TRANSFORM A VEHICULAR ROAD INTO A WATERWAY: RECLAIMING A LOST WATERWAY OF DHAKA CITY THROUGH LANDSCAPE DESIGN

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1 ABSTRACT

In the intense urbanization of fast-growing cities in developing countries, preservation of surface water has consistently been neglected. Overall, rapid urbanization increases impervious surface and decreases natural land surface, resulting in ecological degradation; bringing surface water back into a city will improve its ecology. One means of restoring surface water is to reintroduce lost water bodies or waterway connections. This paper will discuss a hypothesis regarding the process of reviving a lost waterway through landscape design, namely that reviving a lost water channel through transforming a vehicular road into a waterway can bring nature back within the city. Dhaka City was chosen as the study site for this idea-based proposal. First, a physical survey was conducted and the road to be transformed was categorized into several sections based on land use, activities, and appearance on both sides of the road. The ArcGIS flow accumulation tool and watershed tool were used to determine a proposed depth for the waterway. The design proposals are particular to each road section. An overall design concept was developed, and several functions are proposed based on site surveys to support the existing transport system. In addition to restoring nature, the potential outcome of this idea-based experimental proposal may help address the growing demand for water in the urbanized area of the city of Dhaka, Bangladesh

1.1 Keywords:

Lost waterway, landscape design, ecology, Dhaka.

2 INTRODUCTION

For generations, people in developing countries had intimate connections with water; it was part of their daily rural life. In Bangladesh, it was a common scenario for every village house to have a pond that collected and stored water for daily use (Sultana & Crow, 2000). As the urban population increases, however, city residents lose the opportunity to experience the blessings of water during their daily life and work. Urbanization and the associated impervious land have altered the topographies and natural processes of our cities to such an extent that it is not easy for water, soil, vegetation, and heat systems to function naturally (Gajjar, 2017). The ecology of the city is being degraded—but water has power for both mitigation and problem-solving in terms of improving human life and site environments. To restore surface water to a city will improve its ecology. Accordingly, landscape designers and planners can take a strong step by reintroducing lost water surfaces to a city and so reclaim the lost natural system for that place.

This project is a experimental design built upon a hypothesis for bringing a lost waterway of Dhaka City back to life. The waterway in question was buried under a vehicular road and has become a box culvert; it can no longer carry water due to blockage resulting from a lack of maintenance. The road covering it, named “Panthapath,” is very important to the city because it feeds traffic to the Bashundhara City Shopping Mall, one of the largest shopping malls in Southeast Asia. The mall comprises the 19-storey corporate office of the Bashundhara Group and contains retail shops, theme parks, a fitness center, swimming pool, food court, cinema complex, and more. Every day, more than 25,000 people visit the mall (Mandal, 2019). Notably, after reopening the waterway to connect two other water bodies, Dhanmondi Lake and Hatirjeel-Begunbari Channel, a new mode of transport will be introduced for this area (Figure 2).

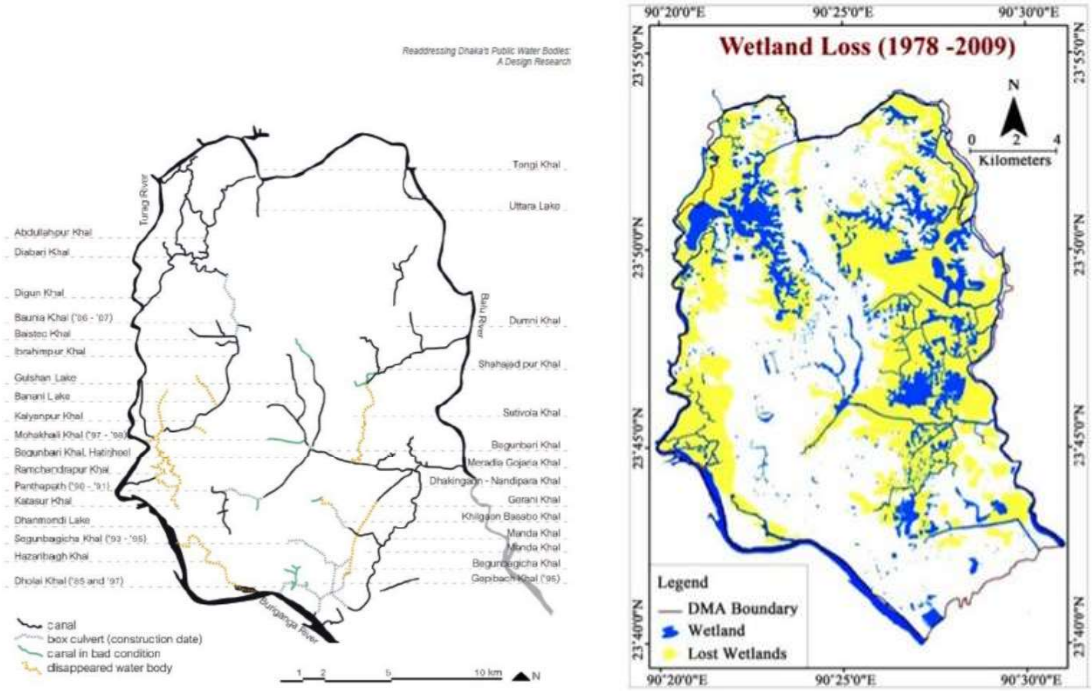


Figure 1. Khals in Dhaka City from 1955 to 2009 (Peeters & Shannon, 2021) & wetland loss from 1978 to 2009 (Mahmud et al. 2011).

Reopening a lost water channel through transforming a vehicular road into a waterway can bring nature back to a city and allow residents to encounter the blessings of water in their everyday work. The transformation has social and economic value; retired couples, friendship groups, and families are the most frequent users of waterway recreational facilities (Social and Economic Benefits of Waterways, n.d.), and the restored waterway would also serve as water collector and storage for the site area. For example, the River Quaggy at Sutcliffe Park in Eltham, South East London was lost underground in a culvert for

years. During flood events, it was quite evident that a river had once flowed there. Restoring the river allowed people to access nature and wildlife and simultaneously improved flood risk management, which is beneficial for the local community (Mandal, 2019). Another great example is the Cheong Gye Cheon Restoration Project, one of the most expensive river restoration projects in the world (Lee & Jung, 2016; Yoon, 2018). In such projects, landscape design proceeds according to three principles: 1) resurrecting the history of the site, 2) urban renewal and revitalization, and 3) bringing nature into the middle of the city (Mandal, 2019). Furthermore, restoration allows for economic growth (Seoul & it, 2011), improves air and water quality, and reduces the temperature of the surrounding area by an average of 3.60 °C (Mandal, 2019). Above all, however, the most positive aspect of this work is introducing an opportunity for ground water recharge. Research shows that in Dhaka, the groundwater level is declining with a trend of 3 meters per year (Islam, et.al., 2017). Groundwater is a critical resource, as it comprises about 97% of the world's freshwater (National Research Council 1994) and can be tapped as part of the water supply in urban areas. In the United States, about half of the population and three-fourths of public water supply systems rely on groundwater (National Research Council 1994). To prevent contamination of a waterway restored from a vehicular road, fast-growing local grasses are introduced beside it, which also serve to reduce runoff and sedimentation (Fiener & Auerswald, 2003).

In preparation for the transformation process in Dhaka, a physical survey was first conducted. After analyzing water flow throughout the whole city, a study area was selected, and the chosen road was divided into several sections based on the activities and appearance on both sides. Design proposals were suggested for each road section according to its context. An overall design concept was developed, and several functions based on the site survey are proposed here to support the existing transport system. This landscape design process can provide a prototype for similar situations in Dhaka City or any other city of Bangladesh.

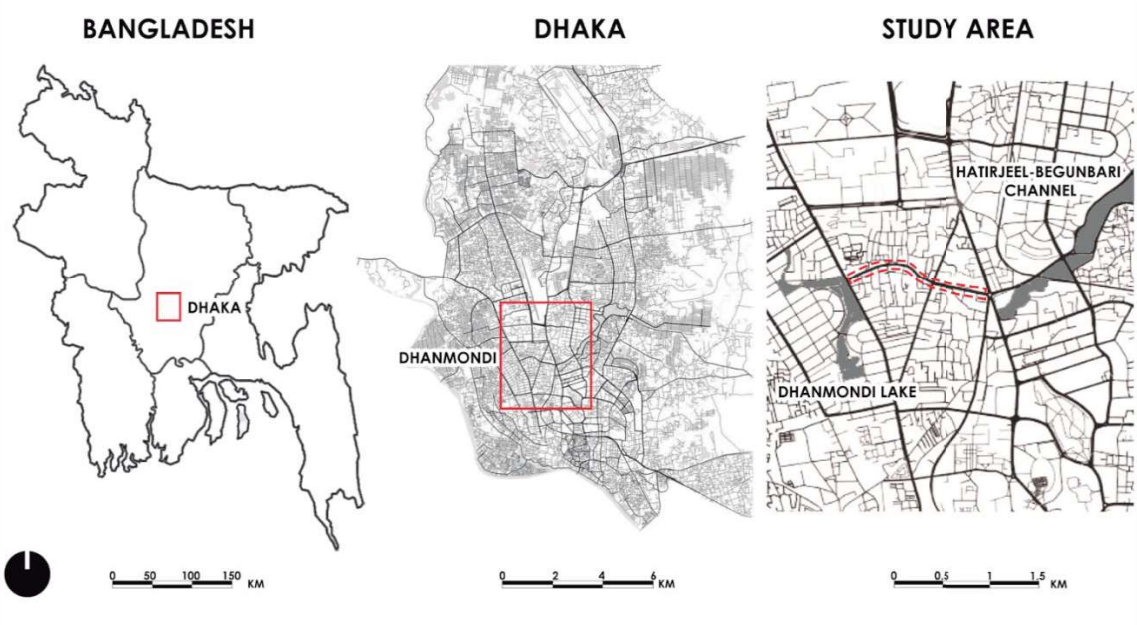


Figure 2: Location of the study area.

3 RESEARCH OBJECTIVES

This study aims to develop a process for reintroducing a lost waterway through landscaping as a possible means of restoring surface water to a city. Specifically, this paper demonstrates how a vehicular road can be transformed into a waterway and bring nature back into the city. The most positive aspect of this proposal is the protection of wetlands and water bodies, in the absence of which the drainage system of any city will collapse. This process will resurrect dead waterways and restore the hydrological balance

of the area. In addition, a continuation of this study will show how to recharge groundwater while minimizing contamination.

4 METHODS

First, a regional-level inventory and analysis was conducted using documents, historical maps, Google Earth Pro images, hydrologic analysis with arch map tools, and review of urban planning proposals to identify the study area for the present work. A stretch of vehicular road was selected for conversion that would restore a lost waterway, provide a reservoir, allow recharge of ground water, and restore the hydrological balance of the study area.

The road to be converted was divided into sections on the basis of its uses and associated activities. Important buildings were noted, and the catchment area was determined through hydrological analysis of the zone. Measures for preventing runoff contamination were incorporated, and a plant list was developed to intentionally restore nature to the city. Finally, a design concept was developed to provide guidelines and proposals for incorporating the changes.

4.1 Regional level inventory and analysis

Water flow analysis was conducted using ArcGIS tools. Notably, Bangladesh does not have public-level access to the resources needed to generate the metadata for this analysis; data must be purchased or generated by the researcher. The water flow analysis map (Figure 3) revealed that water flows from every direction in Dhaka City; even within a single water basin, it flows from several directions. Accordingly, there is no hardship in converting a road into a waterway where the streamlines support one (Figure 3).

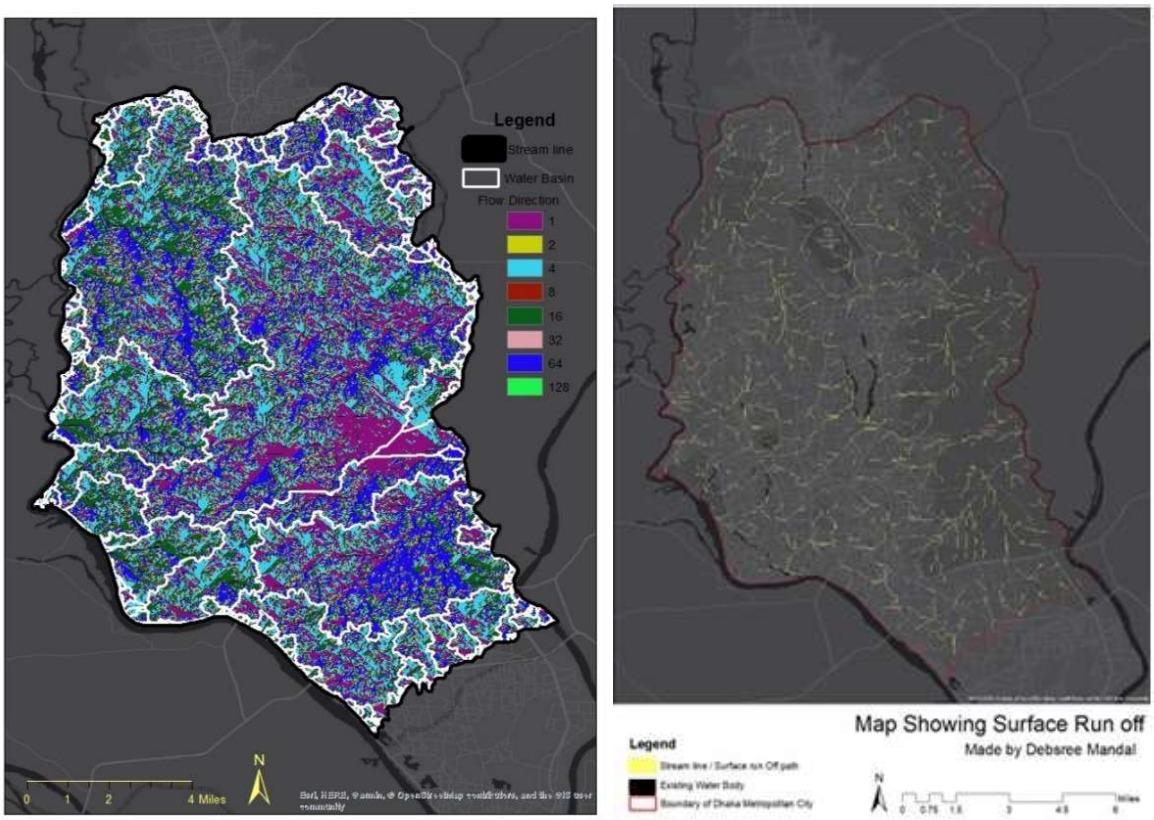
Historical maps and resources helped reveal the city's lost waterways (Datta & Mandal, 2017; Mandal, 2019). Where streamlines do not meet with a water body (colored black on the map) (Figure 3), the water in question is surface runoff. For the selected study area, converting the road into a waterway would reduce waterlogging of Dhaka City.

4.2 Physical survey

The study area is an important east-west secondary connecting route approximately 1.7 km in length, named "Panthapath" and located almost at the center of the western part of Dhaka City (Mandal, 2019). It connects two major roads, Mirpur Road on the west side, where it terminates at Russel Square, and Kazi Nazrul Islam Avenue on the east side, where it ends in the SAARC Fountain Circle (Mandal, 2019). A secondary road, Green Road, crosses Panthapath from north to south between those two major roads (Figure 4, existing road condition view).

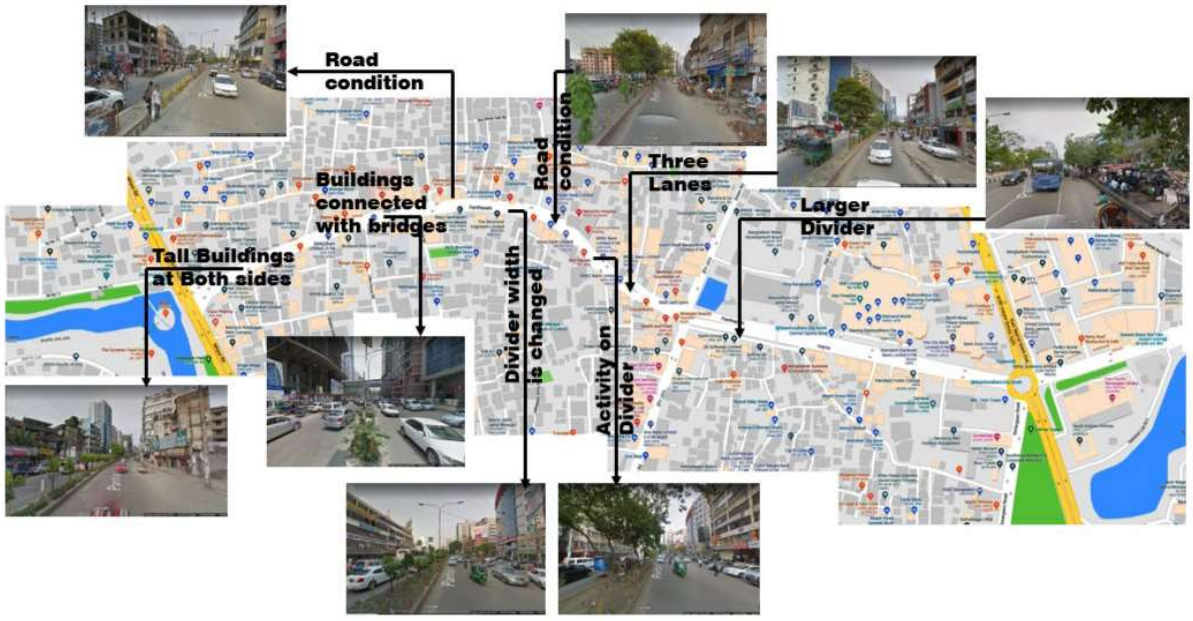
In terms of hydrology, Panthapath connects Dhanmondi Lake on the west side and the Hatirjeel-Begunari water channel on the east. The Begunbari channel can carry 15% of the total runoff of Dhaka City and functions as a water reservoir for the whole area. Originally, there was a passage linking Hatirjeel-Begunbari with Dhanmondi Lake. In the late 1980s, construction began on the east-west route; it was completed in 1995.

Panthapath is among the important business areas of Dhaka City. In particular, it is home to one of the largest shopping malls in Southeast Asia, the Bashundhara City Shopping Mall, which provides spaces for numerous high-tech manufacturers, corporations, theme parks, fitness centers, and shops. Many important buildings are located at the mall, such as a hospital, banks, and mosques, and more than 25,000 people visit it every day. Besides the Bashundhara City Shopping Mall, other key landmarks include Square Hospital, Samorita Hospital, and the Unique Trade Area (Mandal, 2019). Generally, both sides of the road are lined with tall buildings (Figure 4, sectional view), specifically buildings with more than ten stories, although there are high-rise, low-rise, and one-storied buildings at points along the road. Most of the tall buildings are mixed-use, hospitals, and banks. One hospital has an overhead connecting bridge, which is for pedestrian use; there is also a second overhead bridge for general pedestrian use. There are likewise pedestrian paths in front of the buildings, which are above the level of the vehicular road. Regarding vehicular traffic, the road has two, three, or four lanes at different points. The road divider is of different widths in different sections, and where it is more than five feet wide, people use the divider area as a vendor zone (Figure 4, sectional view). Overall, the study area was divided into four sections on the basis of road size, road appearance, building heights, and associated activities (Figure 4).

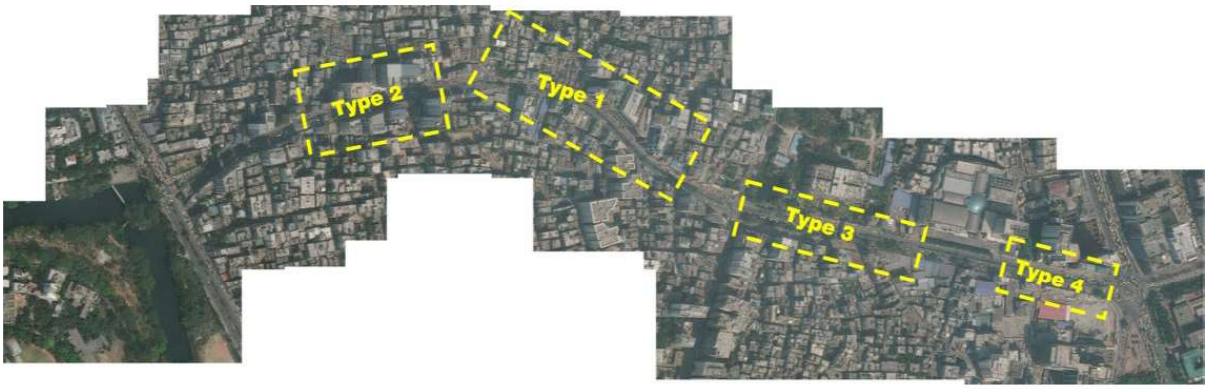


Map of the water basin for Dhaka City

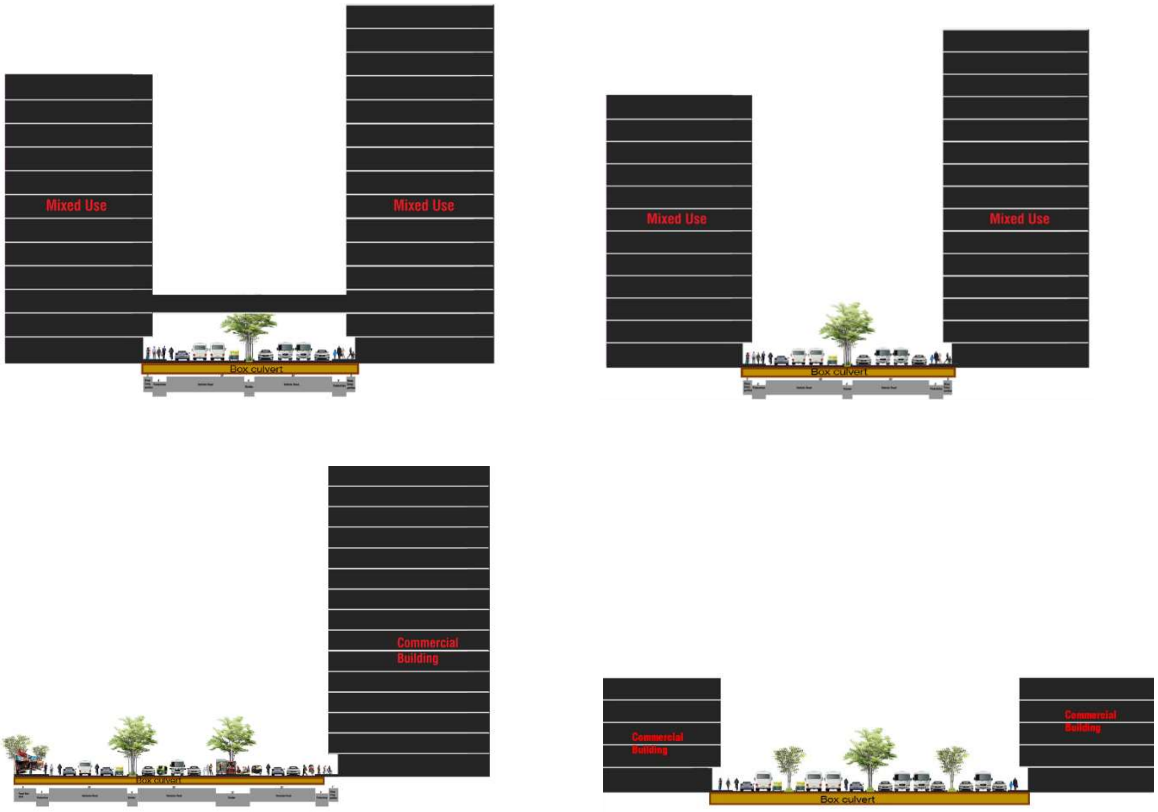
Figure 3: Water flow analysis of Dhaka City.



Existing road condition in the study area



Divisions indicating different situational context

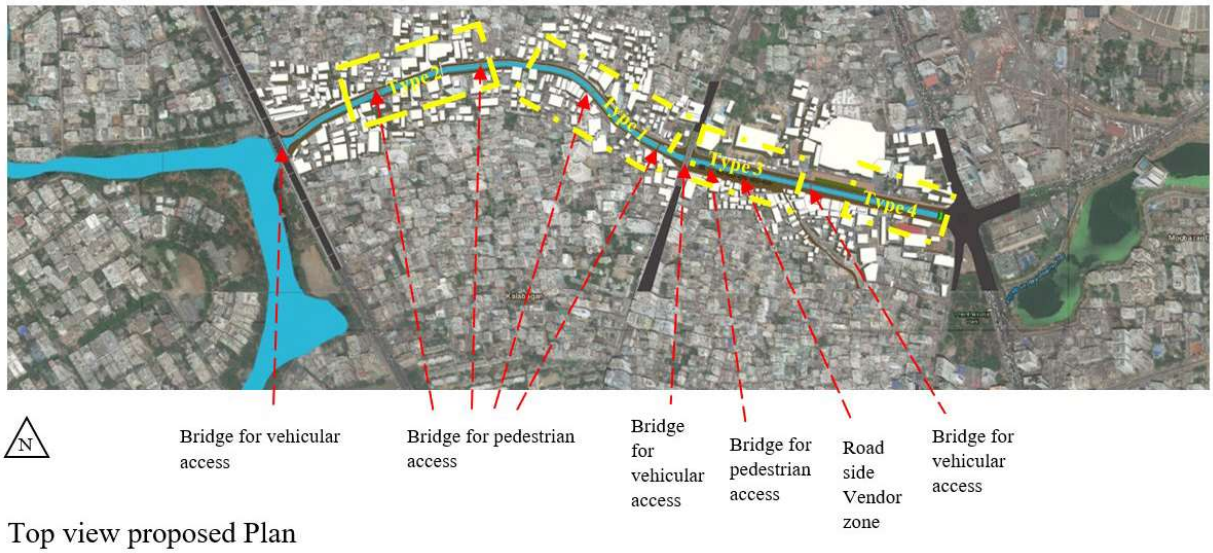


Sectional view of the different situations

Figure 4: Location and condition of road sections (Mandal, 2019).

4.3 Design concept

In addition to bringing nature back into the city, a second purpose of this work is to introduce waterways as a mode of transportation. Both purposes are served here through the design concept. Figure 5 shows the proposed plan, conceptual sectional view, details of the pedestrian and vehicular portions, and a view of the connecting waterways.



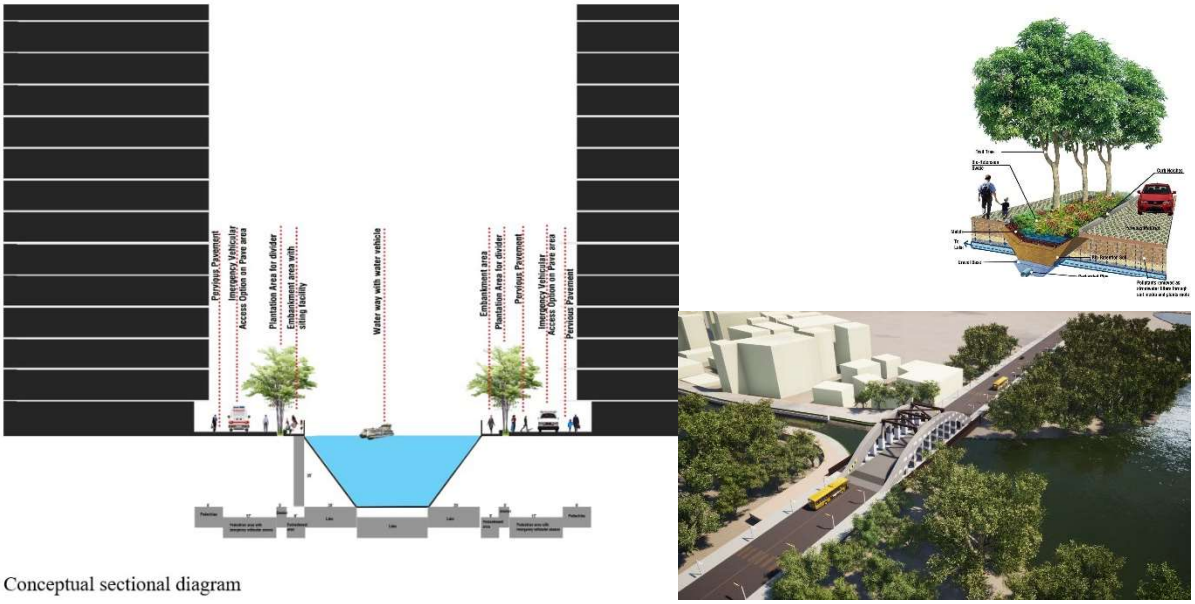


Figure 5: Design concepts (Mandal, 2019).

5 RESULTS

The goal of this design was to incorporate a historical water surface that has been lost and to create surrounding space that will bring nature into the city. This space is envisioned as becoming a vibrant gathering place for the community and as augmenting transport and vehicular circulation. Accordingly, the designs considered were based on the initial site survey and context analysis, taking into consideration the different types of facilities that need to be provided along the banks of the waterway to achieve the concept's goals.

5.1 Incorporating emergency access

As the waterway will limit vehicular access, it was important to ensure the proposal provides emergency access for fire trucks and ambulances to all existing buildings. After analyzing the building typology on both sides of the area, some important buildings such as hospitals and banks were identified where emergency vehicular access needs to be provided.

5.2 Providing opportunity for street markets

Dhaka City is famous for its roadside market stalls, and residents are accustomed to doing their everyday shopping in these marketplaces; hence, a portion of the concept was dedicated as a vendor zone (Figure 5). There is provision for piers to make the area more usable for city dwellers.

5.3 Creating appropriate planting zones

Plants are very important elements of any landscape design. Here, the whole study area was divided into several distinct planting zones with consideration of local climate, sun exposure, and soil type. Native trees with edible fruit were selected to make a productive landscape and promote healthy food habits among visitors; moreover, trees were selected such that fruits can be picked and enjoyed all year round. Each planting section will get one tree to give shade and shelter. For aesthetic purposes, a variety of flowering plants were likewise chosen to provide interest in all seasons.

5.4 Phytoremediation

A number of different ground covers and local grasses were proposed for the purpose of preventing erosion. In addition, aquatic phytoremediative plants capable of absorbing waste material from water were incorporated in the bank areas to improve water quality and provide better conditions for marine life.

5.5 Maximizing walkability

The whole area was designed as a pedestrian-friendly area with provision for emergency vehicular access. After analyzing road connectivity, it was decided to propose an alternative road behind the buildings. Such a road should be implemented by the city's urban planning department to provide services to important buildings in the study area.

5.6 Ensuring universal accessibility

To promote universal accessibility, rams and safety bars have been incorporated into the design. Textured surfaces were used for ease of navigation and for safety purposes. The pedestrian level was kept on the same plane as the building ground level, eliminating any need for steps.

5.7 Maximizing water permeability

Hard surfaces like asphalt roads and concrete pavements increase the surface runoff volume during heavy rains. By minimizing the use of impermeable materials, surface runoff can be decreased and underground aquifers can be replenished. To increase permeability, this design incorporated permeable pavement and other soakable materials. Furthermore, a bio-swale system was used to collect the water from permeable surfaces, with the remaining water directed to the lake (Figure 5). A grassy strip was incorporated to reduce erosion. As storm water percolates through the different layers of soil media and plants, dust particles and heavy elements are removed, thereby improving water quality.

5.8 Bringing nature into city life

Converting a road into an urban waterway creates a natural-looking environment. The resulting wetland fulfills the purpose of a natural drainage system and improves the overall urban environment by several means such as improving air and water quality and providing an ecological conservation area that can bring nature into the city (Figure 5).

6 CONCLUSIONS

The main emphasis of this study is to develop a landscape design process for converting a vehicular road into a waterway. One of the major problems faced by city residents is a scarcity of drinking

water. This study revealed a possible means to recharge groundwater resources from surface runoff in a natural way while reducing contamination. The most positive aspect of this study is the protection of wetlands and water bodies, which will improve the ecological environment and drainage system of the city. Another positive aspect of this study is the use of the proposed waterway for transportation, as water transport is the cheapest of all modes of transportation. All in all, this study can be a key factor in bringing dead water lines back to life throughout Bangladesh.

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