CHAPTER 4

AN ECOLOGICAL FRAMEWORK FOR WATERFRONT DEVELOPMENT PLANNING
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4.0 AN ECOLOGICAL FRAMEWORK FOR WATERFRONT DEVELOPMENT PLANNING

This chapter deals with the context of this research thesis by analysing waterfront and waterfront developments. The history, categories and principles of waterfronts and waterfront developments are discussed from available literature including the role of water as a planning element. Stakeholders, operators and beneficiaries are the requirements for successful waterfront management. This chapter also analyses environmental needs of urban waters, and applicability of similar plans and concepts in the study area. Based on all these investigations a broad framework is adopted, which is driven by environmental sustainability. An inquiry is carried out with Kerala in focus, and the study area in order to understand if there are any waterfront and waterfront development/regeneration issues comparable to the international projects and research.

4.1 Analysis of Waterfronts and Waterfront Development: History, Categories and Principles

Throughout human history, civilizations have been established at river basins, and along natural harbors, lakes, and fresh water sources. In addition to survival requirements for water, water based trade and economic activities have characterized some of the earliest waterfront developments. The ancient civilization of the Indus valley, Nile valley, and the Euphrates are well known examples. The rise in global maritime trade and warfare after the ‘Columbian Exchange’, which followed after the voyage of Christopher Columbus in 1492 (Nunn and Qian, 2010), and establishment of colonies (by (predominantly) the English, Spanish, French and the Dutch) increased diverse waterfront land uses, including the establishment of port centers around the world.

However, changes in technology saw the rise of airline travel, road surface cargo transportation, development of railways and roadways spawning suburban living away from the ports. Riverfronts saw gradual demise of waterfront ports and harbor, and active neighborhoods and industries in the vicinity of waterfronts. Goodwin (1999) traces the decline to the 1950s and 1960s. Many authors have also analyzed underlying structural issues for increased deterioration of waterfronts in the 1970s through the 1980s. In order
to address some of the impacts to local and regional economies and culture, and in order to harness some of the inherent potential of established waterfront locations and existing infrastructures, many cities worldwide started rejuvenating deteriorated or neglected waterfront areas. Many of the old waterfront properties have become sites for temporary, large scale international events like the Olympics, the football World Cup and Expos. The waterfronts have also gained strategic importance as national tourist destinations.

In the process of reviving existing waterfront properties and infrastructure, or in order to develop new waterfront sites, it is important to look at historic transformations in detail, discuss various categories of waterfronts and generally documented principles for success. Yassin, et al. (2012) refer to Wrenn (1983):

…understanding the historical milestone of waterfront is important because these are the stimulates to modern development in the city. (p4).

4.1.1 Waterfront Transformation Phases

As the focal point of urban activity, as a space for religious and cultural events, and as gateways for maritime trade and transportation, the waterfront has undergone many transformations. Although the seminal book Urban Waterfront Development by Wrenn (1983) researched and analysed waterfront developments with reference to North American cities, the historical evolution of waterfronts are widely regarded to be applicable worldwide. Citing Wrenn et al.’s (1983) categorization, (Zhang, 2002), (Yassin, et al., 2010), (Latip et al., 2012) and (Timur, 2013) list four phases of waterfront transformations:

1. Phase One: Establishment/beginning of waterfront areas/cities
2. Phase Two: Growth of waterfronts and waterfront cities
3. Phase Three: The decline/deterioration of waterfronts
4. Phase Four: Waterfront awareness and rediscovery

**Phase One: Establishment/beginning of waterfront areas/cities:** Moretti (2008) highlights that …in pre-industrial cities, riverfront and waterfront areas were intensely used and thriving with people and activities. (Slide 3). And that …river cities displayed an intimate and complex relationship with water, and water itself was never
considered the limit, but an extension of the urban fabric. (Slide 3). Wrenn et al. (1983) describes how the earliest settlements in North America were built close to the ocean / river harbors for safe harbors and to facilitate easy movement of goods and people between Europe and America. Few trails converging at jetties gave way to large wooden piers but the rapid development still maintained direct relationship to water, where water transportation predominated.

**Phase Two: Growth of waterfronts and waterfront cities:** The intimate relation in spatial and functional terms (Dong, 2004) in pre-industrial cities was interrupted due to huge ports and associated commercial and industrial activity (Timur, 2013). Smaller settlements turned into bustling cities with busy streets, increased commercial activities, disassociation of the waterfront from earlier streets, and replacement of wooden piers by bigger stone dock yards. Timur (2013) and Zhang (2002) summarize the discussion by Wrenn et al. (1983): The establishment of railway lines to the ports further disassociated the earlier settlements and new areas of the expanding city from the waterfront. In order to cope with the increased congestion, port authorities were established and elevated highways were built. Moretti (2008) also lists the development of railways and roadways as causes for increased commercial port activities, and for city expansion inwards, towards the mainland and away from waterfronts. All the authors present that industry and transportation were the predominant land uses and industrial warehouses dominated the waterfront. The congestion from these uses started to pollute the waters and the waterfront started to loose its natural attraction to urban residents (Wrenn, et al., 1983).

**Phase Three: The decline/deterioration of waterfronts:** With changes in transportation modes and containerization technologies, many waterfront industries changed (Timur, 2013) and waterfronts gradually underwent structural changes with isolation from the city, and deterioration and neglect (Shrestha et al., 2009). Citing Akköse (2007) and Zhang (2002), Timur (2013) presents many factors for the neglect of once-thriving ports: Increase in volume and speed of port activities after World War II due to containerization technologies; increase in bigger container ships that could not navigate existing shallow ports; preference for highway travel over railroads; increasing pollution and urban blight at waterfronts; and absence of urban residential neighborhoods at the waterfronts. This period also saw reduced preference for railway cargo and goods.
transport, and declining manufacturing plants and industries at the waterfront. Goodwin (1999) summarizes these as national trends having their origins in the 1950s and 1960s:

- The shrinkage of ports due to containerization of cargoes and load centering;
- Port abandonment of downtown piers, wharves, and transit sheds in favour of new container terminals constructed on flat, less-developed industrial shorelines;
- The demise of oceangoing passenger liners as the airlines’ international reach expanded with the advent of jet transports;
- The suburbanization of downtown manufacturing establishments, including water-dependent and water-related industries, as a result of efficient truck transportation; and
- Urban renewal and demolition of downtown blocks adjacent to waterfronts.

(Goodwin, 1999, p. 242).

**Phase Four: Waterfront awareness and rediscovery:** The decline of waterfront areas and economies was accompanied not only by residential flight to the suburbs, but also increased pollution, crime, and abandoned swathes of industrial properties. With container industries and other industries dependent on highway transportation shifting to alternate locations where space was plentiful (Yassin, et al., 2010), the urban-port congestion declined. City authorities realized the impacts of these structural changes on the larger economy and quality of life for its residents; Goodwin (1999) highlights how the loss of local economies that had served industries like fishing, mining, fishing, etc. impacted local cultures that was defined by these economic activities. Raising environmental awareness and concern for the health and quality of shared resources in the 1960s also spurred citizens to recover the aesthetic scenery and access to waterfrotns (Timur, 2013) and (Zhang, 2002). Cities rediscovered the strategic advantages of a waterfront location for leisure and recreation, and for mixed use developments to enhance the architectural and urban design character of the city’s shorelines. The US Federal Coastal Zone Management Act (CZMA) of 1972 and amendments in 1980 have redeveloped over 300 deteriorated urban waterfront districts nationwide (Goodwin, 1999). Shrestha et al. (2009) highlight that
These waterfront transformations, evident in coastal cities around the globe, demonstrate the continuous process that results from multiple forces acting in different ways in different environments. Waterfront, used as a place for production and transportation in the past, has been transformed as a recreational and visual resource in the post-industrial society. (p. 105).

Moretti (2008) points out that regeneration programs in post-industrial cities have been perceived positively as an opportunity to experiment with new opportunities for economic re-vitalization. He calls waterfront regeneration one of the most important urban renewal phenomenon since the 1980s, which has created a laboratory of ideas for urban renewal in the broad range of cases and quality of results, and which can generate ideas for the future despite the marked differences in geography, dimensions, population and culture. Considering this history of waterfront transformations, its impact on urban economies and quality of life for local and regional communities, and considering opportunities for generating innovative urban renewal schemes, it is important to specifically look understand the types and characteristics of urban waterfronnts.

4.1.2 Urban Waterfronts

Centuries of industrial ports, passenger ocean liners, naval warships, etc. made waterfronnts and cities with ports strong economic, political and cultural hubs. The history and continued vitality of contemporary cities like Mumbai, London, Amsterdam, New York, Tokyo, etc. demonstrate this clearly. Yassin, et al. (2012) reinforce this point by referring to Malone (1996), and presenting that the urban waterfront development is widely regarded as a frontier of contemporary urban developments, attracting investment and publicity. Citing (Wrenn et al., 1983) and (Al Ansari, 2009), Timur (2013) points out that cities located on the banks of intersecting rivers, estuaries and deltas, or on peninsulas, headlands or small islands benefit from long waterfronnts, and lists five distinct categories of urban waterfronnts:

1. Urban area located on peninsula.
2. Urban area located on a bay.
3. Urban area located on banks of a river.
4. Urban area located on banks of intersecting rivers.
5. Urban area located on a large body of water.

The first two categories are at an ocean or sea, and the other three can be at inland waterways. Shoreline shape can be an important factor for urban waterfronts. Urban areas along a river and with long coastlines benefit from water based transportation systems and show specific areas of intense activities like boat jetties and ports. Urban areas with larger areas of useable waterfronts like natural harbours and bays, and cities located on peninsulas or islands with shorter distances to other urban centres also benefit from opportunities for multiple uses. The Baltimore inner harbour, a successful redevelopment project of the 1970s in the USA, the Singapore waterfront at Marina Bay, and the waterfront projects on the Thames River bank in London are some examples of urban waterfronts that have benefited from their natural settings.

In order to understand the attraction of urban waterfronts for potential investors and residents alike, it is important to look at the effects and advantages of water on humans and communities in general, and the role of water in planning in particular. Physical and psychological effect of water cannot be denied. Water plays a major role in any religion and has deep spiritual and cultural significance. Water also denotes cleanliness, purity and connections with nature.

4.1.3 Effects of Water as a Planning Element

This section discusses the role of water as a planning element in an urban area. Figure 4.1 shows how water in an urban context has aesthetic and functional effects:

**Figure 4.1:** The effects of water as a planning element in urban areas

![Diagram of the effects of water as a planning element in urban areas](image)

Aesthetic effects include the visual, audial, tactual and psychological effects; these are felt directly by all people interacting with water. Engaging physically with water by swimming, splashing, walking in shallow waters, etc. provides various sensory and psychological experiences. Listening to the sound of water and looking at still or flowing waters has similar effects; it provides serenity, vibrancy, joy, contemplative moments, etc.

Water remains one of the most fundamental universal experiences for all humans and animals. Water as a functional element is shown to provide climactic comfort via cooling; noise control by muffling various sounds and focusing auditory interactions with the water element; circulation effects by limiting or enabling movements at the water’s edge; and recreational effects through various activities at and in the water.

In this context, it is important to note Mangor et al.’s (2008) discussion that waterfront developments have become artificial pieces of new nature. As human design interventions at the waterfront are also subjected to natural hydrodynamic forces after construction, they argue that a thorough understanding of natural processes is essential for creating attractive waterfront environments, which are harmonious with their natural marine environments. Therefore, it can be argued that another effect of water as a planning element in urban areas is the (natural) environmental effect. The quality of natural environments has an immediate impact on the aesthetic and functional effects of water, and public accessibility. Hence, this research recognizes that a range of issues, from a larger regional watershed to the local water environment and communities at the waterfront become essential for the development of an urban waterfront plan.

As discussed in the history of waterfront developments, urban waterfront regenerations since the 1970s have capitalized on the effects of water and its importance to communities through their recreational and visual resources (Shrestha et al., 2009).

### 4.1.4 Categories of Waterfront Plans

Further discussions of urban waterfronts can be seen in a post-industrial context of urban waterfront regenerations and redevelopments where the policies and planning processes include aesthetic and functional effects of water. Additionally, although the waterfront developments are fundamentally driven by economic potential of waterfronts and determined by complex political and policy frameworks, ecological concerns and intentions to re-connect communities to the water’s edge can be observed to guide most of the post-industrial waterfront projects. Waterfront development plans and
regenerations are challenging to categorize due the variety of sites; complexity of issues, which are site specific; and due to multiple aims for each project. However, Moretti’s (2008) categorization of the typologies of urban waterfront regeneration offers a starting point for analysis and discussion. He categorizes urban waterfront regenerations into 7 typologies:

1. **New Urban Expansion**: This typology contains waterfront developments built in available areas, extending existing urban boundaries. The urban areas that developed away from the waterfronts during the third phase (decline/deterioration of waterfronts) are encouraged to expand towards the regenerated waterfronts. Reclaimed old industrial and port areas are converted into mixed use developments, and communities are brought back through a mix of incentives, environmental remediation, and designed urban spaces, amenities, and a mix of residential and commercial facilities. Moretti (2008), Giovinazzi et al. (2008), and Hellweg (2013) as referred to in Timur (2013) give the following examples: Hafen City in Hamburg on Lake Spandau; and the Bay of Rummelsburg in Berlin.

   **Figure 4.2**: Hafen City, Hamburg.

2. **Waterfronts and Great Events**: This typology includes new urban areas that developed as a consequence of temporary mega events like the
Olympics, International Expos, Football World Cup, etc. These newly created areas include residential and commercial uses along with supportive transportation and utility systems. Sporting arenas like indoor and outdoor stadiums, swimming pools, etc. may also be part of the development depending on the type of mega event, which the development catered to. Some of the examples by Moretti (2008) include the Expos in Seville (1992), Barcelona (1992, 2004), Genoa (1992, 2004), Lisbon (1998) and London (2000). After the mega events concluded, these areas were opened up for public use and individual purchases.

Figure 4.3: Examples of various Expos.

3. **New Urban Waterfront Itineraries:** This typology specifically categorizes innovative designs along the water-body and in its immediate vicinity. They include pedestrian paths, bicycle tracks, designed public spaces for gathering and small scale temporary events like movie screening and music concerts, cafes and restaurants, etc.

4. **Reuse of Port Areas:** The old port areas were a direct result of port economies and related settlements. Natural harbors and favorable waterways had encouraged the development of ports, wharves and dockyards. After the decline of these ports, the earlier residential and commercial uses shifted into new urban areas, increasing the decline of the old port areas. With waterfront regenerations specifically focusing on old
port areas, reuse of old buildings like former residential buildings and warehouse become economically viable and innovative. Urban design identifies opportunities for new amenities and re-establishes physical and visual connections to the water. Moretti (2008) calls this as *brining the heart of cities back to the water.*

5. **Flood Defenses:** Infrastructure that creates flood defense and represent new urban areas for a variety of uses are listed in this category. Redevelopment of waterfront areas that are vulnerable to natural disasters like flooding include building defenses for the rest of the city. These could be berms, levies, green area barriers, and artificial barrier islands. Such constructed or reclaimed areas can be used for open air festivals, riverside/beachside walking-jogging-bicycle tracks, and everyday spaces for people to use.

6. **Urban Riverfront Regenerations:** Redevelopment of existing urban riverfronts into vibrant public spaces and livable areas are categorized in this typology. Derelict/abandoned areas, which were once habitable; empty stretches of riverside spaces, which may have been turned into landfills; and contaminated lands leading directly into the water may be regenerated by focused planning, land remediation and urban design.

7. **Urban Beaches:** These are artificially created beach-like areas near or at existing waterfronts. Moretti (2008) and Timur (2013) discuss this phenomenon to be seasonal (during warmer months in the Northern hemisphere, in the cities of Europe) and vibrant urban spaces (with the creation of piazzas and spaces for beach front activities). They can be

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**Figure 4.4a:** The Donauinselfest in Vienna.  
**Figure 4.4b:** Guadalupe River in San José, California, USA

characterized by thematic elements like beach umbrellas, beach chairs, palm trees, and beach themed structures. The authors give specific examples from Europe to illustrate this category of waterfront regenerations: *Strand Pauli in Hamburg, The Badeschiff on the Spree River in Berlin, Porsuk Plage in Eskişehir, Paris Plage in Paris along the Seine River, etc.* (Timur, 2008, p184).

**Figure 4.5a:** Strand Paulion, banks of the Elbe River, Hamburg.  
**Figure 4.5b:** The Badeschiff on the Spree River, Berlin.  
**Figure 4.5c:** Porsuk Plage in Eskişehir. Street beaches.  
**Figure 4.5d:** Paris Plage

Waterfront plans themselves can be classified into **three categories** Tsukio (1984) as cited in Dong (2004):

**Conservation** reuses and restores existing or old waterfront properties by calibrated design and planning decisions.

**Redevelopment** aims to convert and revive harbors into new facilities.

**Development** creates new waterfronts for the present needs of an urban area and can include reclaiming land from the sea or surroundings areas without any earlier waterfront uses.

### 4.1.5 Stakeholders, Triggers and Constraints

For any of the categories of urban waterfronts, two major factors can be identified as being instrumental in generating the planning and development of waterfronts. Gordon
(1997b) as cited in Dong (2004) identifies these ‘triggers’ as urban blight and economic development (p.12). From the discussions on the historic development of waterfronts, we can see that congestion and industrialization of the waterfronts, and development of railways and roadways, especially the highways, led to mixed use urban neighbourhoods moving away from older cores or settlements at the water’s edge. With gradual reduction in industries and ports, this landscape too became vacant of the once thriving uses. Urban blight, contaminated land, unsafe areas, and reduced use of existing buildings concerned city authorities. The potential offered by a strong natural resource like water was offset by underuse or misuse of the waterfront. Raise in environmental activism during the 1960s and 70s in the United States ran parallel to the rediscovery of the potential of waterways. This potential was seen in terms of renewed economic development and the removal of urban blight; these combined with environmental remediation and restoration of the waterways. Therefore, urban blight and economic development can be accepted as the main triggers for waterfront developments and waterfront regenerations.

Moretti (2008) presents a list of key factors aiding urban waterfront regenerations. These factors also centre on economic development for the entire city, and removal of blight at the waterfront. The factors listed are:

1. The ‘strategic’ value of waterfront areas for the development of the city as a whole: this spurs new expansion of the city towards the water’s edge.

2. The ‘location’ factor of the waterfront: the location of older waterfronts with existing transport and utility infrastructure ensures connectivity. The vast post-industrial spaces offers spaces for new development and activities.

3. A rich heritage of infrastructures and historical buildings: in addition to the infrastructure mentioned in the previous point, historical buildings from the original developments offer historical-architectural value.

4. Direct contact with water: This factor concerns the effects of water on people in an urban setting as discussed in a preceding section. Waterfront regenerations recognize this advantage, and consider water to be a positive resource, influential for the quality of urban life and with the capacity to attract residents and diverse investors.
5. The evocative and symbolic value of waterfront areas: Port areas and private/semi-private waterfront areas are perceived to communicate wealth and power for many residents, businesses and cities world over. The establishment of resorts and spas, private residences, exclusive hotels, etc. at the waterfront, and with water related sports/activities reflect the value of this key factor.

Timur (2013) refers to Papatheochari (2011), Jones (2009) and Goddard (2002) in identifying the following additional benefits with regard to economic development and the removal of urban blight:

1. Tourism: Regional, national and international tourism attractions are developed by waterfront regenerations. This also enhances the city’s image and increases its marketing options and strategies.

2. Improved water ecology and water quality: In order to attract and retain the new users at the waterfront, ecological restoration and improved water quality is important. Waterfront regeneration projects with advanced management processes therefore benefits the larger environment and the waterfront development. Opportunities to improve local and regional environmental conditions are afforded by collaborative ventures.

3. Economic benefits: Improvement of local economy in the declining urban waterfront areas through investments, creation of new jobs and local businesses, and supportive economic policies and incentives. Increased real estate property values and tourist economies are also positive outcomes.

However, the focus on only economic development and urban blight is restrictive; as urban waterfront regenerations and redevelopments aim to restore the link between waterfronts and communities, social aspects cannot be ignored. Considering Toronto’s ecosystem approach to waterfront planning as discussed by (Laidley, 2007), the intention to bring together economic recovery, healthy environment and livable communities in Toronto, Canada, can be considered to point towards another important trigger, which involves communities. This research therefore recognizes this third trigger to be ‘community access and enhanced public open spaces’. Latip et al. (2012) discuss public
accessibility at the waterfront in detail, and note how it has become a vital urban design principle along with environmental sensitivity. They quote Manley (1998, p.153) that in the quest to achieve a quality environment, the agenda of urban design has increasingly shifted from the ‘traditional concentration on the visual and functional aspects of design, to a position which reflects a concern for the social and environmental consequences of design decision’ (Latip et al., 2012, p.313).

Despite all the pressing needs, benefits and triggers to waterfront developments as discussed in this chapter, enormous constraints are also evident. Many of the constraints and risks can be under physical, economic, managerial and social aspects (Dong, 2004).

Irrespective of the specific category of waterfront, urban waterfronts are complex spaces with multiple issues. The history of waterfronts demonstrate the political, economic, spatial and social complexities. Wrenn et al. (1983), Dong (2004), Daamen and Vries (2012), Bunce et al. (2007), Latip et al. (2010), Liu (2013), Sairinen et al. (2005), and Sokoloff et al. (2005) discuss various aspects of these complexities in great detail. Apart from the locational advantages, actual physical character of specific waterfronts may require long-term and costly investments; remediation of contaminated lands, restoration of architectural buildings, repair and extensions to existing infrastructure, crime and safety management, and construction of new facilities in an investor-buyer attractive way can be a challenge.

The challenges can also be compounded by lack of coordination between diverse official agencies, fragmented governance and jurisdictional issues. The planning, development and continuous governance of urban waterfronts and surrounding spaces are subject to intense debates and conflicts (Sokoloff et al., 2005), (Daamen and Vries, 2012); and different scales of decision making and socio-political engagements have direct influences on the social and ecological processes that occur at the waterfronts (Bunce et al., 2007). Moretti (2008), Morena (2011) and Timur (2013) list additional risks and constraints for waterfront projects, especially redevelopment/regenerations:

- Standardisation of the interventions without local identity
- Focus and achievement of high profit levels rather than high quality
• Excessive commercial-tourist atmosphere than a mixed-use or residential function: This will restrict the use to a few hours a day, and a mixed-use development with residences will ensure round-the-clock and long-term use of the entire area.

• Scarcity of productive activities: Good urban design can be generated without actually ensuring economically viable and socially acceptable activities at the waterfront.

• Free access to the waterfront: Public access to the waterfront should be free and non-discriminatory. As discussed earlier, community access to public open spaces at the water is important. Lack of such access can constrain the vibrancy of new projects. Morena (2011) also cautions against the neglect of community objectives, and the link to the water while favouring business and property interests.

4.1.6 Principles of Success

Analysis of various triggers and constraints show that a few aspects are absolutely essential to ensure the success of any waterfront project. These include the coherence of a Masterplan and clarity in urban design guidelines (Dong, 2004), (Walters, 2007), and (Timur, 2013); benefits to all the stakeholders including tourists, investors, and residents (Yassin et al., 2010), (Bertch, 2008), (Goodwin, 1999) and (Dong, 2004); preservation of heritage and historic properties (Dong, 2004); and public access to the waterfront through enhanced aesthetic and functional uses (Sairinen et al., 2005) and (Timur, 2013).

Kaymaz (2013), Basiago (1999), Rajasesan, et al. (2012), Latip (2012), and Sairinen et al. (2005) emphasize the importance of community engagement in the planning and development processes; community identity; public access to the waterfront; and the requirement to assess social impacts on urban waterfront projects. Through a comparative analysis of alternative development models in Curitiba, Brazil, Kerala, India, and Nayarit, Mexico, Basiago (1999) argues for public involvement and nature-friendly policy frameworks for sustainable urban developments. Sairinen et al. (2005) echo the need for including society and nature into a holistic urban development framework:

Social impact assessment provides possibilities to improve strategic management and land-use planning practices of urban waterfront areas, as
well as the management of urban natural resources in general. (Sairinen, et al., 2005. P.134)

In addition to social inclusion as a moral and urban imperative, involvement or the buy-in of communities also became important in the post-modern, post-industrial scenario. In Designing Community. Cherrettes, Masterplans and form-based codes, Walters (2007) discusses the changing roles of urban planning and urban design in this post-modern era. He discusses community participation in great detail with attention to community building, and community-based architecture and planning.

Daamen and Vries (2012) discuss the conflicts of urban waterfronts, especially with regard to the port-city interface (the geographical areas where the city and port meet) in great detail. They identify that joint governance processes are important to build long-term and sustainable spatial projects. Moretti (2008) identifies effective public-private-partnerships during all the stages of the project to be an element for success. As waterfront developments tend to be long-term projects, he also identifies a need for long-term political support independent of short-term political offices or budgets.

4.2 Adoption of an Ecological Framework: Environmental Sustainability in Urban Waterfront Development

This section develops an approach for the thesis based on discussions from previous chapters. It adopts a broad ecological framework based not only on the analysis of the study area's waterfronts as presented in Chapter 3, but also on a thorough review of the issues discussed in this Chapter. The thesis recognises the importance and an urgent need for environmental sustainability and its need in urban planning and development, especially in the context of waterfront developments. All the issues surrounding environmental sustainability in urban waterfront development are discussed in this section. The need for planning urban waters is first presented and sustainable planning of urban waters as a critical need is investigated. These aspects are then explored with reference to developments in watershed and waterfront planning globally through the adoption of Water Sensitive Urban Design (WSUD), and sustainable watershed and waterfront plans. This chapter also analyses environmental needs of urban waters, and applicability of similar plans and concepts in the study area.
Analyzing the body of available literature on waterfront development history, and contemporary waterfront developments, it can be seen that issues surrounding economics and the environment predominate. Brebbia (2013), Laidley (2007), Bunce and Desfor, (2007), Giovannazzi and Moretti (2010), Vallega (2001), Seattle Department of Planning and Design (2012), The City of New York (2011) and (Shreshta et al., 2009) discuss the importance of an ecological framework in waterfront development and waterfront regeneration projects. They demonstrate the economic viability and long-term economic advantages for the city and the entire region from adopting an ecological approach to waterfront developments. These cities recognize that the waters at the waterfront are part of a larger system, and regional watersheds. Any impacts on any of the upstream watershed areas has the potential to affect the quality of waters downstream. In order to ensure successful waterfront areas with vibrant public access that provide positive image of the city, and in turn sustain long-term economic competitiveness, waterfront development projects are compelled to address environmental issues at the waterfront. Such a framework has to include social and economic equity and environmental quality. Baschak and Brown (1999) make a compelling case for such an ecological framework for urban river greenways that integrates ecological planning, design and management. Basiago (1999) argues for urban sustainability through a mix of innovative policies in developing countries. Bunce, et al. (2007) identify that the discourse for sustainability (and its association with the concept of livability) is increasingly part of urban waterfront policies. Additionally, they present that

Another common policy discourse is that of the 'global city', which outlines the development of large-scale urban waterfront projects based on the creation of healthy and clean waterfront communities as well as specific built-form spectacles that attract tourists and investors alike. (Bunce, et al., 2007, p6).

Following from the above discussion, this section emphasizes that in order to plan urban waters and any associated waterfronts sustainably, it is important to understand the meaning of the term sustainable. There are various interpretations of sustainability. Although many of these interpretations can be contentious, one of the most commonly accepted definition describes sustainability as the ability to meet the needs of the present without compromising the ability of future generations to meet their own needs (adopted
from a Report of the World Commission on Environment and Development, U.N., 1987). This highlights the integral way the natural world and human settlements are connected, and the dependence of long-term well-being of all humans on the well-being of natural systems and responsible usage of natural resources.

This section further looks into the basic need to plan urban waters, and the critical need for their sustainable planning and development. It also discusses some of the ways urban waterfront areas and urban waterways can be planned, designed and managed to be environmentally sustainable.

4.2.1 Importance of Planning Urban Waters

Urbanization and urban activities impact the health of regional ecosystems, and yet, at the same time depend on it for various resources. All natural ecosystems are interconnected. All the natural waterways and aquifers, and urban water streams (water used and discarded from various urban uses as categorized by Wong, 2011) are also interconnected. Natural habitats are associated with water bodies and waterways. Urban river greenways is a term used in literature (Example - Baschak, et al., 1995) to refer to these interconnections.

All the waters are connected at the level of regional watersheds. A watershed is the area that drains into a lake, stream, or river via streams or ditches, directly over the ground surface, or through the ground. Whatever happens in a watershed can affect water bodies far away (EPA, 2013). Figures 4.6 and 4.7 illustrate the characteristics and functioning of a watershed, the natural hydrological cycle and the impact of urbanization.

Figure 4.6 and 4.7: Watersheds

Source: Shorelandmanagement.org and US EPA - epa.org
(EPA, 2013) and Philly Watersheds (2013) also list that watershed issues impact ecology and economy through: Increased surface runoff volume; Percolation changes; Contaminated groundwater and surface runoff; Absence or reduced tree canopy – interception by canopy reduced; Increased stress on infrastructure and services; Impacts on flood plains; Habitat Loss; Creation of dead zones in rivers, oceans and bays; Impact on watershed dependent economy; and the Creation of Public Health issues from contaminated waters. City of Portland (2006) presents the interconnections of regional waters and natural habitats, and articulates clear goals to enable holistic planning and development of its regional watersheds. Baschak, et al. (1995) had argued for a framework for the ecological planning, design and management of urban river greenways. They highlight how the transformations of urban landscapes are having major ecological consequences for urban habitats. The forces of urbanization can lead to deterioration of natural ecosystems and regional waters. This in turn impacts public health, economy and future development potential.

**Plate 4.1:** Deterioration of urban water canal.

Vanchiyur Todu, TUA.

Source: Author

Additionally, natural and man-made disasters including accidents (For example: Tsunami, cyclone, typhoon, landslides, etc. And, cruise ship accidents, oil spills, nuclear reactor accidents, etc.) affect the health and quality of regional ecosystems and its waters in some of the following ways:

- They affect water quality, water supply, navigation, tourism potential, etc.

- Sometimes, disasters can be opportunities to inform new planning decisions, and impact existing planning strategies.

- Impacts from human settlements like over-fishing, drying up of river beds and wet lands for real estate development, over-drawing
Degradation of natural ecosystems and waterways through urbanization, and their contamination/further deterioration from disasters highlight another important issue: Social_Equity. The costs and impacts get transferred to everyone, especially the poor. Social impacts are of concern to planners and city authorities worldwide. Waterfront development regenerations have been spurred in part due to urban blight and deterioration of the social space. Degradation of natural environs from various causes can compound this issue, creating additional challenges for recovery and rebuilding. Additionally, urban waterfront projects could marginalize existing communities and the poor through gentrification and discriminatory practices for access to the waterfront Sairinen et al. (2005). Along with ensuring social equity and economic viability, the diverse water bodies and inland waterways of some cities have special challenges. These include jurisdictional issues for administering the waters and managing a variety of development issues depending on the specific type and characteristic of each water body. Wong (2011) identifies these cities to have three separate water systems:

1. Potable Water System
2. Sewerage System
3. Stormwater Drainage System

These cities have to balance economic growth with environmental issues by taking strategic decisions regarding all these water systems. Many cities across the world have adopted a sustainable approach to formulating urban policies, developing plans and urban designs, and in implementing them.

4.2.2 Sustainable Planning of Urban Waters

The three urban water streams (potable water, wastewater and storm water) have a direct impact on the health of humans and the natural environment. Rapid urbanization, increased urban density, and developmental pressures for residential and commercial land uses have increased urban water shortages. Even in regions with natural waterways, potable water supply can be a challenge. Increase in the number of bore-wells can contribute to the depleting water levels in aquifers.
Combined infrastructure systems that mix sewage with storm water can be vulnerable to flooding events. Such systems can discharge untreated sewage into natural waterways during heavy rainfall or flooding events when sewage treatment plants cannot cope with increased volumes. This can cause disease outbreaks, long term health hazards and ecological degradation. Untreated wastewater and urban run-off also affect marine life, health of wet lands and watersheds, and can increase dead zones. This substantially impacts local and regional economy dependent on tourism, fishing, pearl harvesting, etc.

The combination of water shortages, increasing volumes of wastewater, and the need to manage storm water makes a strong case for sustainable urban design and planning with consideration to urban water cycle. Planning strategies at all levels—building level, block level, neighborhood level and region level are required. Urban design that incorporates constructed wetlands, bio-retention systems and bio-swales; architecture with designed systems for separate wastewater recycling and rainwater harvesting; and urban planning that encourages alternative sources of potable water, minimized main water consumption, the development of bio diverse waterfront parks and river trails can encourage ecologically sensitive urban developments.

**Figure 4.8:** Schematic illustration of alternative sources of water with an emphasis on minimising import of potable water to, and export of wastewater and stormwater from, the built environment.

![Figure 4.8: Schematic illustration of alternative sources of water with an emphasis on minimising import of potable water to, and export of wastewater and stormwater from, the built environment.](source: Wong (2011) (adapted from Ecological Engineering, 2005).)
This research found the following sustainable approaches adopted internationally:

- **Water Sensitive Urban Design (WSUD)**
- **Integrated/Comprehensive Plans**

These plans and strategies aim for:

- Sustainable water resource management
- Ecologically sustainable development
- Watershed and stormwater management
- Urban water management
- Waterfront development and
- Water sensitive policies

### 4.2.3 Water Sensitive Urban Design (WSUD)

Water Sensitive Urban Design (WSUD) was originally conceptualized in Perth, Australia and formally adopted at the inaugural conference on WUSD in Melbourne in 2000. Wong (2006) describes Ecologically Sustainable Development (ESD) initiatives as those going beyond environmental protection, to also protecting, conserving and restoring natural resources. Sustainable water resource management protects the environment from excess diversion of water for urban consumption, and from wastewater and storm water discharges.

WUSD is an integrated approach with sustainable water resource management and urban development. It specifically looks at the interactions of urban built environment and urban waters in the fields of urban design and planning. Wong (2011) quotes an inter-government agreement on National Water Initiative in Australia defining WUSD as

...the integration of urban planning with the management, protection and conservation of the urban water cycle that ensures that urban water management is sensitive to natural hydrological and ecological process. (Wong, 2011, P).
Wong and Ashley (2006) present WSUD to have two parts – ‘Water Sensitive’ and ‘Urban Design’. WSUD’s aim is seen to ensure that water is given due prominence within the urban design process. The authors continue that

…The words ‘Water Sensitive” define a new paradigm in integrated urban water cycle management that integrates the various disciplines of engineering and environmental sciences associated with the provision of water services including the protection of aquatic environments in urban areas. Community values and aspirations of urban places necessarily govern urban design decisions and therefore water management practices. Collectively WSUD integrates the social and physical sciences. (Wong and Ashley, 2006).

**Figure 4.10** shows the relationships between ESD, Water Sensitive Urban Design and other issues like Energy, Material Resources, Housing and Transport. Wong (2011) discusses that although ESD is concerned with a broad range of sustainable issues, WSUD is directly related to the urban built form (including urban landscapes and buildings) and the integrated management of urban water cycle.

Therefore, WSUD:

- Integrates and protects all aspects of the urban water cycle (potable water, wastewater and stormwater).
WSUD is a part of Ecologically Sustainable Development (ESD) and is an application of its themes into the urban design area.

Directly relates to the urban built form and urban design.

Provides a range of measures that are designed to avoid, or at least minimize, the environmental impacts of urbanization. (In terms of the demand for water and the potential pollution threat to natural water bodies) (City of Melbourne, n.d).

Provides an opportunity to realize holistic visions for water sensitive cities (especially in dense urban environments). (By combining the demands for sustainable stormwater management and city planning through innovative, attractive and usable solutions) (Hoyer, et al., 2012).

**Figure 4.10:** Interactions between ecologically sustainable development, water sensitive urban design and the urban water cycle.

Strategies like WSUD have increasingly become part of integrated or comprehensive plans for watersheds and for sustainable urban developments. Advantages of WSUD can be realized more effectively if it is part of such official plans.

4.2.4 Comprehensive Plans

Building upon a history of environmental activism, existing environmental protection laws, public awareness and institutional support, a number of cities across the world have adopted or are formulating comprehensive water sensitive plans and policies.

To address the growing pressures on water resources, IWA (International Water Association) is working with IUCN (International Union for Conservation of Nature) on the Basins of the Future (BoF) programme. The joint initiative focuses on cities and the competing water demands in their river basins centred on the practical reality of managing the nexus of water, food and energy (IWA, n.d). This initiative is encouraging partner cities to diversify water supply options, optimize existing natural watersheds to work in concert with the urban built environment and infrastructure, and to involve industries and businesses to engage with river basin management and equitable negotiation of water allocation across users.

Apart from new developments, cities are rediscovering and regenerating the edges of their waters (Moretti, 2008). (The City of New York, 2011), (Dong, 2004), (Timur, 2013), (Shreshta et al., 2009) and (Moretti, 2008) discuss how many of these regenerations are fuelled by raising environmental awareness and an acknowledgement that the waterfront has to be accessible (physically and visually) by the public as a place for relaxation, contemplation, and as a destination. Laidley (2007) presents how an ecosystem approach to Toronto’s waterfront development aimed to bring together economic recovery, healthy environment and livable communities in Toronto, Canada. The waterfront plan associated with Toronto’s 2008 Olympic bid to reposition the city in a global context. The process reconciled historically divergent groups, and ensured lasting partnerships towards environmental remediation, land use changes, and a waterfront revitalization plan. The following aspects can be highlighted in the plans: They

- Acknowledge importance of interrelated issues - they take into consideration the interdependence of storm water management, the urban water cycle, watershed issues, and regional environmental issues.
• Emphasis on preserving / restoring / reviving local and regional ecosystems

• Prioritize public access to waterfronts, and economic development potential of healthy waterways.

• Consider regional and local environmental and water issues, and demands on infrastructure and city facilities.

Some examples of comprehensive initiatives are:

1. **Vision 2020 Comprehensive Waterfront Plan by New York City’s Department of City Planning, USA.**

    **Figure 4.11 and 4.12:** Manhattan Skyline and Paddlers on the Bronx River.

    Source: The City of New York (2001). (Carolina Salguero and Daniel Avila for NYC Department of Parks & Recreation)

This builds upon the accomplishments after Comprehensive Waterfront Plan in 1992 and establishes policies for expanded use of the waterways for economic, educational and recreational uses while maintaining ecological vitality. City-wide and neighbourhood reach strategies have been formulated (The City of New York, 2001).

As a part of the watershed of six major rivers and a city-wide park system, the plan is organized around four core principles that emphasize public access; building a network of waterfront parks and public spaces; high levels of environmental health; and creation of new communities. (Laidley (2007) discusses how an ecosystem approach to Toronto’s waterfront development aimed to bring together economic recovery, healthy environment and liveable communities.

**Figure 4.13:** The Central Waterfront Part II Plan for Toronto’s waterfront.

3. **Planning for a sustainable Singapore,** the Urban Redevelopment Authority of Singapore (URA) prioritizes a ‘far-sighted, holistic, and comprehensive planning, which enables...future development needs through an integrated planning process’ (Skyline, 2012, p.4).

**Figure 4.14:** Waterfront Planning, Singapore

Source: Website of the Urban Redevelopment Authority, Singapore.
The objectives include environmental responsibility, and the optimization of limited land and sea spaces. Some of the main features are: Decentralization through land reclamation; Evolving sustainable water solutions for urban needs; Evolving integrated and mixed land uses for an environmentally sensitive development of Jurong Lake District and Marina Bay (Marina Bay, n.d), (URA, n.d) and (Skyline, 2012).

**Figure 4.15:** Planning Decisions for the Waterfront, Singapore.
4. In *The Actions for Watershed, 2005 Portland Watershed Plan*, the City of Portland, Oregon, USA, recognizes that its waters (rivers, five watersheds and rain) and land are its icons. It aspires to reflect these icons and establish a vision for the city as a land of waters (City of Portland, 2006). Distinct strategies and actions are listed, and a watershed management system is detailed.

**Figure 4.16:** Composite Image of Portland’s waters: L-R: Columbia Slough, Fanno Creek, Johnson Creek, Tryon Creek, and Williamette River.

Source: City of Portland (2006).

**Figure 4.17:** City of Portland Watersheds

Source: City of Portland (2006)

Other important aspects of the 2005 Portland Watershed Plan are:
• Instead of traditional, separate responses to individual regulations, it adopts a holistic approach that meets all regulatory requirements.

• Integrates the work of various city bureaus, private citizens, business and local non-profit organizations to improve watershed health.

• The plan perceives that “Rather than regulatory requirements defining City actions, ecological principles and watershed conditions will set the course. The result will be net environmental improvements over time.” (City of Portland, 2006).

• This plan also informs other city plans by recognizing the interrelation of many city issues (like sanitary, stormwater and transportation) - American Forests (n.d).

All these plans recognize that impacts to the larger watershed affect the quality and usability of any waterfront activity/development. Many include guidelines for architectural design, neighbourhood level water sensitive urban design features, and retrofitting heritage structures for sustainability and water management. Residential and commercial developments at the waterfront are required to follow rigorous guidelines, and be engaged with the city governments/ planning authorities to manage the environmental and economic vitality of the waterfront.

4.3 Waterfront Research and Discussions in TUA

As presented in the introductory chapter, the shorelines, deltas, mangroves, and an extensive network of waterways in the cities of Kerala provide unique opportunities to investigate potential opportunities for waterfront development. The study area’s (Thiruvananthapuram Urban Agglomeration or TUA), water bodies are a part of Kerala’s 41 navigable rivers with the total inland waterways in the State being 1687Km (KSIDC, n.d). Additionally, it is worth recalling that urban environments have been identified to have three separate water systems; the potable water system, the sewerage system, and the storm water drainage system (Wong, 2011). This thesis identifies that cities with inland waterways, coastal lines, canals, and ports have a fourth water system – the transportation system. All these systems can be seen in the cities of Kerala State, India.
All these systems can also be seen in the study area. TUA’s context also corresponds to an analysis by Franke, et al. (1999) for the waters and ecosystems of Kerala. They highlight the ecological advantages of Kerala’s waters on its socio-political and economic development:

The undifferentiated access to water led to an evenly dispersed settlement pattern that makes it easier to protect against water-borne bacteria and parasites. This means Kerala starts with an advantage in combating infectious and para-sitic diseases—the main diseases of underdeveloped areas. (Franke, et al., 1999, p10)

And,

Cool, well watered, and close to ocean transport lanes, the Western Ghats were ideal for tea and rubber plantations that British colonialists set up in the late 19th and early 20th centuries. Coir mat-weaving factories, cashew nut processing, tile factories, and sawmills were added. (Franke, et al., 1999, p10-11).

Considering the well documented and researched examples from Europe or North America, we can observe dramatic waterfront transformations and accompanying urban histories. We can also see continued efforts to revitalize and maintain the waterfronts, planning that address the health of the larger watershed and ecosystems, and planning strategies to integrate issues surrounding water all over the urbanized and rural areas. However, TUA and other towns and cities across Kerala have not gone through similar
scales of deterioration or mega events like the Olympics or the World Cup for football to economically justify revitalization efforts for the waterfronts on a similar scale of investments or urban design. But, TUA has similar water supply, drainage and sanitation issues, waterfront issues, environmental challenges as the other global examples, and similar pressures from increasing and changing demands of urbanization. Some of the literature reviewed throughout this study have discussed these issues.

However, it must be pointed out that specific literature concerning waterabouts and waterfront development in Kerala, and especially in TUA is relatively small compared to the huge body of literature available for developed nations, especially in North America and Europe. Specific literature on waterfront planning, waterfront development, or watershed planning for the cities of Kerala or Thiruvananthapuram specifically were not available during the process of this research. The collection of articles on Kerala’s waterways in a multidisciplinary journal (Eds, 2012) reflects the variety of topics addressed in a majority of the available literature. These topics cover a range of issues and concerns pertaining to water and ecology in Kerala.

The literature on Kerala’s waters document and analyze the following aspects: Tourism (Examples: Azaarya, 2004; Saji, n.d, Rajasesan, et al. 2012; Kang, 2002; Sreekumar, et al., 2002; Vincy et al., 2012; and TECS, nd); Water quality and sanitation (Examples: Vairavamoorthy et al., 1998; Harikumar, et al., 2013; Chattopadhyay et al., 2005; and Vincy et al., 2012); Transportation and connectivity (Examples: Government of Kerala, n.d and Czuczman, n.d); Socio-economic and environmental aspects (Examples: Basiago, 1999; Khaleel, 2012; Kang, 2002); Ecological concerns (Example: Geevan, 1996); and Sustainable developmental processes (Examples: Sasikumar, et al., 2013; Franke et al., 1999). Some discussions were found on online public forums regarding proposed plans for municipal services (water supply, sanitation and solid waste), plans to regenerate the navigable canals, and proposals for tourism development near or at the water bodies. Tourism development all over Kerala, and the tourism potential of TUA have also been discussed in many of the online forums, websites, newspaper articles and academic articles referred for this research.

The scarcity of research and literature regarding urban waterfront development in Kerala is not unique; Dong (2004) and Hoyle (2002) present that urban waterfront issues in developing countries have been ignored until the 1990s, when research agenda started
to address them. Dong (2004) highlights that newly industrializing countries (NICs) and less economically developed countries (LDCs) started to revive their historic ports in diverse contexts ranging from post-colonialism and globalization to culture revival and tourism development.

In case of Kerala, similar agendas for tourism and revival of historic ports exist (Govt. of Kerala, 2004), (VizhinjamPort.org, n.d) and (Kerala Ports, n.d). The vibrant maritime history in the States can be seen in its ports, and navigable waters; and the cultural, social, economic and political dynamics are intertwined with Kerala’s unique geography and its urban waters. This research hopes that the current context of rapid urbanization and associated pressures on the natural resources, habitats, water bodies and quality of natural features in the urban environment of TUA provides a unique opportunity to revive old waterfronts, and develop new waterfronts.

4.3.1 Urbanization Impacts on the Water bodies and Waterfronts of TUA

Any discussion of the study area and the descriptions of its water bodies and waterfront areas is not complete without touching upon the obvious problems and environmental impacts. In order to address the health and quality of these water systems, and in order to understand how the contradictions inherent with environment and economy plays out in TUA, a number of literature sources were reviewed. Primary surveys in TUA was also conducted and this included descriptive research into the environmental aspects of waterfronts in the study area.

Selected waterfront areas for detailed investigation in Chapter 3 show deterioration of the waters, the waterfronts, surrounding environment, and the quality of infrastructure. TUA’s waterways and their historic waterfronts have experienced impacts on their waterfronts similar to their international counterparts. It can also be seen that neighborhood waterfronts all over the study area are experiencing the negative impacts of urbanization. An analysis of culturally important waterfronts and their associated natural and built environments also revealed gross disregard regarding environmental sensitivity. Additionally, technological changes have brought diesel powered boats; the expanding population are exerting associated demands on limited municipal services; and there is obvious and perceptible deterioration of local habitats and contamination of waterways. Anto (2012) discusses the impact on waterways by new boat technologies, discharge of effluents from industries, and pollution directly linked to an industrialized and
consumerist lifestyle. With specific examples, the author describes how all these are contributing to environmental calamity in the constructed urban canals.

Despite this overview, there is a need to categorize the various impacts on waterfronts. This will help on various levels; to gain clarity regarding the different types of problems, to identify the range of impact from different issues in each waterfront area, and to provide a starting point for evolving integrated strategies that can be monitored and tracked across TUA. Considering the earlier discussions in this chapter regarding waterways and the impacts of urbanization, the following categories can also be applicable for the waters for the entire study area, and as it is interconnected with the region, this can also be applicable at the district level. The observations above are elaborated here are with respect to specific categories of impacts on the waters and waterfront areas of TUA. Examples from the selected waterfront sites are provided here.

**Contamination of Waters:** Despite a high water table (water is found 10 feet below the ground in many places, and the water level is above the ground level in many places), and despite one of the largest fresh water lakes (Veli), most of the water is not potable. The Kerala Water Authority (KWA) lists the availability of bottled water and tanker water for purchase to overcome shortages and meet growing demand (KWA, n.d). The quality of Vellayani, Veli and Akkulam Lakes, and some of the inland canals have deteriorated due to illegal sewage outflows. TMC CDP (2006) presents the pollution of the rivers and poor management of water bodies as an urgent issue; this is aggravated by dumping of raw sewage from individual plots as well as the City Sewage System occasionally, solid waste disposal, encroachment of river boundaries and valley areas, over extraction of ground water, and contamination of surface run-offs. The water of TS canal and many of the constructed canals was once used for bathing and drinking. It is now neglected, and silting, land sliding and pollution have deteriorated its conditions. The TS canal is now characterized by water pollution; it has raw sewage discharges, accumulation of silt and water hyacinth, and has discharge of other pollutants. The quality of the water in the water bodies all across TUA is not only a threat to public health, but also to the quality of ground waters.

**Increasing Sprawl:** TMC CDP (2006) also presents the following observations: With the main developed areas located in the midlands, the low lying areas within the city region acted as drainage basins; they received surface run-off and flood waters and
released them into the canals and waterways. This helped to recharge ground water and prevent flooding of developed areas. Primary surveys of the study area concur with TVM Corporation (2012) and regarding the following observations: With increasing population, real estate development projects are taking over the low lying areas. This has created blockages to natural drainage basins, increased contaminants in the canals and waterways, and reduced natural wetlands. Unplanned deviations to the land use requirements of the City Master Plan have also depleted agricultural land in the areas adjoining the city. This urban sprawl has had unplanned consequences on water supply, drainage, sewage, and quality of the natural waterways.

**Inadequate sewage facilities:** Although the city had a network of underground sewage system in 1945, which has been extended during different planning periods till 2010 to cover a total of 7 blocks, it has become inadequate to meet the current needs of the entire city (KWA, n.d). The collected sewage is treated and disposed at a sewage farm at Valiathura. However, this farm is unable to handle the increased volumes, and the entire system has become ineffective (TVM Corporation, 2012). Along with TS canal, the quality of Vellayani Lake and some of the inland canals have also deteriorated due to illegal sewage outflows. TMC CDP (2006) and (TVM Corporation, 2012) discuss the continuing pollution of the rivers and poor management of water bodies; this is aggravated by dumping of raw sewage from individual plots as well as the City Sewage System occasionally, solid waste disposal, encroachment of river boundaries and valley areas, over extraction of ground water, and contamination of surface run-offs. In many cases, in order to relive the pressures on the existing sewage lines, man holes have been observed to be punctured and sewage let out into the nearby water drains and canals. Pumping stations are not maintained and pumping mains also discharge raw sewage into the natural water bodies, contaminating them further. The new Sewage Treatment Plant (STP) at Muttathara is already facing challenges in disposal of sludge (Nair, 2013). Sludge usage by the older fodder farms are outdated, farms are reducing, and there are no farms to utilize all the sludge generated by the urban population.

**Neglect and deterioration of the water transportation system:** As discussed earlier, similar to the rest of Kerala, waterways in Thiruvananthapuram are also used for transportation. The section of waterways from Quilon to the city region and beyond forms the southern section of the state’s waterways. Although TS canal was once the main water
transportation route, it is now neglected due to increased efficiencies in other modes (road, rail and air transportation systems). Silting, land sliding and pollution have also deteriorated the canal’s conditions. Channel inefficiencies, inadequate dimensions of tunnels at Varkala, and inadequate infrastructure including backwater port terminals have limited the potential uses of Thiruvananthapuram waterways for cargo and passenger transportation. Despite a vast coastline with port facilities at Valiyathura and Vizhinjam, port activities require revival. Vizhinjam is a harbor with a light house, and is believed to have been an ancient port. However, it has not received any ships since 1986 (Department of Ports, 2001). An International Deepwater Container Transshipment Terminal at Vizhinjam has been proposed by various development plans.

**Deteriorating marine life and dependent economies:** The 78 km long coastline also has a number of fisheries of which Varkala, Anchuthengu, Poonthura, Vizhinjam and Poovar are some of the main centers. With 42 fishing villages, 40,000 households engaged in fishing, and a catch around 32,000 tons, fisheries are important revenue generators (Government of Kerala, 2004). With drainage of urban waters into the sea, health of marine life and quality of the coastal regions require periodic monitoring.

At this juncture of discussion, it is important to note that there is some awareness among the general population regarding the presence of polluted/contaminated waters. Online citizen forums and citizen driven websites discuss and keep track of official plans and efforts to address this situation. Discussions of social sustainability by Basiago (1999) and quality of life indicators in the ‘Kerala Model’ by (Franke et al., 1999) had provided positive scenarios to tackle the environmental deterioration through a responsible, socially equitable and well educated populace. Basiago (1999) had identified opportunity in the involvement of society in Kerala to address issues related to planning and development:

Kerala represents a unique cultural approach to sustainable development. The debate over how to achieve ‘sustainability’ has tended to focus on the economic, environmental, and technological dimensions of development. Moreover, these discussions have emphasized ‘curative’ rather than ‘preventive’ means. Kerala is a valuable case to study because it provides a model of ‘urban sustainability’ that is both social and preventive. (Basiago, 1999, p157)
Citizen discussions on Skyscrapercity.com (2013), Scorpiogenius.com (2009) corroborate some of these findings regarding robust citizen engagement in the social and political processes, especially with regard to urban waters and overall environmental issues affecting the well-being of communities.

4.3.2 Need for Holistic Planning Strategies

The in-depth analysis of the conditions of all the water bodies in TUA through primary surveys and secondary sources show an urgent need for integrated planning, which preserves, protects and celebrates the unique urban landscape.

Fragmented approaches characterize any of the current planning and implementation efforts. Competing agendas; uncoordinated, inadequate or inefficient budget schedules at various levels of the government including local corporations; and lack of engagement of community groups for implementation are generally the drawbacks of urban planning initiatives across India. TUA and the larger district is not an exception. However, well-articulated planning frameworks and implementation strategies can have the potential to overcome some of the confusions and contradictions, especially when citizen-led stewardship of local resources can be established or encouraged as a central requirement of comprehensive plans. This has to include participation of local educational institutions, commitments by public institutions and leading-by-example commitments of government departments/organizations.

From the discussions throughout this study, we can also see that the numerous water bodies of TUA require all the categories of waterfront plans identified by Dong (2004): Conservation, Redevelopment and Development. The waterfronts are urban in location and nature; are part of larger regional watersheds with many typologies of water bodies and navigable waterways; are experiencing ecological deterioration; and are poised to be included in comprehensive sustainability plans. Although specific articles and in-depth research on all of TUA’s waterfronts were not accessible for this research, waterfront development processes can be analyzed based on an exhaustive spectrum of discussions in the official, academic and social realm.

Considering the diversity, quantity and ubiquitous nature of water in TUA, holistic urban planning strategies with water-centric approach might be appropriate. Comprehensive waterfront plans and Water Sensitive Urban Design (WSUD) offer
workable solutions. From all the background discussions, it can also be inferred that waterfronts provide unique opportunities to (re)establish an ecological balance and connect the urban with the natural.

Such opportunities are plenty in the study area. **Plate 4.4** shows a historic waterfront on the Trivandrum-Shornur (TS) Canal. All the elements of successful waterfronts can be seen in this historic image; public access to the water, economic and social vibrancy, environmentally sustainable boats, heritage structures that are distinctive of Kerala’s architecture, and an interconnection with urban farms and greenery. Comparing historic pictures and information with present day images and information in Chapter 3, it has been presented that these old urban waterfront areas were clean, navigable and well maintained. They were cultural and economic hubs of TUA.

In a region like TUA with its extensive natural resource of water bodies and waterways combined with a unique geography of mountains, forests, coastlines, and wetlands, new approaches to planning is required; current planning approaches that are spatially driven need to be combined with principles of sustainability and ecological frameworks. The next chapter discusses some potential planning strategies in greater detail in order to enable a new way of approaching planning and to enable the preservation and celebration of TUA’s natural heritage.

**Plate 4.4:** T.S Canal, boathouse near Chakkai Bridge, Kerala.

Semi-urban and rural areas of TUA have eco-tourism projects and resorts. From anecdotal conversations, eco-tourism initiatives was generally perceived in a positive light and the people felt that it will benefit local economy as well as create opportunities to address the quality of their neighborhood waterfronts. This perception is also supported by Rajasesan et al. (2012) and Kang (2002).

Through a detailed analysis, (Rajasesan et al., 2012) argue that eco-tourism

…has helped to draw attention to reduce overall exploitation of forest land by these communities which in turn perpetuates sustainable development of eco-tourist sites and ecotourism in Kerala. (Rajasesan et al., 2012, p22).

They present that quality of life indicators show positive trends with eco-tourism, and community perception of eco-tourism is shown to not have negative impacts on the environment or their own cultures. This may also be a way to meet some of the objections raised for mass tourism to Kerala (For example, see: Sreekumar et al., 2002).

Some of the other larger waterfront development projects in TUA are the port development projects, waterfront developments in religious sites, and beach front properties. An International Deep-water Container Transshipment Terminal at Vizhinjam has been proposed by various development plans (VizhinjamPort.org, n.d), (Kerala Ports, n.d) and (TVM, 2012). The port exhibits stages of transformations similar to some of the international studies analyzed in the background discussions. Although some of the urban waterfronts in TUA have not lost their vibrancy as public spaces, the deterioration of their environs is of concern for further development potential. The Hindu (2007) discusses how efforts have been periodically made to revive and restore the waters of Padmatheertham Tank/ Padmanabhaswamy Temple Pond. This is located in the Sree Padmanabhaswamy temple complex and is considered to be one of the oldest temple tanks in TUA. Kerala Tourism (n.d) and TVM Corporation (2012) recognize potential for sustainable development and eco-tourism for TUA’s beaches.

4.4 Summary: An Ecological Framework for Waterfront Development Planning in TUA

Discussions of the research context and background issues presented in this chapter is based on existing literature and publicly available information on the history of
waterfronts, the transformative phases, and issues surrounding them through all the phases. The background research for TUA identifies the lack of specific research and studies on waterfronts and waterfront developments. It also identifies a need to document or publicise widely, any existing waterfront development research for the study area. In-depth analysis of historical, cultural, ecological, economic and social aspects with specific attention to waterfront developments are required. Such research on waterfronts in Kerala, and the study area in particular may be beyond the scope of this thesis.

For the purpose of this thesis, available discussions and analysis of the numerous aspects of Kerala’s waters, the study area’s official plans, primary surveys and information from secondary sources have been scrutinized. These are combined with international research and examples, and parallels are drawn to local conditions, issues and critical planning and development. This review is based on widely cited western and Asian research literature. It shows that contemporary waterfront developments and regeneration plans, developments, and maintenance have identified the need for effective partnerships with various stakeholders specific to waterfronts. These include tourists, investors, communities living at and near waterfronts, the city/municipal authorities, and a range of businesses dependent on the health and quality of the waterways.

Review of waterfront development in background discussions also highlighted a need to look at environmental sustainability; urban blight and economics are the main triggers, and numerous constraints concern the quality of urban waters and public access to the waterfronts. Moreover, environment and societal issues dominate the discourse for investments and successful waterfront development projects. This shows that the inter-relations between economics, society and environment are critical. Environmental sustainability and an ecological framework offer a way to approach the holistic planning and development of urban waterfronts.

The three prongs of sustainability – environment, economy and society were considered in this chapter. This review was based on literature concerning sustainable planning of urban waters through WSUD strategies and through comprehensive plans. The former offers specific strategies and design approaches while the latter presents adoption of city-wide and region-wide sustainable plans. Both were reviewed through international research and examples.
Based on all these reviews, an ecological framework is proposed for this thesis. Specific opportunities arise from adopting such a framework: It offers a way to integrate all the seemingly disparate literature on the ecology and waters of Kerala and TUA. This may provide impetus to further investigations with similar research, which may have not been accessible during the process of this thesis.

Most importantly, adoption of an ecological framework has the capacity to address long-term challenges of waterfront developments. Considering the deterioration of physical spaces and resources, including the water itself, from the various phases of transformations, attention to environmental sustainability might prevent future transformative phases from impacting the health, quality and existence of local and regional waters, and their associated habitats. Irrespective of population densities at the waterfront, sustainable approaches also have the potential to provide urban authorities viable and flexible tools to manage the vitality of waterfront areas.

The ecological framework set forth in this thesis can consequently also be used as an analytical context to assess TUA’s water fronts. TUA’s water fronts have undergone transformative phases and TUA has opportunities to develop comprehensive sustainability plans for its water fronts, similar to the examples, strategies and plans identified in the background research.