of Bengal, rocks of upper Gondwana, teritiary alluvium and coastal alluvium are spread over the Archaean formations unconformably. Aeolian sands are also found to occur in isolated pockets in the Cumbum valley and coastal areas. (India WRIS)

4.2.5 Vaigai river Basin Geomorphology:

Vaigai river lies in the Floodplain and are surrounded by pediment and buried pediment shallow. (India WRIS)

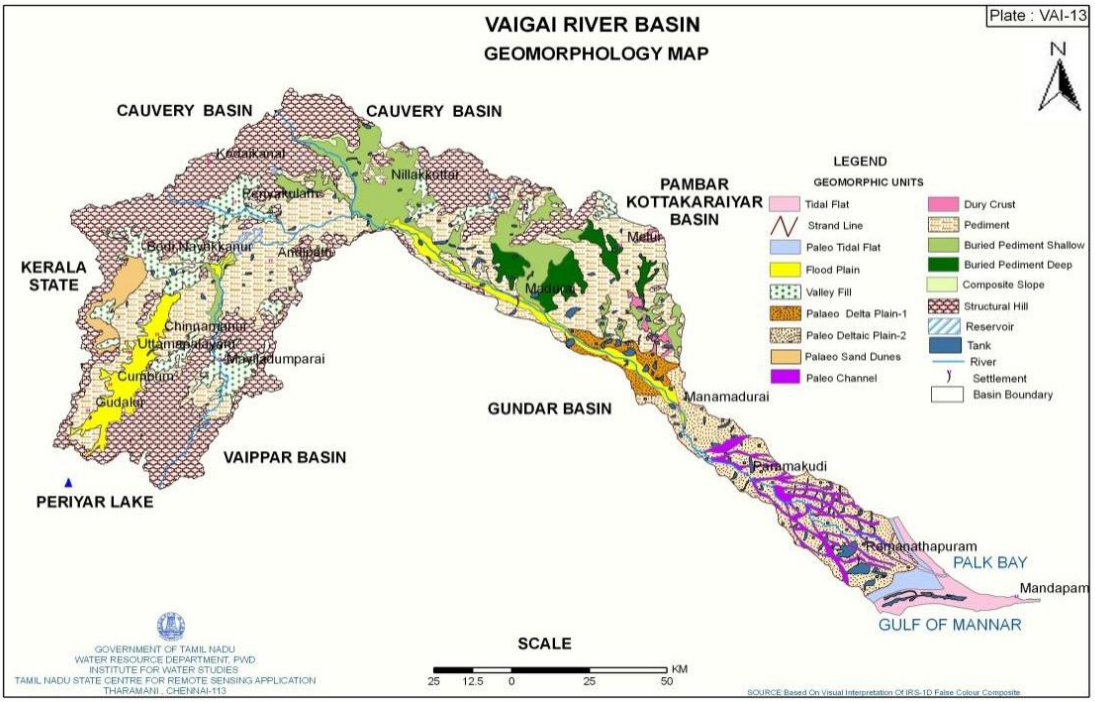


Figure 13 Vaigai Basin Geomorphology (India WRIS)

4.2.6 Vaigai river Basin LandUse:

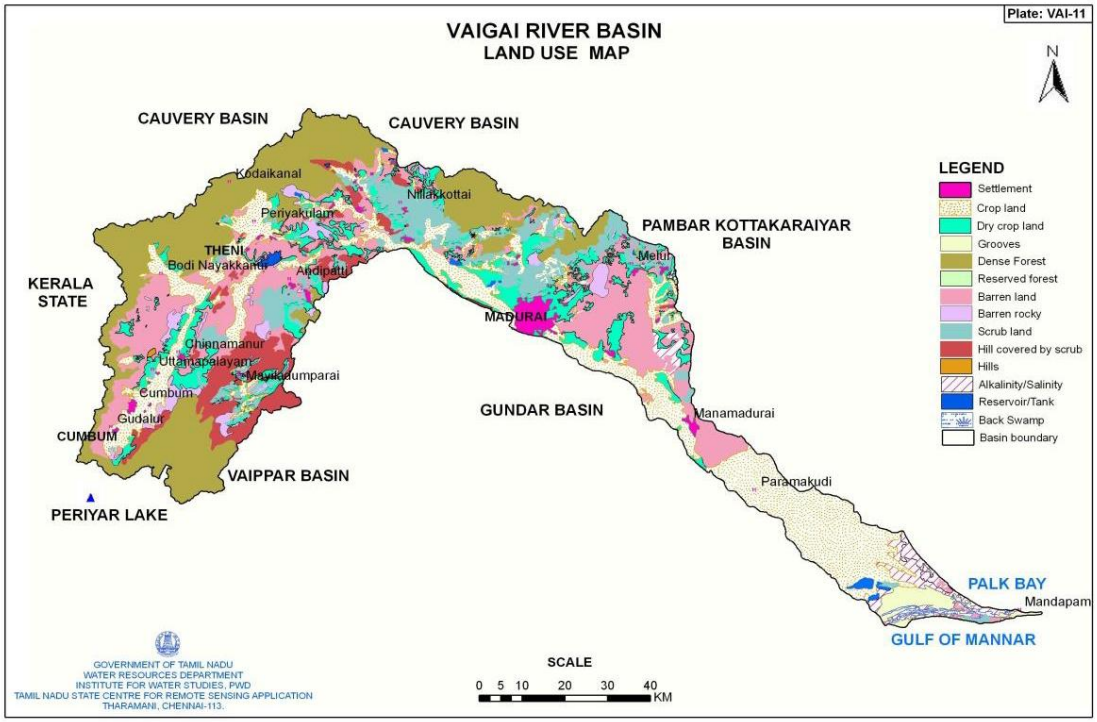


Figure 14 Vaigai River Land Use (India WRIS)

Table 4 Vaigai Basin Land Use (India WRIS)

Sl. No	Land use category		Area in Sq.Km	Percentage %
	I Level	II Level		
1	Built up land	Settlement	124.00	1.77
2	Crop land	**Wet crop land-** Paddy, Sugar cane and banana.	1574.20	22.45
		Dry crop land- Groundnut, ragi, cholam, cumbu, maize, cereals, cotton, chilies, black gram, vegetables, floriculture etc.	670.10	9.56
		Grooves	115.00	1.63
3	Forest land	Medium Dense forest	217.00	3.09
		Dense forest and plantation	1324.50	18.89
		Hills covered by shrubs/ scrubs	532.80	7.60
		Reserved Forest	11.00	0.16
4	Waste land	Barren land, Rocky out crop, stony waste	1636.00	23.33
		Area affected by alkalinity/salinity	242.30	3.50
		Land covered by shrub/ scrub	356.10	5.07
5	Water bodies	Back swamp	25.10	0.36
		Tanks	148.40	2.12
		Reservoir	32.43	0.47
Total area			**7009.13**	**100**

4.2.7 Flow Diagram of Vaigai river System:

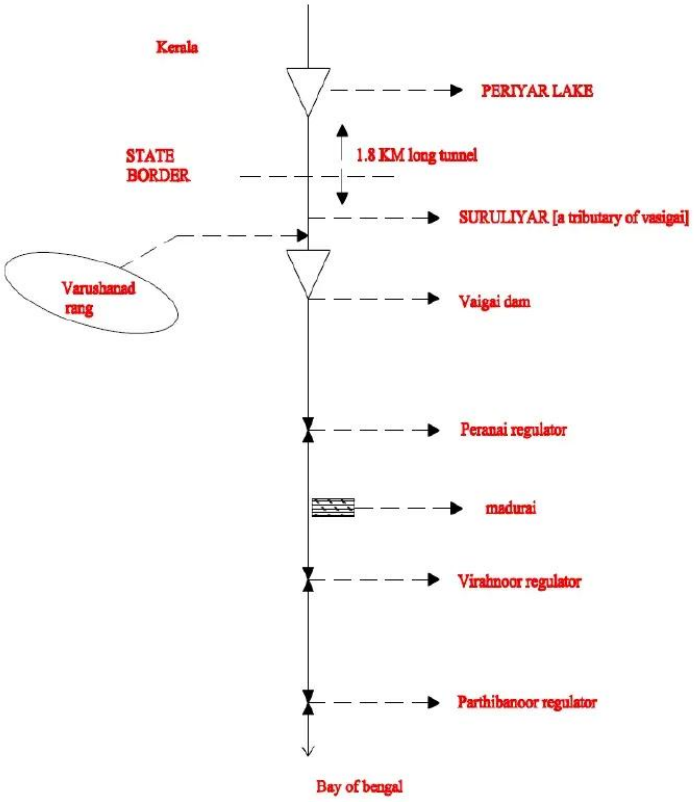


Figure 15 Vaigai River Flow Diagram (India WRIS)

CHAPTER 5: INTRODUCTION TO SITE

Figure 17 Madurai
Source: Madurai Corporation

Madurai, located in southern India, is a historic city in the state of Tamil Nadu. Positioned along the banks of the Vaigai River, it is the third largest city in the state. Geographically, Madurai lies at 9.9252° N latitude and 78.1198° E longitude. Recognized as the cultural capital of Tamil Nadu, it also serves as the administrative center of the Madurai District. With a contin uous history spanning over 2,500 years, Madurai ranks among the world's oldest inhabited cities. It is fondly known as "Thoonga Nagaram," which translates to "the city that never sleeps."

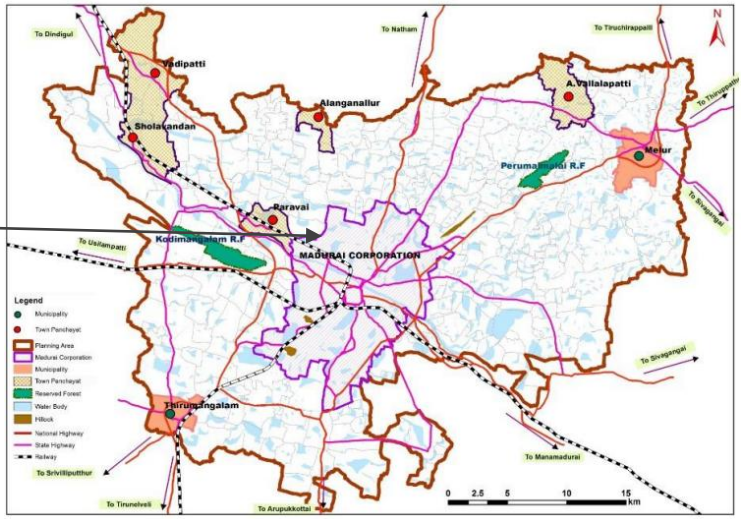


Figure 16 Madurai Boundary
Source: Madurai Corporation

5.1 Connectivity:

5.1.1 ROAD

Madurai District enjoys excellent connectivity through a network of major highways. National Highways such as NH 7, NH 45B, NH 208, and NH 49 pass through the city, while state highways including SH-33, SH-72, SH-72A, SH-73, and SH-73A link different regions within the district. (Corporation of Madurai, n.d.)

RAIL:

Madurai Junction is the primary railway station in the district and serves as the headquarters of the Madurai division under the Southern Railway zone.

AIR:

Established in 1957, Madurai Airport is located in Avaniyapuram, approximately 12 kilometers (7.5 miles) from the city center. (Corporation of Madurai, n.d.)

Sl. No	Road Type	Length in Kms
1	National Highway	285.10
2	State Highway	219.87
3	Major District Roads	215.15
	Total	720.12

Table 5 Classification of Road
Source: Madurai City Municipal Corporation

Sl. No	Road Type	Length in Kms
1	Bitumen Roads	1252.26
2	Cement Concrete	9.391
3	Paver Block and Other	10.957
	Total	1272.61

Table 5 Classification of Road by Surface
Source: Madurai City Municipal Corporation

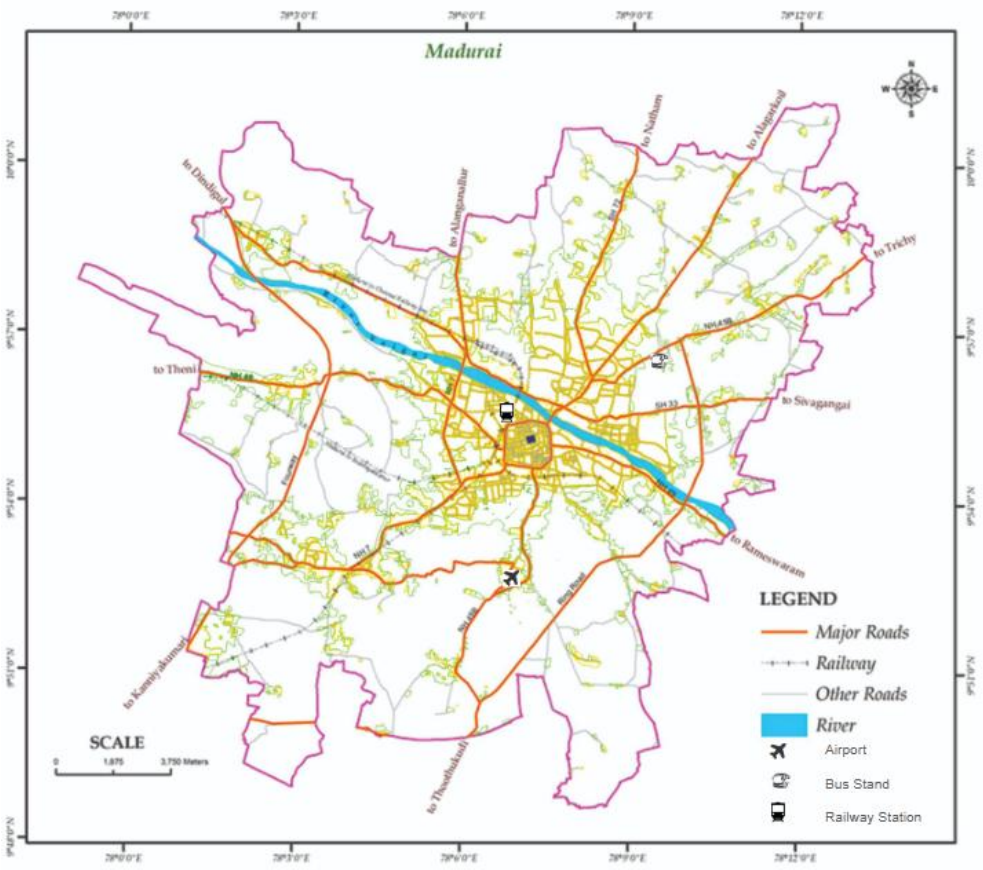


Figure 18 Madurai Connectivity
Source: Madurai Corporation

5.2 History

1. Ancient Origins:

Madurai, one of the oldest cities in India, dates back to at least the 3rd century BCE. Traditionally attributed to the Pandya king Kulasekara, it is prominently mentioned in ancient Tamil literature and Kautilya's Arthashastra, highlighting its early importance. (VISWANATH, 2021)

2.Sangam Age (3rd BCE – 4th CE):

The city became a major center of Tamil culture and literature. It hosted the famed Sangam assemblies of poets and scholars. Temples like the Koodal Azhagar were central to religious and cultural life, as noted in classical Tamil works. (VISWANATH, 2021)

3.Post-Sangam and Medieval Period (12th–17th Century):

Madurai changed hands between the Cholas and Pandyas before re-establishing itself as the Pandya capital. Under Nayak rule, particularly Viswanatha Nayak and Thirumalai Nayak, the city was transformed with planned urban architecture following Shilpa Shastras. Major structures like the Meenakshi Temple precincts and Thirumalai Nayakar Mahal were developed.

4.Colonial Period (Late 18th Century):

European influences, especially British, shaped Madurai’s governance and culture. The British East India Company took control in 1801, integrating Madurai into the Madras Presidency. Interestingly, British officials participated in local religious festivals. (Madurai District, n.d.)

5.Urban Transformation:

Urban design revolved around religious centers, especially the Meenakshi Temple. Streets were laid out in concentric patterns aligned with traditional Tamil concepts, reinforcing cultural integration in city planning.

6.Post-Independence (1947 onwards):

After independence, Madurai became part of Tamil Nadu. It continued to grow as a hub for trade, education, and culture. District boundaries were redrawn over

time, and Madurai retained its importance as an administrative and cultural center. (Madurai District, n.d.)

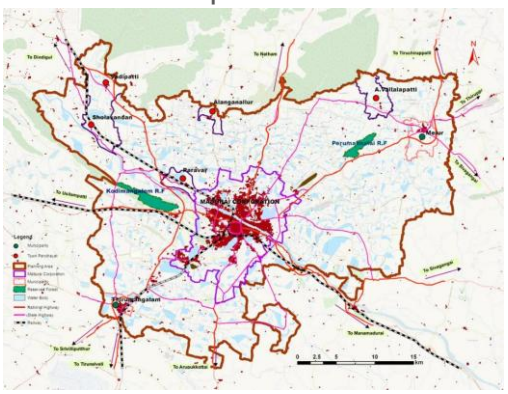
7. Academic and Cultural Significance:

Madurai has remained a key center for Tamil learning, arts, and religion. Institutions like the American College (est. 1881) represent its academic legacy. (Madurai District, n.d.)

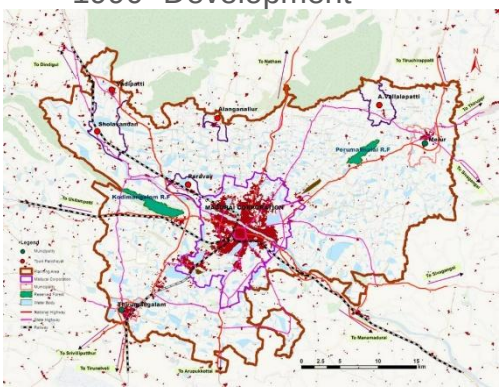
5.3 Settlement Growth:

The Vaigai River bisects Madurai, effectively dividing the city into two parts. The southern side of the river has seen more significant development compared to the northern side. Urban expansion on the northern side is oriented towards Melur, while the southern side extends toward Thirumangalam along State Highway 101 (SH-101). Thirumangalam Municipality is emerging as a prominent commercial hub, second only to the city's core area.

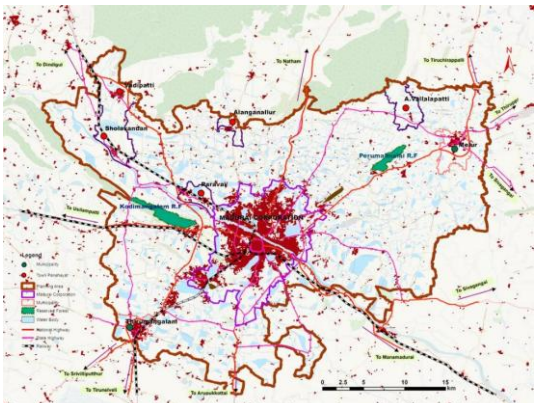
1980 – Development



1990- Development



2010 – Development



2020 - Development

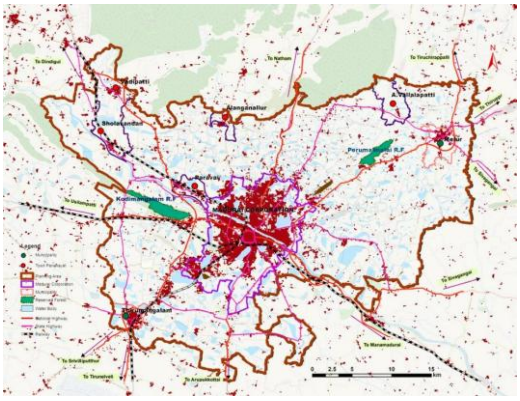


Figure 19 Settlement growth (Corporation of Madurai, n.d.)

5.4 Climate

The temperature data for Madurai Planning Area over the last 12 years (2010-2022) reveals distinct patterns influencing urban planning. April and May consistently experience elevated temperatures, reaching a maximum of 37 degrees Celsius. Conversely, January records the minimum temperature, dropping to 21 degrees Celsius.

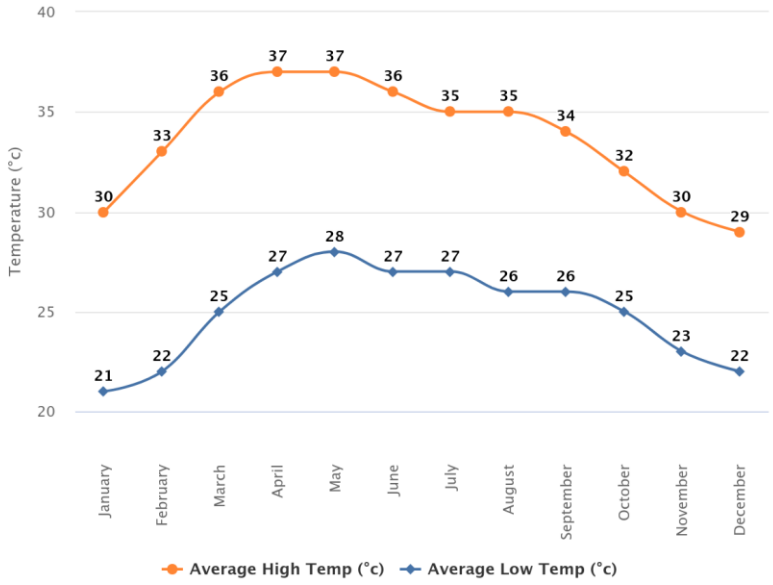


Figure 20 Climate (DTCP)

5.5 Rainfall

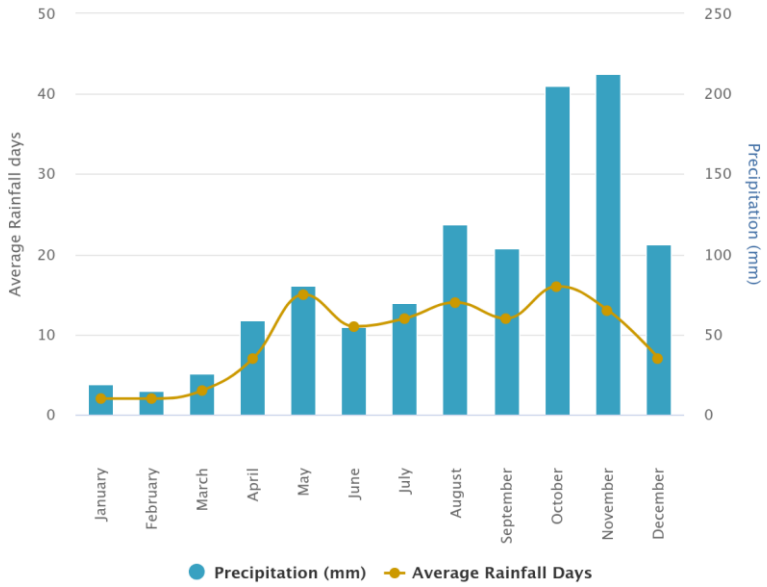


Figure 21 Rainfall (DTCP)

The rainfall patterns in Madurai District unveil significant variations, with the highest recorded rainfall of 220mm transpiring in November 2014, while February

witnesses the lowest at a mere 10mm. Despite an average of 15 rainy days during this period, only 3 days in February receive rainfall, indicating a limited availability of water resource.

5.6 Geology:

Madurai is predominantly covered by four major geological complexes, namely the Migmatite Gneissic complex, Charnockite Gneissic complex, Khondalite Gneissic complex, and Aeolian Sediments. Each complex contributes to the diverse geological landscape of the region, collectively shaping Madurai's unique geological identity. Each complex has its own opportunities for development. (DTCP)

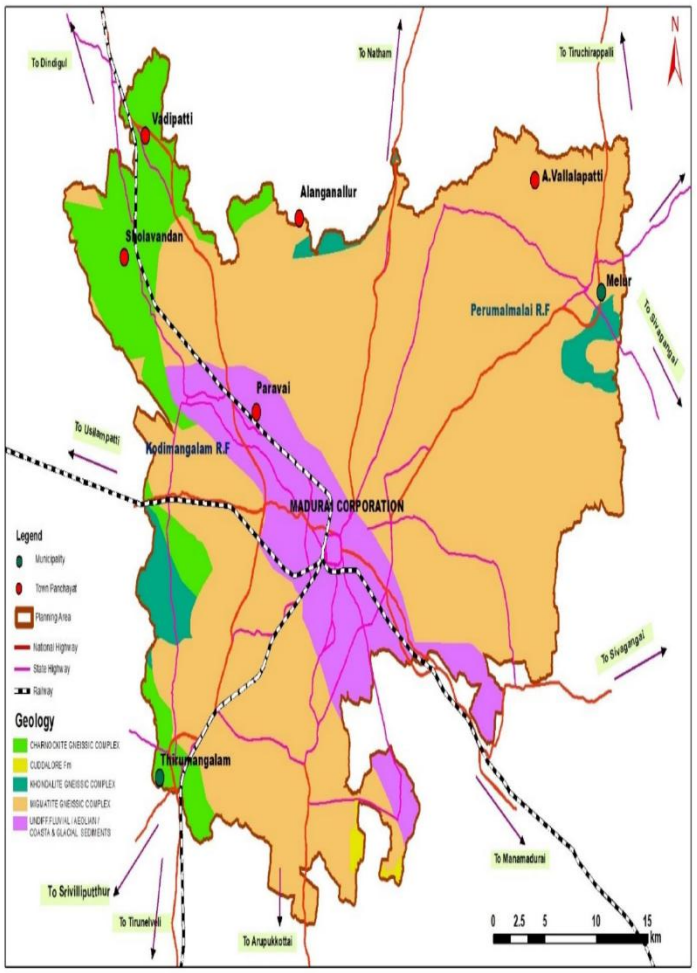


Figure 22 Geology (DTCP)

1. Migmatite-Gneissic Complexes:

- Aesthetic Architecture: Unique patterns of migmatite-gneissic rocks offer opportunities for aesthetically pleasing urban design.

- Geo-tourism: Geological formations can attract geo-tourism, with trails, parks, or information centres showcasing the city's geological richness.

2. Aeolian Sediments:

- Tourism and Recreation: Thoughtful urban planning can enhance coastal landscapes shaped by aeolian processes, turning them into attractive tourist destinations, boosting tourism, and supporting the local economy.

• Eco-Friendly Infrastructure: Designing infrastructure aligned with aeolian dynamics, such as wind-resistant buildings and green spaces, mitigates the impact of urbanization, enhancing aesthetics.

• Renewable Energy: Harnessing wind energy from aeolian processes contributes to sustainable practices, reducing reliance on non-renewable sources. (DTCP)

5.7 Geomorphology;

Nestled in the heart of Tamil Nadu, India, Madurai's geomorphology unveils a tale of diverse landforms, from expansive Alluvial Plains sustaining its agricultural legacy to the gently sloping surfaces of the Pediment Pediplain Complex, contributing to the city's visual charm.

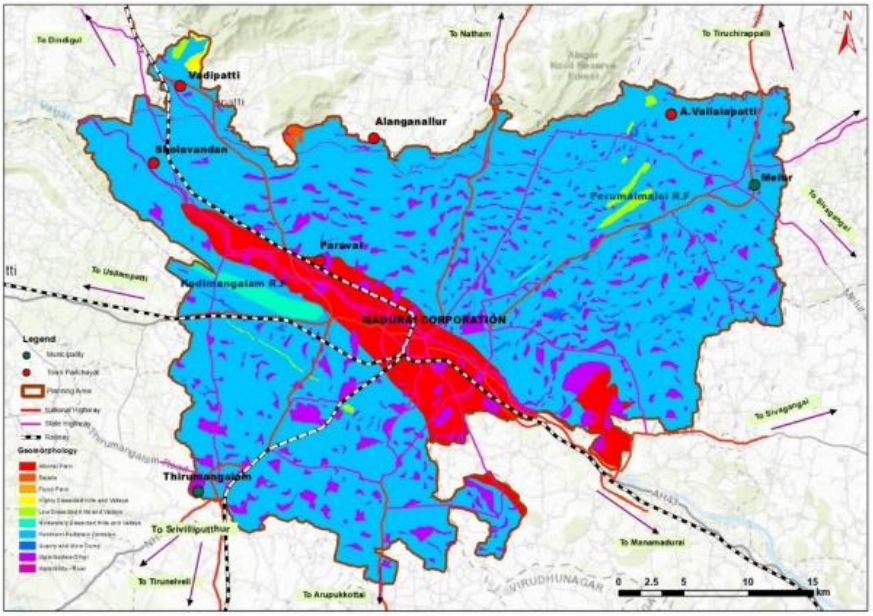


Figure 23 Geomorphology (DTCP)

1. Alluvial Plains:

• The city's landscape features extensive Alluvial Plains, vast areas characterized by the deposition of fertile soils carried by rivers.

• This alluvial plain serves as a crucial foundation for agricultural activities, offering a flat and cultivable terrain that has historically supported the region's agrarian economy.

2. Pediment Pediplain Complex:

• Complementing the alluvial plains is the Pediment Pediplain Complex, adding a layer of topographical complexity to Madurai's geography.

This complex is marked by gently sloping surfaces formed through the erosion and weathering of underlying rocks.

5.8 Soil Type:

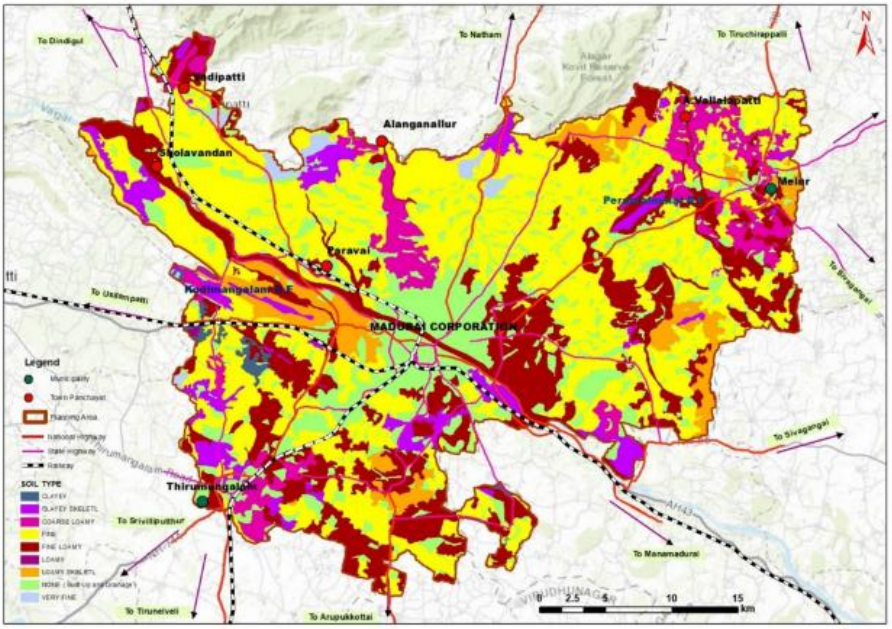


Figure 24 Soil Type (DTCP)

Major Soil Types in Madurai districts includes:

1.Fine Loamy Soil

2.Loamy Skeletal Soil

3.Coarse Loamy Soil

5.9 Land Use:

About 35.27% of the land is set aside for residential areas, where people live in homes ranging from houses to apartments. This is where most of the city's population resides. There are also spaces designated for business and shopping, which make up 5.76% of the area. These areas, known as commercial zones, host shops, offices, and places where people conduct business, contributing to the city's economy. Industrial areas, covering 2.16% of the land, are where

factories and warehouses are located, playing a role in producing goods and providing employment opportunities. Institutional spaces, making up 8.58% of the area, include schools, hospitals, and government buildings that serve the community's educational, healthcare, and administrative needs. Transportation, covering 7.51%, includes roads and transport-related infrastructure essential for getting around the city. Preserving agriculture is also important, with 24.18% of the land dedicated to farming and agricultural activities. This supports local food production and maintains green spaces within the city. There are also hills (0.96%) and waterbodies (15.58%) in the area, which contribute to the city' natural beauty and environmental diversity.

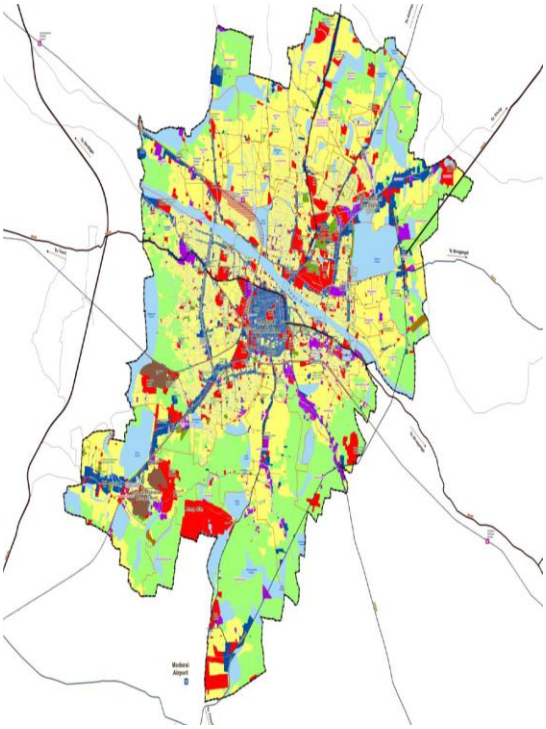


Figure 25 Existing Landuse (DTCP)

Table 6 Landuse Comparitive (DTCP)

Land use	Proposed – 2011 (1991-2011) in sq.km		Existing Landuse in 2021 in sq.km		Comparison Existing Master Plan – Proposed Master Plan in sq.km		Land use area excluded in proposed master plan in sq.km
Land Use	**Corporation**	**Total LPA**	**Corporation**	**Total LPA**	**Corporation**	**Total LPA**	
Residential	30.37	197.91	19.05	126.34	-11.32	71.57	5.95
Commercial	2.03	20.31	4.93	12.57	2.9	7.74	0.43
Industrial	2.10	59.38	1.32	11.21	-0.78	48.17	0.23
Institutional	5.86	27.65	6.34	24.57	0.48	3.08	0.86
Transport	7.40	24.4	8.65	22.11	1.25	2.29	0.44
Total Developed Area	**47.76**	**329.55**	**40.29**	**196.79**			**7.91**
Agricultural	1.26	270.74	4.77	356.54	3.24	-73.4	36.99
Waterbody	3.07	120.38	6.14	111.61	0.64	8.77	10.50
Hills	0.64	5.4	0.64	5.4			
Total	**51.82**	**726.36**	**51.82**	**670.87**			**55.49 - (10 Villages)**

5.10 LULC- 1990 2024:

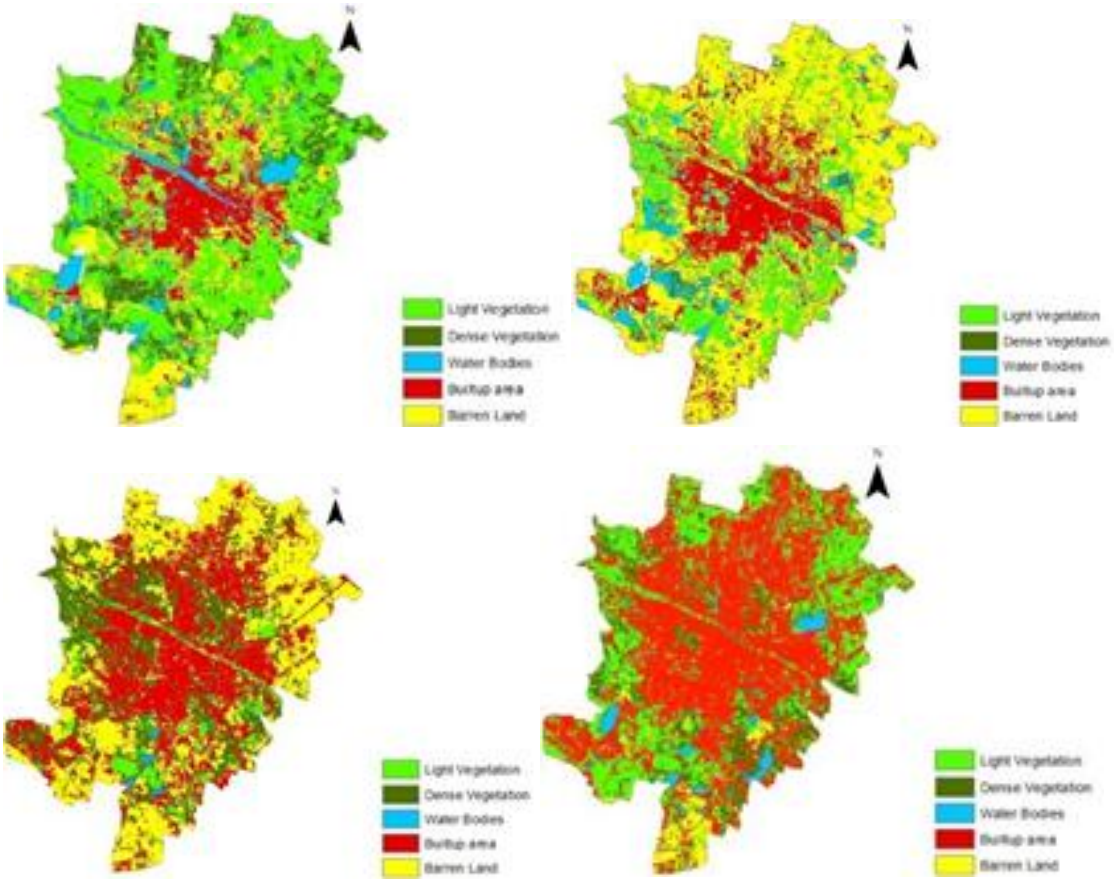
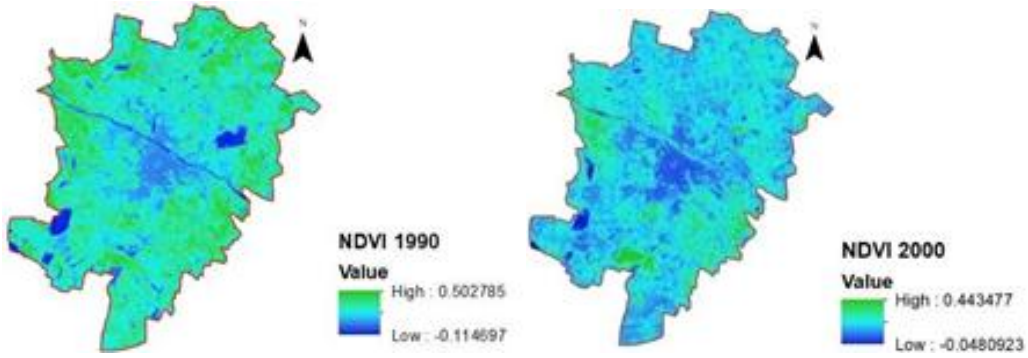


Figure 26 LULC Supervised imagery (P, 2021)

5.9 NDVI:



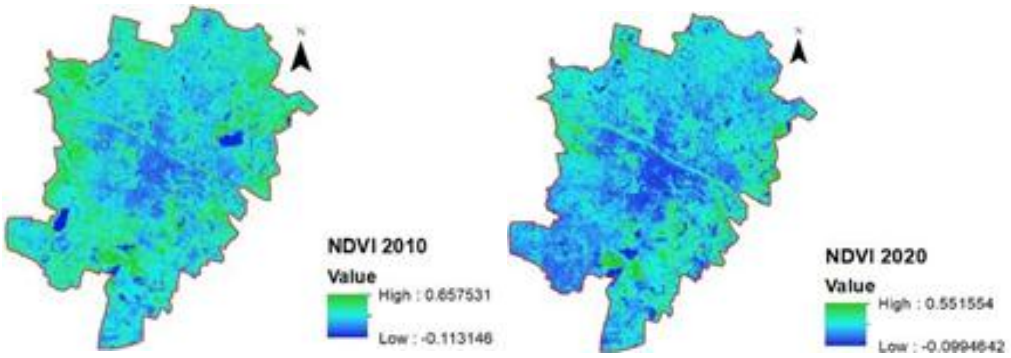


Figure 27 NDVI Imagery (P, 2021)

5.9 SURFACE TEMPERATURE :

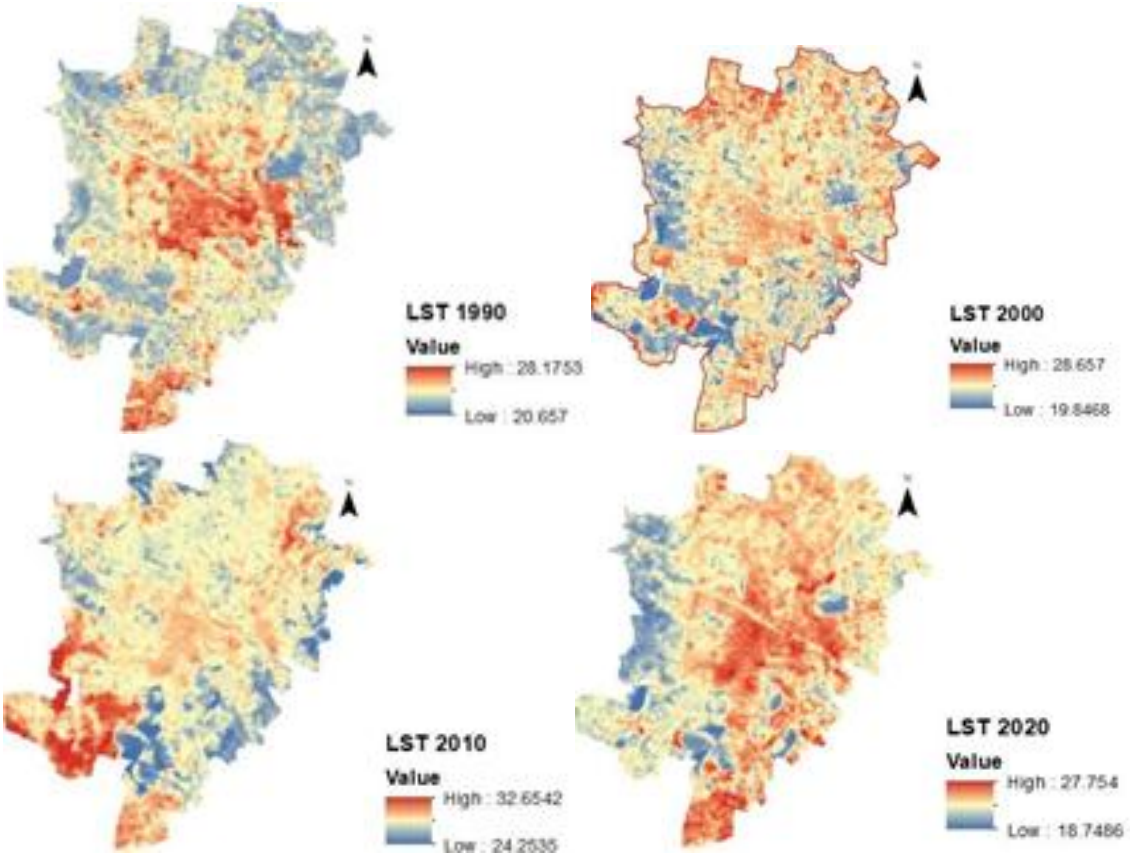


Figure 28 Surface Temperature Imagery (P, 2021)

CHAPTER 6: CASE STUDY

6.1 Sabarmati Riverfront Development, Ahmedabad

The Sabarmati Riverfront project in Ahmedabad is one of India's most renowned urban river rejuvenation efforts. Vaigai proposal is to create a riverfront which is a mirror to Sabarmati river front Spanning 11.25 km, the project created continuous public promenades, cultural spaces, and infrastructure for flood control and sewage diversion. Its two-level pedestrian walkway offers direct access to the river, reclaiming about 204 hectares of land.

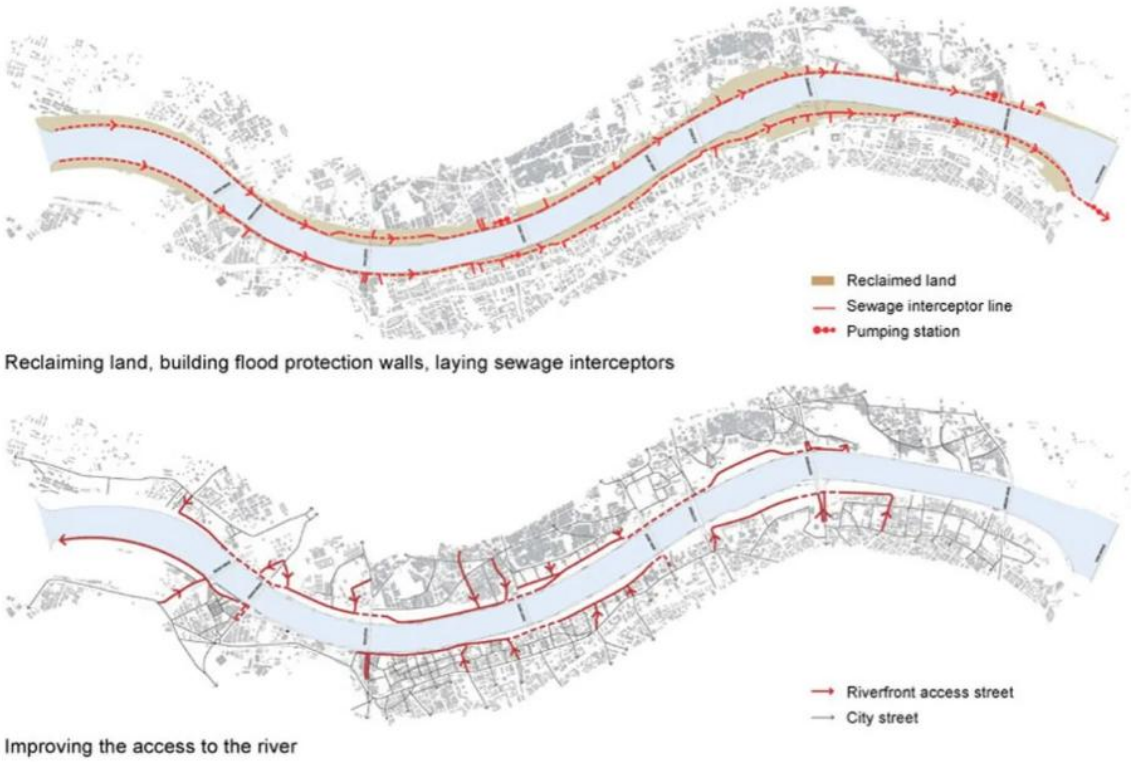


Figure 29 Strategies (Patel)

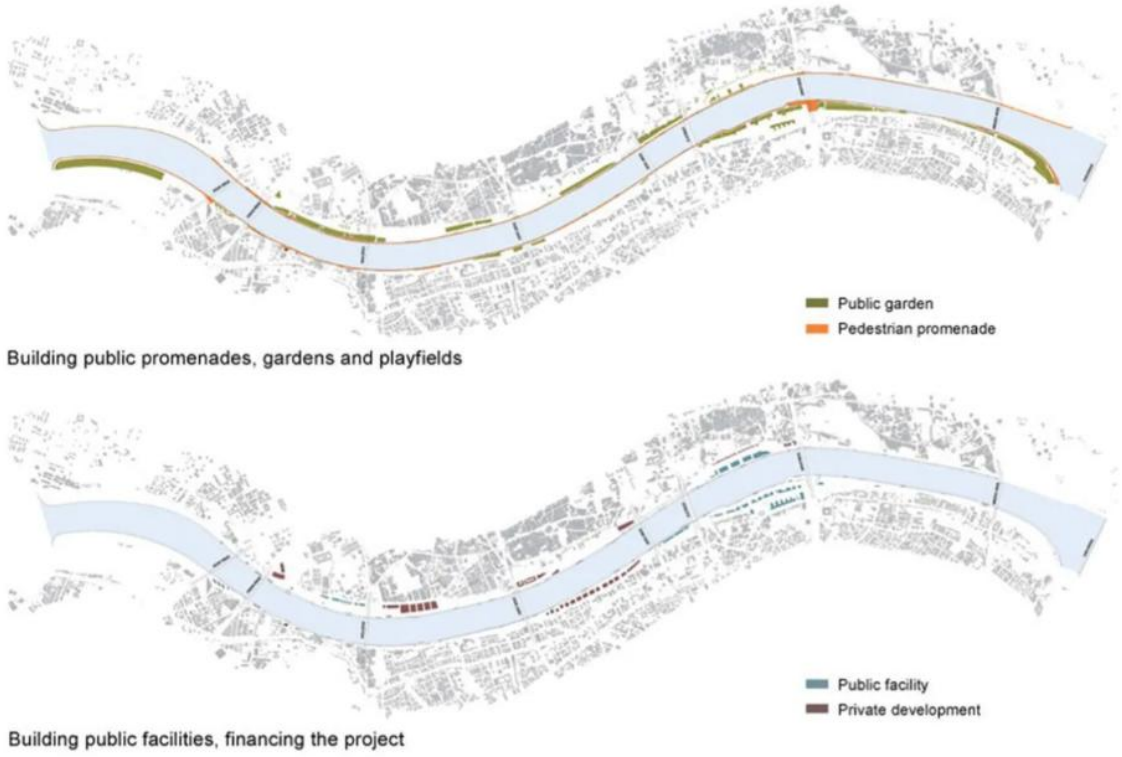


Figure 30 Strategies (Sabarmati Riverfront A Catalyst for Ahmedabad's Economic Growth)

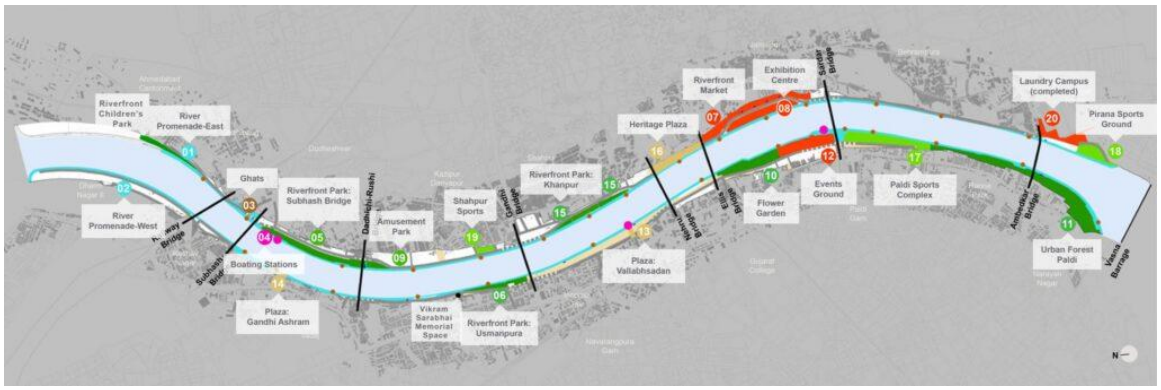
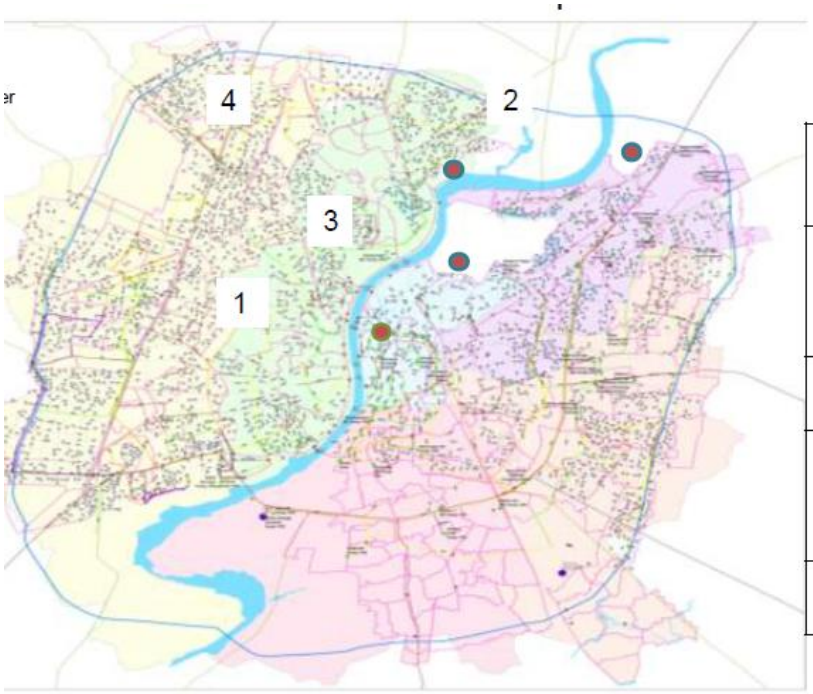


Figure 31 Zoning (Sabarmati Riverfront A Catalyst for Ahmedabad's Economic Growth)

Step 1- Ensuring a Clean River**:**

The foundation for any successful riverfront development begins with restoring and maintaining clean water. A healthy river ecosystem is essential not only for environmental sustainability but also for attracting investments and enhancing the river's overall appeal.



Sr.	Location	Capacity	Status
1	Shankar Bhuvan	25 MLD	Work in progress
2	Kotarpur	60 MLD	Tender reinvited
3	Daff Nalah Shahibaug	25 MLD	Tender reinvited
4	Koteshwar	60 MLD	Tender invited

Figure 32 STP location (Sabarmati Riverfront A Catalyst for Ahmedabad's Economic Growth)

Step 2 **–** Develop Socio-Cultural Infrastructure**:**

Create engaging public spaces with modern amenities that promote community interaction and unify the riverfront. Place-making' with state-of-the-art amenities that attracts people and investments and ties up the entire Riverfront with high-quality infrastructure and a unified vision Design interventions include:

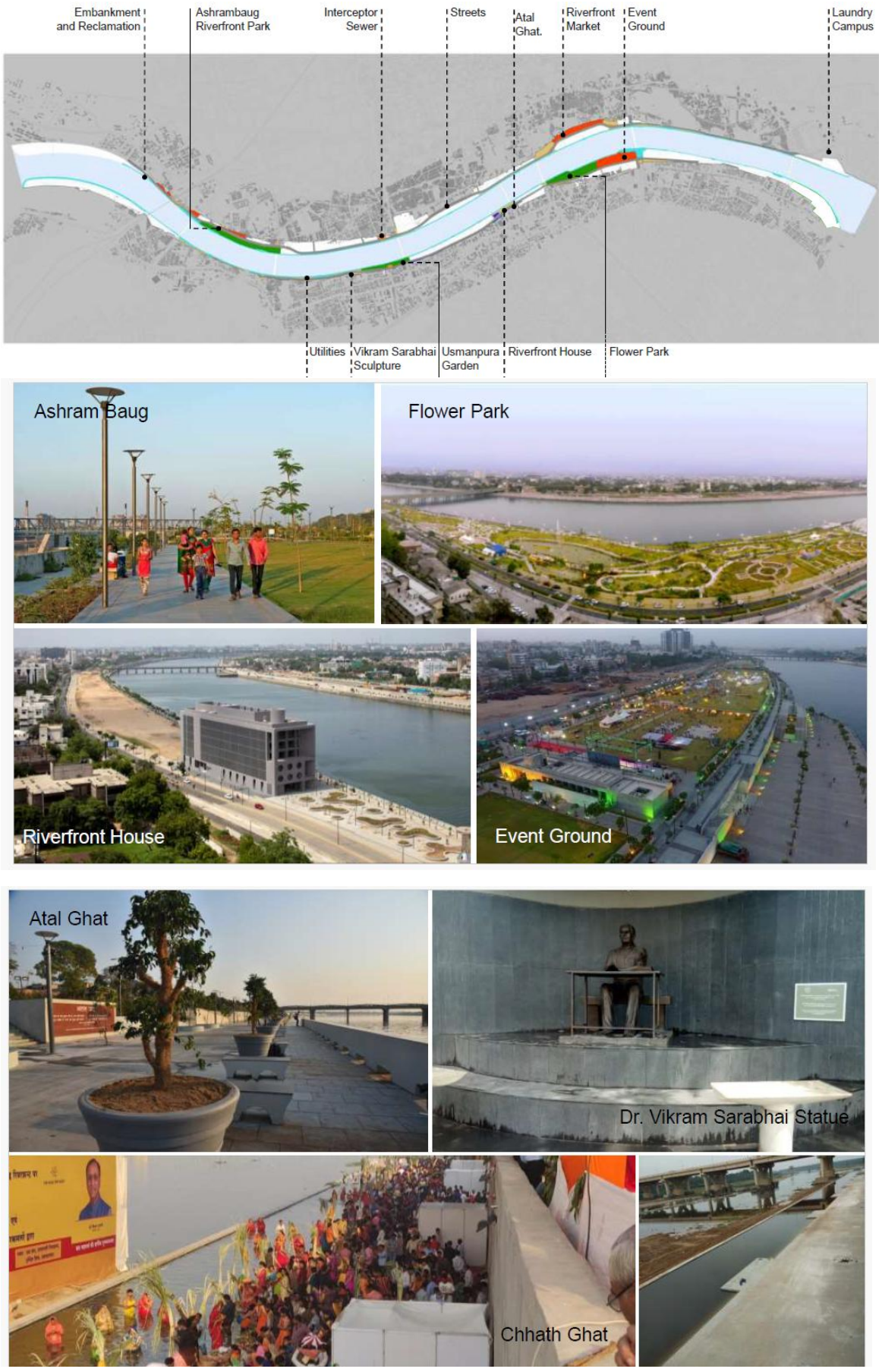


Figure 33 Socio-Cultural Infrastructure (URBAN RIVER MANAGEMENT PLAN (URMP))

Step 3 – Build a World-Class Urban Model:

Establish a high-standard, sustainable urban environment that maximizes investment returns and sets a precedent for future developments.

Figure 34 Business Hub (Sabarmati Riverfront A Catalyst for Ahmedabad's Economic Growth)

Flood Management:

The newly built embankments act as strong protective barriers, effectively containing the river's flow even during periods of heavy rainfall. This system allows for efficient management and redirection of excess water, preventing it from spilling into urban areas. By controlling the river's course and creating designated flow channels, the initiative has greatly improved flood safety. Moreover, reclaiming floodplain land has opened up new possibilities for urban expansion. Enhancing the river's depth and reinforcing the embankments has significantly lowered the annual risk of flood-related damage, which previously posed a serious threat to a large portion of the city's population.

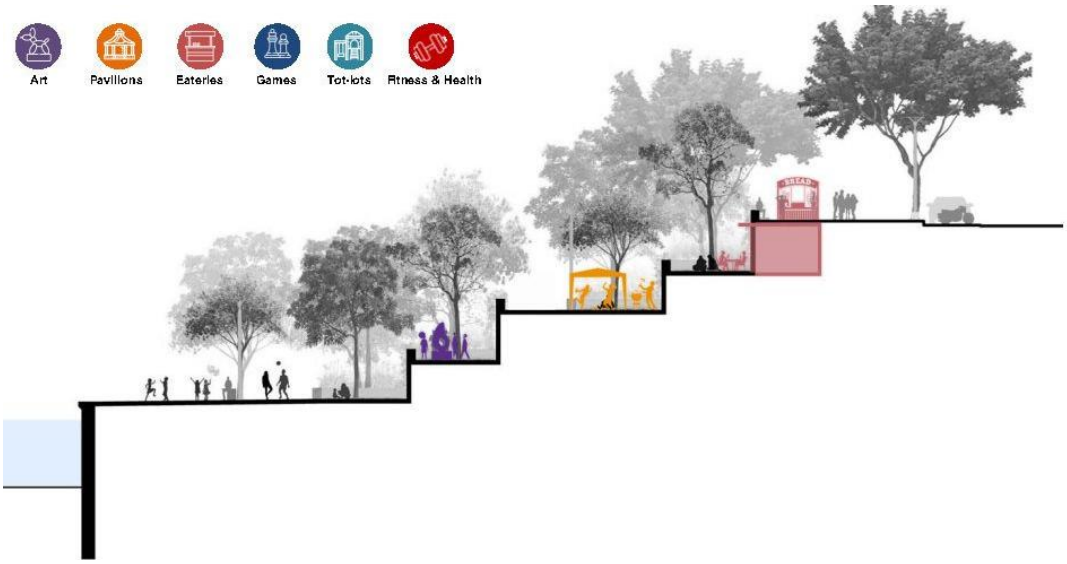


Figure 35 Embankment Design (Sabarmati Riverfront A Catalyst for Ahmedabad's Economic Growth)

1. Environmental Improvement:
The project aimed to improve the environmental quality of the river by reducing pollution and restoring its depth, which also helped with flood management.

2. Rehabilitation of Existing Communities:

A significant number of families were displaced and rehabilitated under a specific policy, ensuring a smooth transition and addressing the needs of those affected by the project.

3. Creation of Public Spaces:

The project created extensive public spaces along the riverbanks, including walking paths, parks, and cultural venues, fostering social interaction and community life. Providing ghats, parks, and urban gardens

4. Biodiversity Restoration:

Sustainable practices were implemented to reintroduce biodiversity, with efforts to restore the river's natural environment.

5. Channeling the river to a uniform width
6. Integrated sewage treatment

The project demonstrates how reclaimed land and river edge activation can improve ecological health, offer recreational spaces, and reconnect citizens to the river. However, challenges around displacement and social equity were raised, underscoring the need for inclusive planning.

6.2 Patna Riverfront Development, Bihar

Patna’s Ganga riverfront revitalization spans 6.6 km from Collectorate Ghat to Naujar Ghat. The precinct integrates historic steps (ghats), promenades, and civic spaces designed to align with the dense urban fabric and heritage structures.

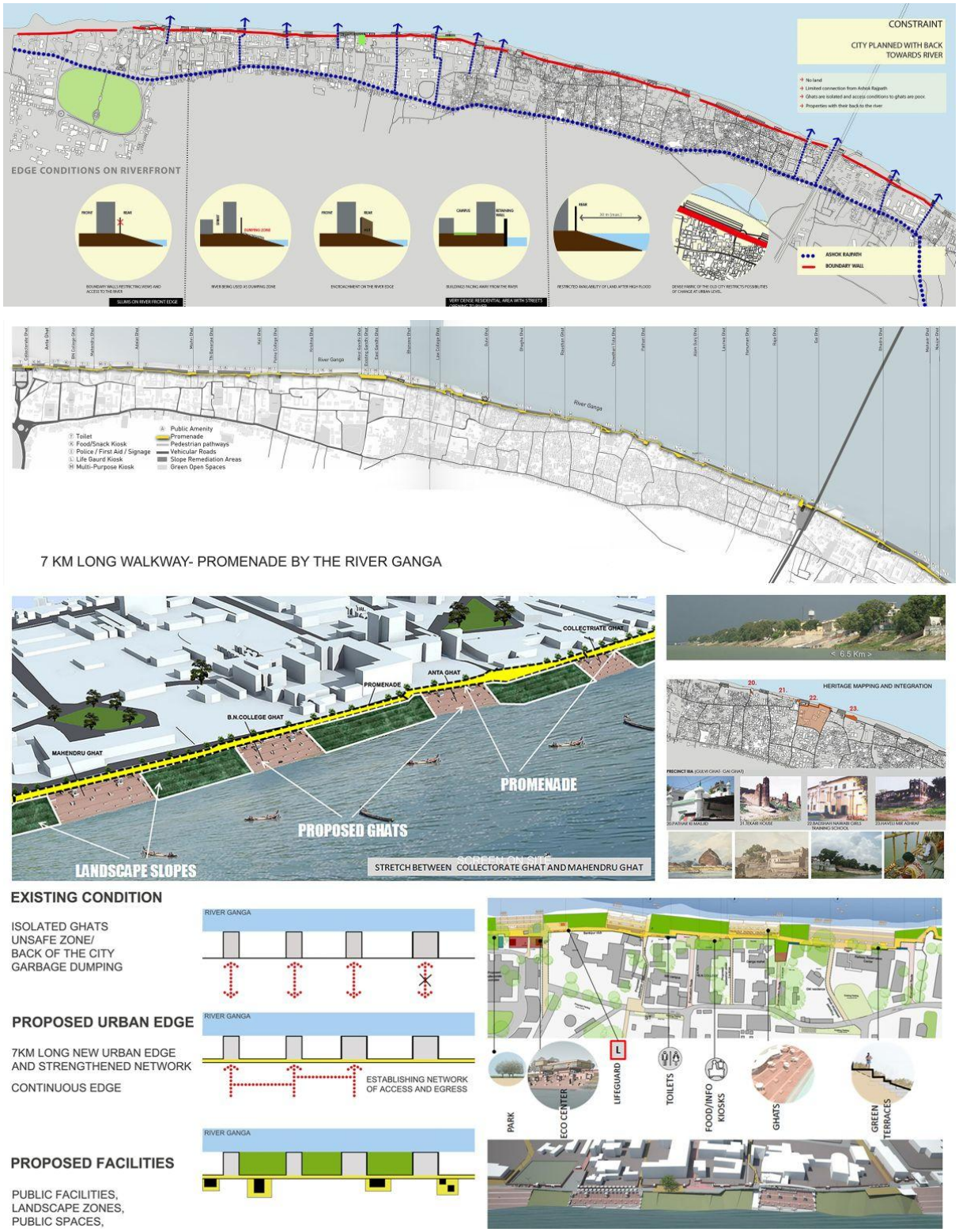


Figure 36 Patna RIverfront (Ganga Riverfront Development at Patna, India: Urban Rejuvenation Project, 2023)

1. Architectural Interventions

- Restoration of existing heritage ghats using local materials.
- Construction of new multi-tiered ghats to support ritual, cultural, and daily uses.
- Pavilions and shaded structures along the river for public rest and congregation.
- Use of traditional stone (like sandstone) to maintain the cultural identity of the waterfront.

2. Ecological Interventions

- Riverbank stabilization using erosion-resistant materials and vegetation.
- Green buffers with native plant species to improve biodiversity and create microclimatic comfort.
- Integration of stormwater drainage systems to manage runoff without polluting the river.
- Seasonal adaptation through tiered landscapes that accommodate flooding cycles.

3. Social/Public Realm Interventions

- A 6.6 km promenade with pedestrian walkways, seating, viewing decks, and gathering spaces.
- Creation of public toilets, changing rooms, and drinking water kiosks to improve usability.
- Designated zones for festivals and rituals (e.g., Chhath Puja platforms).
- Public plazas and parks for everyday recreation and cultural events.

4**.** Infrastructural Interventions

- Installation of LED lighting, CCTV surveillance, and wayfinding systems for security and navigation.
- Boat docking platforms to revive river-based transport and tourism.
- Waste management systems: bins, collection points, and regular cleaning operations.

- Flood-resilient embankments and elevated pathways to maintain functionality year-round.

The project places emphasis on preserving public access while rejuvenating cultural landscapes, making it relevant for Madurai's context where rituals and festivals are river-centric.

6.3 Yamuna River Project, Delhi

The Yamuna River Project is a research and design initiative led by the University of Virginia and the Delhi Development Authority. It focuses on the systemic revitalization of the Yamuna floodplain in Delhi through ecological restoration, landscape architecture, and urban policy reform.

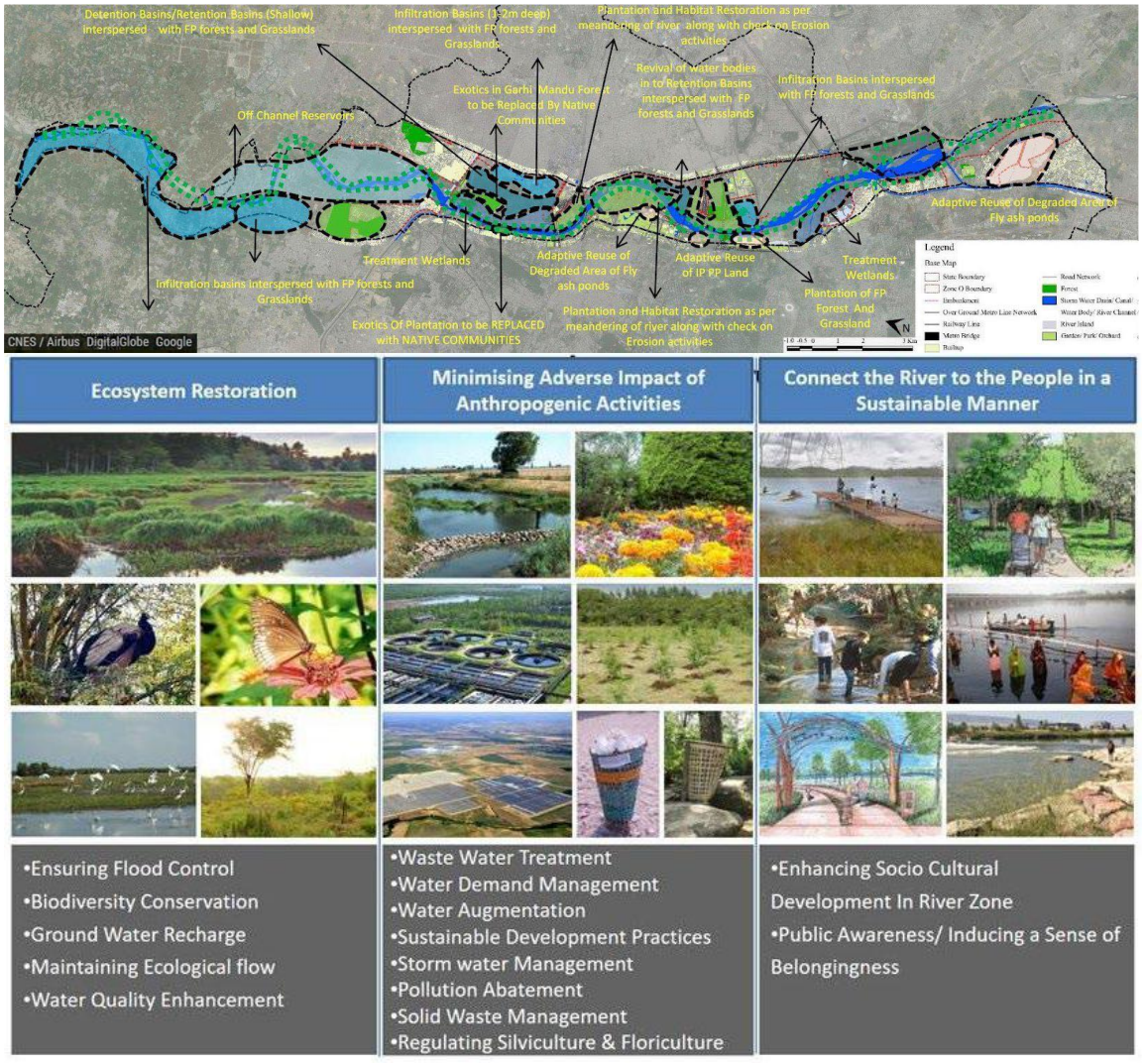


Figure 37 Yamuna Riverfront (Kanoi, 2022)

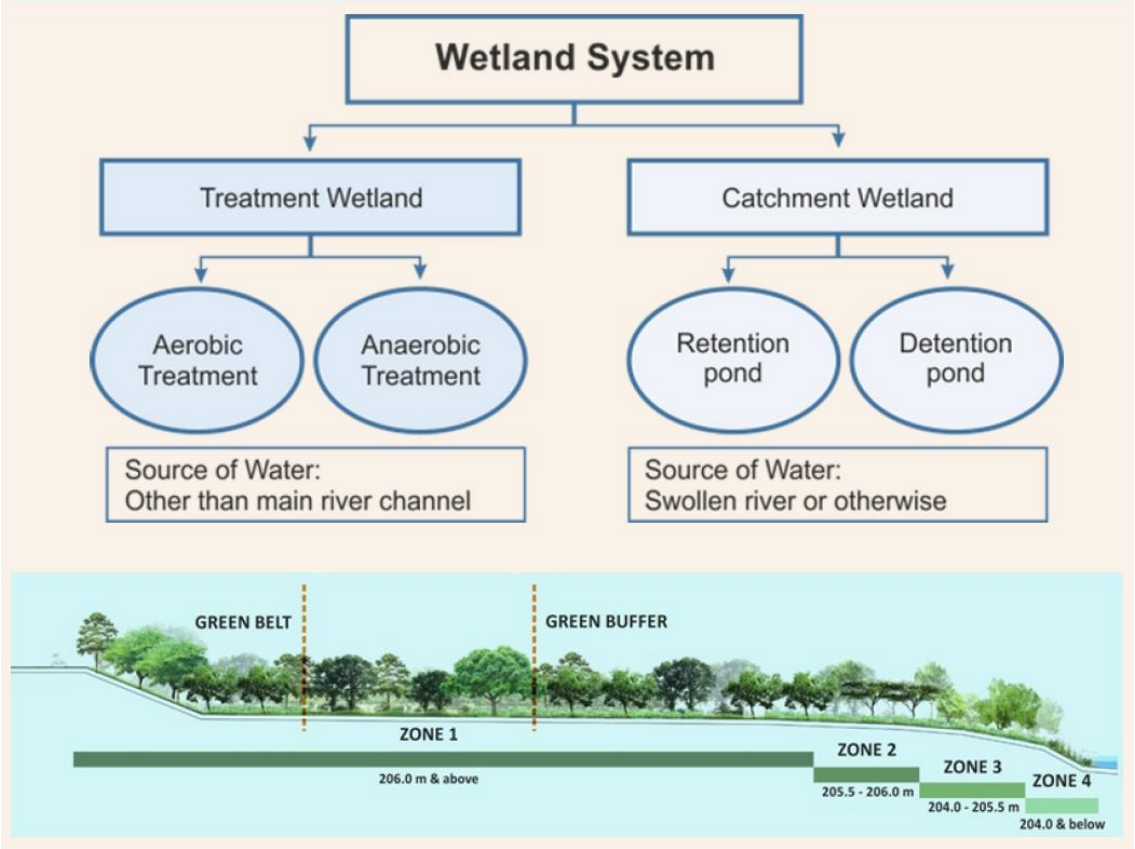


Figure 38 Wetland system of Yamuna (Kanoi, 2022)

1. Architectural Interventions

- Low-impact public access points like stepped terraces, ghats, and walkways for safe river interaction.
- Modular viewing decks and platforms that don't disrupt the floodplain dynamics.
- Proposed cultural pavilions and eco-interpretive centers for education and engagement.
- Minimal built footprint to protect natural terrain while offering controlled access.

2. Ecological Interventions

- Restoration of wetlands and riparian zones to revive natural hydrology and habitat.
- Development of biodiversity parks for native flora and fauna (e.g., Kalindi Biodiversity Park).

- Buffer plantations using native trees and grasses to filter runoff and improve soil stability.
- Control of invasive species and reintroduction of native aquatic life to improve river health.

3. Social/Public Realm Interventions

- Eco-parks, walking trails, and interpretation zones open to the public for recreation and awareness.
- Environmental education hubs and community outreach initiatives to build citizen stewardship.
- Accessible walkways and bike paths integrated with green infrastructure.
- Community-oriented spaces that balance access with conservation.

4. Infrastructural Interventions

- Decentralized Sewage Treatment Plants (STPs) integrated into the river edge to treat inflows before discharge.
- Installation of interceptor drains to prevent direct outflow of untreated sewage into the river.
- Rainwater harvesting and recharge structures along the floodplain.
- Monitoring systems and water quality sensors as part of a long-term river management strategy.

The interdisciplinary approach of the Yamuna Project presents a replicable framework for cities like Madurai seeking long-term sustainable riverfront development.

6.4 Comparative Analysis

Table 7 Comparative study
Source: Author

PARAMETERS	YAMUNA RIVERFRONT DEVELOPMENT	PATNA RIVERFRONT DEVELOPMENT	SABARMATHI RIVERFRONT DEVELOPMENT
ISSUES	Minimum avenue for recreation and open spaces Disconnected waterfront	Pollution due to untreated waste discharge and industrial effluents. Encroachments on riverbanks Seasonal floods	Change in land use along the sides of the river. Varying flood pattern Ecological degradation.
CAUSES	Industrialization Lack of awareness Immersion of Idols Unauthorizes settlement on riverbed bathing cattle in river	Unauthorizes settlement on riverbed Washing and starching cloths in river bank Disposing flowers Poor Waste Management	Rapid Urbanization Deforestation Debris Domestic Sewage
ENVIRONMENTAL IMPACT	Deteriorating water quality. Agricultural run- off Flow of sewage water into the river, affecting the quality of water.	Depletion of water quality. Loss of Biodiversity Soil Degradation	Polluting water via the direct sewage inlets into the river. Destruction of herbal vegetation
SOCIAL ASPECT	Rich history and culture National significance monuments. Unbalanced traffic system.	Rich history and culture Gandhi Ghat and Ganga Diara attract tourists and locals. Gathering space for the college students and also for religius festivals	Slum development along the banks. People live with the lack of basic amenities. Their lives are at risk in case of flooding of the river
DEVELOPMENT AUTHORITIES	The Yamuna Action Plan by DDA (Delhi Development Authority)	Bihar Urban Infrastructure Development Corporation (BUIDCO) National Mission for Clean Ganga (NMCG)	SRFDCL project (Sabarmati River Front Development Corporation Limited)
STAGES OF PROPOSE DEVELOPMENT PLAN	Planning and conceptual stage Execution is in Initial level, New delhi	Completed in 2023	Completed in 2012, Ahmedabad

Table 8 Comparative Analysis of Case Study
Source: Author

Type of Intervention	Sabarmati Riverfront Ahmedabad	Patna Riverfront Bihar	Yamuna Riverfront Delhi	Relevance to Vaigai Riverfront
Architectural	Two-tier promenades, ghats, plazas, seating	Heritage ghats restoration, new platforms, pavilions	Low-impact decks, terraces, minimal built form	Design of multi-use ghats and cultural spaces
Ecological	Channelized riverbed, parks, green belts	Green buffers, erosion control, seasonal adaptation	Wetland restoration, biodiversity parks, buffer planting	Ecological restoration & biodiversity enhancement
Social / Public Realm	Pedestrian access, seating, vending zones	Festival zones, sanitation units, civic spaces	Eco-parks, education hubs, community access	Culturally active river edge and public interaction
Infrastructure	Sewage interceptors, lighting, solid waste systems	Public toilets, flood adaptation, surveillance	STPs, interceptor drains, monitoring systems	Sewage diversion, stormwater, check dams

CHAPTER 7: SITE ANALYSIS AND ISSUE MAPPING

7.1 Site Context:

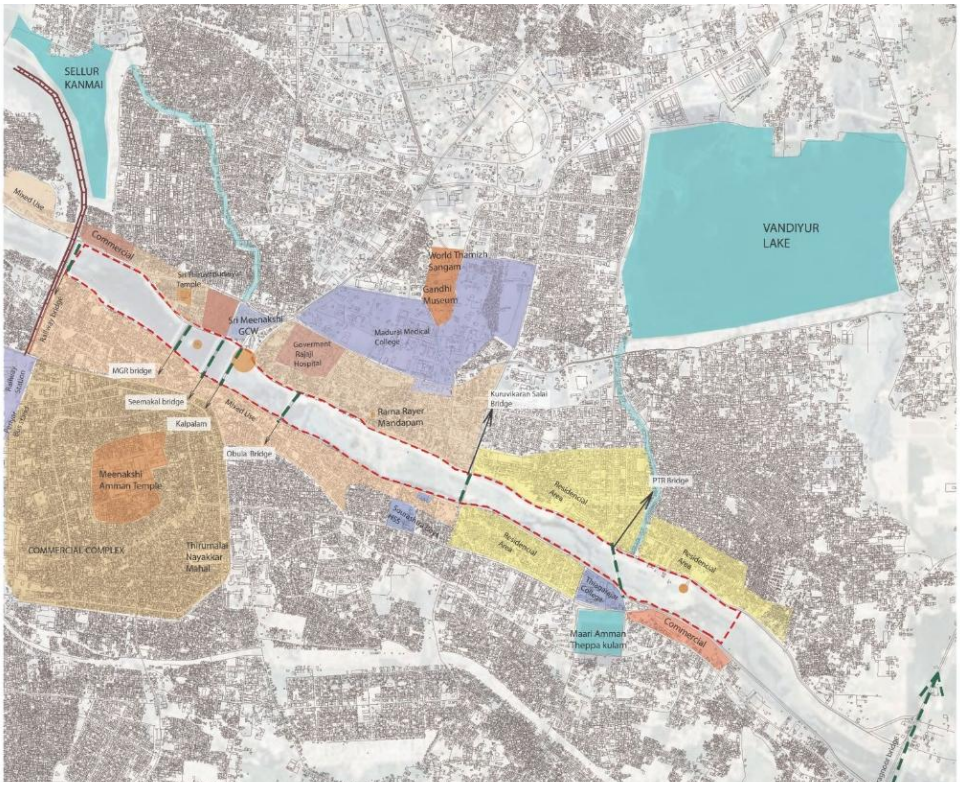


Figure 39 Site Context
Source: Author

- **Northern Bank:** Dense informal housing, temples, washing ghats
- **Southern Bank:** Institutional land use, commercial corridors, school campuses
- **Edge Condition:** Inconsistent; includes retaining walls, encroachments, overgrown vegetation, and trash dumping

7.2 Padithurai:

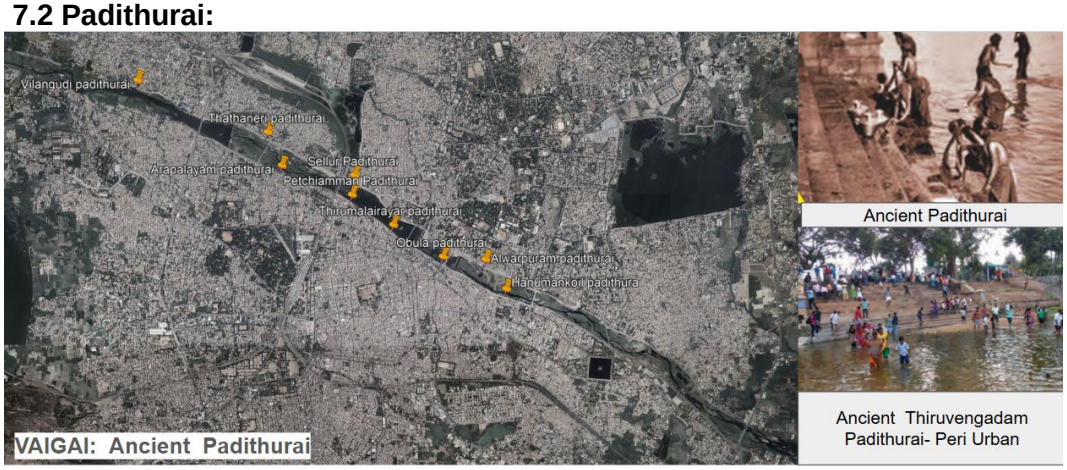


Figure 40 Padithurai
Source: Author

The Vaigai Riverfront beautification initiative, under the Vaigai River Front Development programme, has led to the disappearance of over 14 ancient ghats that once reflected the city's deep-rooted historical and cultural heritage. Traditionally built with stone masonry, these *Padithurais* have now been replaced by concrete structures, often limited to side access. This shift has resulted in the loss of the riverfront's socio-architectural identity. The erosion of cultural significance has turned these once-sacred spaces into neglected areas, now misused for open urination, defecation, and solid waste dumping.

7.3 Connectivity:

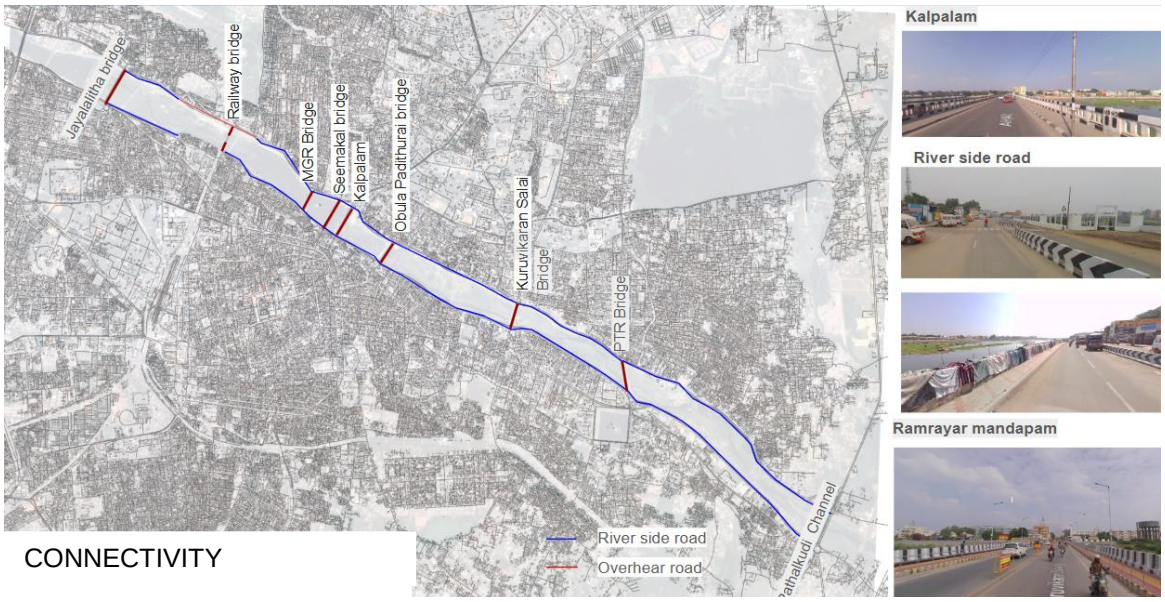


Figure 41 Connectivity
Source: Author

7.4 Construction Ghat:

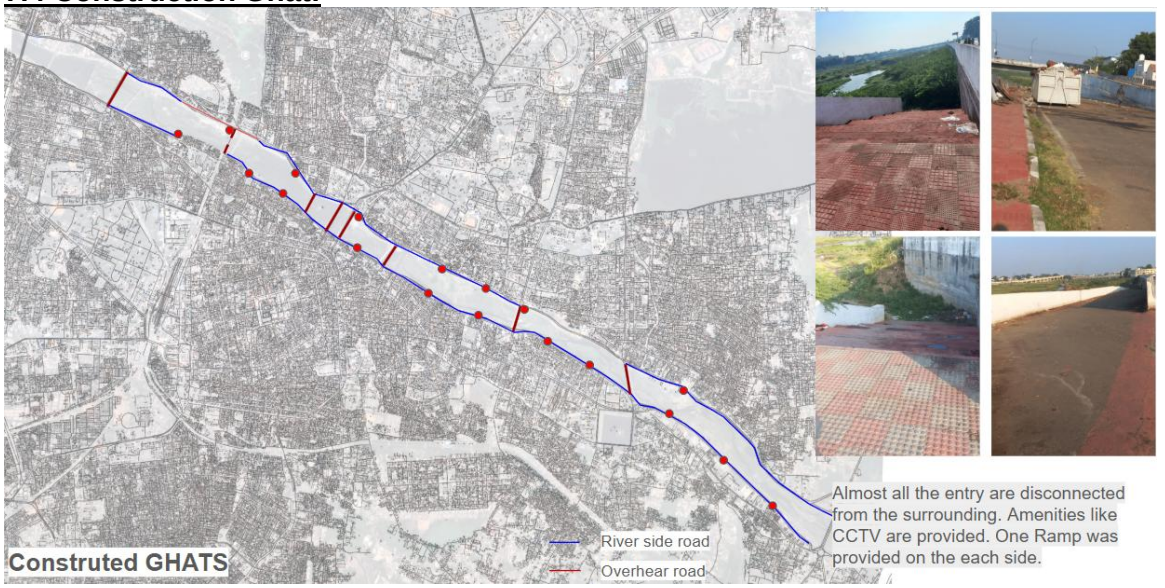


Figure 42 Ghats
Source: Author

7.5 Issues:

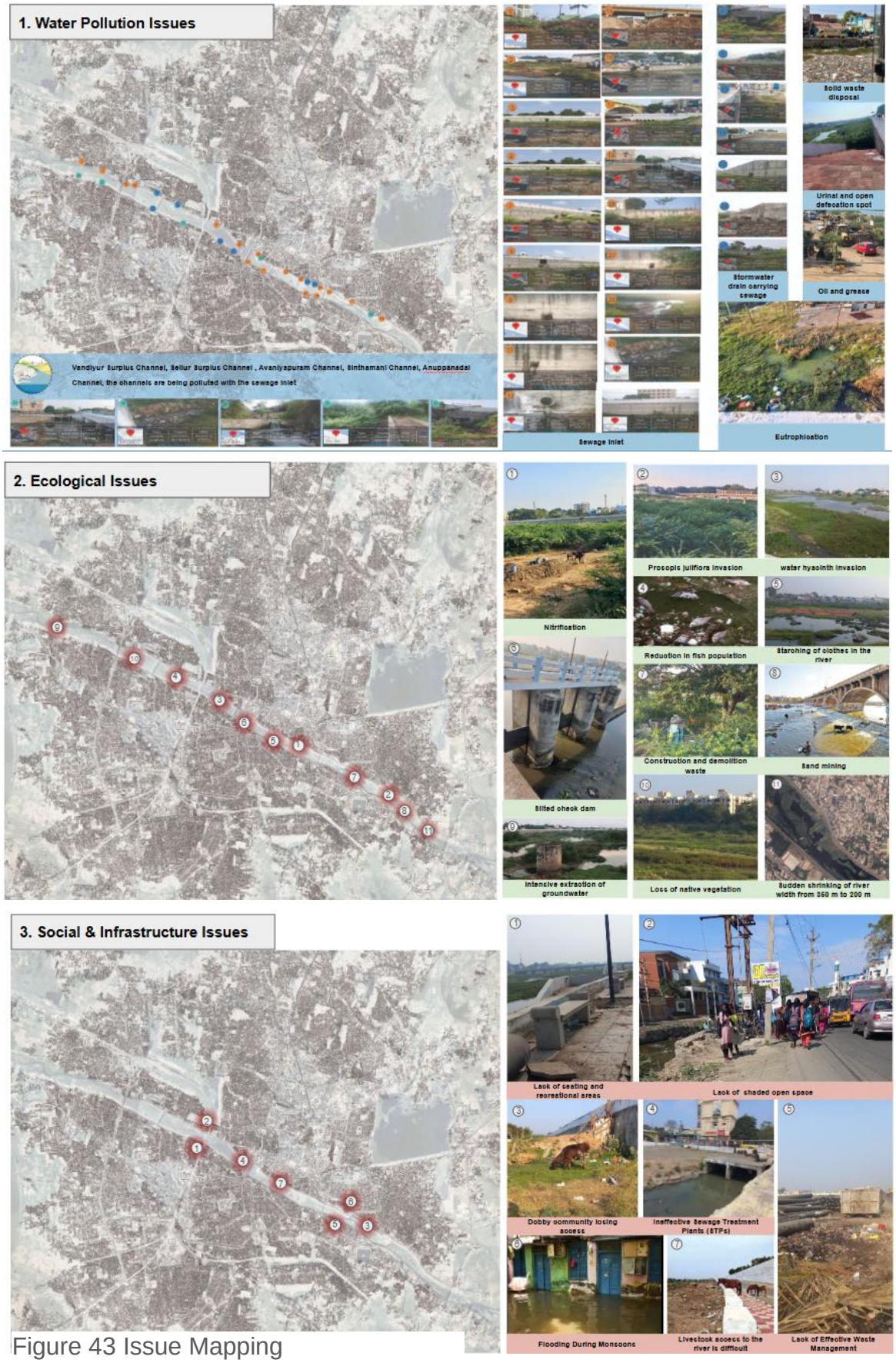


Figure 43 Issue Mapping
Source: Author

Table 9 Issues
Source: Author

1. Water Pollution Issues	2. Ecological Issues	3. Social & Infrastructure Issues
Stormwater drain carrying sewage	Intensive extraction of groundwater	Traditional washerman community losing access due to retaining walls
Sewage water inlet polluting the river water channel	Reduction in fish population	No gathering space
Padithurai acting as a urinal and open defecation spot	Prosopis juliflora invasion	No shaded open space
Disposing of waste into the river	Nitrification	Lack of seating and recreational areas
Industrial effluents from Sidco	Loss of native vegetation	Access to the river for livestock is difficult due to concrete solutions
Cremation activity	The check dam is almost silted	Lack of Effective Waste Management
Oil and grease	Sudden shrinking of river width from 350 meters to 200 meters	Ineffective Sewage Treatment Plants (STPs)
Eutrophication	Sand mining spots visible in the region	Flooding During Monsoons
	Construction and demolition waste	
	Starching of clothes in the river	
	Water hyacinth invasion	

7.6 Activity Analysis:

- **Morning:** Dhobi activity, ritual bathing, temple chants
- **Afternoon:** Low activity, high solar exposure, children playing
- **Evening:** Livestock bathing, informal gathering, open defecation observed in certain areas

Access points are poorly maintained, and there are no organized public spaces or safe pedestrian trails along the riverbanks.

Group	Role/Interaction	Issues Faced
Dhobi (Washermen)	Use ghats and open areas for washing	Lack of clean water, no storage, no shelter
Livestock Rearers	Use shallow zones for bathing animals	Access blocked due to retaining walls
Religious Groups	Conduct rituals and processions	Unsafe access, missing Padithurais
Informal Vendors	Operate near high-traffic ghats	Lack of facilities, encroachment threats
Students	Use open areas for gathering	Underutilized due to unsafe/unhygienic edges

Figure 44 Activity Mapping
Source: Author

7.7 Festival:

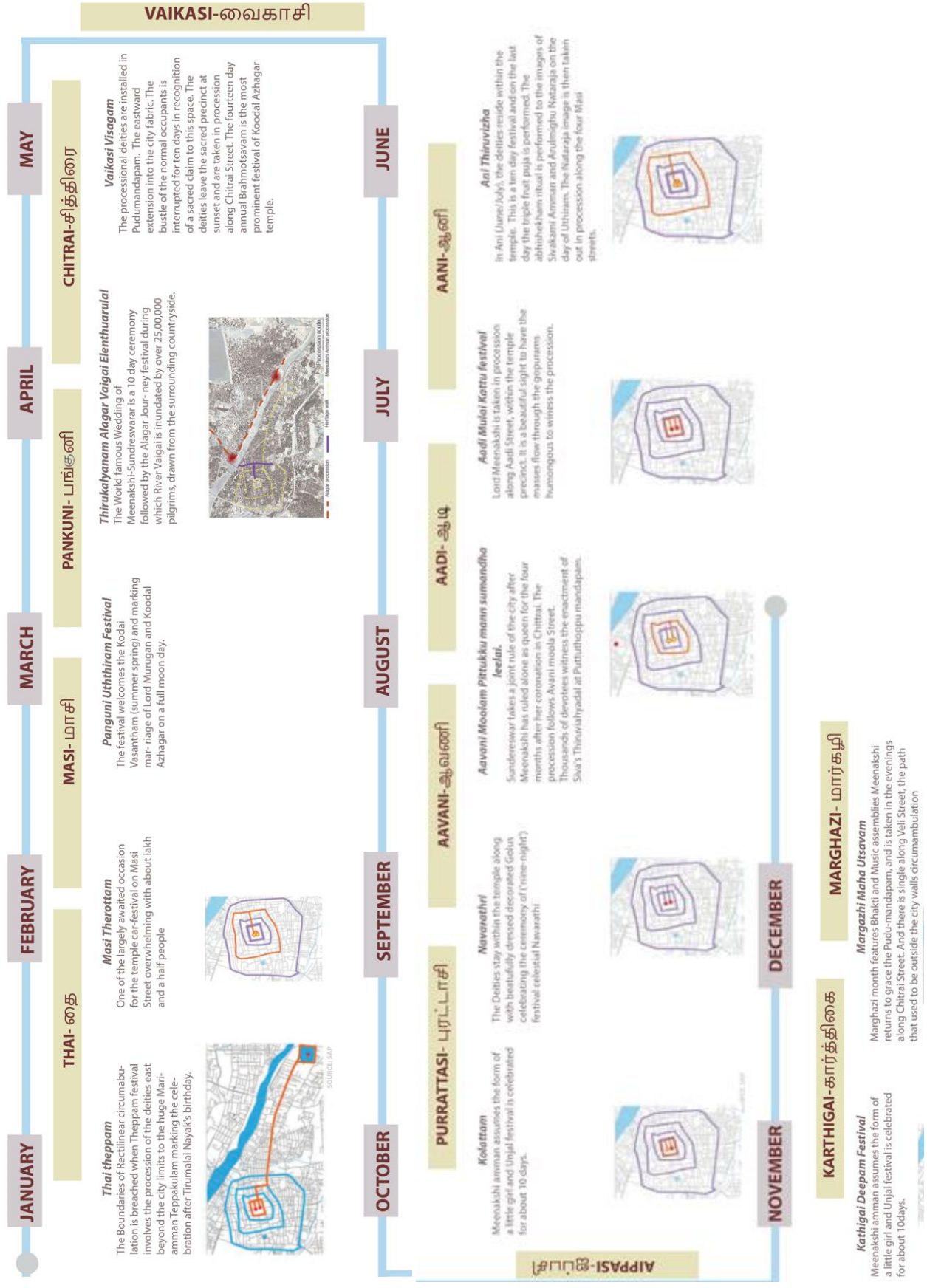


Figure 45 Festival timeline

7.8 Flood Vulnerability:

Table 10 Flood mitigation measures
Source: Atkins

Slum Area	Core characteristics	Key Environmental Risks/Hazards	Risk mitigation measures
SMP COLONY (Ward 33)	Located along the river Vaigai and within the flood plains Primarily housing construction workers	Repeated floods every 3-4 years. Last major flood 2003-04. Unsafe drinking water Open drains and sewers Solid waste dumping Health and sanitation issues: water borne diseases, jaundice typhoid and dengue	Artificial bund (about 3-4m high) provides some barrier to prevent flooding. Houses have been allocated for slum relocation under JNNURM: families are unwilling to relocate due to increased travel distance for employment.
Vandiyur Devar Nagar (Ward 32)	Located along the river Vaigai and within the flood plains Primarily housing skilled labourers – masons, carpeters, hotel workers	Repeated floods every 3-4 years. Last major flood 2003-04. Poor quality of drinking water Poor sanitation Poor waste management	Some construction of houses on raised platforms allowing water to penetrate ground floor areas.
Nethaji Nagar (Ward 32)	Located along the river Vaigai and within the flood plains Primarily housing skilled and semi-skilled labourers in construction sites	Subject to frequent flooding during rains. Contaminated drinking water Absence of land tenure Improper sewerage & drainage systems leading to health issues	No flood barriers Residents have constructed stone houses over the time to protect them from floods Unanimous consent for relocation is lacking.
Nagamal Madam, Therkuvaasal (Ward 62)	Located along the Kridhumal river channel Primarily housing marginal workers - waste picking, old newspaper collection	High flood risk Water contamination Land contamination Air pollution	No flood barriers Families are unwilling to relocate due to increased travel distance for employment.
Avaniapuram – emerging growth area on edge of city	Low lying area on urban fringe with close proximity to water tanks	Water contamination due to encroachment and sewage dumping in tanks - high levels of BOD, COD and NOx content Lack of integration of storm water drainage plans and sewage network plans Dengue and malaria	None

Madurai city went through many floods during North east Monsoon. The flood year of Madurai are 1677, 1709, 1814, 1843, 1884, 1922, 1977, 1979 and 1993. The 1993 was worst in recent time, Vaigai dam opened 1lakh cusec, Sathaiyar dam was overflowing breaching many tanks

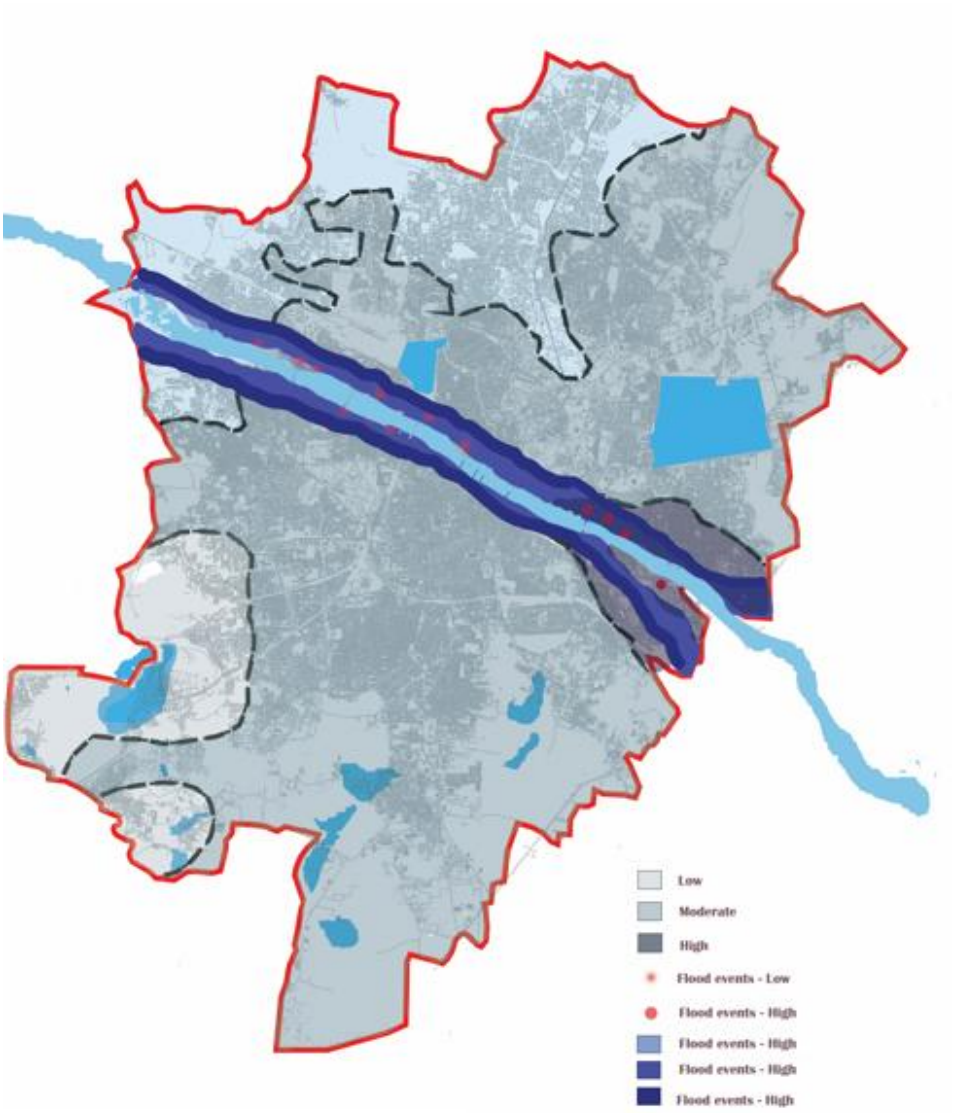


Figure 46 Flood Vulnerability
Source: Author

Figure 47 Flood Image
Source: TNgeography

CHAPTER 8: DESIGN DEVELOPMENT AND FRAMEWORK

8.1 Design Philosophy:

Culture + Ecology + Public Realm

The core philosophy behind the design integrates three pillars:

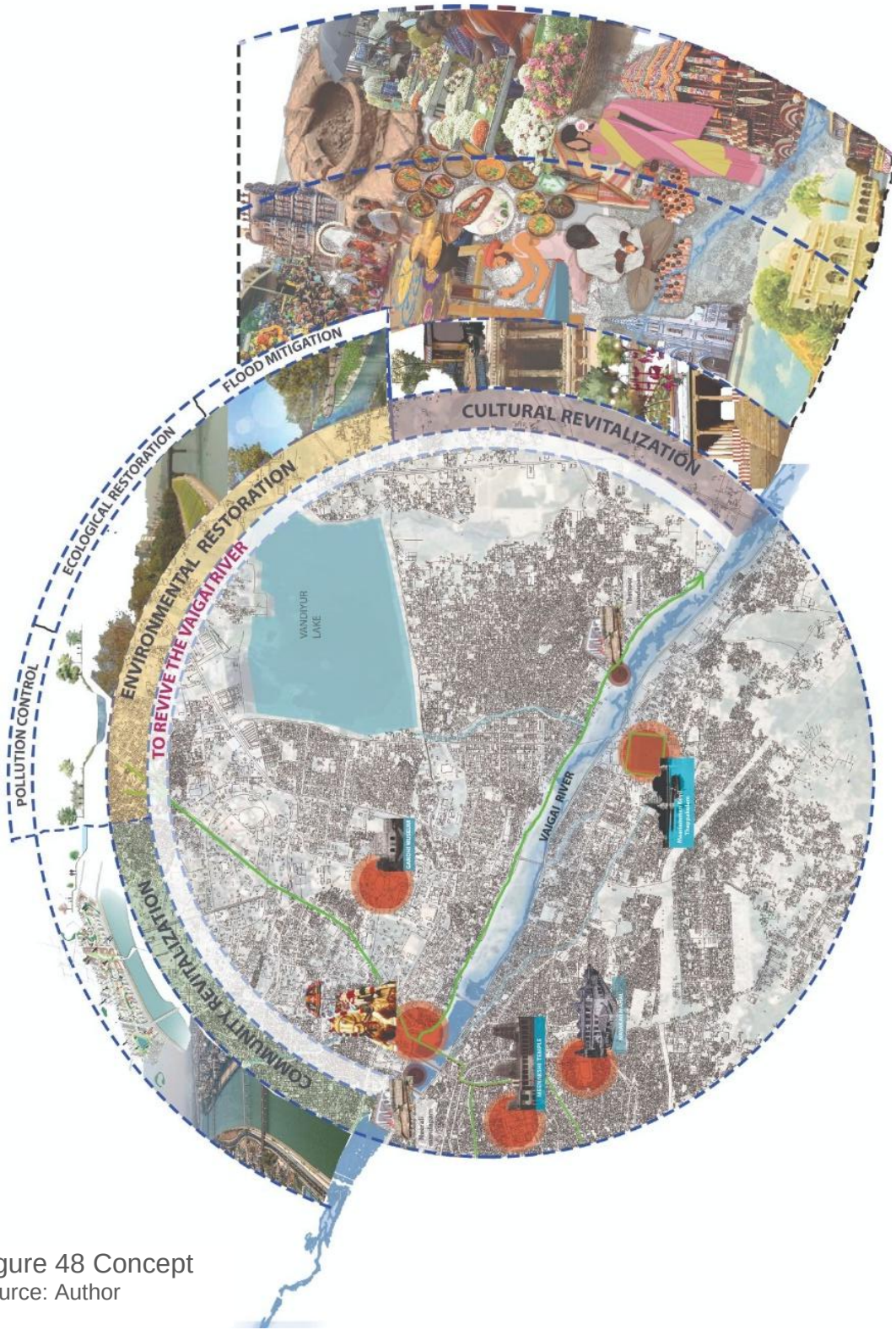


Figure 48 Concept
Source: Author

1. Cultural Connectivity
   Re-establishing links between ritual sites, padithurais, mandapams, and temples through processional pathways, cultural plazas, and interpretive design.
2. Ecological Regeneration
   Using landscape strategies like wetlands, native forest patches, and riparian buffers to restore the river's health and its ecological networks.
3. Inclusive Public Spaces
   Creating a walkable, safe, and multifunctional river edge with zones for informal livelihoods, recreation, and community engagement.

8.2 Spatial Framework

The spatial design is organized as a series of three interconnected zones, each responding to distinct physical, social, and ecological characteristics of the site. These zones form the structure for phased implementation and differentiated interventions.

Zone 1: Cultural and Heritage Corridor

- Located near prominent temples and padithurais
- Includes mandapams, religious routes, ritual ghats
- Focus on restoring historic architecture and integrating modern us

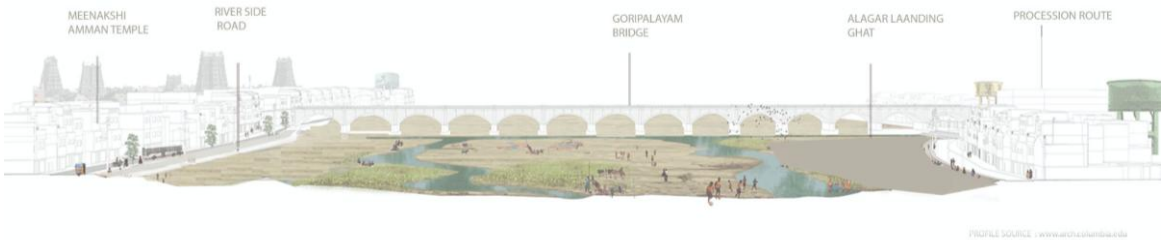


Figure 49 Cultural Ghat Section
Source: Water Urbanism, Madurai

Zone 2: Ecological and Community Interface

- Densely populated with informal settlements and stormwater outlets
- Focus on constructed wetlands, floating wetlands, and community parks
- Spaces for dhobi ghats, livestock access, ragpicker stations

Zone 3: Urban Recreation and Resilience Zone

- Open lands and institutional interfaces
- Bioswales, urban forests, sports zones, and resilience landscapes
- Smart infrastructure like solar lights, CCTV, and emergency points

8.3 Landscape Strategies

1. Riparian Edge Typologies

- Hard Edge Revival: For rituals and high-footfall zones using stone masonry and stepped ghats
- Soft Edge Restoration: Natural banks with native vegetation for infiltration and wildlife
- Floating Edge Modules: Removable decks for variable water levels during dry/monsoon seasons

2. Green-Blue Infrastructure

- Constructed Wetlands near sewage outlets to treat greywater
- Miyawaki Forest Patches in low-density banks to create urban biodiversity hubs
- Permeable Trails and Swales to allow groundwater recharge and prevent runoff

3. Public Realm Features

- Plazas and Gathering Spaces with shaded pergolas
- Informal Market Pockets for vendors and local craft exhibitions
- Interpretation Panels on river rituals, biodiversity, and architecture

8.4 Policies and Guidelines:

Table 11 Policies and guidelines
Source: Author

Policy	Existing condition and drawbacks	Policies and guidelines		
		Short term	**medium term**	**Long term**
WATER QUALITY				
Water Quality - Industrial water pollution	The vandiyur channel is carrying effluents from the industrial sector and releasing it into vaigai without any treatment . as a reselt eutrophication is noted along the river	Channel Tapping:Direct releasing of effluents ito channels should be closed Leaching: The hazardous solid waste are disposed on the riverbed . During rainy days leacing is happening thereby affecting the riverbed	Pipeline Networking: seperate pipe network for sewage water drain to STP has to be laid Reuse of Wastewater: Increasing the reuse of of waste water by the industries itself	Exclusive STP: Seperate Stp for Industries PPP Model: Adopted by the industrial . In which the operation of Cetp is done by ndustries itself. Phyto remediation: helps in reducing the heavy metals and dissolved particles.
Water Quality - Agricultural water pollution	The upstream and the downstream of the vaigai is having large area of agricultural land and that are mainly using fertilizer and this increases the nutrient content of the water	Organic Farming : Reducing the use of fertilizer in agriculture Creating Buffer zone: Helps in absorbing the excess nutrients in the water.	Agro forestry: Converting the available open space of land into agro forestry. Soil Fertility: As the fertility of the sand are increased the use of fertilizers are also reduced	Irrigation Method: water has to be used effectively for agriculture.excess extraction of water should be monitered Recharge Pits: Construction of recharge pits or retention ponds that will helps in recharging the ground water level.
Water Quality - Domestic water pollution	The sewage from the residential and the mixed group zone were released directly onthe river without any treatment. the channels are also opened into stormwater inlets.	Tapping: Nallah tapping should be done and a strict prohibition of sewage discharge into the river should be done. Integrated Approach: Depending solely on mechanical means of treating waste water i.e. installing STP's should be looked upon. Coupling Nature Based Soultions with Mechanical methods would reduce the load on STP and will help in creating more green spaces. Constructed wetlands, Cleansing Biotpes, Riparian Buffers are some of the many methods of Nature Based Water Treatment.	Reuse treated water: Reuse of treated water in different areas like irrigation of public green areas, for flushing and cleaning etc. should be promoted. Local level treatment :Local level treatment of waste water on smaller levels should be implememnted by installing STP's at apartment complexs, inside gated communities and then the treated water should be conveyed by the municiple pipelines.	Community Involvement-Community-driven initiatives of conserving water, treating water at a local level and decentralising the watse water treatment chain will help in building long lasting impact.

GROUND WATER				
Reduction of Ground water level	There is a sudeen depletion of 7 m of ground water level which is documented on the north side of the site.	Increase the pervous layer by introducing ripparian zone and permiable mmaterial will help in increasing the ifiltration	Constructing Infiltration tank and retention ponds that will helps in recharging the ground water	Creating awareness among the citizen for the over explotation of ground water.
FLOODPLAIN				
Regulating Activities in flood plain	At present there is no regulation od activities happening in the floodplain . The shultering of cows in the floodplains causes nitrification , contamination of riverbed and water	Creating a buffer zone after the floodplain that helps in regulating the movement and activities	Time based activies and restriction of activities in the riverbed has to done	Monitoring: Monitoring of activities happening in the floodplain and proper investigation of has to be done to prevent encroachment of fllodplain
River health Monitoring	Despite many issue. the river still hold the self revival character. and it is still used for agriculture and drinking in downstream	Creating Riparian Zones: to facilitate infiltration and increase perculation Removal of seemai karuvai (prosopis juliflora) that completely alters the bed characters of the river.	Plantation drive - to revive the native plant specious growth	Proper Monitoring of river bed from sand MInning.
WASTE MANAGEMENT				
Solid Waste Managem ent	More residential areas on the northern side disposes solid wastes and raw sewage into to the river on a regular basis.	Segregation of wastes. blocking the hazardous waste from being disposed into river	Value generated system can be incoperated in the solid waste management	Monitoring of river bed from dumping of waster. and by laws has to enforced
Awareness				
Awareness program by NGO ' S	The public connection with the vaigai river is missing. The awareness program has to given to address this issue	Awareness program , Instalation describing the importance of the riverine system for the city		

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