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CAUSES AND EFFECTS OF WATER LOGGING IN MIRPUR AREA, DHAKA CITY

Sk. Md. Imdadul Islam*[1], Sayed Shams-E-Rabbi[2] and Maria Shirin Anita[3]

[1] Lecturer ,World University Of Bangladesh, Dhaka, Bangladesh, e-mail: imdadulemon109@gmail.com
[2] Post-graduate Student, AEM, IPE, BUET, Bangladesh, e-mail: sayed.rabbi@outlook.com
[3] B.Sc., CE, KUET, Bangladesh, e-mail: mariashirin17@gmail.com

***Corresponding Author**

ABSTRACT

Dhaka is the capital city of Bangladesh, is one of the populous mega City in the world. As the growth of urban population is taking place at an exceptionally rapid rate, the city is unable to cope up with the changing situations due to their internal resource constraints and management limitations. In recent years Dhaka City is facing extensive water logging during the monsoon (May to October) as a common and regular problem of the city like water pollution, traffic congestion, air and noise pollution, solid waste disposal, black smoke, etc. This paper focuses on the rainfall-induced flooding that is caused by high-intensity storm rainfall runoff in the city area that is inundated for several days mainly due to lack of proper drainage system and inefficient management. It ascertains the inherent causes of such water logging and its effects on the city life from the perception of authorities of different development organizations, experts and people living in different parts of Dhaka City. Heavy downpour occurs in Dhaka City during monsoon, as it is located on the extensive floodplains of Ganges and Brahmaputra. But the unplanned spatial development activities and growth of habitation due to rapid population growth are causing encroachment on retention areas and natural drainage paths with little or no care of natural drainage system that creating obstacles to properly drained out the urban runoff. Therefore water logging is taking place as different parts of the city remain inundated for several days. Inadequate drainage sections, conventional drainage system with low capacity and gravity, natural siltation, absence of inlets and outlets, indefinite drainage outlets, lack of proper maintenance of existing drainage system, and over and above disposal of solid waste into the drains and drainage paths are accounted for the prime causes of blockage in drainage system and water logging. Also, seasonal tidal effects and the topography of the city area causing water logging. This water logging becomes a burden for the inhabitants of Dhaka City and creating adverse social, physical, economic and environmental impacts. Disruption of traffic movement and normal life; damage of structures and infrastructure; destruction of vegetation and aquatic habitats; loss of income potentials are the encountered effects of water logging on city life. The storm water becomes polluted as it mixes with solid waste, clinical waste, silt, contaminants, domestic wastes and other human activities that increase the water-borne diseases. The stagnant storm water leads to the creation of breeding sites for disease vectors that becomes a hazard to health as well as being unsightly and foul-smelling.

Management of drainage system of Dhaka City is presently a challenge for the urban authorities because of the rapid growth of population and unplanned development activities. Therefore, close coordination among urban authorities and agencies and collaboration between public and private sectors is needed for effective management and sustainable operation of the urban drainage system.

Keywords: *Water logging, Excessive rainfall, Mismanagement of waste ,Drainage, Mirpur.*

1. INTRODUCTION

Water logging is one of the prime urban problems that Dhaka suffering for decades. Even after a light rain many areas of the Dhaka turned out to be small islets with thousands stranded or wallowing through knee-deep dirty waters stuck up in roads and streets. If the rain lasts for hours it changes the view of the Dhaka city - most of the busy roads Mirpur-10 Kazi para Shewra para and streets become inundated because canals, being the primary drainage system of the city are blocked cannot carry the huge volume of storm water. This water logging is a problem creating adverse social, physical, economic and environmental impacts in life and living in Dhaka. Water logging becomes a burden for the inhabitants of Dhaka City and creating adverse social, physical, economic and environmental impacts. This Study will assess the causes and effects of water logging in Mirpur Area. Disruption of traffic movement and normal life; damage of structures and infrastructure; destruction of vegetation and aquatic habitats; loss of income potentials are the encountered effects of water logging on city life. The storm water becomes polluted as it mixes with solid waste, clinical waste, silt, contaminants, domestic wastes and other human activities that increase the water borne diseases. The stagnant storm water leads to the creation of breeding sites for diseases vectors that becomes a hazard to health as well as being unsightly and foul-smelling even death of pedestrians. (Tawhid, Causes and effects of water logging in Dhaka city, 2004)

Bangladesh is located on the extensive floodplains of the Ganges and Brahmaputra. Therefore, flooding is a natural part of the life of its inhabitants. Thus water logging in Dhaka City is not a new problem but the frequency of this problem is increasing day by day. Flooding due to rainfall is also a severe problem for Dhaka City that is inundated for several days mainly due to the drainage congestion (Haq & Alam, 2003). Dhaka metropolitan area has experienced water logging for last couple of years. Even a little rain causes a serious problem for certain areas, so that parts of Dhaka are inundated for several days. The water depth in some of the areas may be as much as 50-70 cm, which creates large infrastructure problems for the city and a huge economical loss in production for the city together with large damages of existing property and goods (Mark & Chusit, 2002). In addition, deceases are spread and gives problems to the population e.g. in terms of diarrhoea. Dhaka City is protected from river flooding by an encircled embankment called Buckland Flood Protection Embankment. During the monsoon (May to October), the water level of the surrounding rivers remains higher than the internal drainage level. Consequently, the drainage of the city depends very much on the water levels of the peripheral river system. At present, the drainage depends mostly on the difference in water level between the river and the drainage system in the city and when the water level in the river increases the drainage capacity to the river is reduced (Mark & Chusit, 2002). Flooding in Dhaka Metropolitan area can be classified into two types. One results from high water levels of peripheral river systems, thus rendering any natural drainage impossible.

1.1 Objectives of the Study

The Main objective of this paper is to identify the Water logging in Mirpur area. The ultimate goal of the study is to improve the drainage condition of the Mirpur area to remove the water logging problem of the area. However there are some specific objectives to full fill the goals. These are,

- To identify the causes of drainage congestion of the Mirpur area.
- To investigate the problem of drainage congestion on city life.
- To suggest some recommendation for improving the Water Logging on of Mirpur area.

basins, which in turn lead to shortening of the runoff concentration time and an increase of the peak flow.

1.2 Location

Mirpur is located at 23.8042°N 90.3667°E. It has a total area of 58.66 km2 (22.65 sq. mi) and is situated in the north-east of Dhaka city. Mirpur is one of the prominent regions of Dhaka city. Established in 1962, it is located to the north-east of the city (BRACK, 2016). If the rain lasts for hours it changes the view of the Dhaka city - most of the busy roads Mirpur-10 Kazi para, Shewra para and streets become inundated because canals, being the primary drainage system of the city are

blocked cannot carry the huge volume of storm water. This water logging is a problem creating adverse social, physical, economic and environmental impacts in life and living in Dhaka. Water logging becomes a burden for the inhabitants of Dhaka City and creating adverse social, physical, economic and environmental impacts. This Study will assess the causes and effects of water logging in Mirpur Area. Disruption of traffic movement and normal life; damage of structures and infrastructure; destruction of vegetation and aquatic habitats; loss of income potentials are the encountered effects of water logging on city life. The storm water becomes polluted as it mixes with solid waste, clinical waste, silt, contaminants, domestic wastes and other human activities that increase the water borne diseases. The stagnant storm water leads to the creation of breeding sites for diseases vectors that becomes a hazard to health as well as being unsightly and foul-smelling even death of pedestrians.

1.3 Water Logging Situation in Dhaka City

Water logging in urban areas is an inevitable problem for many cities in Asia. In Bangladesh, Mirpur area has serious problems related to water logging. The situation was highlighted in September 2017-2019 when residences experienced ankle to knee-deep water on the streets. Daily activities in parts of the city were nearly paralyzed and heavy traffic jams occurred due to stagnant water on the streets.
Given the severity of the problem, some organizations, including both private and public ones, have conducted several studies to identify the major causes of water logging in the city. Dhaka South City Corporation (DNCC) and Dhaka Water Supply and Sewerage Authority (Wasa) have recently jointly carried out such a study, the findings of which will be released around the middle of next month. The Dhaka Tribune obtained a copy of the study report that describes the causes and possible solutions at length. The draft report says sewage makes its way into nearby rivers, but the authorities are constructing a system of sewers that is not properly connected to the main streams or canals. “If a drain or a sewer pipe is not properly linked with another drain or pipe, water will never drain away. Most of the drains in Dhaka are not correctly connected with one another causing flood and water logging in the city.

1.4 Causes and Effect of Water Logging

1.4.1 Major Causes Identified

Extensive field observations in and around mirpur area, long discussions with officials of relevant organizations and analyses of available data suggest the followings to be the major causes of water logging in Metropolitan Dhaka.

- Poor discharge capacity of existing drainage pipes and canals.
- Clogging of existing drainage pipes due to inadequate collection of solid wastes, street sweepings and lack of maintenance.
- Impediment of canal waters due to encroachment of buildings and by problems caused by road and railway crossings.
- Insufficiency of drainage pipe length.
- Electrical breakdown of equipment at the existing pump stations.
- Encroachment of the natural drainage channels.

To find out inherent causes of water logging in Dhaka City, a field survey as a questionnaire survey, informal interviews and open discussion has been conducted with the authorities of different concerned organizations, experts and people living in different parts of Dhaka City.

1.4.2 Excessive Rainfall

Bangladesh is a tropical country and is located on the extensive floodplains of the Ganges and Brahmaputra. The Himalayas stands to the northeast of the country and the Bay of Bengal lies on the south of the country. As a result heavy downpour occurs on the country, especially in the monsoon season (May to October). In recent years the Dhaka Metropolitan area has been exposed to water logging due to heavy rainfall. During the 2018, 2019 , excessive rainfall occurred in Dhaka caused short duration flooding in different areas of the City namely Shantinagar, Nayapaltan, Rajarbag, Dhanmodi, Azimpur and Green Road (S. Huq and M. Alam, 2003). The most recent downpour

occurred from September 11th to 16th 2004 in Dhaka forced the City life standstill. 341 mm. of rain in 24 hours between September 14th and 15th is the heaviest ever rainfall. Dhaka's previous record of 274 mm of rain on September 16, 1966. Dumped with average 300 mm of rain in that week (MDB, September 2004), Dhaka was sloshing with floodwaters that sent many places, including Motijheel commercial heart, under chest-deep water. The devastating impact of the downpour that paralyzed Dhaka City is a salutary reminder of the severity of the problem.

According to survey, 74 percent of the respondent has been mentioned that heavy rainfall is one of the main reasons for water logging in Dhaka City. Relatively low intensity of rainfall causes serious water logging problems for certain areas of the City that are inundated for several days mainly due to the drainage congestion.

1.4.3 Disappearance of Natural Drainage System

The disappearance of the natural drainage system is one of main causes for water logging. Rapid population growth and unplanned development, unplanned land filling to develop new residential areas, uncontrolled and haphazard disposal of solid wastes and garbage into the existing drainage system, and encroachment on lakes, khals/canals and rivers with unauthorized construction are the summarized general man made physical and social activities related to the disappearance of natural drainage system. 95 per cent of the respondent claimed these activities for prime causes of water logging in Dhaka City.

1.4.4 Waste Management System

"Waste management system is one of the important factors for water logging in Dhaka City," said 82 per cent of the interviewers from different development organizations and inhabitants. The increased congestion of the city area, the high population density and the rapid growth all around it has made it impossible to clean the street and drains as fast as the waste thrown onto them. Dhaka, with a population about 18 million, generates a massive quantity of waste every day from various sources. The major sources of solid waste in Dhaka are residences, streets, market places, commercial establishment, and hospitals. Sources and characteristics of urban wastes in Bangladesh are shown in Table 1.

Table 1: Sources and Characteristics of Urban Waste in Dhaka

Types of Solid waste	Quantity (%)
Domestic	40-60
Commercial	5-2
Street Sweeping	20-30
Combustible	20-30
Non-combustible	30-40
Moisture	45-50

Source: Bangladesh Centre for Advanced Studies (BCAS), 2017

Due to urban development, population growth, and consumption increase, the volume of solid waste generation in Dhaka City increases every year. At present Dhaka City generates 3500-4000 tons solid waste per day, with a per capita generation of about 0.5 kg per day (Kazi, 2017). The composition of solid waste varies according to location, standard of living, energy sources and season. The quantity of waste generation increases during rainy season when many vegetables and fruits, especially mango and jackfruit, are available. Solid waste in Dhaka mainly consists of food, grass and plants, brick, dirt, paper and polythene materials (Table 2)

Table 2:Composition of Solid Waste in Dhaka City

Materials	Quantity (%)	
	Residential Areas	Commercial Areas
Food Waste (Organic)	84.37	79.49
Paper/cardboard	5.68	7.22
Textiles	1.83	1 .59
Plastics	1.74	1 .48
Glass/metals and construction debris	6.38	10.22

Source: Bangladesh Centre for Advanced Studies (BCAS), 2017

1.5 Effects of Water Logging

Urban runoff causes problems. These become obvious when a constructed drainage system fails. Urbanization disrupts natural drainage patterns; natural watercourses are destroyed; natural retention of runoff by plants and soil is removed and the creation of impervious surfaces increases the amount of runoff. This runoff becomes polluted as solid waste, silt and contaminants are washed off roads. The increase in volume and rate of runoff causes erosion and siltation. Therefore, it becomes a burden for the inhabitants of the city, leading to water logging and creating adviser social, physical, economical as well as environmental impacts. A field survey as questionnaire survey, informal interview and open discussion has been conducted with inhabitants of Dhaka City to know the problem faces due to water logging. The total sample was 100 in different parts of the city including authorities of different concerned organizations, experts and general people and their summarized opinions about the problem faces due to water logging are as follows.

Table 3: Types of Problems Faced due to Water Logging in Dhaka City

Problems	Percentage
Disruption of traffic movement	88
Disruption of normal life	93
Damage of roads	70
Damage of underground service lines	56
Damage of household goods	65
Water pollution	95
Water borne diseases	84
Damage of trees and vegetation	48
Increase of construction and maintenance cost	58

Source: Report from brac, 2018

1.5.1 Social Problem

Disruption of Traffic Movement

Disruption of traffic movement is an important identified impact according to 88 per cent of interviewers, which arises due to the traditional water logging problem. Normal traffic movement is hampered during rainfall over 25 mm, creating traffic jam in the city area and people lose their valuable time. Where the storm water cannot drain out, puddles will form. This is not just inconvenience for pedestrians but also dangerous for road users. Following pictures (Picture-2.1) illustrates that the heavy rainfall in August 2019 disrupted traffic movement in Mirpur area**.**

Disruption of Normal Life

Water logging seriously disrupts normal life and it has direct impacts on the poor, as they often live on unsuitable, low-lying and flood prone or steep, and unstable sites, have high-density housing (increasing the impermeability of the ground), poor urban planning and control and lack of investment

in urban infrastructure. 93 per cent inhabitants (according to field survey) mentioned that water logging hamper daily life of the city dwellers. The more affluent members of society have the option to move to less flood prone or less polluted areas or flood-proof their homes, e.g. through raising the ground level. But the poor bear the brunt of bad drainage, through direct flood damage, pollution of water supplies and the aquatic environment, the breeding of vectors and soil erosion, leading to direct financial costs, loss of income potential, as the home may also be the workplace, and adverse health impacts. Sometimes, they don't have access to potable water and so had to rely on surface or shallow groundwater sources that are polluted. Picture-6.2 illustrates an example that the heavy down pour disrupt the daily life of the city in different places in Dhaka**.**

Purabi-Kalishi road in Dhaka's Mirpur goes under water after rains – An article named "Water logging in city" by Mahmud Zaman Ovi. Published on August 14, 2019 in reader's forum of The New Nation (Bangladesh's Independent News Source) can be a practical example for disruption of traffic movement and normal life.

1.5.2 Environmental Impact

Water Pollution
Theoretically, Dhaka WASA maintains two separate sewer systems: one for domestic wastewater and another for storm water. However, in reality storm sewers also receive domestic wastewater, which causes unwanted deterioration of the storm water discharges. These discharges in turn pollute the receiving water bodies including the lakes, rivers and detention areas. According to survey, 95 per cent inhabitants said that storm water of Dhaka City becomes polluted as it is mix with solid waste, clinical waste, silt, contaminants, domestic waste water and other human activities, which contaminated ground water as well as the receiving water bodies. In recent years Dhaka City is facing extensive water logging during the monsoon (May to August) as a common and regular problem of the city like water pollution, traffic congestion, air and noise pollution, solid waste disposal, black smoke etc.

2. METHODOLOGY

2.1 Methodology

It has already been mentioned earlier that flooding in Dhaka Metropolitan area can be classified into two types. One is river flooding that results from high water levels of peripheral river systems and another is rainfall induced flooding that is caused by high intensity storm rainfall runoff in the city area. The study would be focus on the rainfall induced flooding treated as water logging due to storm water in this study. The methodological approaches of the study are as follows. 1. Selection of the study area.

2.2 Data Collection

To fulfil the objective of the study both primary and secondary data were needed. All the necessary data has been collected from various sources.

2.2.1 Collection of Maps

For the purpose of the present study, three different types of maps have been collected. These are Cadastral Survey (CS) map (1912-1915), Revenue Survey (RS) map (1965-1975) and Dhaka topographic survey maps (1998). First two types of maps have been collected from Directorate of Land Records and Survey (DLRS) the last map is from Survey of Bangladesh. The existing land use map has been collected from Rajdhani Unnayan Kartripakkha (RAJUK) and the land use of different periods has been collected from some relevant literatures and organizations. The existing drainage layout map was also needed and this has been collected form Institute of Water and Flood Management (IWFM), BUET.

2.2.2 Other Secondary Data

Rainfall data and the storm water drainage system data were needed for the study. The rainfall data has been collected from Meteorological Department of Bangladesh (MDE) and the drainage data has been collected from Drainage Department of Dhaka City Corporation (DCC). The past and present data on natural drainage system has been collected from different land use maps prepared by RAJUK. Some literature related to the topic has been reviewed for better understanding of the problem and their main objectives and outputs are attached at the end of this chapter.

2.2.3 Collection of Photographs

Lot of photographs was also needed to illustrate the situation of water logging, related obstacles into the smooth drainage of urban runoff and its effects on urban life. Some of these photographs have been collected directly from field survey and some other from daily newspapers as well as from internet websites.

2.3 Questionnaire Survey and Informal Interview

To find out inherent causes of water logging in Dhaka City and its associate impact on city life, a field survey as questionnaire survey, informal interview and open discussion has been conducted with the authorities of different concerned organizations, experts and people living in different parts of Dhaka City. The questionnaire was designed in such a way that it would track down the problem from the inception and the impact of the water logging in the locality. The sample questionnaire is given in Appendix A. The sample size of these survey activities was 100. Again the respondents were selected in different water logging prone area of the city with different professions. To identify the quality of environment certain environmental parameters were fixed. It also covered the people's perception on conservation/sustainable development of drainage system. Informal interview of official experts of different development agencies was also done in order to know their view of causes and effects of water logging in Dhaka city and sustainable solutions.

3. RESULTS & DISCUSSIONS

Dhaka city, the capital of Bangladesh, is located on the flat deltaic plain of the three major international rivers, the Ganges, Brahmaputra and Meghna and is surrounded by their tributaries. Flood waters overflowing the river banks - frequently inundate the low-lying areas of the city. On the other hand, heavy monsoon rains cause water logging in many places within the city creating manifold problems for the citizens.

3.1 Results

Experimental studies generally focus on the durability of the vehicle, dry and wet for water logging. Provides some of the earliest analysis to determine the required speed of a vehicle and a vehicle. However, the efficiency of the vehicle is calculated as a result of dry and wet movement. Those experimental tasks are now investigating the value of traffic congestion time and further studies economically reducing traffic congestion time.

Table 4: Data Sheet

Traffic Movement		
Name of road: Mirpur Area	Direction- from: Mirpur-10	To: Kazi Para
Place: Kazi para	Distance: 2.00 Km	Date: 27/07/2019

Data Calculation & Graph

Dry Traffic Movement Calculation (1Hour)		**Wet Traffic Movement Calculation(1Hour)**	
Time	Vehicle	Time	Vehicle
11:30 AM-11:40 AM	69	04:20 PM-04:30PM	40
11:40 AM-11:50 AM	159	04:30 PM-04:40 PM	65
11:50 AM-12:00 PM	191	04:40 PM-04:50 PM	92

12:00 AM-12:10 PM	195	04:50 PM-05:00PM	95
12:10 AM-12:20 PM	192	05:00 PM-05:10PM	105
12:20 AM-12:30 PM	222	05:10 PM-05:20 PM	125

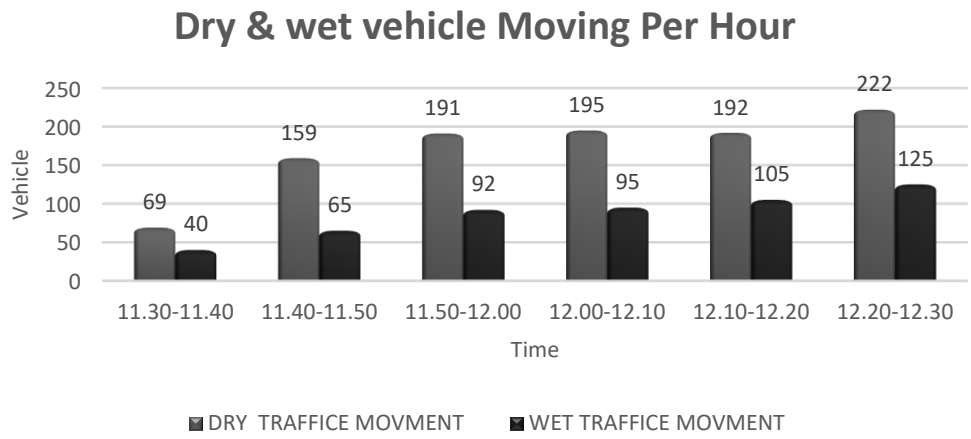

Figure 1: Dry & wet traffic movement

Table 5: Dry & wet traffic movement Calculation

1 hour Total Moving Vehicle				Efficiency	Decrease
Dry		Wet			
Time(1 hour)	Vehicle	Time(1 hour)	Vehicle		
11:30 AM-12:30PM	1028	04:20 PM-05:30	512	49.81%	50.19%

3.2 Discussions

Existing approaches to assessing the impact of Water logging on transport disruption do not capture the complexity of inter-actions between the Water logging hazard and transport system. Typically, assumptions can include.

- Traffic volumes and speeds are assumed to correspond to regional (or even national) average statistics;
- A road is assumed to be completely closed when its crown is covered by water logging, regardless of depth;
- Traffic on open roads continues to flow smoothly, perhaps at a slightly reduced maximum speed;
- Traffic volumes do not exceed the design capacity of a road;
- Traffic conditions do not change over the course of the day, or seasonally; and
- Diversion routes, and changes (or not) to driver behavior as a result of the flood, are often assumed without any clear rationale.

4. RECOMMENDATIONS

4.1 Permeable Pavement Design And Construction

Permeable pavements have gained very rapid use across North American in the past ten years. For new designs and retrofit projects, permeable pavements transform conventional, non-permeable pavement into a storm water management asset. Almost all permeable pavements use an open-graded aggregate base or sub base to store and infiltrate water into the soil sub grade. The asphalt, concrete and interlocking concrete pavement industries, as well as a number of other manufacturers of permeable surfaces, provide a variety of pavement surface options. Regardless of the surface,

permeable pavement systems include three design approaches. First, they are primarily used to promote complete or full infiltration of rainfall into the soil sub grade. Second, where soil sub grades have low infiltration rates, partial infiltration into the soil sub grade occurs and the remaining water exits via under drains. Third, for designs that require no infiltration, permeable pavement systems are enveloped with a geo membrane that prevents detained water from entering the soil sub grade and the stored water exits via under drains.

4.1.1 Key Permeable Pavement Design Features

A successful permeable pavement considers structural and hydrologic design. Structural design considers the pavement strength required to accommodate the vehicle loadings without the pavement failing. Hydrologic design considers the capacity required to infiltrate, store and release water in a manner that contributes positively to storm water management. Some key design, construction and maintenance considerations are as follows:

Site Drainage - Consider the overall site drainage and evaluate rainfall onto the pavement and water. That may drain onto the permeable pavement from surrounding areas. This could include adjacent pavements, grassed areas, building roofs, etc.

Contaminant Loading - Consider potential contaminants such as winter sand (for traction), biomass (tree leaves and needles, grass clippings, etc.) and sediment. Contaminants may reduce the long-term permeability of the pavement system and likely require maintenance such as vacuum sweeping.

Groundwater Depth - The top of the sub grade under a permeable pavement should be no less than 0.6 m from the seasonal high groundwater level.

Sub grade Type and Strength -The type of sub grade and its compaction/consolidation govern if water can be adequately infiltrated into the ground. Permeability values in the order of 12 mm/hr. permit full infiltration designs that accommodate rainstorm depths in most areas of North America. Lower permeability sub grade in high rainfall event areas may require supplemental under drains. Permeable pavements constructed over fine-grained soils (silts and clays) generally require thicker pavements than those constructed over coarse-grained soils (sands and gravels).

Traffic Type and Composition - Avoid using permeable pavements in high, concentrated traffic areas subjected to many heavy vehicles such as trucks and buses. While permeable pavements can be designed to accommodate very heavy loads.

Pavement Surface - Consider the type of surface most appropriate for the traffic and infiltration. Capacity conditions. For example, porous asphalt or pervious concrete may be more appropriate for some slope conditions whereas permeable interlocking concrete and grid pavements may be more suitable for situations where vehicles are turning. While some projects have steeper slopes, most permeable pavements should have slopes less than 5 percent.

Aggregate Base and Sub base - Permeable pavements typically utilize open graded aggregates to provide structural and hydraulic capacity for the pavement. The aggregates should be hard, durable and have a low percentage of material passing the 75 µm sieve size. Select durable, crushed aggregate materials to maximize structural capacity and porosity for water storage. For heavier traffic conditions, a cement- or asphalt-stabilized open-graded aggregate may be more suitable. Dense-graded aggregates for road bases are generally not used because of low water storage capacity and fines that can weaken them when saturated. To prevent migration of smaller base aggregate material into the larger sub base aggregate, aggregate gradations should satisfy the following criteria:

$$D50\ \text{Sub base}/D50\ \text{Base} < 25$$

$$D15\ \text{Sub base}/D85\ \text{Base} < 5$$

For example, the ratio of the D50 Sub base (sub base aggregate size at which 50 percent of the material is larger than this size and 50 percent is smaller) to D50 Base (base aggregate size at which 50 percent of the material is larger than this size and 50 percent is smaller) must be less than 25.

Subgrade Slope - Infiltration designs should minimize subgrade slope to promote water infiltration. Sites with subgrade slopes over 3 percent often require buffers,

Pavement Overflow - During high intensity/depth storm events, the pavement design should incorporate features such as curb cut outs, grading to supplementary drainage outlets such as catch basins, storm water ponds, etc. to prevent the pavement system from flooding.

Under drains - For partial or no infiltration designs determine the type, location and need for under drains. Specify outlet details and clean out provisions.

5. CONCLUSIONS

The findings of the study helped to conclude that water logging is affected by different significant factors including political & regulatory factors, drainage and waste management factors, unplanned development factors, population and development factors, etc. The study has also found that the residents of Dhaka city faced different problems due to water logging, most influential problems are; productivity loss, increase of construction and maintenance cost, environmental problem, sanitary problem, damage of roads, financial loss, health hazard, increase mosquito, disruption of normal life and economic loss etc. It is projected that this study will provide some useful thoughts for the water logging problems in Dhaka city and thus will help to solve water logging problems of the city. It is expected that this paper will give some valuable thoughts to the future researchers and policy makers to eradicate this problem. The major limitations of the paper are location, lack of secondary data and lack of time. Therefore, the future study may look at the extra variables. Whereas endorsing these limitations, next we expect that they do not notably diminish the significance of a comprehensive investigation of factors affecting the water logging in Dhaka city**.**

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