Dhaka Transport Coordination Authority

Feasibility Study and Conceptual Design of Proposed Bus Terminal and Depot

Final

Final Report

Submitted on - July 2021

Revised on – 30 September 2021

Submitted by

Infrastructure Investment Facilitation Company

An enterprise of ERD, Ministry of Finance

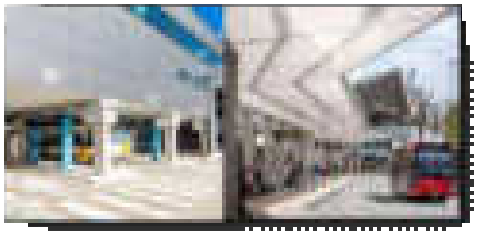
AJ Tower (1st, 2nd & 3rd floor); 4 Kawran Bazar, Sonargaon Link Road, Dhaka

Contents

List of Annexures

Abbreviations

BIWTA	:	Bangladesh Inland Water Transport Authority
BOA	:	Bus Owners Association
BRT	:	Bus Rapid Transit
BRTC	:	Bangladesh Road Transport Corporation
BTV	:	Bangladesh Television
CCTV	:	Closed-circuit television
COVID	:	Corona virus
DAP	:	Detailed Area Plan
DNCC	:	Dhaka North City Corporation
DSCC	:	Dhaka South City Corporation
DTCA	:	Dhaka Transport Coordination Authority
EHS	:	Environmental Health Safety
EIA	:	Environmental Impact Assessment
FGD	:	Focus Group Discussion
GCC	:	Gazipur City Corporation
GDP	:	Gross Domestic Product
GOB	:	Government of Bangladesh
GPS	:	Global Positioning System
JICA	:	Japan International Cooperation Agency
Kph	:	Kilometer per hour
LAO	:	Land Acquisition Officer
LAP	:	Land Acquisition Plan
MRT	:	Mass Rapid Transit
NGO	:	Non-governmental Organization
PAPs	:	Project Affected Person
PHP	:	Private Group of Company
RAJUK	:	Rajdhani Unnayan Kartripakkha
RHD	:	Roads and Highway Department
RSTP	:	Revised Strategic Transport Plan
SIA	:	Social Impact Assessment
SLM	:	Sound Level Meter
STP	:	Strategic Transport Plan
	:	Bangladesh Taka
TDS	:	Total Dissolved Solids
TOR	:	Terms of Reference
TPE	:	Total Population Engaged
TSS	:	Total Suspended Solids
UNDP	:	United Nations Development Programme
USB	:	Universal Serial Bus
VOC	:	Vehicle Operating Costs
WASA	:	Water Supply and Sewerage Authority



Feasibility Study and Conceptual Design of Proposed Bus Terminal and Depot

FINAL REPORT
EXECUTIVE SUMMARY

Background: Dhaka, a megacity of 2 crore population (Dhaka Structure Plan of RAJUK) is growing beyond a sustainable level. The city's large population generate a large number of vehicles in the city; in addition, vehicles from other parts of the country enter Dhaka carrying passengers and goods. These cause traffic congestions resulting in reduction of vehicle speed to merely 7 kph. For improving the accessibility and mobility, the Revised Strategic Transport Plan (RSTP) has suggested development of additional interdistrict bus terminals at the periphery of the city. In this regard, DTCA engaged IIFC in association with BETS in March 2020 to carry out a "Feasibility Study and Conceptual Design of Bus Terminals and Depots."

Objective of the Study: The objective of the study is to (i) select required number of interdistrict bus terminals at the city periphery ensuring multimodal connectivity backed by robust economic and financial analysis (ii) prepare conceptual design of terminals with adequate facilities for passenger for the next 25 years (ii) and prepare environmental and social report including land acquisition plan.

Existing Bus Terminals: There are three interdistrict bus terminals in Dhaka located at Gabtoli, Mohakhali and Sayedabad. The Consultant has carried out a situation analysis of these three terminals, which has provided valuable information and guidance for the concept design of the proposed ones. The analysis covered the aspects like terminal capacity, number of routes served by the terminals, number of operators, quality of service, and social and environmental aspects. Presently, the three terminals are located at busy areas of the city creating traffic congestion.

About 40% of the interdistrict buses use terminals and others operate informally in different parts of the city. Currently the terminals do not provide adequate facility for passengers and bus crews with poor drainage condition and less than desired quality of service. Management of the terminals is also not as streamlined as expected. The details of the situation are described in Section 2 of this report.

Selection of Proposed Bus Terminals and Depots: The Consultant investigated 14 locations out of which 10 have been considered (based on location and connectivity) for the new bus terminals and depots:

(1)	Baghair	33.63	acres	(2)	Kanchpur South	27.7	acres
(3)	Kanchpur North	15.5	“”	(4)	Gram Bhatulia	26.7	“”
(5)	Bhulta	24.2	“”	(6)	Bhawal, Ati Bazar	25.78	“”
(7)	Hemayetpur	45	“”	(8)	Baipail	37.10	“”
(9)	Gazipur	11.7	“”	(10)	Kanchan	24.2	“”

Out of the ten sites, five were selected through an iterative process of identifying several combinations of terminal locations (*Kanchpur North is considered both for Interdistrict terminal and City Bus Depot. Preferrable recommendation by consultant team is for City Bus Depot.).* GIS based network allocation was used as a tool to identify five terminal locations that can serve as interdistrict bus terminals with optimal travel distance:

(1) Baghair
(2) Kanchpur-South
(3) Gram Bhatulia
(4) Bhulta
(5) Hemayetpur

The aspects of land availability, connectivity, existing and future land use and drainage, proximity to major highways, safe exit and entry facilities, multimodal and city bus route connectivity were considered. The details of locations and connectivity analysis are given in Section 3.

Passenger Trip Estimate and Transport Survey: Number of bus trips is central to the bus terminal design. It depends upon population, economy, employment, poverty and willingness-to-pay. Number of bus trips was estimated based on transport survey at important bus corridors and existing bus terminals. The number of passengers in the proposed terminals is estimated to be 344,000 in 2025 and 515,000 in 2045.

The transport survey included bus counts, passenger and traffic counts, survey of boarding/alighting of passengers and dwell-time of buses. Based on the analysis, bus arrivals at Dhaka is estimated at 10,000 per day in 2025 and 15,000 in 2045.The following information have emerged from the transport survey:

- Around 16,000 interdistrict bus trips are made each day (incoming and outgoing).
- Traffic counts show 6 a.m-7 a.m. as peak period for incoming and 8 p.m. -9 p.m. for outgoing.
- It was found that interdistrict buses account for 38% of total buses that pass Dhaka cordon line; others are sub-urban and city buses.
- It is estimated that five proposed terminals will serve 7 lakh passengers in 2025 which would reach 10 lakhs by 2045.
- From dwell time survey, it was found that interdistrict buses take about 20 minutes for boarding and unboarding passengers.
- It was also found that around 20% of the buses make long or overnight stay in the terminals

The detail estimates of passenger and bus trips are provided in Section 4 and 5.

Topographical Survey: The objectives of the topographical surveys were to prepare geo-coordinate maps of the terminal locations. They were carried out at 10 potential locations covering existing roads, physical features within site and ground level of specific areas. The details of the surveys are providedin Section 6.1.

Geotechnical Investigation: Site assessments were undertaken for the proposed sites of bus terminals/depots, which included visual inspections survey and geotechnical investigations. For this purpose, five boreholes (upto a depth of 20 m) were made for each site for

geotechnical assessment and foundation design. Field tests included exploratory borings, standard penetration tests (SPT) and extraction of soil samples. Laboratory facilities were done for grain size analysis, specific gravity test and direct sheer test.

The results helped in determining bearing capacity of soil. Structural stability and settlement control measures including choice of soil treatment were considered in the design options. Since most of the structures of the proposed terminal buildings (3 storied) shall rest on soft/ clayey soil layers in general (as observed from bore logs) sand compaction pile method was used because it is most widely used for soft soil layer treatment. The details of geotechnical investigation are laid out in Section 6.2.

Social Impact Assessment (SIA): The number of passengers in the proposed terminals (total) is expected to be around 344,000 daily in 2025 (expected year of terminal opening) and expected to be 515,000 in 2045. The number of passengers during peak hours in the proposed five terminals (total) is expected to be around 41,000 in 2025 and 61,000 in 2045. SIA was carried out to assess demand of facilities depending on the projected volumes of passenger traffic and to assess the impact of the project on the Project Affected Persons (PAP). The information for SIA were obtained by conducting passenger surveys, topographical surveys and FGDs with the PAPs.

The terminals require acquisition of 271.51 acres of land in Dhaka, Gazipur and Narayanganj districts. Out of total area, 136.21 acres are government owned (khas) (51%) and 135.3 acres belong to private owners (49%). In total, 45 households and 250 persons are anticipated to be displaced if all of the ten sites are implemented. The estimated cost of land acquisition and resettlement and details of the SIA (including Land Acquisition and Resettlement Plan) are described in Section 7 and LARP report. Land ownership can be changed during Land Acuisition and Detail design phase.

Preliminary Assessment of Environmental Aspects: It is envisaged that there will be dense concentrations of people at the proposed sites comprising of bus passengers, bus crew and service providers (involved in the management of the terminal). Therefore, an environment-friendly design is essential for the safety and health of the people using the terminal. As such, an environmental assessment was carried out considering noise and air pollution, solid waste management, drainage, effluent treatment, carbon emissions issues, prospects of renewable energy and provision of solar energy. For assessing the negative environmental impacts and planning remedial measures, a preliminary assessment of the environmental aspects were carried out under this study as laid out in Section 8.

Hydrological Assessment: Dhaka is surrounded by four major rivers: Buriganga, Turag, Balu and Sitalakshya. These rivers largely impact hydrological characterstics of the city and its surroundings. The hydrological assessment covered rivers, rainfall and flood levels and waterlogging issues. The information were used to determine the water drainage from the proposed terminals. The details of hydrological assessment are described in Section 9.

Assessment of Utilities and Social Infrastructure: Information regarding existing utilities and nearby social infrastructure were collected through site visits and described in Section 10. The information were used in designing utility services for the proposed bus terminals and depots.

Conceptual Design: Facilities of the proposed bus terminals will be used mainly by traveling passengers, the crew and staff of bus service providers and staff be involved in terminal

management. Facilities have been provided based on passenger trip demand and the number of buses that is projected to operate during peak period.

Since the proposed terminals will be located outskirts of the city, adequate transfer facilities are needed for the passengers for commuting to and from the city. International best practices were considered for planning, architectural design, efficient operation and functioning of the bus terminals. Adequate bus parking facilities, separate entries and exits, separate lounges for arrivals and departures and facilities for bus crew have been provisioned for in the the proposed terminals. The details of conceptual design are covered in Section 11.

Institutional Issues: The consultant has reviewed the operation and management practices prevailing in the existing terminals *i.e.,* Mohakhali, Sayedabad and Gabtoli and are concerned to note that existing situation is not sustainable due to management of the terminals and the vehicles, being inadequate. Unless a better management system is created in the new terminals, sustainability and financial viability in the long run will remain as questionmarks. Therefore, the team carried out a preliminary institutional review and proposed strengthening of the relevant institutions through reorganization and development of human resources. The details of the institutional review are described in Section 13.

Economic and Financial Viability: The consultants have carried out economic and financial analysis for the individual projects and found that EIRR of the proposed terminals are in the range of 13.40% - 24.11% and FIRR ranges between 7.22% and 9.13%. EIRR in all cases are found to be more than 12% benchmark. Therefore, it can be concluded that they are viable economically, if not financially.

	EIRR	FIRR
Baghair	21.29%	7.81%
Kanchan South	20.83%	9.12%
Gram Bhatulia	34.11%	7.22%
Bhulta	15.78%	8.49%
Hemayetpur	15.88%	9.13%

Recommendations: For optimising efficient use of terminal space through modern fleet management and reducing passenger trip demand, following principles of Transport Demand Management (TDM) are to be followed:

(1) Ensure multimodal integration of interdistrict passenger trips by increasing railway services between districts and Dhaka
(2) Introduce commuter train services to sub-urban destinations to reduce dependence on bus service
(3) Extend MRT to suburban districts, if economically viable
(4) Carry out a study for route rationalization and franchising of bus operation
(5) Carry out institutional review of terminal operation and management
(6) Provide modern training on terminal operation and management to terminal managers
(7) For strengthening financial management, reduce cash transactions and Introduce electronic system for collection of terminal fees and parking charges.
(8) Since the planned terminals have limited capacity for bus parking, process should start to find additional parcels of land close to the terminals.
(9) Strengthen monitoring of terminal management and service quality and, if required, establish monitoring cell at DTCA.

Feasibility Study and Conceptual Design of Proposed Bus Terminal and Depot

1 Introduction

1.1 Background

Dhaka is a megacity with a population of 2 crore[1], which is growing at a rate not enviormentally and socially sustainable, unless appropriate diversion measures are taken. The city's large population generates a traffic of large number of vehicles in the city beyond its capacity. In addition, vehicles from other parts enter Dhaka carrying passengers and goods. These cause traffic congestions resulting in slow vehicle speed to merely 7 kph[2]. In order to ease the situation, a Strategic Transport Plan (STP) was prepared in 2005, which was subsequently revised (as RSTP) in 2015 by DTCA. The ongoing BRT, MRT and expressways are the outcome of RSTP. The RSTP has also suggested for additional interdistrict bus terminals along the periphery of the city.

1.2 Objective

The objective of the study is to increase terminal facilities and to enhance mobility, safety and accessibility for bus passengers and crews, which will also enhance the livability of the city. It can be attained through selecting terminals at proper locations with efficient connectivity, better terminal design and ensuring sustainability through robust economic and financial viability. Relocation of the existing terminals at the outskirts of the city, is expected to reduce traffic congestion on the major bus routes in the city.

1.3 Scope of the Study

As recommended in the RSTP, DTCA engaged a consulting firms (Infrastructure Investment Facilation Company (IIFC) in 2020 to carry out a "Feasibility Study and Conceptual Design of Proposed Bus Terminals and Depots.[3]" The scope of the study as agreed is outlined below:

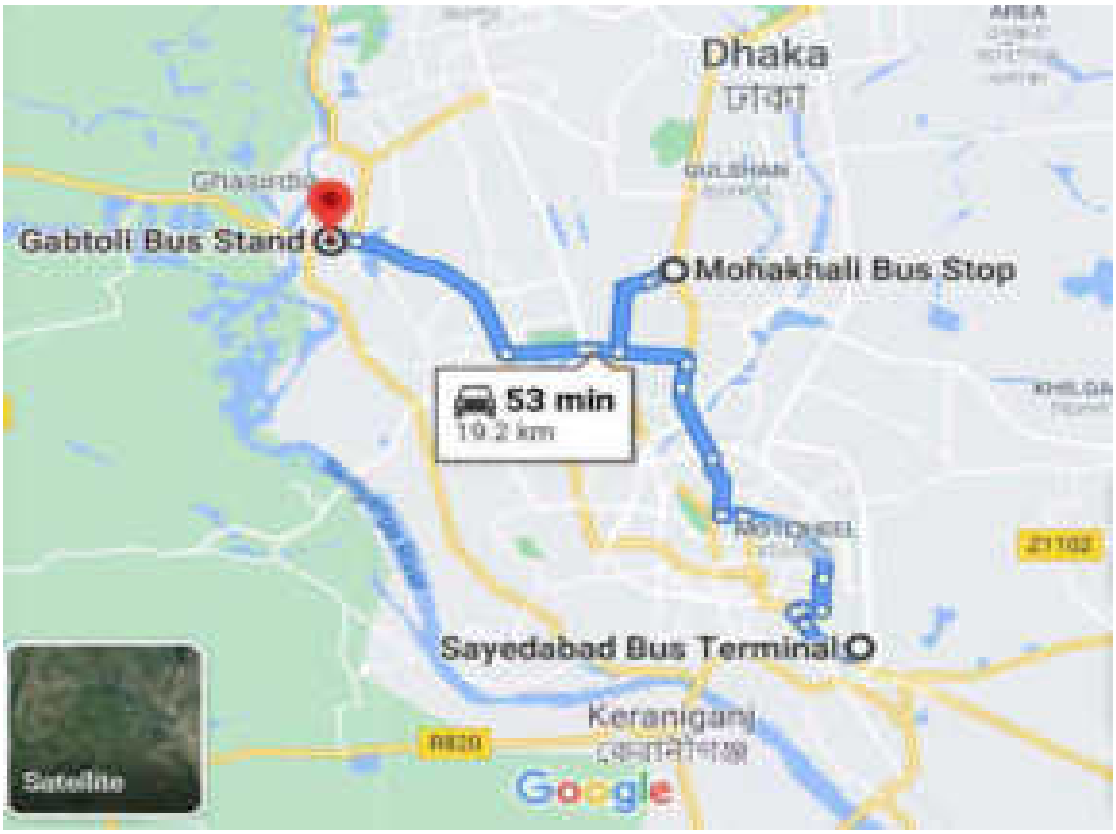
- preparation of the feasibility study of the interdistrict bus terminal and depot based on technical, social, environmental and economic considerations;
- examination of the present situation concerning demand and supply (includingfuture projection);
- determination of facilities required for the new terminals leading to future growth;
- carry out economic and financial analysis;
- preparation of concept design
- preparation of environmental and social reports.

[1] in 2020 (Dhaka Structure Plan of RAJUK)
[2] The Daily Sun 2018
[3] The consultant mobilized the team on 20 March 2020, but closed the office from 26 March to 31 May 2020 due to the lockdown declared by the government for COVID-19 pandemic situation.

2 Existing Interdistrict Bus Terminals Connecting Dhaka

There are three interdistrict bus terminals in Dhaka city: (1) Gabtoli, (2) Sayedabad, and (3) Mohakhali. Gabtoli and Mohakhali bus terminals are located in Dhaka North City Corporation (DNCC) area and Sayedabad in Dhaka South City Corporation (DSCC).

Figure 2-1: Locations of Existing Interdistrict Bus Terminals of Dhaka[4]



Because of the limited management by DNCC and DSCC[5], BOA[6] oversees some of the functions belonging to terminal management. They are in general responsible for the following:

- Creating social awareness on HIV/AIDS, COVID virus
- Controlling nuisances; like child labor, child, women trafficking
- Helping management and operation of vehicles (departure and arrival)
- Controlling traffic movement inside the terminal

[4] Google Map

[5] Onsite observations and consultations with stakeholders (passengers, shop keepers, bus crews and members of BOA), as an upfront picture, revealed the following issues:

- Potho Shishu (street children) issue is a significant problem in this bus terminal. These children, including some drug addicts, sleep and occupy the waiting lounge overnight
- CCTV camera does not function properly
- flooding occurs due to poor drainage
- terminal managers are seldom present

[6] Bus Owner's Association

2.1 Sayedabad

The Sayedabad busterminal is playing an important role for connecting the Southeast and Northeast parts of Bangladesh with Dhaka city. This area is under the jurisdiction of DSCC and DTCA is the regulating authority. The terminal is in Ward 48 of Jatrabari area of DSCC. It has 10 acres of land and can accommodate 300 buses. Surrounding land is being used mainly for commercial purposes. This terminal has a number of entry points with a capacity of accommodating 200 vehicles for night halt. The activities of the Sayedabad Bus Terminal have spread over many places of the city (such as Kamalapur, Motijheel (in front of NDC), Malibag, Moghbazar, Gulistan Shadhinata Square Market, Jatrabari, Shanir Akhara, Signboard in Narayanganj, Chattogram Road, Mograpara crossing near Kanchpur Bridge). About 300 buses commute daily from Sayedabad to nearby districts of Dhaka.

2.2 Mohakhali

Mohakhali bus terminal falls under the jurisdiction and ownership of DNCC. It is located in Ward 20 of Gulshan Thana. It occupies 9 acres of land. The district buses from Dhaka to the north and northeast parts of Bangladesh operate from this terminal. It has two entry points with a capacity of catering 600-700 daily trips to 60 different destinations. The areas surrounding the terminal are mainly used for commercial purposes.

It has a capacity for 200-250 vehicles to stay for night halt. Among the three bus terminals of Dhaka, management at Mohakhali is the most streamlined. At the entry to the terminal, traffic police maintain separate bus queues, preventing obstructive use of the main road. As the terminal is situated on the left (east) side of the road, north-bound buses have to take a right turn during their departure from the terminal, blockings vehicles on the main road.

2.3 Gabtoli

The north-west, west and north bound interdistrict buses usually terminates at Gabtoli terminal. It is under the jurisdiction of DNCC. The terminal is situated in Ward 9 of DNCC on 22 acres of land. The surrounding areas are busy mostly for commercial purposes. It has three entry points and two exit points. On average, daily 1,500 - 1,600 buses travel from Gabtoli to 46 districts of the country's north and south-western areas. The terminal has the capacity of 800-900 vehicles for night-halt. Two adjacent empty fields are also used as night-halt parking spaces for additional buses.

Like in Sayedabad, several activities centered about Gabtoli terminal are actually dispersed to different locations of the city. (*e.g.,* Kallaynpur, Asad Gate, in front of Shishu Hospital, Shyamoli, Mirpur 1, Mirpur 10, Panthopath Russel Square)

Figure 2-2: Location of Sayedabad Bus Terminal

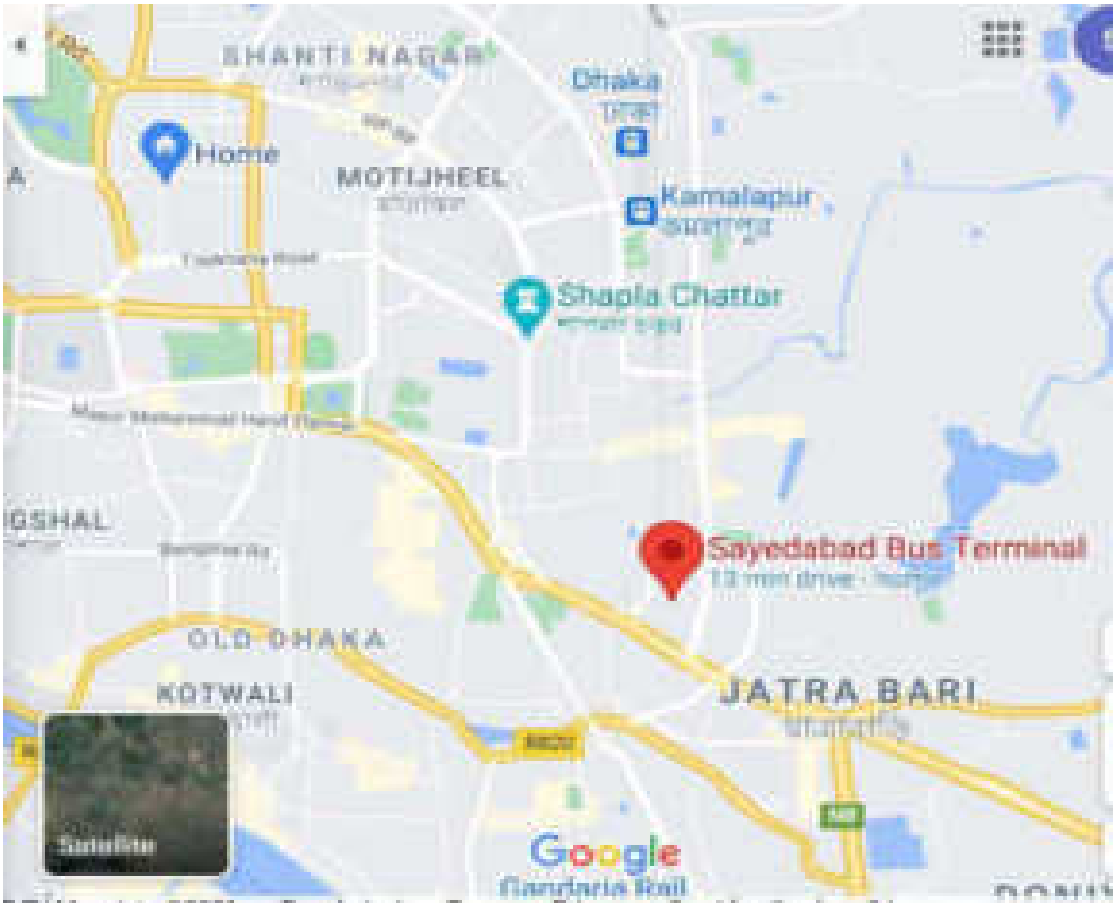


Figure 2-3:Existing Situation of Sayedabad Terminal[7]

Tin shed hotel inside the terminal

[7]Field Survey

Vehicle parking place in a bad condition

Front view of Bus Owners' Office

Meeting with Bus Owners' Association

Figure 2-4: Location of Mohakhali Bus Terminal

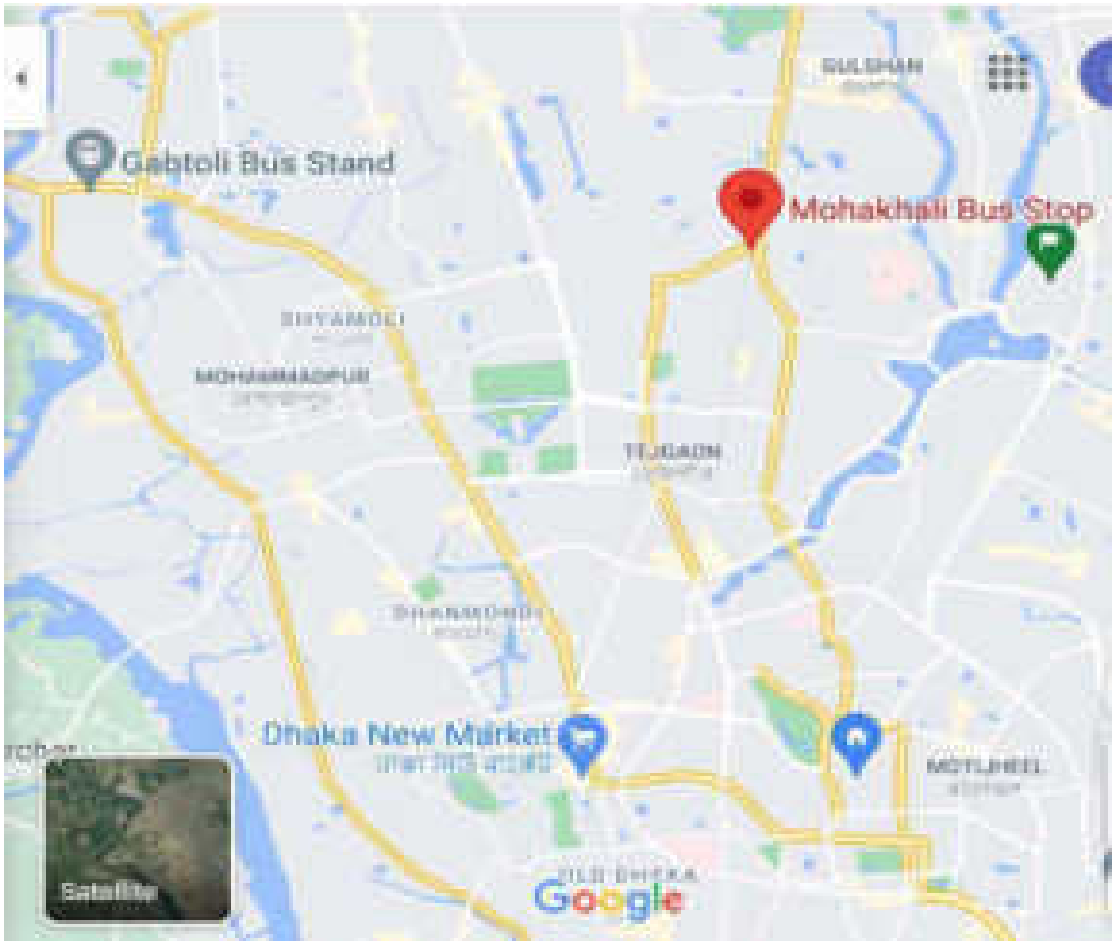


Figure 2-5: Existing Situation of Mohakhali Terminal[8]

Separate Toilet for women

View from 1st floor

[8]Field Survey

Meeting with members of BOA

Figure 2-6:Location of Gabtoli Bus Terminal

Figure 2-7: Existing Situation of Gabtoli Terminal

No separate waiting space for women

Separate male and female toilets

Ticket Counters

Open Waiting space of City Corporation

Shops and vendors on walking spaces

Informal interviews session held with shop-keepers

Table 2-1: Salient Features of Interdistrict Bus Terminals

	Item	Gabtoli	Mohakhali	Sayedabad
(1)	Location	DNCC Ward-9	DNCC Ward-20	DSCC Ward-48
(2)	Regions Serving	West, North West, South West	North, North West	East, South East. North East, South West
(3)	Land Size	22 acres	9 acres	10 acres
(4)	Surrounding land use	Commercial	Corporate office dominated land use	Commercial
(5)	No of ticket counters	240	40	108
(6)	Terminal capacity	400	200	200
(7)	Average daily passengers	40,000	25,000	40,000
(8)	Women seat	No separate seat	No separate seat	No separate seat
(9)	No of bus Arr./dep.daily	1500-1600	600-700 (Thurs-Sat 900-1000-family trip);	1300-1400; 1600-on Thurs-Sat
(10)	No of entry/exit point	2	2	No separate, 2
(11)	Walkway of passengers	Open area, no boundary wall in front	Yes-open area	Yes
(12)	Pedestrian crossing facility	One underpass, not clean	Inadequate	Inadequate
(13)	Separate Toilet for male/female	4 toilets by BOA, one by DNCC, separate sections for women are available	3 toilets and separate sections for women are available	4 toilets and separate sections for women are available
(14)	Facilities of passengers: Waiting lounge	Open space with steel chairs, no separate space for women and children	Open space with steel chairs, no separate space for women	Open space with steel chairs, no separate space for women
(15)	Arr./Dep. Display Board	No	No	No
(16)	Canteen/snacks shop	More than 100 hotels, vendors/shops/fruits vendors/ hawkers occupy a large space disturbing passengers' mobility (all rented out by DNCC)	20 shops/hotels privately rented from DNCC	20 shops/hotels privately rented from DNCC
(17)	Drinking water facility	No purified water containers at any corners; only WASA supply faucet near the toilet area	WASA Water Supply	WASA Water Supply
(18)	Information Desk	No	No	No
(19)	Mosquito control/ disinfect service	DNCC spray twice a month	DNCC	DSCC
(20)	WIFI/ Mobile charge facility	No	No	No

	Item	Gabtoli	Mohakhali	Sayedabad
(21)	Computer service	BOA office has a service	No	No
(22)	Shelter during rains	Yes, at DNCC lounge	Yes, at DNCC lounge	Yes, at DSCC lounge
(23)	Complaint Box	Did not see, but was informed that occasionally open during the festive periods	Did not see, but was informed that occasionally open during the festive periods	Did not see, but was informed that occasionally open during the festive periods
(24)	Smoking zone	No separate space, open space	No security zone	No security zone
(25)	Drivers/labors waiting/rest space	No	No	Available at nearby local hotels/ not in terminal
(26)	Bus cleaning services	Only for 2-3 buses, dirty –open place	Rented piped water –WASA (one inch)	One ramp out of order, other in bad condition
(27)	Vehicle repairing facility/ workshop	No	No	No
(28)	Utility services include: water, gas, electricity and solar energy	Yes No solar system	No GAS, solar & water. Available electricity, generator, deep tube well	No GAS and deep tube well, solar; Available- WASApiped water, electricity, generator-
(29)	Drainage system	Very poor	Very poor	Very poor
(30)	Cleanliness at Canteen and toilet area	Below average	Below average	Below average
(31)	Solid waste management	Not satisfactory, dump on backyard- from where truck transferred to Amin Bazar land-fill area	Dump at the backyard, locally- Gulshan area, transferred by truck to other areas.	Dump at the backyard, locally- Sayedabad area, transferred by truck to other areas.
(32)	Social Issues: Women passengers' composition (%)	40%	25%	24%
(33)	Senior citizen composition %	12%	27%	22%
(34)	Children %	Dependent on family members travel	Dependent on family members travel	Dependent on family members travel
(35)	Eve teasing issue	No, control by BOA	No	No
(36)	Child labor	No	No	No
(37)	Drug addict issue	Major problem of street children and adults occupying lounge area night and day	95% clean/controlled by BOA	No
(38)	Human trafficking	No	No	No

	Item	Gabtoli	Mohakhali	Sayedabad
(39)	Women/child care space	No	no	No
(40)	Police box / farhi	One	One	One
(41)	First Aid facility	No	On demand service not available	On demand service not available
(42)	CCTV Facility	One seldom working, one out of order	8, fully operative	No
(43)	Passengers crossing facility	One underpass	No Facility	No Facility

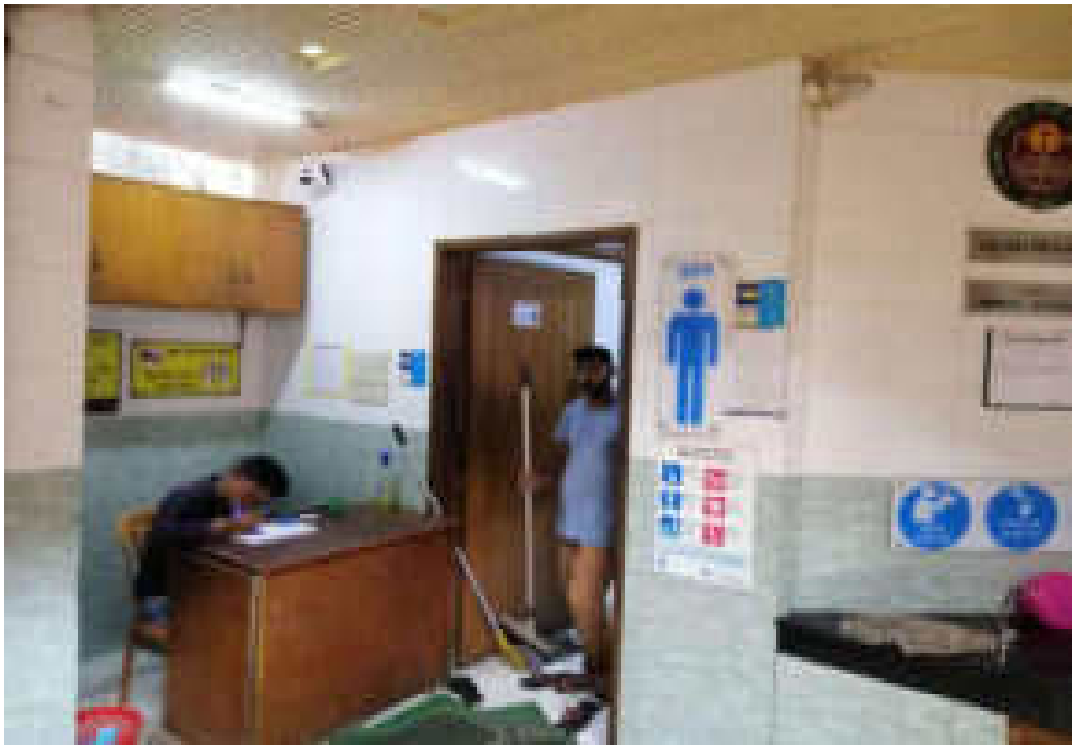
2.4 Environmental Screening of Existing Bus Terminals

These transportation fccilities, alongwith their city lifeline image, also brings forth negative impacts on environment, health and life expectancy. These terminals are the key locations of the city for the passenger transport network. A substantial number of passengers visit these terminals daily for travelling. However, key Environmental Health Safety (EHS) guidelines are not maintained or monitored appropriately. Inadequate waste management, sanitation and hygiene and other environmental hazards (such as air pollution, odor pollution, water pollution and noise pollution, etc.) constrain the operations of the terminals. It is expected that the authorities will develop a comprehensive environmental and social management system for the planned new terminals proposed.

2.5 Key Environmental Issues

The consultant team conducted a survey and collected important information on the current state of the three existing terminals of Dhaka City. The following photographs show the current status.

Figure 2-8: Sayedabad Bus Terminal



Separate Male and Female Toilets

Unhygienic and Unhealthy Waiting Area

Solid, chemical Waste in open area of the Parking area of Terminal

Figure 2-9: Mohakhali Bus Terminal[9]

[9]Field Survey

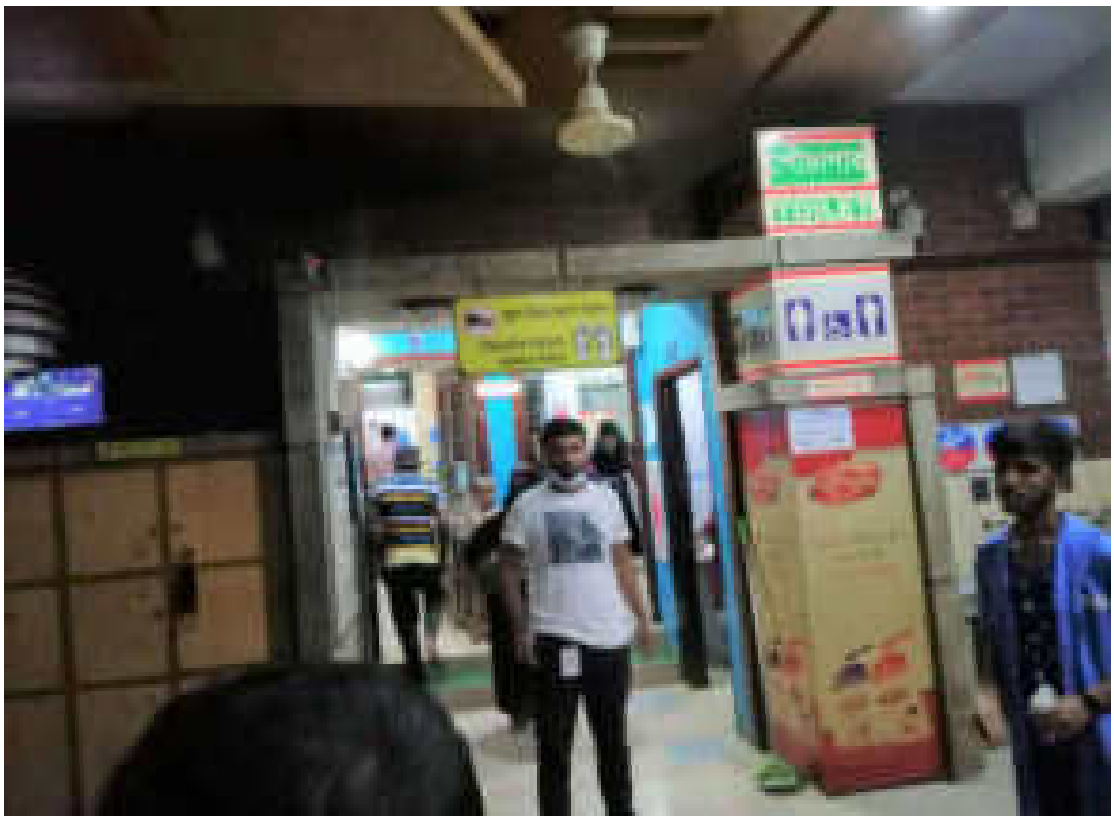
Unhygienic andUnhealthy Waiting Area

Separate Toilets for male and female

Solid, chemical Waste in open area of the Parking area of Terminal

Figure 2-10: Gabtoli Bus Terminal

Cooking Arrangement on Terminal walkway



Public Toilet

Waste Dumping Area at Southern side of the Terminals

Table 2-2: Brief Information of Environmental Survey of Existing Interdistrict Bus Terminals[10]

Item	Gabtoli	Mohakhali	Sayedabad

[10]Source: Field Survey

Item	Gabtoli	Mohakhali	Sayedabad
A. Project Setting			
(1) Location	DNCC Ward-9	DNCC Ward-20	DSCC Ward-48
(2) Regions Serving	West, North West, South West	North, North West	East, South East. North East, South West
(3) Land Size	22 acres	9 acres	10 acres
(4) Land Use	Commercial	Corporate office dominated land use	Commercial
B. Is the Project area adjacent to or within any of the following environmentally sensitive areas?			
(1) Cultural heritage site	No cultural heritage site adjacent to the location	No cultural heritage site adjacent to the location	No cultural heritage site adjacent to the location
(2) Protected Area	No environmentally protected area	No environmentally protected area	No environmentally protected area
(3) Wetland	Behind the terminal at South portion, around 20 acre seasonal wetland exists. Some portion near to the existing boundary area is free for waste disposal.	No wetland exists	No wetland exists
(4) Estuarine	No estuarine	No estuarine	No estuarine
(5) Buffer zone of protected area	Does not exist	Does not exist	Does not exist
(6) A particular area for protecting biodiversity	No	No	No
(7) Residential Area	No		
(8) Commercial Area	Yes. Some commercial buildings exist on the north side of the terminal	Yes. Some commercial buildings exist around the terminal	Yes. Some commercial buildings exist around the terminal
C. Potential Environmental Impacts			
(1) Utility services include: water, gas, electricity and solar energy	Yes, except solar system	No gas, solar and water; available-electricity, generator, deep tube well-	No gas and deep tube well, solar system; Available are WASA-piped water, electricity and generator.
(2) Drainage system	Very poor	Very poor	Very poor

Item	Gabtoli	Mohakhali	Sayedabad
(3) Drinking water facility	No purified water containers at any corners; only WASA supply faucet near the toilet area	No	No
(4) Black Smoke emission	Emissions of smoke from vehicles is visible. No monitoring activities of DoE or bus terminal authority.	Emissions of smoke from vehicles is visible. No monitoring activities of DoE or bus terminal authority. But two years back, DoE conducted a monitoring survey.	Emissions of smoke from vehicles is visible. No regular monitoring activities of DoE or bus terminalauthority.
(5) Noise Pollution	Vehicular noise pollution common	Vehicular noise pollution common	Vehicular noise pollution common
(6) Cleanliness at Canteen and toilet area	Below average	Below average	Below average
(7) Solid waste manageme nt	Not satisfactory, dumped on backyard- from where transferred to Aminbazar landfill area	Dumped at the backyard, transferred by truck to other regions.	Dumped at the backyard, locally- Sayedabad area, transferred by truck to other areas.
(8) Walkway of passengers	One underpass and open area, no boundary wall in front	Yes. Open area	Yes
(9) Smoking zone	No separate space, open space	No	No

Table 2-3:Key Environmental Issues Identified in Existing Three Bus Terminals[11]

		Key Environmental Issues
(1)	Water Source and Quality	As per DNCC, DSCC and BOA, the usable water (for drinking also) generally consumes from the DWASA supply system. But it is not sufficient compared to demand. The bus operators face scarcity of water for cleaning of vehicles. To mitigate the problem, bus owners association arranges water by additional payments. The hotels and restaurants usually use purified water jars for drinking.
(2)	Waste Water and Drainage Management	Generally, storm drainage and domestic wastewater and sewage are discharged. No Effluent Treatment Plant (ETP) is available at the terminals. Some portion of wastewater directly discharges to the low area of Gabtoli terminal on the southern side. The inside roadside drains are not properly maintained/ cleaned. As a result, water-logging creates problems during rainy season.[12]
(3)	Air Emissions	A sizeable number of gasoline and CNG-run-buses create specific pollutants in the terminal area. Air emissions occur. As per BOA, it lacks regular monitoring.
(4)	Waste	DNCC provides several waste bins around the terminal premises.

[11]Field Survey
[12]It is sometimes flooded up to three feet (3') high in Sayedabad terminal.

		Key Environmental Issues
	Management	Appointed cleaners remove the daily garbage from open area. However, they are not sufficient in number.
(5)	Hazardous Materials and Oil Management	No separate area is available for handling hazardous materials and oil management (oil, fuels, solvents, lubricants and other dangerous substances). Regular maintenance works of every bus take place in the open space of the terminal parking area.
(6)	Noise and Vibration	Noisy beyond prescribed limits. Drivers ignore the signboard marked as "No Horn." DNCC, DSCC and BOA do not have any noise monitoring activities.
(7)	Cleanliness, Health and Safety	The authority and BOA do not maintain adequate cleanliness and other hygienic issues. The waiting area is very unhygienic, dark, noisy and there is no separate room for female and infant care.

2.6 SWOT Analysis of Existing Bus Terminals

SWOT[13] analysis of the existing interdistrict bus terminals is based on the following assumptions

- The interdistrict terminal activities will be shifted to the proposed new terminals
- The land use of the existing terminal and its surroundings will retain its current characteristic features (*i.e.,* commercial feature)
- Existing terminals will be transformed to city bus depots since there is shortage of city bus depots in the city

Table 2-4: SWOT Analysis for Existing Bus Terminal

Indicators	Strength	Weakness	Opportunity	Threat
Location	Located within city and has formed a center of activities	Creates traffic congestion,	Provides possibility of using it as city bus depot	Passengers need to travel longer distance from home to reach to new bus terminal
Performance	Accessibility to different areas of the city is good	Unmanaged parking cause congestion on highway/major road	It can be hub for city bus service	If parking and passenger boarding is not properly managed it may be a reason of congestion.
Facilities	Basic facilities are present	Inadequate facility for passengers and drivers, no separate terminals for arrival and departing passengers	Prospect for multimodal hub with city service integration	Need to modify and update facilities for city service – need investment

[13] strength, weakness, opportunity and threats

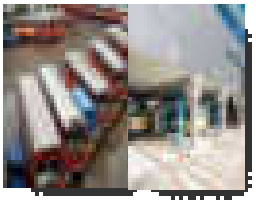
Indicators	Strength	Weakness	Opportunity	Threat
Women, Disable & Children		No facilities for the disable. Facilities for women are not sufficient	There is scope to build appropriate infrastructure for women, disable and children	Current infrastructure needs to upgrade and managed well to make usable for women and disable in case of multimodal hub for transfer of passengers.
Drainage & Waste Management	Being in the city, waste and waste water are served by city service and network.	Poor drainage and waste disposal system. Its dirty all around.	With waste collection, cleaning & sweeping it can be made more acceptable and usable.	
Safety & Security	Being within city, city police.	Inadequate safety, poor terminal management	With appropriate police box and other security arrangement it can be improved	Without improving security information, it won't attract passengers specially at evening/night
Tariff		Low tariff encourages bus owners to occupy parking space for longer time	With proper management policy tariff can be increased	Owners' association may oppose market-based tariff
Entry /Exit facility	Connected with major road	No separate provision for exit and entry of bus in the terminal	Opportunity for separate exit/entry facility, and better traffic circulation based on ITS managed from Traffic Control Center	
Pedestrian safety		The existing terminal is not pedestrian friendly	Opportunity for a safe pedestrian network in the new terminal	
City Bus Connectivity	Only selected routes may be available to passengers for city transfer	Integration is poor. Not appropriate infrastructure for transfer of goods and passenger	Aligned with bus franchise route and can be used for depot/terminal	Investment needed for infrastructure development (terminal building renovation, ITS)

Indicators	Strength	Weakness	Opportunity	Threat
Environment		Excessive noise and air pollution, absence of ETP, and lack of monitoring	Opportunity to provide environment friendly atmosphere with green technology, modern ETP, reduce carbon foot print, and ensure better monitoring	Difficulties in locating optimum outlet for storm water drainage

2.7 Factors considered for the conceptual design of the new terminals

Based on the information collected from field investigation of the three existing terminals, the consultant has identified the shortcomings related to the aspects of physical infrastructure, social and environmental issues, facilities for passenger and bus crews, quality of services, management of terminal. During the conceptual design the shortcomings were addressed with the following provisions:

(1) Separate arrival and departure lounges for passengers and separate entry and exit for buses;
(2) Sufficient parking area for city buses for transferring passenger to and from the city and parking space for taxi, auto-rickshaws and private cars;
(3) Breast feeding center, sufficient toilet, separate prayer rooms for women, separate sitting arrangement for women; and facilities for disabled persons;
(4) Bus washing facility and work shop for small repairs
(5) Limited number of food and stationary shops and restrict hawkers (presently hawkers occupy sizable terminal area at random);
(6) Ticket booths to a maximum of twenty (currently it varies between 40 to 120 booths occupying substantial terminal space);
(7) INTRODUCTION of fleet demand management throughhourly parking charges (currently only 40 is charged for the whole day which encourages bus owners to park bus for a long time);
(8) Better drainage and solid waste management system and ETP for discharging bus wash effluent;
(9) Dormitory facility to the crew of waiting buses at night
(10) CCTV cameras, WIFI, digital display of arrival and departure information and encouraging cashless collection of terminal charges and e-ticketing;
(11) Electric charging facility for electric vehicles;
(12) Encouraging use of renewable energy through provision of solar panels;
(13) Safe entry and exit to the terminal by providing grade separated facility (presently at grade entry and exit to the main highway causes congestion and safety hazard).



3 Location and Connectivity Analysis of the Proposed Sites

Appropriate site identification for future bus terminals and depots remains the central theme of this project. The terms of reference of this project provided nine indicative locations for the bus terminal [Table-3.1]. The locations are distributed in such a way that interdistrict buses can serve their purposes with more efficiency. Presently, several Mass Transit Projects (MRT, BRT, expressway, Ring Road and Circular Railway) are at different stages of development and several projects are in the planning process.

Having such potential connectivity issues in the background, the consultant teams have explored the indicative sites and their vicinity and discussed with Dhaka Detailed Area Plan (DAP) team, BOA and DTCA experts, which was followed by several field visits to finalize potential locations around Dhaka [Map-3.1]. The Consultant team has carried out detailed screening of proposed Bus Terminal and depot location which are described below.

Table 3-1: Screening of Proposed Terminal and Depot Locations[14]

Sl.	Location as per ToR	Area (acres)	Additional Locations Explored	Locations finally selected by DTCA	Finalized Area (acres)	Justifications
1	Jhilmil, Teghoria	20	Additional 1: Baghair	Additional 1: Baghair	33.63	Baghair has larger area
2	Ati Bazar, Bosila	10	Additional 1: Opposite of Ati Bhawal High School and adjacent to Ati Bazar-Kalatiya Road	Additional 3: Bhawal, Ati Bazar	25.78	Selected Location has better connectivity (one side is connected with proposed Middle Ring Road and the other side is connected main city road) through
			Additional 2: South of Sheyael Road			
			Additional 3: Bhawal, Ati Bazar (Adjacent to Ati Bazar Kalatiya Rd and Middle Ring Road)			
3	Hemayetpur	10	Additional 1: Beside Karnatali River	ToR Location	45.00	Adjacent land has been included

[14]Project ToR

Sl.	Location as per ToR	Area (acres)	Additional Locations Explored	Locations finally selected by DTCA	Finalized Area (acres)	Justifications
4	Birulia	10	Additional 1: Near Abdullahpur Fish Market	ToR Location	26.70	Explored locations were not suitable
			Additional 2: Near Kamar Para Local Bus Depot			
5	Baipail	24.3	Additional 1: Opposite of ToR Location	ToR Location	37.10	Additional adjacent area is included
6	Gazipur	10	Additional 1: Behind the BRTC Training Center	ToR Location	11.70	Additional location has connectivity problem and adjacent to residential area
7	Purbachal	10	Additional 1: Near MRT Line 1 Depot	Additional 4: Kanchan	24.20	Location proposed in TOR is small area, high density area and located on a curve (accident prone). Kanchan location has larger area with better connectivity
			Additional 2: Inside Jalshiri Residential Area			
			Additional 3: Inside Purbachal Sector 3 Near MRT Line 1 Purbachal Terminal			
			Additional 4: Kanchan (Opposite of US-Bangla Group and Green University)			
8	Kanchpur North	16	Additional 1: Northeast of Rahim Group of Industries	ToR Location	15.50	Selected for future Dhaka-Sylhet corridor since demand can not be met by terminal ToR location
			Additional 2: Bhulta	Additional 2: Bhulta	24.20	
9	Kanchpur South	20	Additional 1: Madanpur (Adjacent to N1-Dhaka-Chattogram Highway and Modonpur-Modanganj-Sayedpur Rd)	Additional 1: Madanpur	27.70	Prime location becaudse of connectivity

After multiple field visits and consultations with stakeholders, public transport connectivities were analysed on selected potential sites (Annex 3). Figure 3.1 shows the locations for the proposed sites. The criteria that were followed to identify potential sites were:

- Access to national/regional highway
- Size and shape of site/plot
- Current land use
- Land tenure/ownership
- Connectivity with city bus routes, MRT, BRT
- Other planned projects

Figure 3-1: Proposed Locations for Bus Terminals and Depots

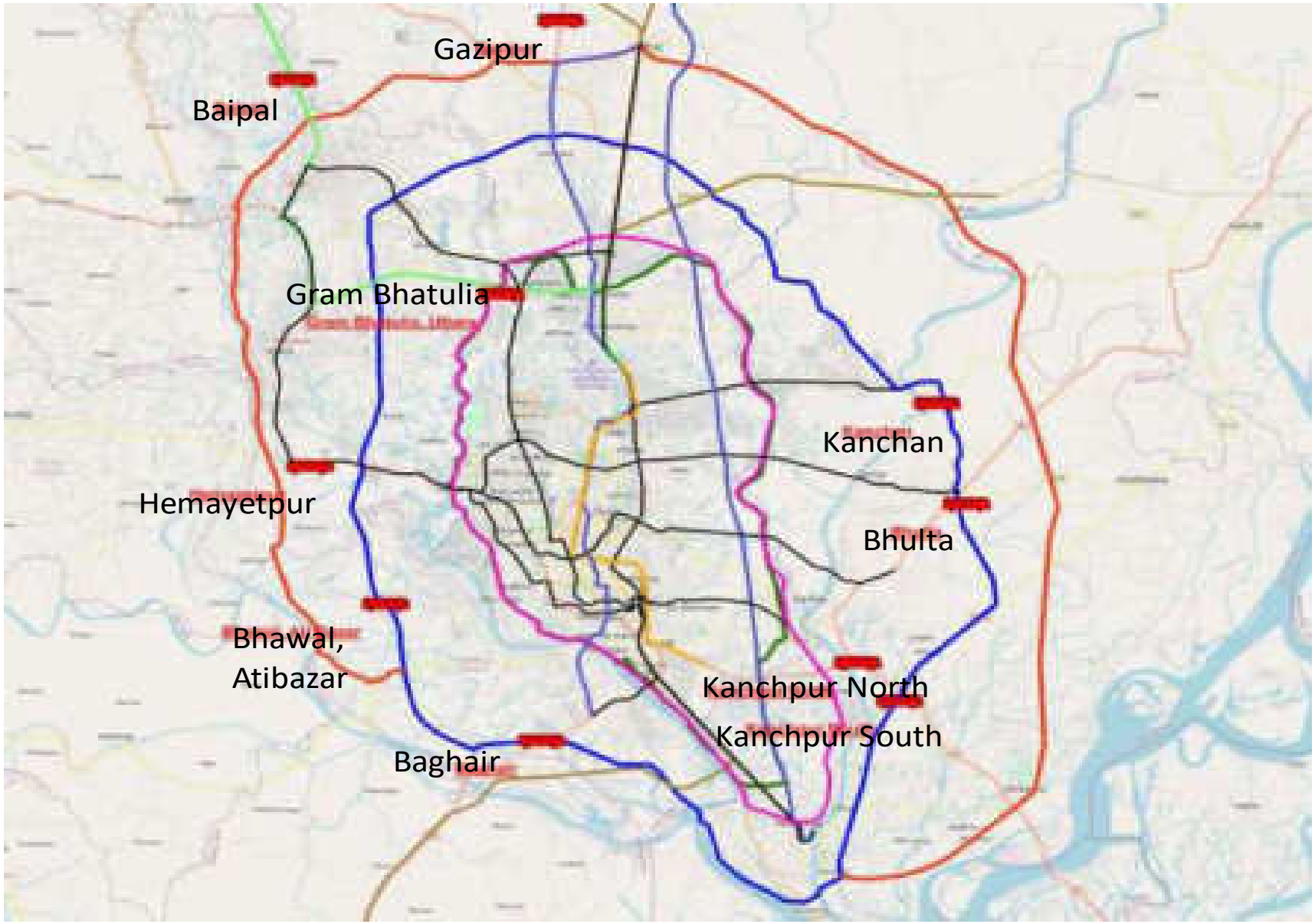


Table 3-2: Summary Description of Sites[15]

	Location	Area (acre)	Connectivity	Current Land Use	Future Land Use	Habitation	Permanent Structures	Ownership	Adjacent Road Level (m)	Average GL (m)
(1)	Baghair	33.63	N8- Dhaka-Mawa Highway (Proposed Middle Ring Road)	Brick-field	Growth management area in SP zone and mixed use zone (predominantly residential)	Less populated	Houses, Chimneys on Brick-fields	Khas	8.16	4.2179
(2)	Kanchpur South	27.70	Middle Ring Road and N1(Dhaka-Chattogram Highway)	Wetland dominated area and industrial wastewater drained to this area. A mosque and a filling station inside the proposed location	Mixed-use zone (predominantly residential)	Less populated	Houses and a Chimney on a Brickfield	Private	7.015	3.564
(3)	Kanchpur North	15.50	N1 (Dhaka-Chattogram Highway) and near N2 (Dhaka-Sylhet Highway)	Currently usedas freshwater aquaculture and a CNG refueling station is also there	Transport communication	Vacant	CNG Station	RHD	6.302	-0.32
(4)	Gram Bhatulia	26.7	Inner Ring Road, Circular Railway, Circular Waterway, MRT-6, MRT-4, Dhaka- Ashulia EE.	Fallow land with seasonal water bodies where fish cultivation happens seasonally	Growth management area in SP Zone and mixed use zone under land use	Vacant	No structures	Private	9.886	4.685

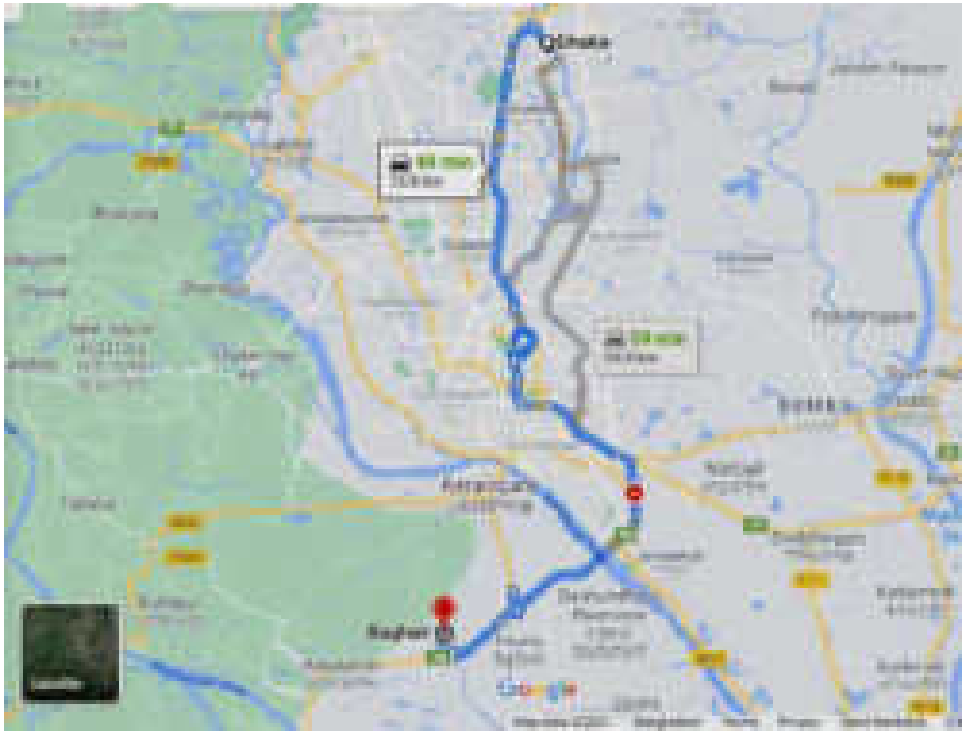
[15]Field Survey data &secondary sources (Google earth, Different Govt. Dept.)

	Location	Area (acre)	Connectivity	Current Land Use	Future Land Use	Habitation	Permanent Structures	Ownership	Adjacent Road Level (m)	Average GL (m)
(5)	Bhulta	24.20	Close to N2 (Dhaka-Sylhet Highway), Dhaka City bypass and Adjacent to R203 (Bhulta-Brahmanbaria Road)	Agricultural land dominated area and a brickfield with a water body in South Eastern side of the location	Mixed-Use Zone (Predominantly Industrial)	Vacant	No structures	Khas	5.168	0.8552
(6)	Hemayet -pur	45.00	N5 (Dhaka-Aricha Highway), MRT-5 (North) and Middle Ring Road in 800m	Vegetation and Brick's stockyard dominated area where a pond, a mosque, 4-5 small buildings, some tin shades and a small park is seen	Growth management area in SP Zone and mixed use zone under land use	Less populated	Houses, commercial, industrial and religious structures	Private	8.08	6.125
(7)	Bhawal, Ati Bazar	25.78	Ati Bazar-Kalatiya Road, Proposed Middle Ring Road	Agricultural Land	Conservation area in SP zone and agricultural land in landuse	Vacant	No structures	Khas	6.915	3.5756

	Location	Area (acre)	Connectivity	Current Land Use	Future Land Use	Habitation	Permanent Structures	Ownership	Adjacent Road Level (m)	Average GL (m)
(8)	Baipail	37.10	Nabinagar-Chandra Road, Dhaka- Ashulia EE.	Bushy area, wetland and fallow land dominated area. Some areas are using as a residential project illegally and continuing cases with Government	Growth management area in SP zone and mixed use zone under land use	Populated	Buildings, CNG Station, commercial structures	Khas & RHD	10.64	7.625
(9)	Gazipur	11.70	N3 (Dhaka-Mymensingh Highway), BRT-3	Maximum land of the proposed Bus Terminal is Bare land and Wetland. Rest of the land is used as a truck stand, a shopping complex and two markets East and West of the land.	No class under SP zone and mixed use zone under land use	Populated	Buildings and houses	Private	13.505	12.513
(10)	Kanchan	24.20	Dhaka City Bypass	Fully fallow land where the land filling was done by the owner	Out of DAP jurisdiction	Vacant	No structures	Private	7.236	6.842

3.1.1 Baghair

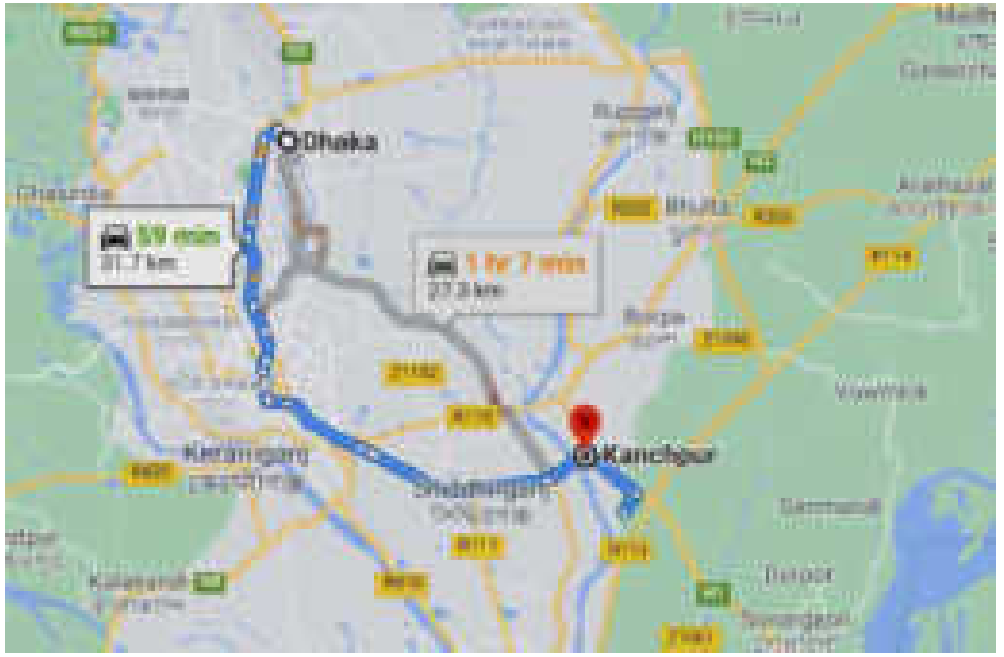
The site is located opposite to the central Jail in Keraniganj, adjacent to Dhaka-Mawa Highway (N8). The land is currently used as brick-fields. Therefore, the facilities will not require significant resettlement. But for ensuring that the bus terminal activities do not obstruct the highway capacity, service/access lanes and grade separations may be required.



Area (Acres)	Dimension (meter)	Connectivity	Existing and Future Roadside Width (meter)	Administrative Information	Relative Location	Land Ownership	Distance from Nearest Landmark
33.63	North: 290; South: 410; East: 400; West: 400	N8- Dhaka-Mawa Highway (Proposed Middle Ring Road)	410m in Dhaka-Mawa Highway (N8) side	Mouza: Baghair Union: Tegharia Thana: Keraniganj District: Dhaka	Opposite of Keraniganj Central Jail	Khas	5.4 km from Postogola Bridge

3.1.2 Kanchpur South

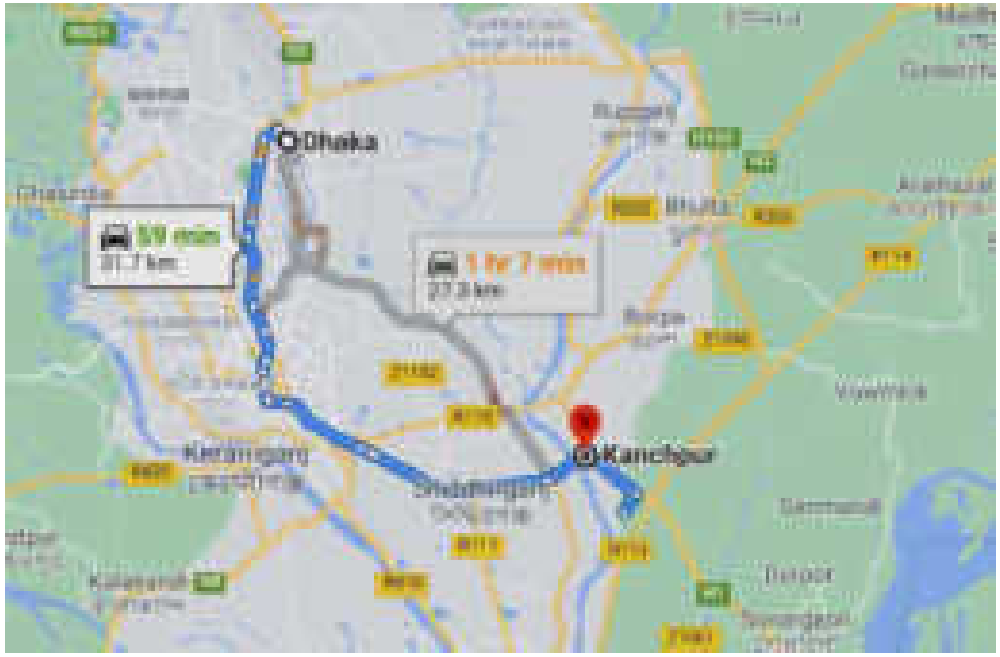
The location is about 2.5 km South of Kanchpur bridge. When ring road will be implemented as per RSTP, it is expected to be the most efficient location for a bus terminal. An abandoned rail track lies adjacent to the site.



Area (acres)	Dimension (meter)	Connectivity	Existing and Future Roadside Width (meter)	Administrative Information	Relative Location	Land Ownership	Distance from Nearest Landmark
27.70	North: 295; South: 335; East: 245; West: 350	Middle Ring Road and N1(Dhaka-Chattogram Highway)	50m in Dhaka-Chattogram Highway (N1) side and 265 m in Proposed Middle Ring Roadside.	Mouza: Fular Union: Madanpur Thana: Bandar District: Narayanganj	Vacant land behind Fulhor Baitun Nazat Jame Masjid with Brick Field	Private	3.5 km from Kanchpur Bus Stop and 500m from Madanpur

3.1.3 Kanchpur North

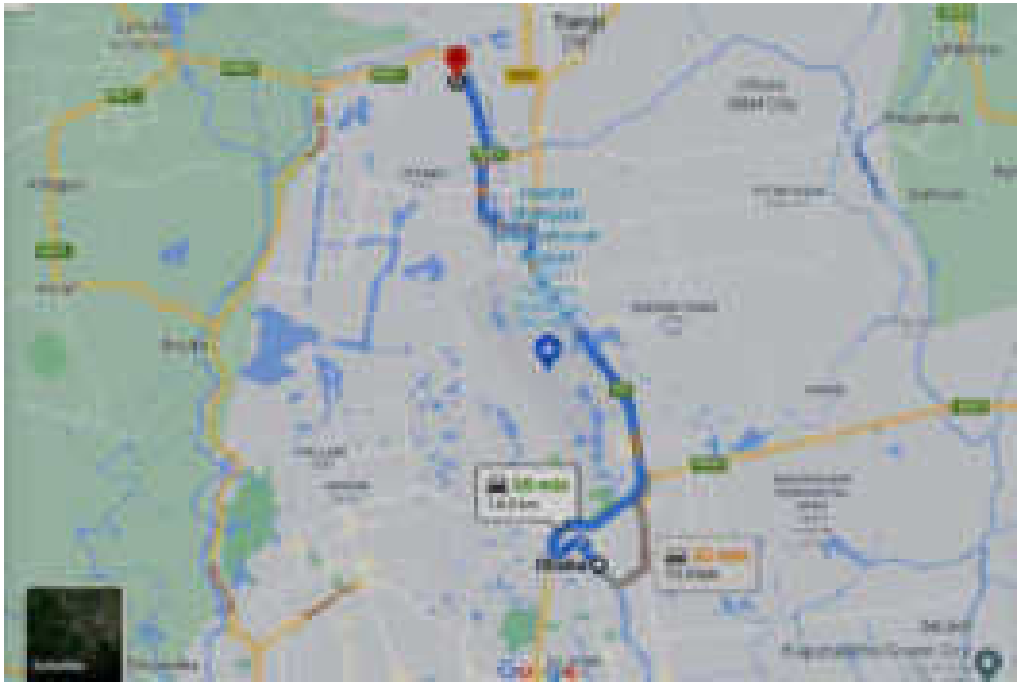
The site, close to Kanchpur bridge and lying relatively low, is owned by RHD. Significant earth filling will be required for the development. Closeness to Kanchpur bridge is the most formidable challenge for this site. If not properly managed, the activities of the terminal if implemented may constrain the capacity of the bridge.



Area (acres)	Dimension (meter)	Connectivity	Existing and Future Roadside Width (meter)	Administrative Information	Relative Location	Land Ownership	Distance from Nearest Landmark
15.50	North: 230; South: 235; East: 290; West: 290	N1 (Dhaka-Chattogram Highway) and Near N2 (Dhaka-Sylhet Highway)	235m in Dhaka-Chattogram Highway (N1) side and 330m in 100' Proposed connecting Roadside	Mouza: Kanchpur Union: Kanchpur Thana: Sonargaon District: Narayanganj	200 m east from Kanchpur Highway Police Station/RHD Land and behind the SS CNG and Fuel Station	RHD	500m from Kanchpur Bus Stop

3.1.4 Gram Bhatulia

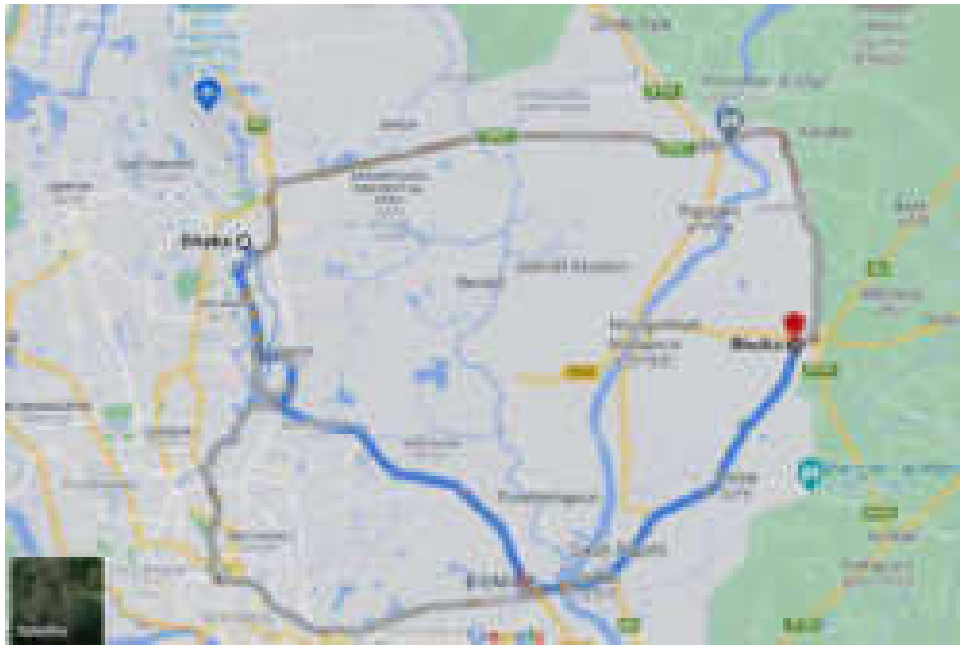
The site is located close to MRT-6 depot in Uttara. Currently, it is earmarked for a residential project but no structure has been developed.



Area (acres)	Dimension (meter)	Connectivity	Existing and Future Roadside Width (meter)	Administrative Information	Relative Location	Land Ownership	Distance from Nearest Landmark
26.7	North: 260; South: 290; East: 210;West: 269	Inner Ring Road, Circular Railway, Circular Waterway, MRT-6, MRT-4, Dhaka- Ashulia EE.	125m in Mirpur Beribadh Roadside (proposed Inner Ring Road)	Mouza: Gram Bhatulia CC Ward: DNCC 53 Thana: Uttara District: Dhaka	North of MRT 6 Depot and Behind New Heaven City	Private	1.5 km from Dhour Bus Stop and 7 km from Abdullahpur Bus Stop

3.1.5 Bhulta

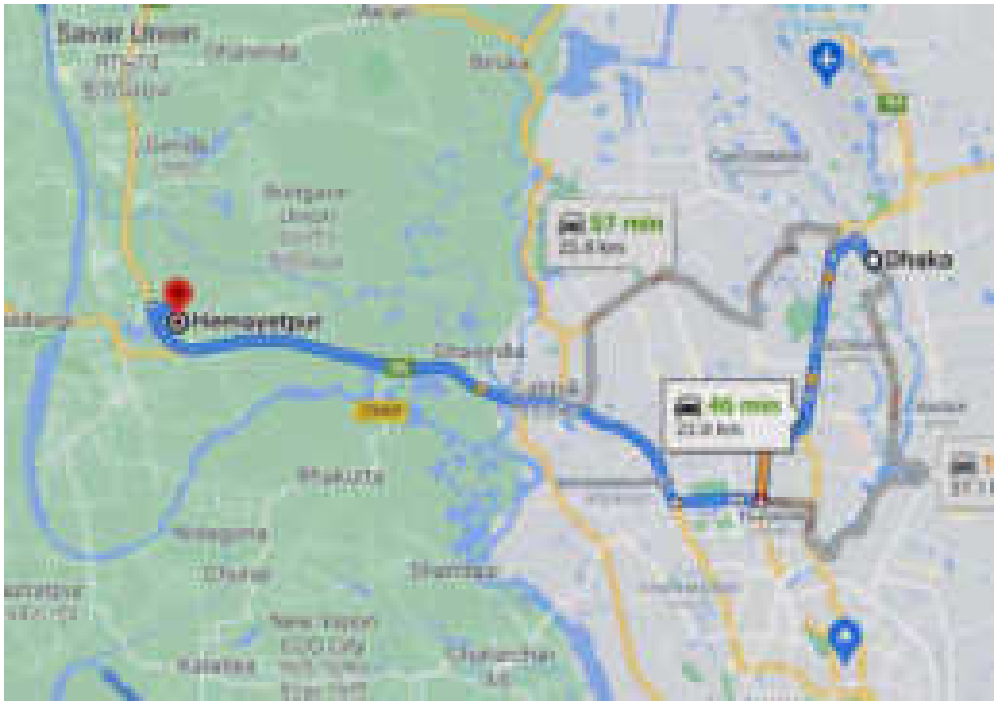
The Bhulta site is an apparently vacant land located at a very important intersection of major roads. It can serve the Eastern districts of Bangladesh.



Area (acres)	Dimension (meter)	Connectivity	Existing and Future Roadside Width (meter)	Administrative Information	Relative Location	Land Ownership	Distance from Nearest Landmark
24.20	North: 260; South: 270; East: 350; West: 315	Close to N2 (Dhaka-Sylhet Highway), Dhaka City bypass and Adjacent to R203(Bhulta-Brahmanbaria Road)	135m in Bhulta-Nabinagar (R203) Roadside	Mouza: Golakandail Pauro. Ward: Bhulta 4 Thana: Rupganj District: Narayanganj	Vacant Land behind Sidon Textile Mills and the land of the Brickfield	Khas	1 km from Gausia Bus Stop, Bhulta

3.1.6 Hemayetpur

This proposed site is located on Dhaka Aricha Highway (N5) and halfway between Savar and Gabtoli bus terminals, around 7 km from both. Currently, it is occupied by brick-fields and some metal fabrication workshops. The part of the site adjacent to the highway, has a few car repairing workshops but ample space is available on the back-side. This land is relatively low and needs land-filling to make it suitable for a bus terminal. In terms of urban transport accessibility, it has good connection with city buses and planned MRT-5.

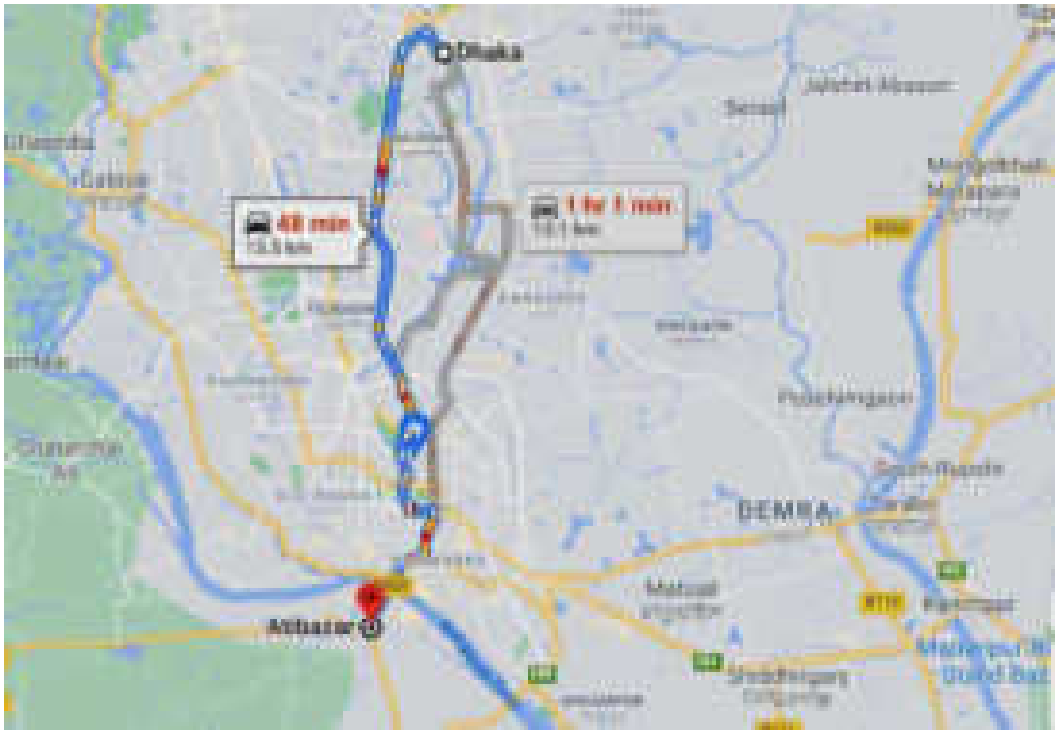


.

Area (acres)	Dimension (meter)	Connectivity	Existing and Future Roadside Width (meter)	Administrative Information	Relative Location	Land Ownership	Distance from Nearest Landmark
45.00	North: 500; South: 500; East: 194; West: 194	N5 (Dhaka-Aricha Highway), MRT-5 (North) and Middle Ring Road in 800m	500m in Dhaka-Aricha Highway (N5) side	Mouza: Bilamalia Union: Tetuljhora Thana: Savar District: Dhaka	East of AKH Group Head Office and adjacent to MRT 5 Depot	Private	7 km from Gabtoli Bus Terminal and 7.5 km from Savar Bus Stop

3.1.7 Bhawal, Ati Bazar

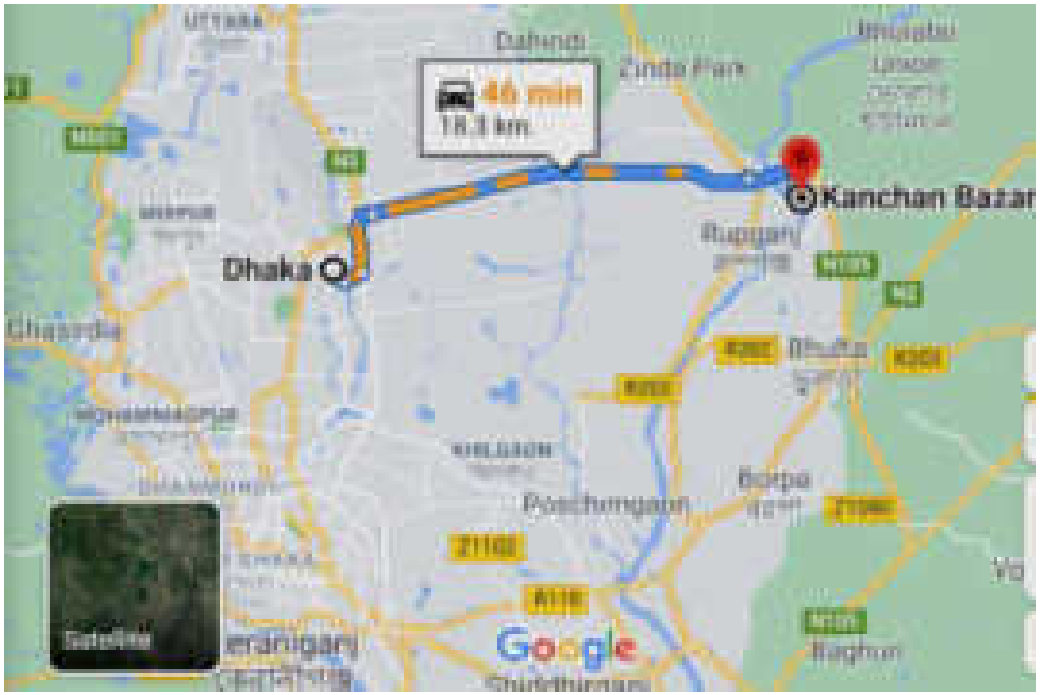
This site is not located near any prominent highway, but connected with wider city roads. It is connected with the West of Dhaka through Bosila bridge. Currently, the land is used for agriculture purposes. This location with rural settings may be suitable for a city bus depot.



Area (Acres)	Dimension (meter)	Connectivity	Existing and Future Roadside Width (meter)	Administrative Information	Relative Location	Land Ownership	Distance from Nearest Landmark
25.78	North: 255; South: 175; East: 620; West: 395	Ati Bazar- Kalatiya Road, Proposed Middle Ring Road	250m in Kalatiya-Ati Bazar Roadside and 135m in Proposed Middle Ring Roadside	Mouza: Taranagar Union: Taranagar Thana: Keraniganj District: Dhaka	Vacant Land behind Bhawal Moddho Para Jame Masjid	Khas	2.9 km from Ghatarchar Circle and 6.3 km from Mohammadpur Bus Stop, Beribadh

3.1.8 Kanchan

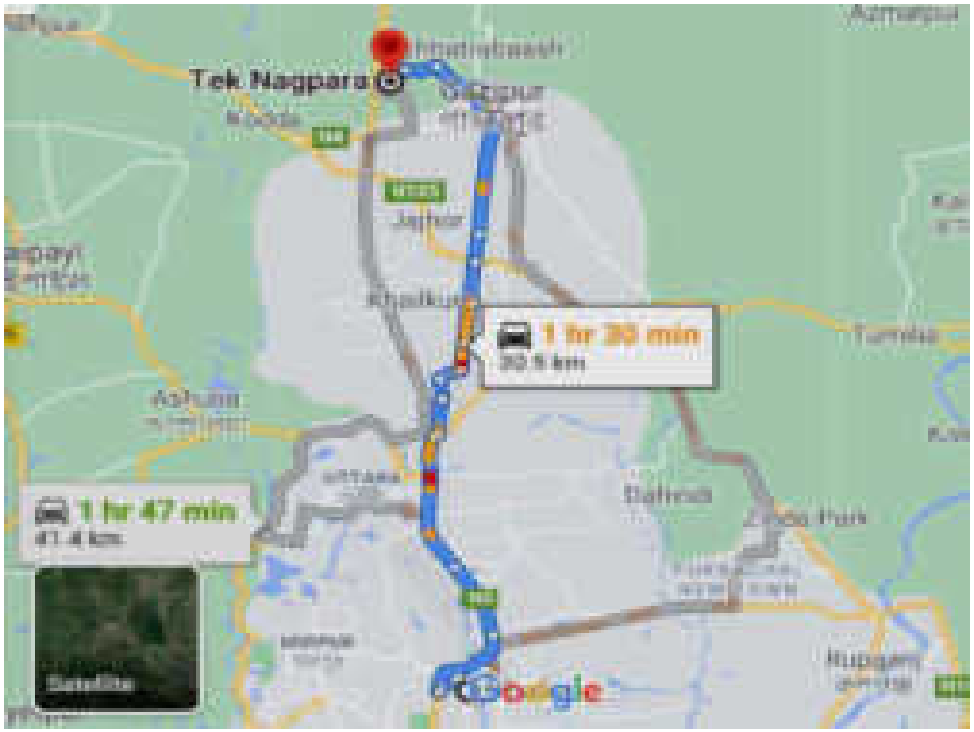
This site, once a low land, is now filled up but not used. If Bhulta site is developed it may not thrive as an interdistrict terminal but can be a bus depot. The surroundings have several residential projects. If those are developed, this location may be suitable for stoppage of city buses.



Area (acres)	Dimension (meter)	Connectivity	Existing and Future Roadside Width (meter)	Administrative Information	Relative Location	Land Ownership	Distance from Nearest Landmark
24.20	North: 230; South: 180; East: 405; West: 140	Dhaka City Bypass	405m in Dhaka City Bypass roadside	Mouza: Nobarun Jute Mill Pauro. Ward: Kanchan 7 Thana: Rupganj District: Narayanganj	The land under PHP Family signboard which is opposite of Green University Permanent Campus and USB Courier	Private	2.4 km from Kanchan Bridge

3.1.9 Gazipur

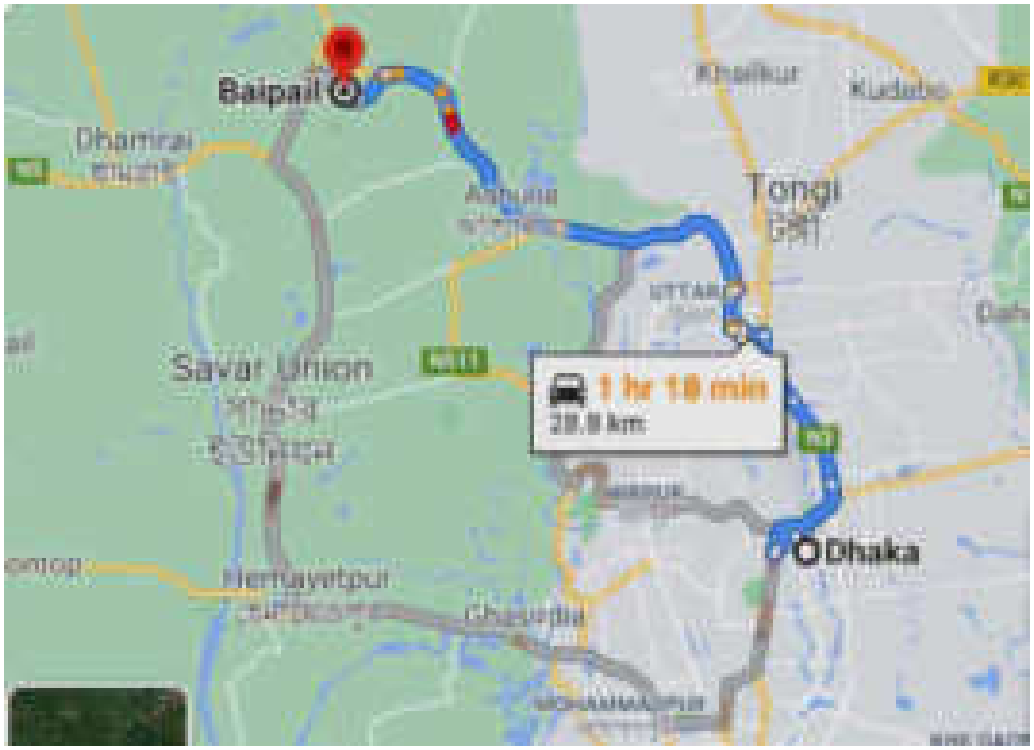
The land of this Gazipur site is currently used as a covered van depot. Without improving the traffic situation on N3, it may not be used as a bus terminal. Because travelling from this location to Uttara or Dhaka is time consuming.



Area (acres)	Dimension (meter)	Connectivity	Existing and Future Roadside Width (meter)	Administrative Information	Relative Location	Land Ownership	Distance from Nearest Landmark
11.70	North: 120; South: 235; East: 245; West: 155	N3 (Dhaka-Mymensingh Highway), BRT-3	155m in Dhaka-Mymensingh Highway (N3) side	Mouza: Tek Nagpara CC Ward: GCC 18 Thana: Joydebpur District: Gazipur	Opposite of BRTC Central Training Institute	Private	2.3 km from Gazipur Chowrasta Bus Stop and 6.3 km from Joydebpur Railway and Bus Stop

3.1.10 Baipail

The land of Baipail site is high and ready for development. However, the location is far away from the city.



Area (acres)	Dimension (meter)	Connectivity	Existing and Future Roadside Width (meter)	Administrative Information	Relative Location	Land Ownership	Distance from Nearest Landmark
37.10	North: 178; South: 380; East: 469; West: 500	Nabinagar-Chandra Road, Dhaka-Ashulia EE.	500m in Nabinagar-Chandra Roadside	Mouza: Dakshin Panishail CC Ward: GCC 1 Thana: Gazipur District: Gazipur	Near Chakraborty Bus Stop where the land covered under National Bank signboard and the illegal Padma Housing Residential Area behind Jyoti CNG Filling Station	Khas & RHD	5.2 km from Baipail Bus Stop, 8.3 km from Nabinagar Bus Stop and 7.6 km from Chandra Bus Stop

3.2 Comparison Matrix of Candidate Sites (Landuse-Existing and Future)

Land use of the proposed terminals and their surrounding area will play a key role in efficient functioning of the terminal. The following provides information on existing land use and future land use of the sites proposed in DAP.

Table 3-3: Existing land use and land use proposed in DAP

Sl.	Proposed Bus Terminal and Depot	Area (acres)	Connectivity	Existing Landuse in the Proposed Location	Future Landuse (in Draft DAP) in the Location and Surroundings	Future Landuse (in Final DAP) in the Location and Surroundings	Land use of surrounding area proposed in DAP
1	Baghair	33.63	N8- Dhaka-Mawa Expressway, Middle Ring Road	Brickfield Dominated Area. There are three brickfields and some tin sheds for the brickfield laborers and some houses of local people. A big pond is found there which was created due to arrangement of the supply of raw materials for bricks.	Growth Management Area in SP Zone and Mixed Use Zone (Predominantly Residential)	DTCA has proposed to revise the Landuse type which is recommended by RAJUK in the final DAP Report.	North: One Local road and housholds of local people. South: N8-Dhaka-Mawa Expressway, East: Local road and housholds of local people. and West: Brickfields
2	Bhawal	25.78	Atibazar- Kalatiya Road, Middle Ring Road	Agricultural Land	Conservation Area in SP Zone and Agricultural Land in Landuse	DTCA has proposed to revise the Landuse type which is recommended by RAJUK in the final DAP Report.	North: Ati Bazar-Kalatiya Rd, Local Households, and a Canal. South: A canal, Middle Ring Road, Local Road, Households. East: A canal, Local Road, and Households. and West: Agricultural Land

Sl.	Proposed Bus Terminal and Depot	Area (acres)	Connectivity	Existing Landuse in the Proposed Location	Future Landuse (in Draft DAP) in the Location and Surroundings	Future Landuse (in Final DAP) in the Location and Surroundings	Land use of surrounding area proposed in DAP
3	Hemayetpur	45.00	N5 (Dhaka-Aricha Highway), MRT-5 (North) and Middle Ring Road in 800 meters	Vegetation and Bricks stock yard dominated area where a pond, a mosque, 4-5 small buildings, some tin shades and a small park are seen	Growth Management Area in SP Zone and Mixed Use Zone under Land Use	DTCA has proposed to revise the Landuse type which is recommended by RAJUK in the final DAP Report.	North: Local Road, Seasonal flooded Zone, Karnatali River. South: N5-Dhaka-Aricha Expressway. East: MRT Line 5 Depot and Housing and West: Residential and Readymade Garments Factory Dominated
4	Gram Bhatulia	26.70	Inner Ring Road, Circular Railway, Circular Waterway, MRT-6, MRT-4, Dhaka- Ashulia EE.	Fallow land with seasonal waterbodies where fish cultivation happens seasonally	Growth Management Area in SP Zone and Mixed Use Zone under Land Use	DTCA has proposed to revise the Landuse type which is recommended by RAJUK in the final DAP Report.	North: Uttara Police Lines. South: MRT Line 6 Depot. East: Residential Area. and West: Mirpur Road (Beribadh).
5	Baipail	37.10	Nabinagar-Chandra Road, Dhaka- Ashulia EE.	Bushy area, wetland and fallow land dominated area. Some areas are using as a residential project illigally and continuing cases with Government	Growth Management Area in SP Zone and Mixed Use Zone under Land Use	DTCA has proposed to revise the Landuse type which is recommended by RAJUK in the final DAP Report.	North: Residential Area, South: Residential and Industrial Area, East: Residential and Industrial Area, and West: Nabinagar-Chandra Road.
6	Gazipur	11.70	N3 (Dhaka-Mymensingh Highway), BRT-3	Maximum land of the proposed Bus Terminal is Bare land and Wet land. Rest of the land using as a truck stand, a shopping complex and two market in East and West of the land.	No class under SP Zone and Mixed Use Zone under Land Use	DTCA has proposed to revise the Landuse type which is recommended by RAJUK in the final DAP Report.	North: Residential and Industrial Area, South: Residential and Industrial Area, East: Residential Area, and West: N3-Dhaka-Mymensingh Highway.

Sl.	Proposed Bus Terminal and Depot	Area (acres)	Connectivity	Existing Landuse in the Proposed Location	Future Landuse (in Draft DAP) in the Location and Surroundings	Future Landuse (in Final DAP) in the Location and Surroundings	Land use of surrounding area proposed in DAP
7	Kanchan	24.20	Dhaka City Bypass, Middle Ring Road, MRT Line 1	Fully fallow land where land filling has done by the owner	Out of DAP Jurisdiction	DTCA has proposed to revise the Landuse type which is recommended by RAJUK in the final DAP Report.	North: Residential Dominated Area, South: Residential Dominated Area, East: Dhaka City Bypass-N105, and West: Residential Dominated Area.
8	Bhulta	24.20	Close to N2 (Dhaka-Sylhet Highway), Dhaka City bypass and Adjacent to R203(Bhulta-Brahmanbaria Road), MRT Line 1	Agricultural land dominated area and a brick field with a waterbody in Southeastern side of the location	Mixed Use Zone (Predominantly Industrial)	DTCA has proposed to revise the Landuse type which is recommended by RAJUK in the final DAP Report.	North: Bhulta-Nabinagar-Radhika Rd-R203 and Industry dominated Area, South: Agricultural Land, East: Brickfield and Industry Area, and West: Agricultural Land.
9	Kanchpur North	15.50	N1 (Dhaka-Chattogram Highway) and Near N2 (Dhaka-Sylhet Highway), MRT Line 2	Currently using as a freshwater aquaculture and a CNG refueling station is also there	Transport Communication	DTCA has proposed to revise the Landuse type which is recommended by RAJUK in the final DAP Report.	North: Residential and small industry dominated area, South: Residential and industry dominated area, East: Residential and industry dominated area, and West: N1-Dhaka-Chattogram Highway
10	Kachpur South	27.70	Middle Ring Road, Dhaka City Bypass and N1(Dhaka-Chattogram Highway), MRT Line 2	Wetland dominated area and industrial waste water drained to this area. A mosque and a filling station inside the proposed location	Mixed Use Zone (Predominantly Residential)	DTCA has proposed to revise the Landuse type which is recommended by RAJUK in the final DAP Report.	North: Local Residence and N1-Dhaka-Chattogram Highway, South: Fellow Land, East: Industry and fellow land dominated area, and West: Modonpur-Madonganj-Sayedpur Road.

3.3 Comparison Matrix of Candidate Sites

All contending sites are compared based on several factors/indicators and is presented in the table below. This multi-criteria assessment is a qualitative system of evaluating those sites. The scores in the matrix represent preference against the indicators. The sites were repeatedly visited by several teams and stakeholders to evaluate their suitability for bus terminals.

Table 3-4: Multi-criteria Matrix for Site Selection[16]

Criteria	Indicator	Baghair	Kanchpur (S) - Madanpur	Kanchpur (N) – RHD	Gram Bhatulia, Uttara	Bhulta	Hemayetpur	Bhawal, Ati Bazar	Baipail	Gazipur	Kanchan	Kanchpur (S)– RHD
(1) Accessibility												
	Distance from National HW (km)(ease for interdistrict connectivity)	5	5	5	4	4	5	1	4	5	3	5
	Distance from proposed Ring road / Expressway (km)	5	5	3	5	4	4	3	3	2	5	3
	Distance from city center (km)	3	2	1	3	2	3	2	2	2	3	2
	Distance from Rail/River port (multi modal) (km)	2	3	3	3	1	3	1	1	1	1	3
	Access (current road type if any)	5	5	2	4	3	5	2	4	5	3	3
	Distance from nearest market / *Hat / Bazar* (km)	3	3	3	3	3	4	3	2	2	2	4
	MRT/BRT Connectivity	1	1	2	4	1	4	1	2	3	1	2
(2) Utility	Electricity Supply	3	3	3	3	3	3	3	3	3	3	3
	Water Supply	3	2	1	3	1	3	3	3	2	3	2
(3) Land and Land use	Storm water drainage	3	2	1	4	2	2	3	3	1	1	4
	Size and Shape	5	5	3	3	5	4	4	5	2	4	2
	Surrounding landuse	4	4	4	5	4	3	3	2	3	3	4

[16]*Note: 5 represent highest preference and 1 for lowest

Criteria	Indicator	Baghair	Kanchpur (S) - Madanpur Kanchpur (N) – RHD	Gram Bhatulia, Uttara	Bhulta	Hemayetpur	Bhawal, Ati Bazar	Baipail	Gazipur	Kanchan	Kanchpur (S)– RHD
	Distance from existing/proposed location for gas/petrol station (km)	3	5	5	3	3	4	2	4	3	3	3
	Ownership / Tenure ship	3	3	5	3	4	3	3	1	4	4	5
	Current Use of land	4	4	3	4	5	4	4	2	3	5	4
	Proposed landuse in DAP	4	4	5	4	4	4	3	4	3	0	5
	Nearest Hospital (km)	2	3	2	2	4	2	2	3	2	3	4
	Nearest School/College (km)	3	3	3	3	3	3	3	3	3	3	3
(4) Environment												
	Any biodiversity sensitive area within 5km	5	5	5	5	5	5	5	5	5	5	5
	Flooding history	3	3	3	3	2	3	3	3	3	3	3
	Any site for archeological or historical importance	5	5	5	5	5	5	5	5	5	5	5
(5) Geology	Land elevation	3	3	2	3	3	4	3	4	5	4	3
	Water Level	3	2	1	3	1	3	3	3	2	3	3
(6) Disaster Prone Area	Flood	2	2	2	2	3	2	2	2	2	2	2
	Earth Quake	4	4	4	4	5	4	4	4	4	3	4
	Landslide	5	5	5	5	5	5	5	5	5	5	5

After carefully analyzingthe locations, connectivity, districts to be served and taking into consideration the opinion of the members of Bus Owners Association (BOA, the recommended use of selected sites (including phasing) is given in table 3.5 below.

Table 3-5: Recommended Use of Selected Sites

	Sites	Possible Use	Phasing[17]
(1)	Baghair	Interdistrict bus terminal	Phase I
(2)	Kanchpur South	Interdistrict bus terminal	Phase I
(3)	Kanchpur North	Interdistrict bus terminal /city bus depot	Phase I
(4)	Gram Bhatulia	Interdistrict bus terminal	Phase I

[17]Phase I is planned to be in operation in 2025 and phase II planned to be in operation in 2030/2035

	Sites	Possible Use	Phasing[17]
(5)	Bhulta	Interdistrict bus terminal	Phase II
(6)	Hemayetpur	Interdistrict bus terminal	Phase I
(7)	Bhawal, Ati Bazar	City bus depot	Phase I
(8)	Baipail	Reserved for future truck/bus depot use	-
(9)	Gazipur	Reserved for future truck/bus depot use	-
(10)	Kanchan	City bus depot	Phase II
(11)	Kanchpur North (RHD Stack yard)	Discarded due to proximity of Kanchpur Bridge and technical consideration	-

Kanchpur North is considered both for Interdistrict terminal and City Bus Depot. Preferrable recommendation by consultant team is for City Bus Depot.

3.4 Proposed Interdistrict Bus Terminals

The proposed sites were further analyzed to identify the most suitable locations for interdistrict bus terminals in such a way so that the countrywide connectivity is ensured through minimum number of terminals. At the same time, access to major roads and public transport connectivity were a major concern too. Following five sites have been identified for interdistrict bus terminals (Table-3.4 and Map-3.2).

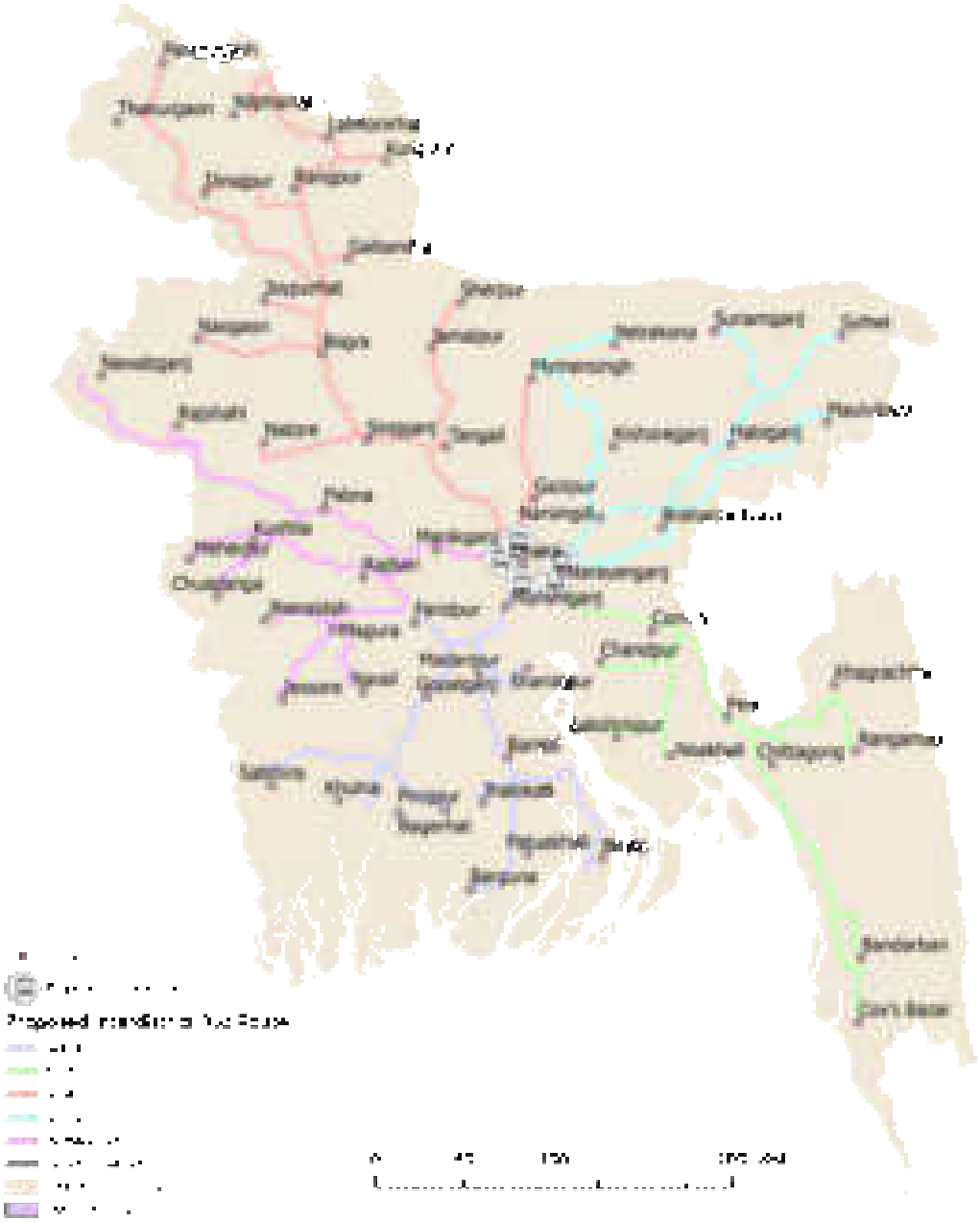
Five sites have been selected through an iterative process of identifying several combinations of terminal location. GIS based network allocation was used as a tool to identify five locations that can serve the whole country with optimal travel distance.

Table 3-6: Proposed Sites for Interdistrict Bus Terminals

	Proposed Terminal	Connecting Districts	
(1)	Baghair	14	Bagerhat| Barguna| Barisal| Bhola| Faridpur| Gopalganj| Jhalokati| Khulna| Madaripur| Munshiganj| Patuakhali| Pirojpur| Satkhira| Shariatpur
(2)	Kanchpur	11	Bandarban| Chandpur| Chattogram|Cumilla| Cox's Bazar| Feni| Khagrachhari| Lakshmipur| Narayanganj| Noakhali| Rangamati
(3)	Gram Bhatulia	18	Bogura| Dinajpur| Gaibandha| Gazipur| Jamalpur| Joypurhat| Kurigram| Lalmonirhat| Mymensingh| Naogaon|Natore| Nilphamari| Panchagarh| Rangpur| Sherpur| Sirajganj| Tangail| Thakurgaon
(4)	Bhulta	8	Brahamanbaria| Habiganj| Kishoreganj| Maulvibazar| Narsingdi| Netrakona| Sunamganj| Sylhet
(5)	Hemayetpur	12	Chuadanga| Jessore Jhenaidah| Kushtia| Magura| Manikganj| Meherpur| Narail| Nawabganj| Pabna| Rajbari| Rajshahi

Chapter 5 lays out detailed methodology for estimating interdistrict bus movements and passenger numbers. These numbers of passengers and buses and their distribution during the whole day were used for the conceptual design of the proposed terminals.

Figure 3-2: Proposed Bus Terminals and Catchments



3.5 Exit-Entry of the Proposed Bus Terminals and Depots

All the proposed terminals are situated adjacent to expresswaysand national highways (or expected to be upgraded to expressways in the near future). Some of the terminals are close to under construction elevated expressways and bypasses and proposed ring road and expressways (which are at different stages of implementation- from feasibility stage to design stage). These transport infrastructures pose both opportunity and challenges for safe entry and exit to the terminals.

Discussions were held with RHD, BBA, DMTCL and BRTC regarding their ongoing and future projects. Based on the discussions held, the consultant has made preliminary designs of entry exit facilities to avoid conflict with the through traffic of the main highway; in most

cases grade separations have been proposed. The preliminary drawings are shown in Annex 3.

3.6 Connectivity of the Proposed Bus Terminals

Efficient functioning of a bus terminal is a prerequisite for timely arrival and departure of the buses. Passengers' satisfaction depends on a safe and timely arrival at the terminal; and subsequent safe and timely trips to the final city destinations. For this purpose, the consultant has carried out connectivity analysis through the following:

- investigate the proximity of major highway, ring road, expressway (both existing and proposed) which would facilitate timely arrival and departure of the bus at the terminal;
- explore the possible safe entry and exit facilities (existing and proposed) in the terminal which may include grade separation possibilities;
- explore multimodal transport facilities (both existing and proposed) for bus passengers for their safe and timely trip to city destination (to and from the terminal). Explore possible city route connectivity. In case, city route connectivity is not possible, an alternative shuttle service route from the terminal to some selected locations in the city will be explored.

This chapter will describe the findings related to the connectivity of the terminal on major routes. Information related to entry/exit connectivity to terminal will be provided during the conceptual design of the selected bus terminals.

3.6.1 Public Transport Connectivity

It is expected that relocating interdistrict bus terminal will reduce number of buses in Dhaka roads which we all hope will reduce traffic and city congestion. However, it is essential to ensure that people using the new terminal can come to the city destination with ease and quickly that requires good connectivity with MRT, BRT and Bus route. Those were analyzed and are depicted in the next two figures.

The consultant has visited the proposed terminal sites several times and reviewed several documents related to the existing and proposed transport infrastructure of all modes (national highways, expressways, Ring Road, Circular Railway, MRT and BRT) concerning the proposed terminal locations. The members of the consultant's team also had a discussion with relevant stakeholder agencies about future transport infrastructure projects. The list of documents and maps reviewed are shown in Annex 3. The consultant is of the opinion that the proposed terminals are located in close proximity to the major transport network.

Table 3-7: Proposed Terminals and Public Transport Connectivity[18]

	Proposed Terminal	Planned/Proposed Public Transport Route	
		MRT/BRT	Bus Route Cluster
(1)	Baghair	BRT-3, MRT-1	South 23 South 24
(2)	Kanchpur	MRT-2	Green Cluster 11C
(3)	Gram Bhatulia	MRT-6	Pink Cluster1D
(4)	Bhulta	MRT-5	Green Cluster 11B
(5)	Hemayetpur	MRT-5	Blue Cluster 3A Maroon Cluster 4A North West 21

3.6.2 Connectivity among Proposed Terminals

It is important that passengers who would like to travel seamless from one corner of the country to the other without passing through the capital city, Dhaka have got alternative routes available. With the completion of ring road and bypass around Dhaka each terminal will be connected to other terminal for passengers to ensure interconnectivity.

3.6.3 Status of Major Transport Infrastructure

Presently there are some major transport infrastructures at different stages of implementation. When completed these will play a major role in improving mobility of bus transport in ensuring timely arrival and departure of intercity bus. Table 3.8 below gives the details:

Table 3-8: Status of Transport Infrastructure in Dhaka[19]

	Type of Infrastructure	Implementing Agency	Present Status
(1)	Mass Rapid Transit 6	DMTCL	Construction ongoing
(2)	Mass Rapid Transit 1	DMTCL	Design ongoing
(3)	Mass Rapid Transit 5 (North)	DMTCL	Design ongoing
(4)	Mass Rapid Transit 5 (South)	DMTCL	Design ongoing
(5)	Mass Rapid Transit2, 4,6	DMTCL	Planned
(6)	Bass Rapid Transit 3	BRTCL	Construction ongoing
(7)	Bass Rapid Transit 7	BRTCL	Feasibility completed
(8)	Dhaka Elevated Expressway	BBA	Construction ongoing
(9)	Dhaka Subway Project	BBA	Feasibility completed
(10)	Ashulia Expressway	BBA	Contract to be awarded
(11)	Dhaka-Mawa Expressway	RHD	Construction completed
(12)	Dhaka Expressway (part of Middle Ring	RHD	Construction ongoing

[18]Data collected from feasibility study & cluster summary
[19]Data collected from different Govt. agencies

	Type of Infrastructure	Implementing Agency	Present Status
	Road)		
(13)	Dhaka –Sylhet Expressway	RHD	Contract to be awarded
(14)	Dhaka-Chattogram Expressway	RHD	Design completed
(15)	Dhaka- Aricha Expressway	RHD	Planned
(16)	Dhaka-Mymensingh Expressway	RHD	Planned
(17)	Inner Ring Road	RHD	Feasibility study completed
(18)	Middle Ring Road	RHD/BBA	Feasibility study completed
(19)	Circular Railway	BR	Feasibility study completed
(20)	Circular Waterway	BIWTA	Under implementation

Figure 3-3: Proposed Bus Terminals and MRT and BRT Routes

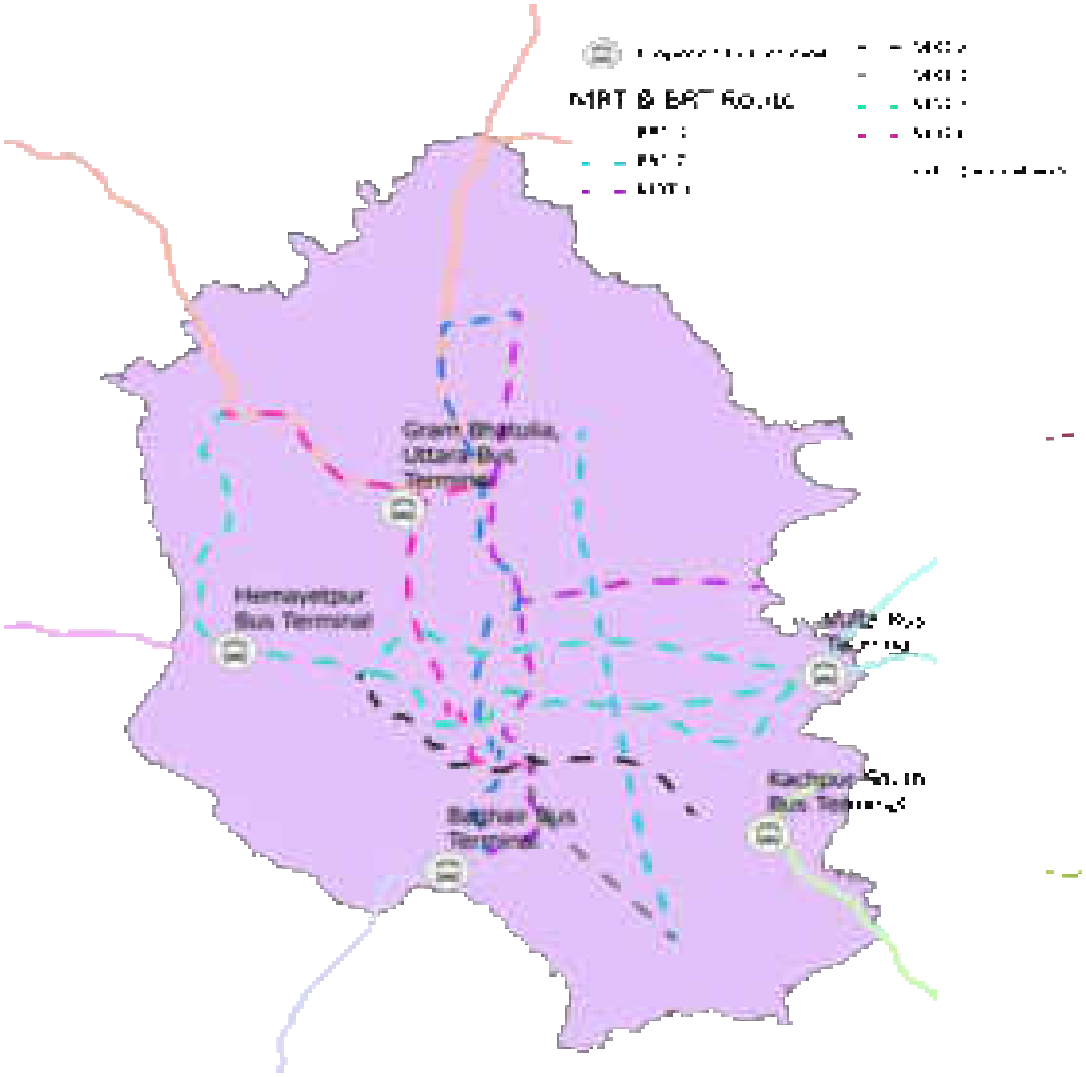
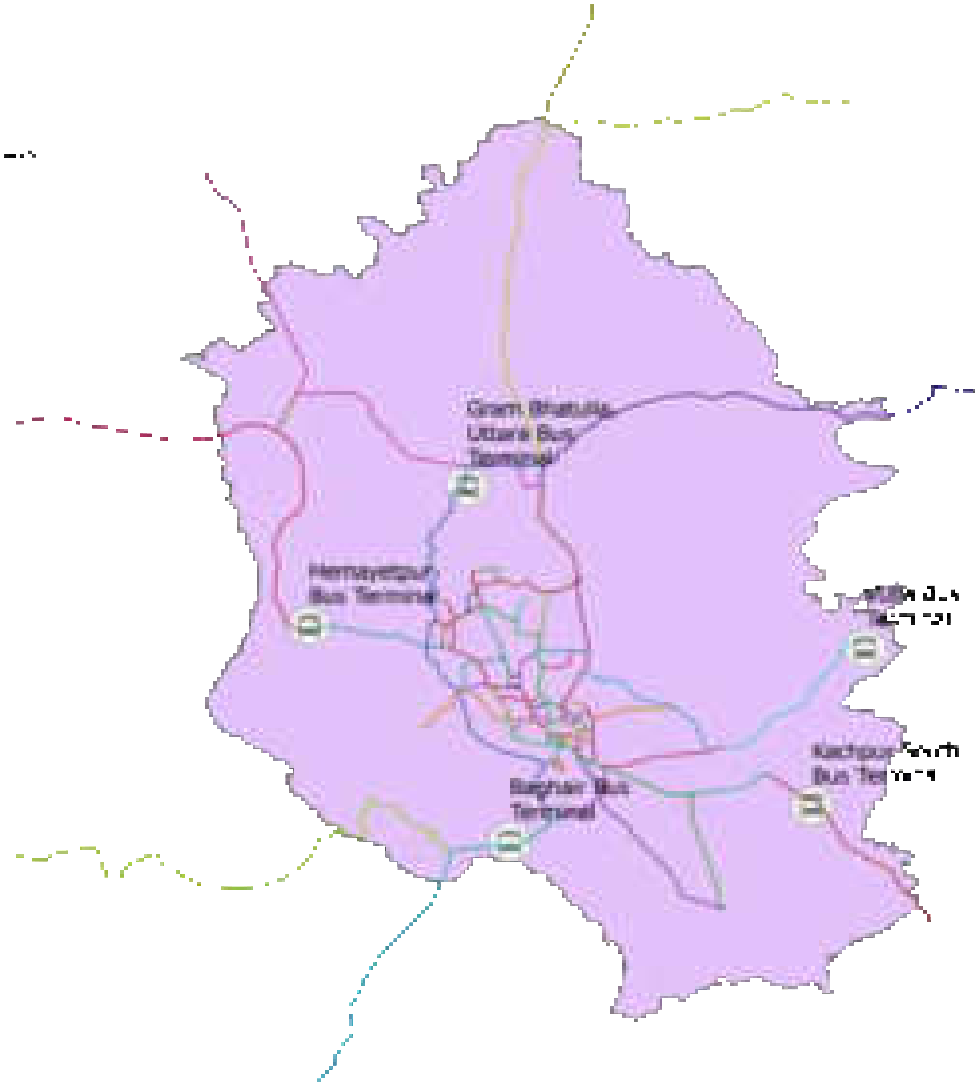


Figure 3-4: Proposed Bus Terminals and Bus Routes (rationalization)[20]



[20]Data adopted from cluster summary

3.7 Connectivity of Individual Sites

Baghair: The proposed site at Baghair is adjacent to the Dhaka-Mawa Expressway (N8). Since the expressway is already constructed, the underpass and overpass near the proposed terminal can be used for entry into and exit from the terminal.

Kanchpur North: Dhaka-Chattogram Highway-N1 runs alongside the proposed site of Kannchpur North. The N2 highway is also at a close distance from the location. It is also close to the Kanchpur Bridge and Kanchpur Bus stop. There is a 100' proposed road on the West side.

Kanchpur South: This location chosen for the terminal at Kanchpur South is close to Dhaka-Chattogram highway. The Southern section of Middle Ring Road is also expected to be passing North of the terminal which will ensure seamless connectivity to the city. During conceptual design, possible entry and exit connectivity will be studied in detail.

Gram Bhatulia: Gram Bhatulia is adjacent to the Embankment road (which is expected to be upgraded to six-lane soon as part of inner ring road). One ramp from Ashulia Elevated Expressway will land on this road. The intersection near Abdullahpur is critical where Ashulia Elevated Expressway, Dhaka Elevated Expressway and Dhaka –Tongi road (along with BRT) will meet. After reviewing the design of these three projects, adequate provision is made to accommodate turning movements. There is a station of MRT 6 close by and a railway station (of the proposed Circular Railway project) is 100m away. During detail design, exit/entry for the bus terminal and possible city bus route would be identified. The proposed bus terminal at this location will enjoy multimodal connectivity.

Figure 3-5: Baghair[21]

[21] Google Map

Figure 3-6: Kanchpur South[22]

Figure 3-7: Kanchpur North[23]

[22] do
[23] Google Map

Figure 3-8: Gram Bhatulia[24]

Bhulta: The location of the proposed site for Bhulta is adjacent to a regional road of RHD which is expected to be upgraded to a four-lane divided highway in the near future. It is connected to Dhaka-Sylhet Highway which is also being upgraded to an expressway. The proposed Rampura-Amulia-Demra Expressway will facilitate passengers traveling to the city center. The Dhaka Bypass can also be connected to this terminal giving more flexibility to the passengers using the terminal.

Hemayetpur: Dhaka-Aricha Highway-N5 runs adjacent to the site earmarked at Hemayetpur. The highway is expected to be upgraded to expressway standard in the near future. The location of the proposed MRT 5 station at Hemayetpur is close to the terminal which will ensure multimodal connectivity. City bus route may be extended up to the terminal to facilitate passenger traveling to the city.

Bhawal, Ati Bazar: The proposed site at Atibazar is connected with an existing road which will be developed by RAJUK to a sixty feet road. Moreover, it will also be connected with the proposed Middle Ring Road. This location also can be connected to the city center by crossing the Basila Bridge (over Buriganga River).

Baipail: The site earmarked for the proposed terminal at Baipai is close to the starting point of the Ashulia Elevated Expressway.[25] After reviewing the design/drawing it was found that it is not expected to pose any problem for entry into and exit from the terminal.

[24] Google Map
[25] Construction is expected to start soon.

Gazipur: Dhaka-Mymensingh Highway-N3 runs adjacent to the location earmarked for the site at Gazipur. The highway is expected to be upgraded to a ten-lane expressway. The proposed terminal will be linked with the service road and subsequently to the expressway through an overpass/underpass. DTCA can coordinate with RHD/BBA to locate the underpass close to the terminal to ensure safe and efficient connectivity. Tongi Railway Station starting point of BRT-3 is located within a distance of 500 m which will provide an opportunity for multi-modal integration.

Kanchan: The proposed site at Kanchan is adjacent to the Dhaka City Bypass (under construction). The underpass and overpass to be constructed on the bypass will be helpful for the entry into and exit from the terminal. The alignment of MRT will be extended up to the Dhaka bypass (passing through JALSIRI residential area), an MRT station is also expected here. Moreover, Madani Avenue is being upgraded to expressway standard (bridge over Balu River is under construction) which will facilitate passenger movement to the Gulshan area.

Figure 3-9: Bhulta[26]

[26] Google Map

Figure 3-10: Hemayetpur[27]

Figure 3-11: Bhawal, Ati Bazar[28]

[27] Google Map
[28] Google Map

Figure 3-12 : Baipail[29]

Figure 3-13 : Gazipur[30]

[29] Google Map
[30] Google Map

Figure 3-14: Kanchan[31]

3.7.1 Transfer of the Activities of the Existing Terminals to the Proposed Sites

Based on the estimation of future passenger trips and route analysis, the activities of the three existing bus terminals are being proposed to be undertaken by five new terminals which are located at outskirts of the city. The proposed terminals will reduce substantially the entry of buses into the city and are expected to reduce traffic congestion. The activities to be transferred are described below:

- Gabtoli to the proposed Hemayetpur and Gram Bhatulia terminals
- Mohakhali to the proposed Gram Bhatulia and Bhulta terminals
- Sayedabad to the proposed Kanchpur South, Baghair and Bhulta terminals.

The distances of the proposed terminals from the existing terminals vary from 10 to 20 km (shown in the table below). The existing terminals are expected to be used as depots for city buses. It is essential to ensure that people using the new terminals can come to the city destinations safely and quickly. As such it requires good connectivity with MRT, BRT and city bus routes.

[31] Google Map

Table 3-9: Distances from Proposed Bus Terminals to Dhaka City[32]

	Proposed Bus Terminal	Existing Bus Terminal	Distance to the Proposed Bus Terminal	City Locations and Distance from the Proposed Bus Terminal Locations
(1)	Baghair	Sayedabad	9.5 km	Asad Gate (18 km)| Gulistan (11 km)| Mirpur 10 (24 km)| New Market (14.6 km)| Farmgate (13.3 km)
(2)	Kanchpur South	Sayedabad	14 km	Malibagh (19 km)| Farmgate (21.6 km)| Gulistan (16 km)| Gulshan 1 (24 km)
(3)	Bhulta	Sayedabad Mohakhali	19 km 29 km	Malibagh (24 km)| Farmgate (27 km)| Gulistan (21.5 km)| Gulshan 1 (25 km)
(4)	Gram Bhatulia	Mohakhali Gabtoli	13.3 km 13.3 km	Gulshan 1 (20.5 km)| Mirpur 10 (14.5 km)|Farmgate (20.5 km)| Gulistan (27 km)
(5)	Hemayetpur	Gabtoli	7.5 km	Asad Gate (11.6 km)| Mirpur 10 (12 km)| Farmgate (13.5 km)| Gulistan (18.5 km)

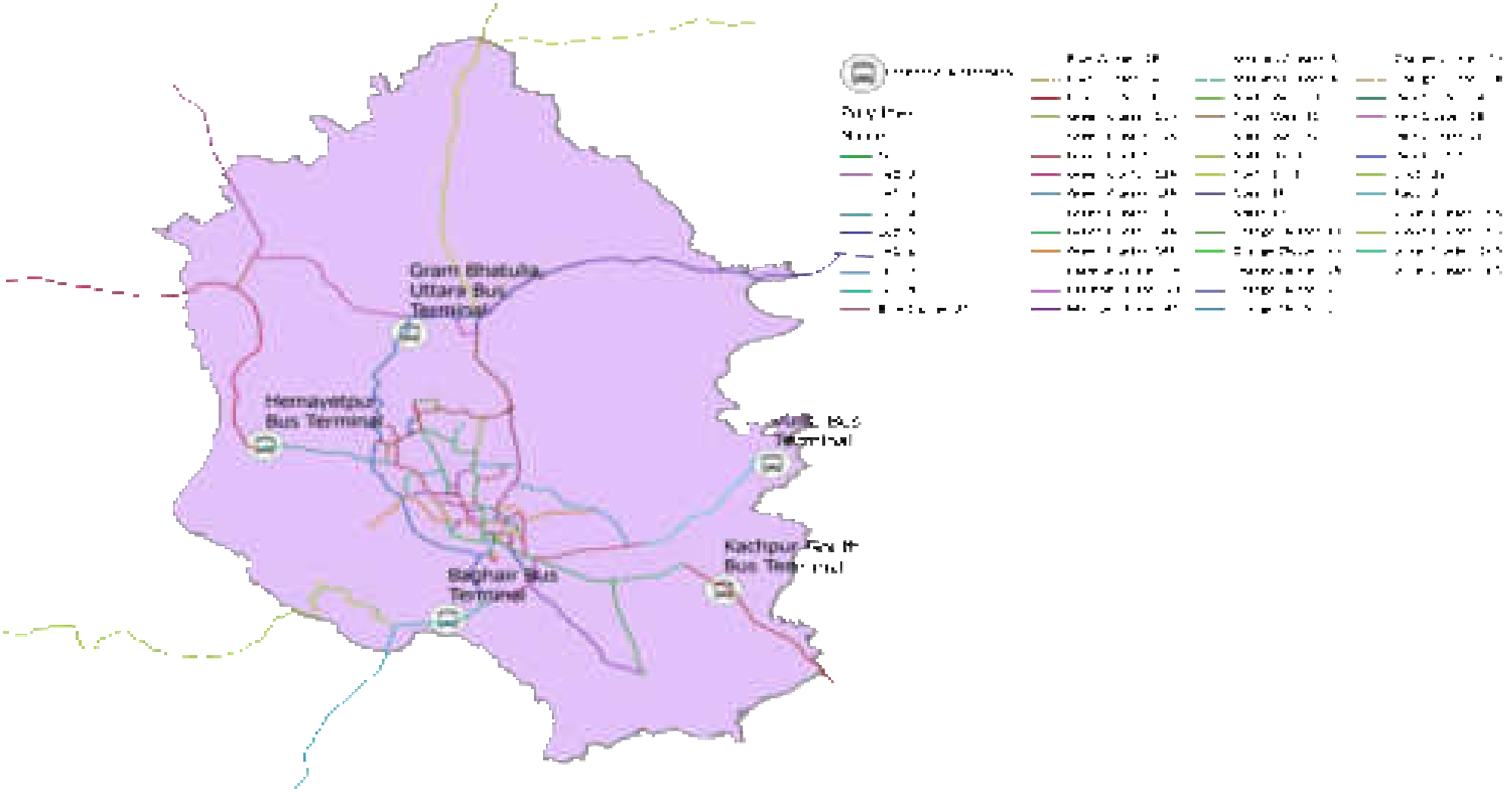
3.7.2 Connectivity with Mass Rapid Transit System and Multi-modal Network

Presently, MRT 6 and BRT 3 are under construction and several more MRTs and BRTs are at different stages of implementation (from feasibility stage to design stage). All mass transit networks will have connectivity (directly and indirectly) with the proposed bus terminal which is shown in the map below. Some of the terminals will also be linked with stations of the proposed Circular Railway Network and landing stations of Circular Waterway Network (under implementation).

The information collected by the consultant for the planned up-gradation and improved/under construction transport infrastructure of the Dhaka-Chittagong highway, Dhaka-Aricha highway, inner ring road, Dhaka bypass, Dhaka elevated expressway, Dhaka Ashulia expressway, Dhaka Mawa expressway, Bandar Madanpur highway, and Mass Rapid Transit routes, and BRT routes are shown in **Annex 3.4**. This information would be useful for the design consultant for proposing a grade-separated connection between the terminals and the adjacent highways/expressways/bypass.

[32]Source: Google earth

Figure 3-15: Proposed City Bus Routes Connecting the Proposed Sites[33]



[33]Cluster Survey, 2020

Table 3-10: Connectivity with Mass Transit and City Route[34]

	Proposed Terminal	Planned/Proposed Public Transport Route	
		MRT/BRT	Bus Route Cluster
(1)	Baghair	BRT-3, MRT-1	South 23 South 24
(2)	Kanchpur	MRT-2	Green Cluster 11C
(3)	Gram Bhatulia	MRT-6	Pink Cluster 1D
(4)	Bhulta	MRT-5	Green Cluster 11B
(5)	Hemayetpur	MRT-5	Blue Cluster 3A Maroon Cluster 4A North West 21

3.7.3 Connectivity with City Bus Routes

DTCA is carrying out a study on restructuring of bus routes for Dhaka city. The salient features of the study are described below:

- Presently, there are about 300 bus routes in Dhaka city operated by a number of owners resulting in overlapping of bus movements, which causes inefficient and chaotic public transport.
- Another DTCA appointed consultant has proposed separate city routes and sub- urban routes through clustering.
- It is proposed to form six city clusters and three sub-urban clusters.
- There will be total 42 routes in the clusters which will be operated by 22 companies; and it is expected to reduce overlaps and increase efficiency.

Some of the cluster routes are proposed to start from the proposed sites so that incoming passengers can use city bus to enter the city. The proposed terminals will mainly cater for the activities of interdistrict bus operation (including provision of depot). However, provision will be kept for parking of some city buses and suburban buses to provide transfer facilities (both incoming and outgoing) for passengers facilitating safe and efficient trip to city.

The passenger survey carried out under this study reveals that about 55% of the passengers carry heavy luggage, about 37% of them use auto-rickshaws (conventionally termed as CNG). Among the passengers, 41% use city buses to commute from terminal to home. As such, a dedicated city shuttle service (with provision of luggage space) with minimum number of stops (compared with normal city bus) may be a better option. Parking spaces will be provided for taxi, private car and auto-rickshaws in the proposed terminals.

[34]Secondary Data

4 Traffic Survey and Analysis

Transport infrastructure like bus terminals or depots have a large-scale impact on the spatial distribution of the city. These facilities and their operational efficiency play a significant role on real estate development, creation of road congestion and pattern of local land use to mention a few. The terminals are in fact make integral parts of the urban fabric and changes in location cause significant impacts on accessibility, public transport system, congestion scenario etc. To comprehend the potential impacts and learning from experiences at current locations of the existing terminals, several survey activities were designed. Surveys were conducted at:

- Current terminals
- Proposed locations
- Between the above locations

The traffic survey and analysis carried out points to the fact that Dhaka is growing beyond a sustainable limit and current locations of the terminals are to be dispersed to mitigate the problem. Additional facilities need to be established in such a way that integration with other modes of transport is coordinated, congestion is mitigated and travel time and cost are reduced. The main objective of transport data collection was to facilitate different activities of this study with the following information:

- Total number of buses that ply through the terminal everyday
- Hourly distribution of bus and peak hours at terminals
- Passengers who use the terminal and their access/ingress
- Traffic situation around proposed location
- Passenger occupancy in intercity buses

Several types of surveys were conducted. A list of surveys and their short description is presented in Table 4.1.

Table 4-1: Surveys Conducted in this Assignment[35]

	Survey	Description
(1)	Bus Count Survey at three terminals in Dhaka	Purpose of this survey is to have a better understanding about interdistrict bus service, its frequency and identify its peak and off-peak. This helps to identify how many buses are coming/leaving the terminal in hourly basis: • 24 hours (hourly) by manual count • Incoming and outgoing • Sizes/types of buses
(2)	Passenger	This survey was conducted for the waiting passengers at existing

[35]Field Survey. Survey formats are attached in Annex.

	Survey	Description
	Survey	terminal. Purpose is to know about their origin and connected mode. This helps to assess the need for public transport. It covers: • Location from • Mode • Female/child/elderly • Accompanied baggage
(3)	Traffic Count around proposed location	For traffic count, all types of buses in six locations were chosen that coveredroad transport entries and exit points for Dhaka. Purpose of the 'traffic count' was to enable assessment of possible changes in traffic pattern due to change in terminal location. This helped in estimating the impact of the proposed bus terminals/depots. • 2 days traffic count (hourly) by camera • Vehicle count by type (both way) • Interdistrict, urban and regional buses (separate)
(4)	Boarding Alighting or unboarding Survey	This survey was conducted on major bus routes from all three terminals. 10% of buses from each of the existing terminals was chosen. This survey collected boarding and alighting information between current terminal and (close to) proposed terminal. Data collectors boarded on the bus from terminals and travelled up to a proposed location. On return, they rode on a bus from proposed (terminal/depot) location to travel to terminal preferable of same route • Onboard passenger survey (origin, destination within city, mode from terminal to home, with/without luggage and child, waiting time) • Occupancy survey (number of passengers, number of female, child and elderly passengers)
(5)	Dwell Time Survey	Dwell time survey collectsthe information about the time bus spends in terminal and activities they perform. Such surveys were conducted in all three terminals. It was found that there are at least three types of bus dwelling behaviors in terminals at Dhaka.

4.1 Passenger Survey at Terminals

Passengers at three terminals were surveyed to gather about their origin, travel time, cost and other related information.[36] Passenger survey from all three terminal shows that 25 to 40% of passengers are females (Figure 4.1). It is assumed that the number of elderly citizens, children and women are travelling less due to Covid-19.

Few passengers prefer cars for reaching the terminals (Figure 4.2) due to various reasons one of them being the hassle to park. Rather most of the passengers come to the terminals by buses or auto-rickshaws (30 to 45%). It was also observed that up to 77% passengers carry luggages (Figure 4.3), which are weighty to carry by hands.

[36] It is essential to mention that due to COVID-19 situation, the number of passengers and hence that of buses were low compared to that of normal time. However, that the behavioral pattern is assumed remain the same which helped in designing the terminal.

Figure 4-1: Male-Female Passenger Ratio

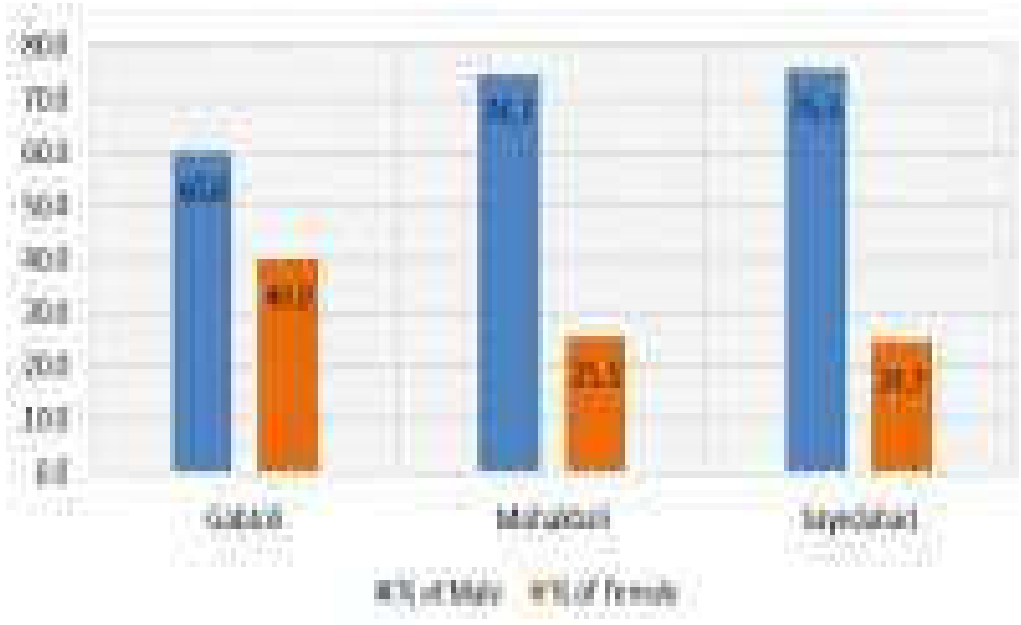
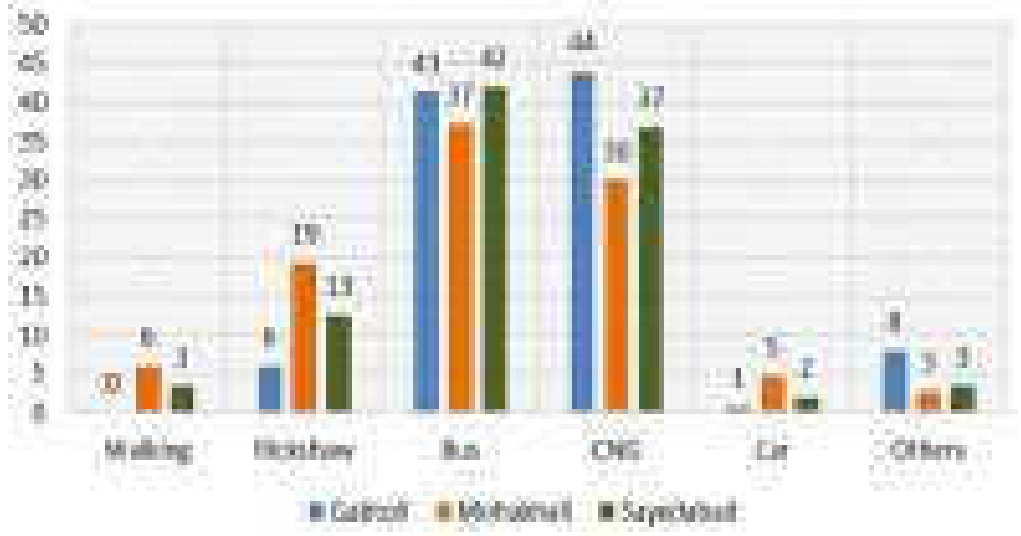
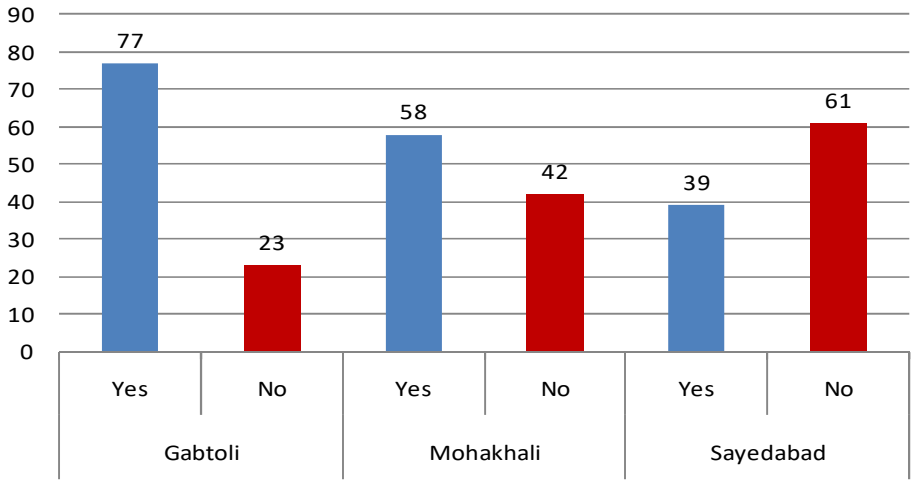


Figure 4-2: Home to Terminal Modes



These mode choices indicate the need for connectingthe city bus services with the proposed bus terminals.

Figure 4-3: Number of Passengers with Heavy Bags



4.2 Frequency of Buses at Interdistrict Terminals

Arrivals and departures of buses at the terminals vary with time. Due to COVID situation, the number is low. The hourly number of buses at Mohakhali shows a peak from noon to evening. However, for Gabtoli and Sayedabad maximum number reached in a short span of the morning.

As a common pattern, it was observed that during the period from 0:00 to 5:00 a.m., the number of buses leaving and coming to terminals is insignificant. During peak period, the number of buses destined to Mohakhali and Sayedabad terminals was around 70 and Gabtoli 45. This number was low due to COVID.

Figure 4-4: Frequency of Buses at Mohakhali

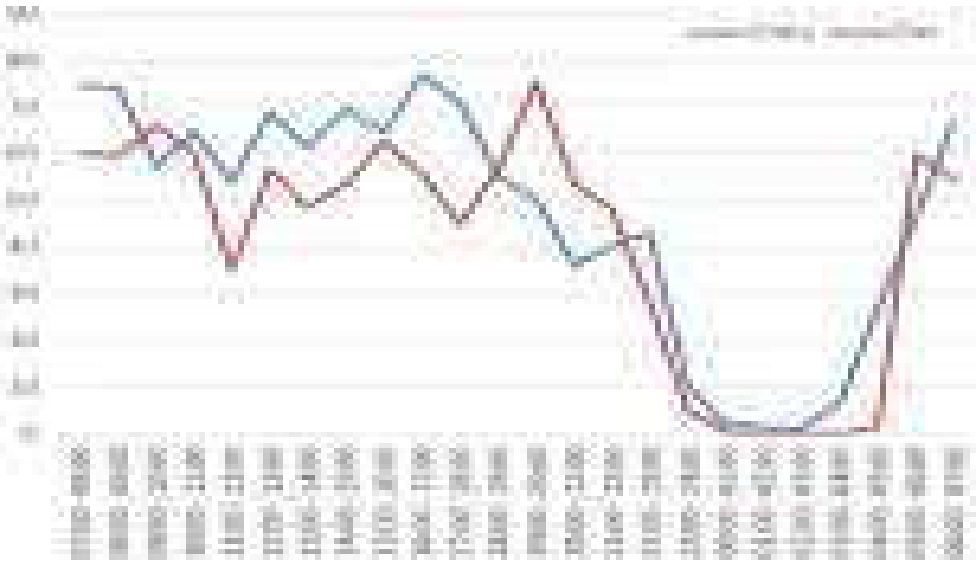
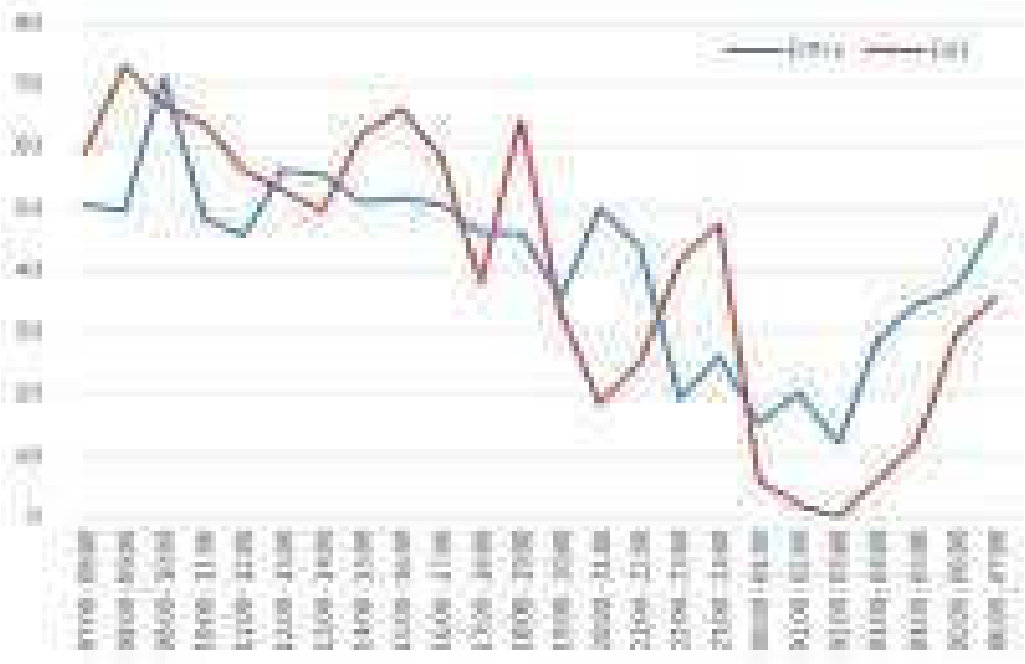


Figure 4-5: Frequency of Buses at Gabtoli Terminal

Figure 4-6: Frequency of Busesat Sayedabad



The number of buses operating from the designated interdistrict terminals are much less than that of those licensed from BRTA. Local experience also suggests that a number of buses do not terminate at the terminals, rather they are destined to city terminals or turns back for other destinations. Therefore, for capturing the scenario as a whole, Dhaka bound buses entering through a cordon line were counted.

4.3 Traffic Count Survey

Cameras were installed at six locations around Dhaka (Figure 4.7) to capture traffic to and from Dhaka. Annex 5 provides the data recording template from camera recording.

Observations of two days show that around 16,000 interdistrict bus trips were made to and from Dhaka. It was also found that (for both incoming and outgoing) 500 trips were carried out at peak periods (Figure 4.8). However, the peak period shifts. Incoming trips experience a peak in early evenings, while outgoing trips at mornings. Interdistrict buses comprised around 39% of total bus trips that crossed the Dhaka cordon. The following two figures show that the correlationship among the frequencies of interdistrict buses, suburban buses and city buses is high.

Figure 4-7: Location of Cameras Used for Traffic Count

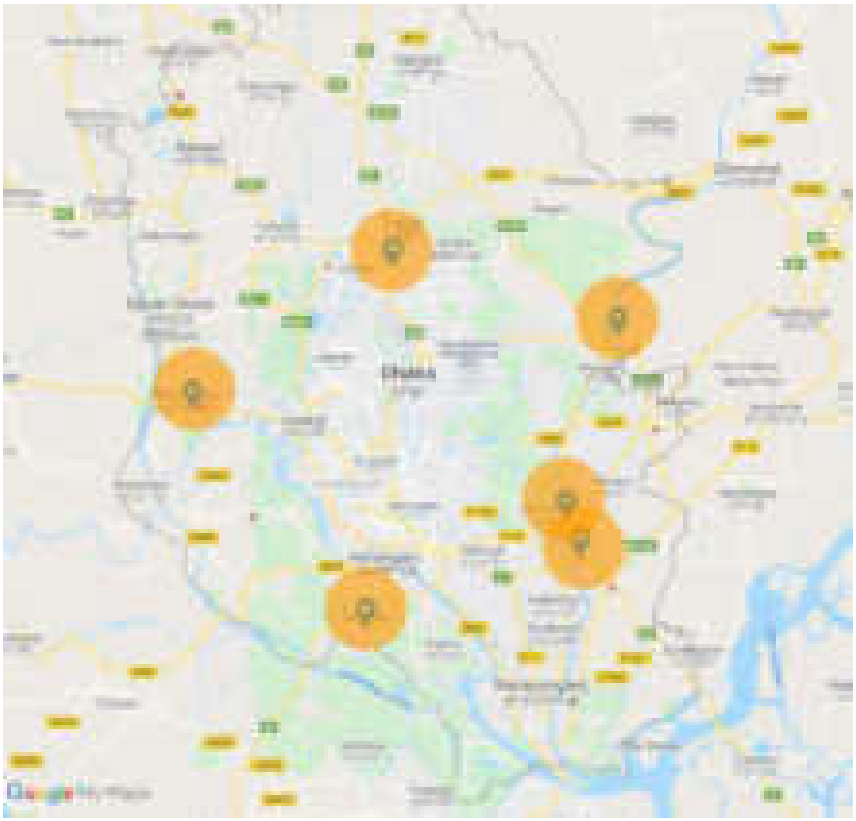
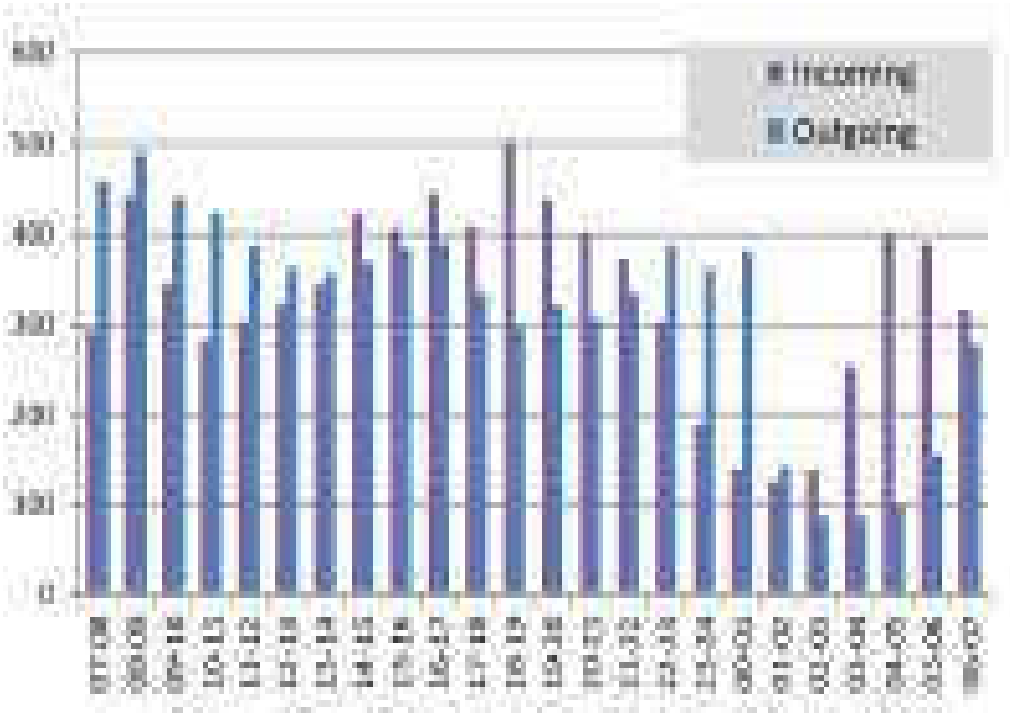


Figure 4-8: Number of Interdistrict Buses to and from Dhaka



It also appears that during peak period around 6% of the buses operate to and from Dhaka.

Figure 4-9: Hourly Pattern of Frequency of Buses

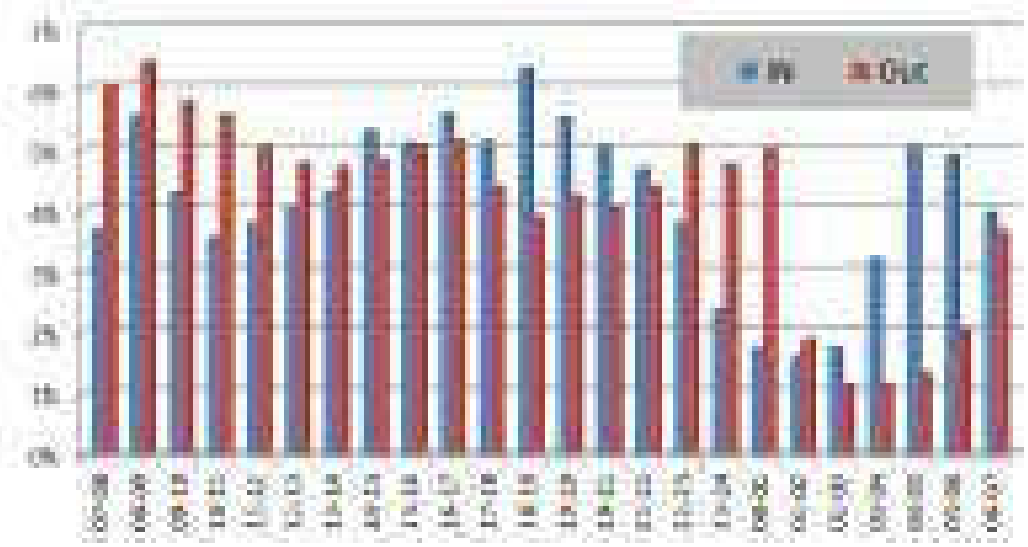


Figure 4-10: Frequency of Different Types of Buses to Dhaka

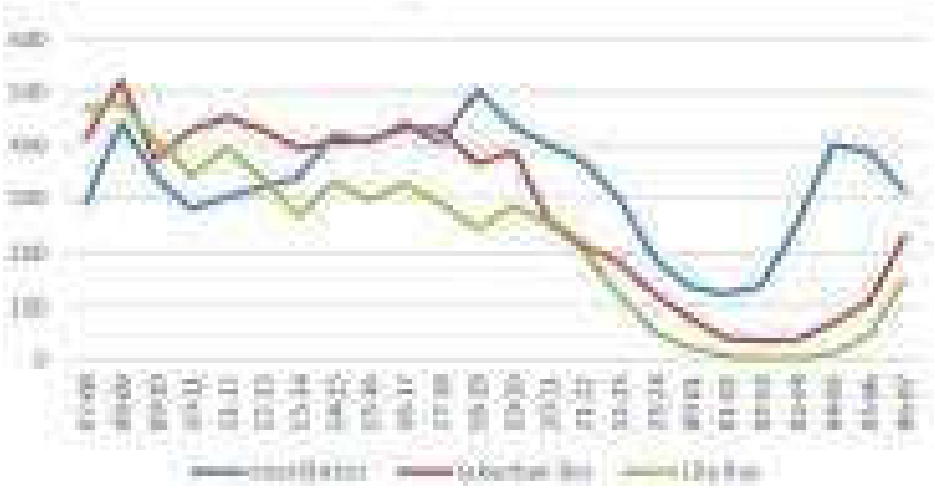
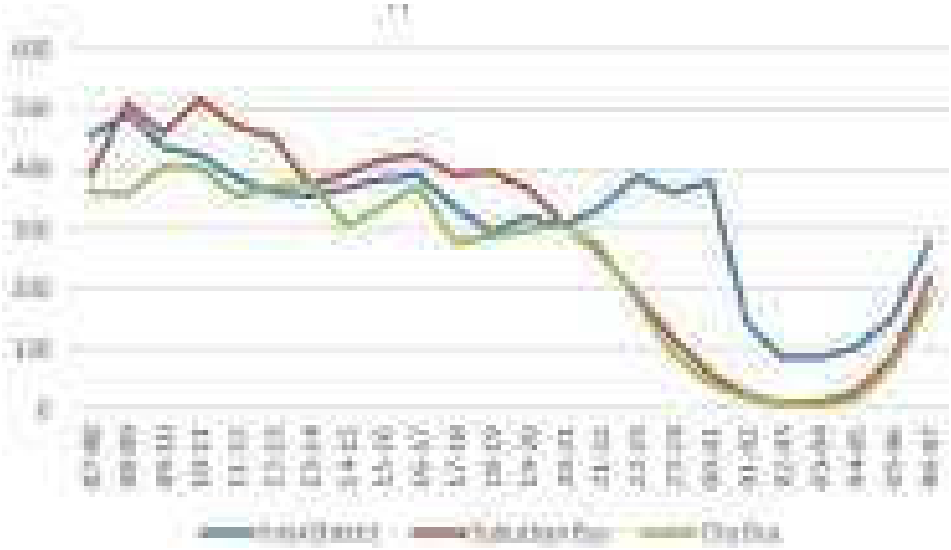


Figure 4-11: Frequency of Different Types of Buses from Dhaka



4.4 Boarding-Unboarding Survey

Passenger boarding-unboarding survey was conducted for all three terminals at outer periphery of the city where proposed terminals are located or close by. Thirty (30) major routes were selected to conduct the survey. The distances travelled and travel times of such traffic are presented in Table 4.2. Annex 5 lays out a detail survey sheet.

It is evident that interdistrict buses make post-departure boardings and pre-arrival drops of passengers at multiple locations other than the terminals. It influences up to 38 km radius from the respective terminals. During the survey, passenger occupancy rates were also measured, which were found to range from 60 to 72%. Due to COVID situation, the occupancy was low. In a normal situation, however, interdistrict passenger occupancy is around 75%.

Table 4-2: Distances from Existing Terminals and Travel Time along the Survey Routes

Survey Routes			Distance of target location (km)	Travel time(hr)[37]
Gabtoli	-	Jatiyo Sriti Soudho/Chandra, Savar	38	1.19
""	-	Jatiyo Sriti Soudho, Savar	22	0.57
""	-	Jatiyo Sriti Soudho/chandra, Savar	38	1.33
""	-	Jatiyo Sriti Soudho/chandra, Savar	38	1.17
""	-	Jatiyo Sriti Soudho/chandra, Savar	38	1.11
""	-	Jatiyo Sriti Soudho/chandra, Savar	38	1.13
""	-	Jatiyo Sriti Soudho, Savar	22	0.46
""	-	Jatiyo Sriti Soudho, Savar	22	0.38
""	-	Jatiyo Sriti Soudho, Savar	22	0.46
""	-	Jatiyo Sriti Soudho, Savar	22	0.57
""	-	Jatiyo Sriti Soudho, Savar	22	0.52
""	-	Jatiyo Sriti Soudho, Savar	22	1.03
Mohakhali	-	Tongi Bridge	14.3	1.18
""	-	Ashulia approach road	23	1.3
""	-	Tongi Bridge	14.3	0.37
""	-	Tongi Bridge	14.3	1.42
""	-	Tongi Bridge	14.3	1.24
""	-	Tongi Bridge	14.3	0.28
""	-	Tongi Bridge	14.3	0.57
""	-	Ashulia approach road	23	1.1
""	-	Ashulia approach road	23	1.37
""	-	Ashulia approach road	23	1.45
""	-	Ashulia approach road	23	1.43
""	-	Ashulia approach road	23	1.16
Sayedabad	-	Kanchpur Bridge	12	0.31
""	-	Keraniganj Jail Khana	10.6	0.33
""	-	Kanchpur Bridge	12	0.16
""	-	Kanchpur Bridge	12	0.19
""	-	Kanchpur Bridge	12	0.1
""	-	Kanchpur Bridge	12	0.4
""	-	Kanchpur Bridge	12	0.51
""	-	Kanchpur Bridge	12	0.52
""	-	Keraniganj Jail Khana	10.6	0.14
""	-	Keraniganj Jail Khana	10.6	0.15
""	-	Keraniganj Jail Khana	10.6	0.58
""	-	Keraniganj Jail Khana	10.6	0.44

[37](excluding lost time): hh:mm

Table 4-3: Passenger Occupancy[38]

	Terminal	Avg passenger capacity of bus	Total capacity in passenger seats	Total occupancy of passengers	Occupancy %
(1)	Gabtoli	40	399	252	61
(2)	Mohakhali	47	471	314	60
(3)	Sayedabad	43	430	170	72
	Total		**1300**	**736**	

4.5 Dwell Time Survey

In transportation, dwell time or terminal dwell time refers to the time a vehicle such as a public bus or train spends at a scheduled stop for the purpose of serving passengers without moving. A series of reconnaissances were conducted to have an understanding of the functions of the existing terminals and learn from its experiences. Along with bus and passenger survey, a dwell time survey was conducted in all three terminals. It was found that there are at least three types of bus dwelling behaviors in the terminals at Dhaka.

(1)	Stop and go to other destination	Those buses that drop the passengers inside or in front of terminals and starts for another destination with/without passenger
(2)	Stop and go to city stop/terminal or for cleaning	This type of buses dropthe passengers and go to their city stop/terminal or for cleaning purpose
(3)	Stop and park	This type of buses, after unloading passengers go to depot (inside the terminal) and wait for longer time (more than 4 hours) or for maintenance purpose.

The dwell time survey was conducted at three terminals in February 2021 and results have been presented in Table 4.4 and 4.5. It reveals that in average 12% of the buses board/drop passengers at the terminal and end up trips at the bus company's own city counter. However, 67.6% buses stay less than four hours at the terminal and return to their origin. It was also found that 20% buses stop for longer time or overnight.

Table 4-4: Composition of Buses by Nature of Stay in Dhaka Terminals[39]

		Stop and go to other destination	Stop and go to city stop/terminal or for cleaning	Stop and park
(1)	Gabtoli	56.00%	26.00%	18.00%
(2)	Sayedabad	86.49%	3.38%	10.14%
(3)	Mohakhali	60.32%	7.29%	32.39%
	Average	**67.60%**	**12.22%**	**20.17%**

[38]Field Survey
[39]Field Survey 2021

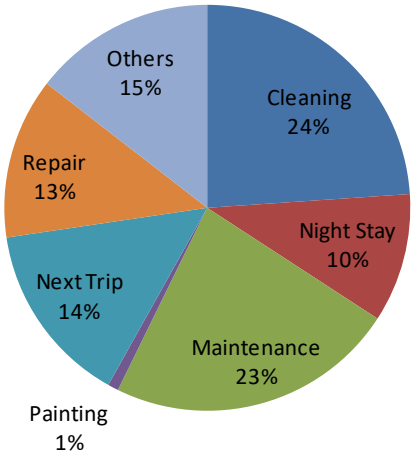
Dwelling time data for each category were collected. It shows that a bus generally stays 20 minutes (0.29 hrs) to drop or board passengers. However, buses which go to their original city depots generally return after 3 hrs to start their return trips. The survey shows that 20% of buses stay for long. During this period, buses may remain idle or may perform cleaning or routine maintainance (Figure 4.12).

Table 4-5: Bus Dwelling Time Pattern in Dhaka Terminals[40]

		Average Dwell Time (hrs)		
		Stop and go to other destinations	Stop and go to city stop/terminal or for cleaning	Stop and park
(1)	Gabtoli	3.91	0.38	11.3
(2)	Sayedabad	3.22	0.20	6.5
(3)	Mohakhali	3.0	0.29	11.25
	Average	**3.37**	**0.29**	**9.68**

As per current practice, each bus pays 40 to 50 as parking fee irrespective of time of stay. Nearly 13% buses do small repair works that can be done with technical hands at terminals. In the event of larger breakages (due to an accident), repair work takes place at workshops outside the terminals.

Figure 4-12: Spectrum of Activities Carried out by Long Stay Buses



Dwell time survey gives a better understanding about the activities done and time spent by buses in the terminal. This helps better designing of the space of the new terminals and gives an indication about the space required for each activitiy (like cleaning, repair and maintenance bay and hostel for bus crews). The findings of survey are provided below:

(1) Around 16,000 interdistrict bus trips were observed every day (including incoming and outgoing).

(2) Traffic counts show 6:00 -7:00 p.m. as peak for incoming buses and 8:00 -9:00 a.m. as peak for outgoing. During peak period 6% of buses (500 trips as incoming and the same for outgoing) travel.

(3) It was found that interdistrict buses account for 38% of total buses that pass Dhaka cordon line. Others are sub-urban buses and city buses.

[40] do

(4) Five locations are found suitable for the new interdistrict bus terminals for Dhaka. They are:

- Baghair
- Kanchpur South
- Burilia
- Bhulta
- Hemayetpur

(5) These five terminals are estimated to serve around 7 lakh passengers daily from 2025 which would be 10.3 lakh by 2045. During peak period, each of the proposed terminal will serve around 8,000 passengers.

(6) By 2025, the number of total buses operating through these five terminals will be 20,000 which is projected to increase up to 30,000 by 2045.

(7) Dwell time survey indicated that interdistrict buses take about 20 minutes for boarding and unboarding passengers;

(8) It was also found that around 20% of the buses stay for long time or overnight.

4.6 Traffic Impact Assessment

A traffic impact assessment is a study/analysis which assesses the traffic and safety implications relating to a specific development. TIA determines the transportation impacts of a particular development on existing road network and user of transport facilities. This TIA was taken up since each of the proposed terminals is expected to generate more than 100 vehicle trips (inbound and outbound) during peak period. A preliminary TIA was carried out focusing on the following aspects:

- Impact on the city roads currently being used by Interdistrict bus for arriving/departing from existing terminal
- Impact on the highway at the locations of the proposed terminals
- Safety implications
- Impact on the passengersof the existing and proposed
- Impact of the proposed terminals on the surrounding areas

It involved site visits, data collection, traffic impact analysis and identification of mitigation measures. The consultant has carried out several field visits of the existing terminals and proposed terminal locations, collected information from RHD, BBA, DNCC, DSCC, RAJUK and DMTCL regarding their ongoing and future transport infrastructure projects. The consultant carried out extensive transport survey at the existing terminals covering, passenger survey, dwell time survey, traffic count survey on major bus corridor near the proposed bus terminals (for details see Section 4 and 5).

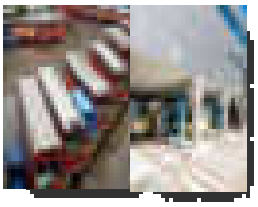
The proposed projects will have impact in two areas, namely on the existing terminals and on the proposed terminals. The possible impacts with corresponding mitigation measures related to existing terminals and proposed terminals are summarized in the table below:

Table 4-6: Impact Analysis and Mitigation Measures

	Impact/Existing Situation	Mitigation /Benefits
(1)	About 40% interdistrict buses do not use the existing terminal and operate from different busy places of the city (Kamalapur, Rajabazar, Mirpur, Shonir Akhra) thereby causing traffic congestion.	The relocation of the terminals will bring discipline to the bus operation and free up space in the existing terminals to be used as city bus depots
(2)	Through the major transport corridor, the interdistrict and suburban busses enters the city and travels through the major city road corridors which amounts to about 24% of the vehicles and 74% of the total buses entering the city which causes traffic congestion in major city road corridors.	Relocation of bus terminals at the periphery of the city will reduce number of buses entering the city and will reduce traffic congestion
(3)	Due to relocation of bus terminals passengers will have difficulty in reaching their final city destinations from the proposed terminals.	Provisions of parkings have been kept at the terminals for city bus service and other transport facilities for the arriving and departing passengers.
(4)	All proposed terminals are located adjacent to highway and expressway, with high speed for through traffic, which may cause safety hazards for buses entering and exiting from the terminals.	Separate acceleration and de-acceleration lanes have been proposed for safe merging and diverging. Moreover, grade separated U loops have been proposed where right turn is required.
(5)	Presently the modal share of Interdistrict and suburban buses on the major corridors is about 24% of the total traffic. The amount of bus trips is estimated to be increased by additional 50% which may create capacity constraints.	Dhaka-Mawa highway has already been upgraded to expressway. The remaining national highways connecting Dhaka city are being planned to be upgraded to expressway in the near future; as such no capacity constraint is anticipated.
(6)	Sufficient night parking facility and facilities for bus crew is not available in the existing terminals which forces the buses to park on city roads.	Adequate night parking for buses (late night arrival and early morning departure) and dormitory facilities for bus crew have been proposed in the new terminals.
(7)	Efficient interconnectivity is absent between existing terminals.	Proposed terminals will have interconnectivity through ring roads and bypasses.
(8)	Existing terminals have no separate exit and entry facilities and no separate arrival and departure lounges creating confusion to the passengers.	The proposed terminals will have separate entry exit facilities for arrival and departure for both Interdistrict and city buses; and separate arrival and departure lounges.
(9)	Multimodal connectivity is absent in the existing terminals.	Multimodal connectivities with MRT for some of the proposed terminals have been suggested.

	Impact/Existing Situation	Mitigation /Benefits
(10)	Efficient use of existing terminal facilities is disturbed due to large number of small operators.	For the proposed terminals, modern terminal management with route rationalization and route franchise systems have been suggested supported by Intelligent Transport System (ITS).
(11)	Surrounding areas of the proposed terminals are not developed yet and land use has been designated as mixed in most cases. When developed, these areas will have local road network adjacent to the terminal locations and may conflict with the entry/exit to the terminals.	Separate service roads and acceleration and de-acceleration lanes are proposed for the terminals to differentiate terminal related transport from local area transport.

After analyzing the impacts on the existing terminals and proposed terminals, it is evident that the project will have more positive impacts than negative ones. Adequate mitigation measures are suggested for the negative impacts. After the opening of the Padma Bridge, MRT Line 6 and operation of city bus route rationalization system, the transport situation will undergo changes and will have major impact on the transport network in Dhaka city. The consultant is of the opinion that a comprehensive Integrated Transport Assessment (ITA) study be carried out during design stage of this project to provide guidance in planning of new urban transport projects for Dhaka city.



5 Transport Survey and Analysis

Dhaka, being the capital city of Bangladesh, remains the center of economic and administrative activities. Geographically, also, it is located at the center of the country and possesses good connectivity with most other districts, mostly by roads. Currently Dhaka has three interdistrict bus terminals (Sayedabad, Mohakhali and Gabtoli) to cater to the demand for interdistrict buses. In addition, there are private bus depots. With the rapid urbanization, the city has expanded by many folds in recent decades and the interdistrict bus terminals are engulfed by surrounding developments. As a result, the buses that ply through these terminals add to the road congestion of the city.

Therefore, it has become imperative to move the interdistrict bus terminals to the city peripherals with good connectivities. If implemented, the decision will reduce traffic congestion inside the city. Secondly, it will reduce overall door-to-door travel time even for interdistrict trips. Third and most importantly, due to easing traffic congestion, emissions from vehicles will be reduced significantly.

One of the major stages in the study is the estimation of number of passengers which dictates the number of buses to be handled at each terminal. Passenger/bus demand to and from Dhaka was estimated based on demographic and economic data of different districts and calibrated with current interdistrict bus fleet which was captured by cordonline camera survey. The estimated demand and passenger behaviors observed during surveys helped to identify peak traffic and its magnitude. All these information were critical for developing design of terminal.

5.1 Demand Estimation

It is widely accepted that bus trips generated from any area largely depend on its population, economy, distance, modal options, socio-cultural aspects and interaction with the destination areas. For estimating interdistrict bus passengers (to and from Dhaka) a wide pool of data was collected from different districts in Bangladesh. There is a good range of prediction tools available to estimate the number of interdistrict passengers. Among several methods and tools, correlation and linear regression were used to find out the relationship between passenger demand and determinant factors for sample data requirement and for predicting capacities of the proposed terminals (Figure 5.1).

Several factors were tested for finding their relationships with the number of Dhaka bound passengers. Those with reliable statistical significance were used to estimate number of passengers travelling between the districts and Dhaka. In this study, the number of passengers travelling to Dhaka from other districts was considered as a dependent variable. For independent variable, a wide range of factors was considered. They were tested to understand the relationship between passenger carriage demands and the individual factors.

5.2 Data and Data Source

Number of buses operating between Dhaka and other districts varies with seasons. Due to prevailing COVID-19 situation, it was difficult to conduct full-fledge survey and the survey itself in this neo-normal situation may not reflect the travel pattern of normal time. As a result, this estimation may not reflect peak season passenger demand rather annual average passenger travel demand between districts. Having constrained by this situation, number of buses operating from the three terminals were gathered from recent survey report by JICA (2018) which were adjusted and verified with information collected from owners' association.

During survey in October-November 2020, passenger occupancy ratio was found to be 60-72%. In normal situation, it was 75%. For compensating the shortage of data due to COVID, the same from recent past was taken into consideration to match the normal situation.

Table 5.1 presents a list of factors that was considered. Population and employment data were collected from census and adjusted to base year (2020) using growth factor as recommended by Bangladesh Bureau of Statistics (BBS). Factors like affluence, alternate modal options were considered as proxy variables.

Figure 5-1: Use of OLS Method for Trip Generation

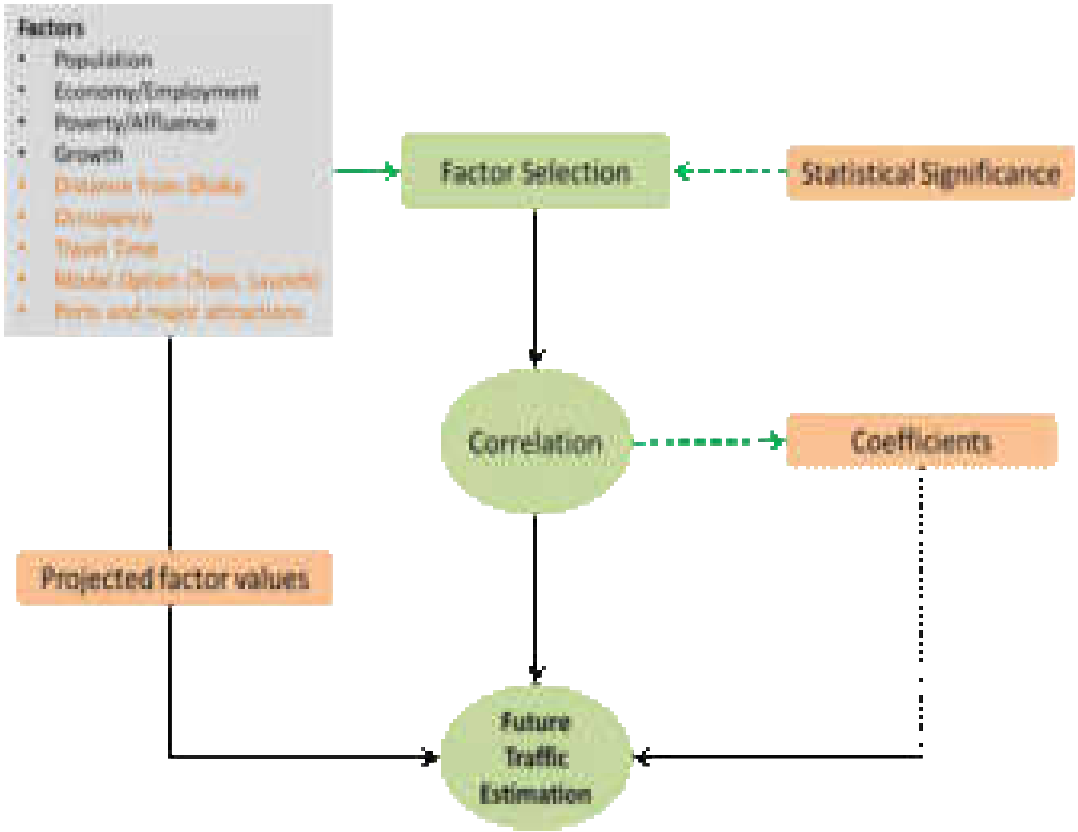


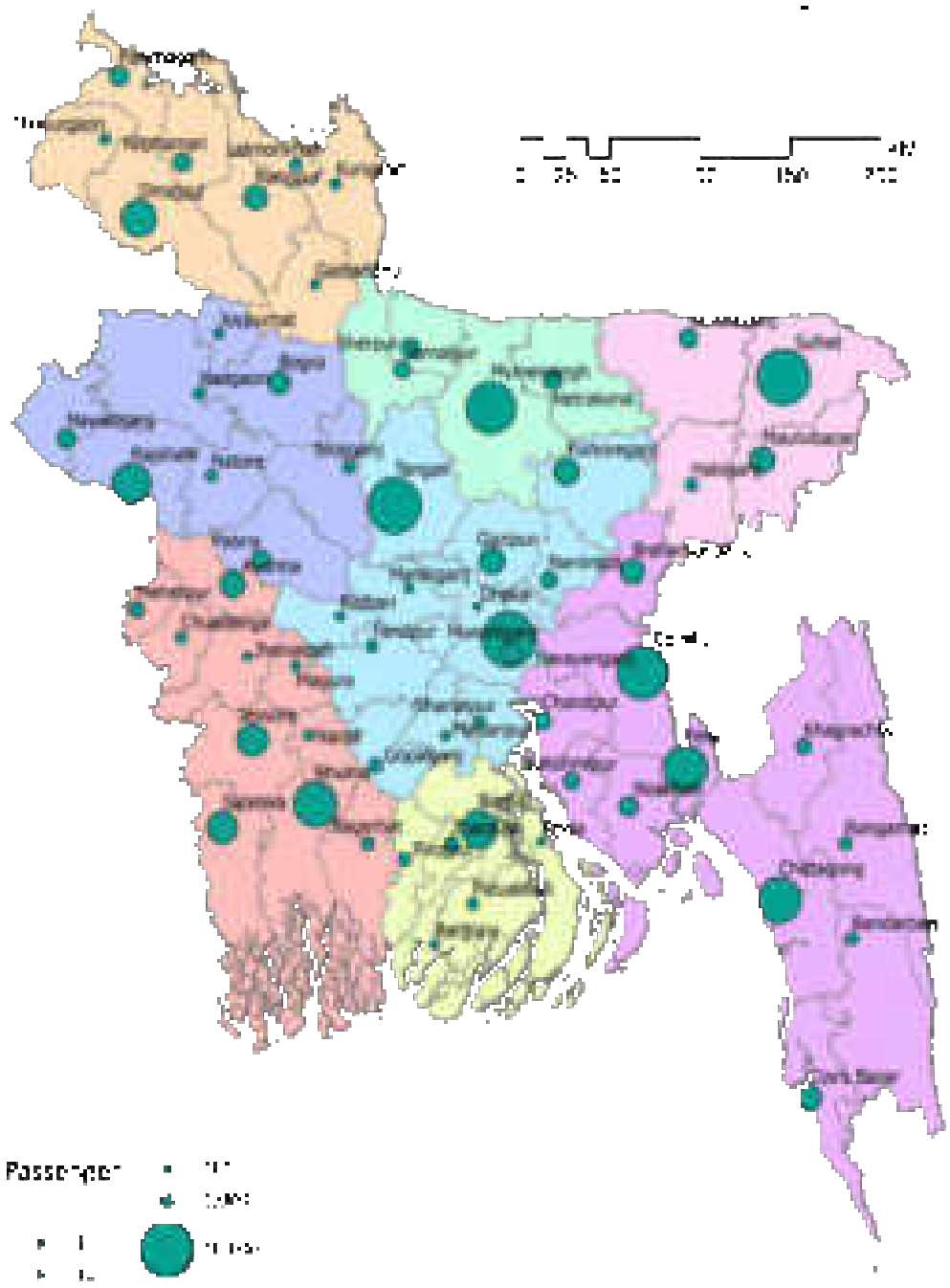
Table 5-1: Factors considered developing a linear regression model for demand estimation

	Initial Factors	Data Source
(1)	Interdistrict Bus Passenger	MRT Study (JICA 2018), Secondary Information from Interdistrict Bus Owners' Association, Field survey
(2)	Population 2020	Census 2011 and Population Forecasting 2016
(3)	Economy/Employment	Economic Census 2013
(4)	Poverty/Affluence	Vehicle Ownership (census 2011), Employment
(5)	Growth (population, employment)	Census 2001, 2011, 2013
(6)	Distance from Dhaka	RHD
(7)	Interdistrict Bus Occupancy	Field Survey
(8)	Accessibility level by Alternative Modes (rail, launch)	Bangladesh Railway, BIWTA

5.3 Estimating Number of Passengers

From the correlation/regression exercise, it is found that only population and employment plays logical and consistent relation with the number of passengersto Dhaka. Using the varying population growth factor and employment situations, future passenger traffic to Dhaka from different districts was estimated (Table 5.2).

Figure 5-2: Base Year Interdistrict Passenger Carriage Demand[41]



[41]Secondary Data

Table 5-2: Projected Number of Interdistrict Passengers to Dhaka[42]

	District	Number of Interdistrict Passengers					
		2020	2025	2030	2035	2040	2045
(1)	Barguna	695	879	1,049	1,149	1,209	1,229
(2)	Barisal	5,501	7,041	8,489	9,361	9,900	10,089
(3)	Bhola	579	817	1,066	1,250	1,378	1,435
(4)	Jhalokati	2,316	2,828	3,281	3,514	3,643	3,675
(5)	Patuakhali	1,448	1,753	2,021	2,153	2,224	2,239
(6)	Pirojpur	1,737	2,294	2,837	3,191	3,419	3,509
(7)	Bandarban	1,737	1,915	2,047	2,058	2,045	2,019
(8)	Brahmanbaria	5,212	6,615	7,923	8,692	9,161	9,319
(9)	Chandpur	3,474	4,569	5,631	6,316	6,757	6,927
(10)	Chattogram	11,581	18,465	26,626	33,715	39,196	41,994
(11)	Comilla	13,782	16,232	18,297	19,163	19,572	19,589
(12)	Cox's Bazar	5,212	6,616	7,924	8,693	9,162	9,320
(13)	Feni	5,791	6,830	7,708	8,080	8,257	8,267
(14)	Khagrachhari	2,316	3,232	4,181	4,866	5,339	5,547
(15)	Lakshmipur	2,895	3,625	4,294	4,671	4,894	4,964
(16)	Noakhali	3,764	4,990	6,190	6,977	7,489	7,691
(17)	Rangamati	1,737	1,956	2,126	2,166	2,171	2,153
(18)	Faridpur	1,448	1,677	1,865	1,933	1,961	1,955
(19)	Gazipur	5,791	9,879	15,057	19,906	23,843	25,960
(20)	Gopalganj	2,027	2,454	2,828	3,013	3,113	3,134
(21)	Kishoreganj	5,791	7,028	8,118	8,661	8,958	9,024
(22)	Madaripur	579	704	814	869	899	906
(23)	Manikganj	579	712	831	894	930	939
(24)	Munshiganj	3,938	5,147	6,312	7,052	7,525	7,704
(25)	Mymensingh	13,318	19,124	25,316	30,002	33,327	34,849
(26)	Narayanganj	17,372	24,414	31,759	37,133	40,869	42,527
(27)	Narsingdi	2,895	3,791	4,657	5,209	5,563	5,697
(28)	Rajbari	579	420	450	432	397	377
(29)	Shariatpur	1,274	1,631	1,968	2,170	2,296	2,340
(30)	Tangail	14,476	18,137	21,493	23,388	24,514	24,865
(31)	Bagerhat	1,737	2,288	2,824	3,170	3,393	3,480
(32)	Chuadanga	1,216	1,583	1,935	2,156	2,297	2,349
(33)	Jessore	7,528	8,648	9,553	9,852	9,958	9,914
(34)	Jhenaidah	463	522	567	578	579	574
(35)	Khulna	11,581	14,381	16,918	18,309	19,118	19,354
(36)	Kushtia	5,791	6,016	6,130	5,944	5,765	5,620
(37)	Magura	695	882	1,056	1,158	1,220	1,241
(38)	Meherpur	2,606	3,358	4,072	4,509	4,783	4,882
(39)	Narail	926	1,835	3,161	4,600	5,891	6,654

[42]Growth rates of population and non-agricultural employment have been taken from Economic Census of Bangladesh (BBS, 2013) and Population Projection of Bangladesh - Dynamics and Trends 2011-2061 (BBS, 2016)

	District	Number of Interdistrict Passengers					
		2020	2025	2030	2035	2040	2045
(40)	Satkhira	7,412	8,552	9,480	9,803	9,926	9,892
(41)	Jamalpur	2,895	3,378	3,779	3,935	4,003	3,999
(42)	Netrakona	3,764	3,464	3,202	2,884	2,663	2,534
(43)	Sherpur	3,474	4,324	5,097	5,524	5,774	5,849
(44)	Bogra	4,632	6,128	7,588	8,541	9,160	9,403
(45)	Joypurhat	579	700	807	859	887	893
(46)	Naogaon	1,448	1,733	1,980	2,095	2,154	2,163
(47)	Natore	1,158	1,588	2,026	2,333	2,541	2,629
(48)	Nawabganj	3,474	4,721	5,975	6,839	7,419	7,662
(49)	Pabna	3,474	4,397	5,253	5,752	6,054	6,154
(50)	Rajshahi	9,844	12,569	15,124	16,653	17,595	17,921
(51)	Sirajganj	1,737	1,952	2,119	2,156	2,159	2,140
(52)	Dinajpur	8,975	10,257	11,283	11,599	11,699	11,634
(53)	Gaibandha	695	776	837	848	847	838
(54)	Kurigram	1,158	1,367	1,543	1,618	1,654	1,656
(55)	Lalmonirhat	1,448	1,787	2,092	2,255	2,349	2,375
(56)	Nilphamari	3,474	4,807	6,175	7,150	7,817	8,105
(57)	Panchagarh	3,474	4,528	5,541	6,179	6,586	6,738
(58)	Rangpur	5,212	6,489	7,651	8,293	8,670	8,782
(59)	Thakurgaon	1,158	1,358	1,526	1,594	1,625	1,625
(60)	Habiganj	1,737	2,122	2,464	2,640	2,738	2,762
(61)	Maulvibazar	5,791	7,809	9,823	11,192	12,102	12,477
(62)	Sunamganj	3,474	4,119	4,668	4,908	5,027	5,038
(63)	Sylhet	16,214	20,093	23,600	25,507	26,611	26,928
	Total	**269,089**	**344,308**	**419,003**	**468,107**	**501,075**	**514,510**

5.4 Number of Bus Trips from Each District

It is considered that average capacity of buses is 45 each with an occupancy rate of 75%. The following table presents the projection of the Dhaka bound bus trips based on the above assumption with the projected number of passengers.

Table 5-3: Projectionof Dhaka-bound Bus Trips[43]

	District	Estimated Number of Bus Trips					
		2020	2025	2030	2035	2040	2045
(1)	Barguna	21	26	31	34	36	36
(2)	Barisal	163	209	252	277	293	299
(3)	Bhola	17	24	32	37	41	43
(4)	Jhalokati	69	84	97	104	108	109
(5)	Patuakhali	43	52	60	64	66	66

[43]Occupancy rates were planned to be obtained from field survey. However, due to COVID situation, the number of interdistrict buses and occupancy levels were still very low (<70%). This is not realistic for planning estimate. Therefore, for occupancy levels, previous study was considered and numbers were estimated accordingly.

	District	Estimated Number of Bus Trips					
		2020	2025	2030	2035	2040	2045
(6)	Pirojpur	51	68	84	95	101	104
(7)	Bandarban	51	57	61	61	61	60
(8)	Brahamanbaria	154	196	235	258	271	276
(9)	Chandpur	103	135	167	187	200	205
(10)	Chattogram	343	547	789	999	1,161	1,244
(11)	Cumilla	408	481	542	568	580	580
(12)	Cox's Bazar	154	196	235	258	271	276
(13)	Feni	172	202	228	239	245	245
(14)	Khagrachhari	69	96	124	144	158	164
(15)	Lakshmipur	86	107	127	138	145	147
(16)	Noakhali	112	148	183	207	222	228
(17)	Rangamati	51	58	63	64	64	64
(18)	Faridpur	43	0	0	0	0	0
(19)	Gazipur	172	50	55	57	58	58
(20)	Gopalganj	60	293	446	590	706	769
(21)	Kishorganj	172	73	84	89	92	93
(22)	Madaripur	17	208	241	257	265	267
(23)	Manikganj	17	21	24	26	27	27
(24)	Munshiganj	117	21	25	26	28	28
(25)	Mymensingh	395	152	187	209	223	228
(26)	Narayanganj	515	567	750	889	987	1,033
(27)	Narsingdi	86	723	941	1,100	1,211	1,260
(28)	Rajbari	17	112	138	154	165	169
(29)	Shariatpur	38	12	13	13	12	11
(30)	Tangail	429	48	58	64	68	69
(31)	Bagerhat	51	68	84	94	101	103
(32)	Chuadanga	36	47	57	64	68	70
(33)	Jessore	223	256	283	292	295	294
(34)	Jhenaidah	14	15	17	17	17	17
(35)	Khulna	343	426	501	542	566	573
(36)	Kushtia	172	178	182	176	171	167
(37)	Magura	21	26	31	34	36	37
(38)	Meherpur	77	100	121	134	142	145
(39)	Narail	27	54	94	136	175	197
(40)	Satkhira	220	253	281	290	294	293
(41)	Jamalpur	86	100	112	117	119	118
(42)	Netrakona	112	103	95	85	79	75
(43)	Sherpur	103	128	151	164	171	173
(44)	Bogra	137	182	225	253	271	279
(45)	Joypurhat	17	21	24	25	26	26
(46)	Naogaon	43	51	59	62	64	64
(47)	Natore	34	47	60	69	75	78
(48)	Nawabganj	103	140	177	203	220	227
(49)	Pabna	103	130	156	170	179	182
(50)	Rajshahi	292	372	448	493	521	531

	District	Estimated Number of Bus Trips					
		2020	2025	2030	2035	2040	2045
(51)	Sirajganj	51	58	63	64	64	63
(52)	Dinajpur	266	304	334	344	347	345
(53)	Gaibandha	21	23	25	25	25	25
(54)	Kurigram	34	40	46	48	49	49
(55)	Lalmonirhat	43	53	62	67	70	70
(56)	Nilphamari	103	142	183	212	232	240
(57)	Panchagarh	103	134	164	183	195	200
(58)	Rangpur	154	192	227	246	257	260
(59)	Thakurgaon	34	40	45	47	48	48
(60)	Habiganj	51	63	73	78	81	82
(61)	Maulvibazar	172	231	291	332	359	370
(62)	Sunamganj	103	122	138	145	149	149
(63)	Sylhet	480	595	699	756	788	798
	Total	**7973**	**10,202**	**12,415**	**13,870**	**14,847**	**15,245**

5.5 Location Analysis

Locations of proposed terminals were evaluated using the multi-criteria matrix (Table 3.3 and Chapter 3). It helped to investigate the locational settings in terms of accessibility, topography, surrounding landuse and other relevant factors. This was checked with field visits and data were collected on land tenure, highway connectivity and access to city public transports. The location analysis was performed with guidance from DTCA and RAJUK to evaluate them in light of other projects of relevance by assigning scores to individual locations for its suitability.

5.6 Assignment and Network Analysis

Five locations were primarily selected for interdistrict bus terminals from Dhaka. Minimum distance from Dhaka was considered as main criteria to identify what location will serve which districts (assignment). The predicted numbers of passengers/buses were assigned to proposed terminals (Table 5.2 and Map 5.3). Current pattern of multiple terminals could be an option as well. It is to be mentioned that Dhaka region has engulfed several adjacent cities/town (Gazipur, Narsingdi, Narayanganj, Keraniganj, Munshiganj) and they have become a part of Dhaka mega urban region. Buses to these cities were excluded in intercity trip assignment and has become a part of Dhaka urban transport rather than inter-city.

5.7 Demand for the Proposed Terminals

Occupancy rate was assumed 75%. Peak hour traffic was found 12% from traffic count survey (Chapter 4). Based on these findings number of bus trips were estimated for each of the proposed terminals and used in the conceptual design of them.

Table 5-4: Proposed Sites for Interdistrict Bus Terminals and Incoming Traffic[44]

	Proposed Terminal	Connecting Districts		Passengers /day [2025]	Number of buses/Day [2025]
(1)	Baghair	14	Bagerhat| Barguna| Barisal| Bhola| Faridpur| Gopalganj| Jhalokati| Khulna| Madaripur| Munshiganj| Patuakhali| Pirojpur| Satkhira| Shariatpur	52,444	1,554
(2)	Kanchpur	11	Bandarban| Chandpur| Chattogram| Comilla| Cox's Bazar| Feni| Khagrachhari| Lakshmipur| Narayanganj| Noakhali| Rangamati	92,846	2,751
(3)	Gram Bhatulia	18	Bogura| Dinajpur| Gaibandha| Gazipur| Jamalpur|Joypurhat| Kurigram| Lalmonirhat| Mymensingh| Naogaon|Natore| Nilphamari| Panchagarh| Rangpur| Sherpur| Sirajganj| Tangail| Thakurgaon	98,314	2,913
(4)	Bhulta	8	Brahamanbaria| Habiganj| Kishoreganj| Maulvibazar| Narsingdi| Netrakona| Sunamganj| Sylhet	55,042	1,631
(5)	Hemayet-pur	12	Chuadanga| Jessore|Jhenaidah| Kushtia| Magura| Manikganj| Meherpur| Narail| Nawabganj| Pabna| Rajbari| Rajshahi	45,662	1,353

Table 5-5: Projected Number of Buses for the Proposed Terminals

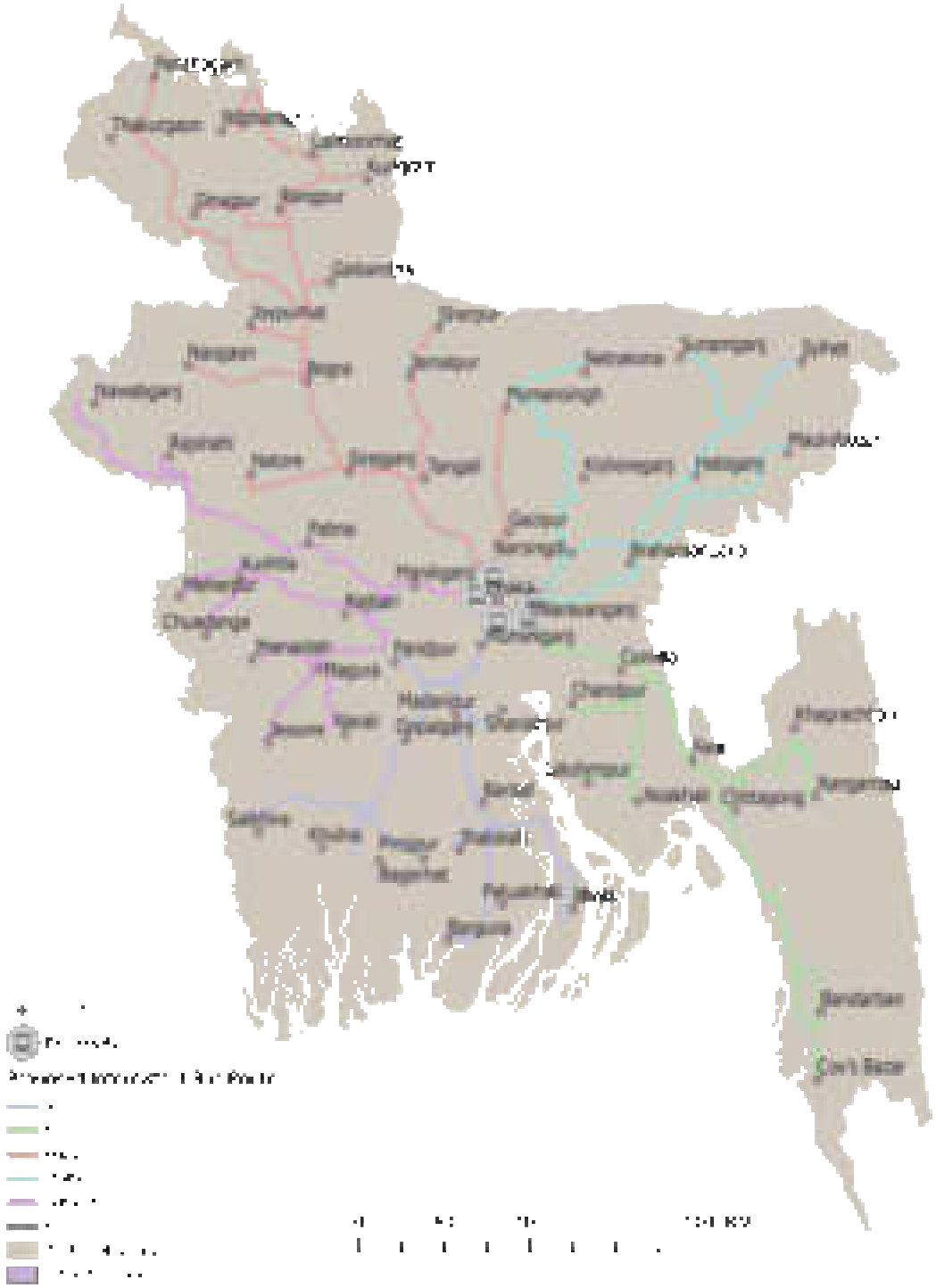
	Terminal	Connecting Districts	Total Number of Buses / day				
			2025	2030	2035	2040	2045
(1)	Baghair	14	1,554	1,830	1,983	2,074	2,102
(2)	Kanchpur	11	2,751	3,460	3,966	4,319	4,474
(3)	Gram Bhatulia	18	2,913	3,612	4,097	4,433	4,578
(4)	Bhulta	8	1,631	1,910	2,065	2,158	2,186
(5)	Hemayetpur	12	1,353	1,603	1,759	1,863	1,905
		Total	**10,202**	**12,415**	**13,870**	**14,847**	**15,245**

	Terminal	Connecting District	Total Number of Buses /day (peak period)				
			2025*	2030	2035	2040	2045
(1)	Baghair	14	186	220	238	249	252
(2)	Kanchpur	11	330	415	476	518	537
(3)	Gram Bhatulia	18	350	433	492	532	549
(4)	Bhulta	8	196	229	248	259	262
(5)	Hemayetpur	12	162	192	211	224	229
		Total	**1,224**	**1,490**	**1,664**	**1,782**	**1,829**

It is assumed that the terminals will be ready in 2025 after detail design, land acquisition and construction.

[44]Secondary Data

Figure 5-3: Interdistrict Bus Terminals and Catchments[45]



5.8 Future Passenger Carriage Demand at Proposed Terminals

It is estimated that total number of interdistrict passengers will be around 354,000 perday by the year 2025.

[45] result from network assignment

Table 5-6: Projected Daily Passenger Number for Proposed Interdistrict Terminals

	Bus Terminal	2025	2030	2035	2040	2045
(1)	Baghair	52,444	61,752	66,935	70,004	70,940
(2)	Kanchpur South	92,846	116,783	133,837	145,753	150,999
(3)	Gram Bhatulia	98,314	121,909	138,275	149,608	154,504
(4)	Bhulta	55,042	64,453	69,693	72,822	73,779
(5)	Hemayetpur	45,662	54,107	59,368	62,888	64,289
	Total	**344,308**	**419,003**	**468,107**	**501,075**	**514,510**

From survey, it reveals that 12% bus operates during peak hour. Assuming that same travel pattern will prevail, it is estimated that 41317 passengers will use five interdistrict bus terminal during peak hour (Table 5.7).

Table 5-7: Projected Number of Passengers during Peak-period in the Proposed Interdistrict Terminals[46]

	Bus Terminal	2025	2030	2035	2040	2045
(1)	Baghair	6,293	7,410	8,032	8,400	8,513
(2)	Kanchpur South	11,141	14,014	16,060	17,490	18,120
(3)	Gram Bhatulia	11,798	14,629	16,593	17,953	18,540
(4)	Bhulta	6,605	7,734	8,363	8,739	8,854
(5)	Hemayetpur	5,479	6,493	7,124	7,547	7,715
	Total	**41,317**	**50,280**	**56,173**	**60,129**	**61,741**

5.9 City Bus Trip Demands at Proposed Terminals

From interdistrict passenger survey at the existing three terminals in Dhaka, it was found that 40% passengers use or prefer public transport to come to the bus terminals. Assuming the same behavior in the future, demands for city bus trips is presented in the following two tables.

Table 5-8: City Bus Trip Demand per Day

	Destination	2025	2030	2035	2040	2045
(1)	Baghair	420	494	535	560	568
(2)	Kanchpur South	743	934	1,071	1,166	1,208
(3)	Gram Bhatulia	787	975	1,106	1,197	1,236
(4)	Bhulta	440	516	558	583	590
(5)	Hemayetpur	365	433	475	503	514

[46]*12% of buses arrives at peak

Table 5-9: City Bus Trip Demand during Peak[47]

	Destination	2025	2030	2035	2040	2045
(1)	Baghair	56	66	71	75	76
(2)	Kanchpur South	99	125	143	155	161
(3)	Gram Bhatulia	105	130	147	160	165
(4)	Bhulta	59	69	74	78	79
(5)	Hemayetpur	49	58	63	67	69

Dwell time survey [Chapter-4] at all three existing terminals reveals that 20% of buses stay longer time/overnight at terminals/depots [Table 5.8]. This will require parking space for upto 583 at Gram Bhatulia.

Table 5-10: Demand for Long Stay Bus Parking[48]

	Terminal	2025	2030	2035	2040	2045
(1)	Baghair	311	366	397	415	420
(2)	Kanchpur South	550	692	793	864	895
(3)	Gram Bhatulia	583	722	819	887	916
(4)	Bhulta	326	382	413	432	437
(5)	Hemayetpur	271	321	352	373	381

Given the space available in these locations, it may not be possible to allow 20% for long time parking. Fleet management need to be done actively as the incoming buses can be cleaned/maintained and start back to their destination in the shortest possible time. At the same time, private depots can be used by operators with large fleet.

It appeared that among the terminal users,40% are bus-passengers, 37% users arrivethrough auto-rickshaws and 2.6% with car. The daily car arrivals in the terminals are provided in the following table, assuming 2.6% of the passengers use cars to come to terminal with average occupancy of 2 passengers:

Table 5-11: Demand for Daily Car Parking

	Destination	2025	2030	2035	2040	2045
(1)	Baghair	698	821	890	931	943
(2)	Kanchpur South	1,235	1,553	1,780	1,939	2,008
(3)	Gram Bhatulia	1,308	1,621	1,839	1,990	2,055
(4)	Bhulta	732	857	927	969	981
(5)	Hemayetpur	607	720	790	836	855
	Total	**4,579**	**5,573**	**6,226**	**6,664**	**6,843**

For auto-rickshaws, if we assume average occupancy of 2 passengers per vehicle, the demand for parking is estimated as follows:

[47] Based on field survey
[48] *20% of buses stay overnight

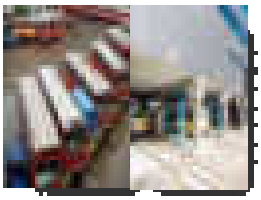
Table 5-12: Demand for Auto-rickshaw Parking

	Destination	2025	2030	2035	2040	2045
(1)	Baghair	5,244	6,175	6,693	7,000	7,094
(2)	Kanchpur South	9,285	11,678	13,384	14,575	15,100
(3)	Gram Bhatulia	9,831	12,191	13,827	14,961	15,450
(4)	Bhulta	5,504	6,445	6,969	7,282	7,378
(5)	Hemayetpur	4,566	5,411	5,937	6,289	6,429

Table 5-13: Estimated Hourly Auto-rickshaw Demand

	Destination	2025	2030	2035	2040	2045
(1)	Baghair	437	515	558	583	591
(2)	Kanchpur South	774	973	1,115	1,215	1,258
(3)	Gram Bhatulia	819	1,016	1,152	1,247	1,288
(4)	Bhulta	459	537	581	607	615
(5)	Hemayetpur	381	451	495	524	536
	Total	**2,869**	**3,492**	**3,901**	**4,176**	**4,288**

These auto-rickshaws do not stay/park for longer time except dropping and picking passengers at the terminals. Since the proposed terminals are located outside the city, number of required city buses/shuttles will be higher. Passengers may not be willing to pay for example, 400 where as to take a bus to Khulna costs 500. Therefore, it is likely, and should be encouraged, that there will be modal shift from auto-rickshaws to city buses. For stations like Hemayetpur, MRT will take up most passengers. To make the other terminals successful, we need expansion of MRT/BRT/shuttle services as it can draw passengers very quickly to the city.



6 Topographic and Geo-technical Survey

6.1 Topographic Survey

The principal objective of conducting topographical survey is to prepare geo-coordinate maps of the project sites depicting the existing roads and specific land areas with ground levels to facilitate design of Bus Terminals around Dhaka City at the proposed ten locations.

Based on the above objective, the survey (following Global Positioning System GPS) was conducted through following steps:

(1) Conducting total station survey of 10 locations with ground levels with 5 meter intervals or less to cover all areas at change in topography and preparation of geo-coordinated maps in AutoCad program in relative scale.

(2) Carrying out total station topographical survey of land area at different locations taking spot levels in 5m grid and preparation of geo-coordinated maps in AutoCad program in 1:100 scale.

(3) Transfer of BM[49] to work sites from the nearest available BM and providing BM reference pillars at any permanent place.

GPS control points were established by using differential global positioning system (DGPS) at different locations of the proposed bus terminals. The GPS points established at different locations are shown in Table 6.1. The UTM 46 Zone projection system was used. Ten locations of proposed bus terminal sites were surveyed. The areas of each location and coordinates are given below:

Table 6-1: Area and Coordinates of the Proposed Sites

	Location	Area (acres)	X	Y
(1)	Baghair	32	233,284	2,619,357
(2)	Kanchpur South	27.7	249,598	2,621,702
(3)	Kanchpur North	15	247,643	2,623,559
(4)	Gram Bhatulia	15.3	231,105	2,643,547
(5)	Bhulta	24.07	252,811	2,632,467
(6)	Hemayetpur	45	222,413	2,634,102
(7)	Bhawal, Ati Bazar	30	225,798	627,095
(8)	Baipail	38	21,364	654,836
(9)	Gazipur	12	233,876	2,657,980
(10)	Kanchan	24.3	251,668	2,637,597

Surveys were carried out using lan metric control (based on procedures evolved by Survey of Bangladesh), Total Station Traverse and Height Control.Height control was provided through

[49] Benchmark

fly leveling by using a Leica Auto Level. The locations and value (height) of the established Survey of Bangladesh (SoB), BMs are indicated in the following table.

Table 6-2: Locations and SOB Values

	Location	Source (SoB)	Permanent Site		Project Site
			Location of the Pillar	TBM	TBM
(1)	Baghair	GPS BM-5676.	In the compound of Abdullahpur Government Primary School. It is North of Dhaka Mawa road and East of school tin shed Bhaban. Vill: Abdullahpur, Upuzilla: Keraniganj, Dist: Dhaka.	RL : 5.9936 (SOB)	RL=8.073M (SOB)
(2)	Kanchpur South	BM-6193	North-west corner of the Playground of Omar Ali School on Dhaka - Daudkandi High way. Vill: Kanchpur, Upazilla: Sonargaon, Dist: Naraynganj.	RL=5.9630 (SOB)	RL=6.832
(3)	Kanchpur North	BM-6193	North-west corner of the Playground of Omar Ali School on Dhaka - Daudkandi High way. Vill: Kanchpur, Upazilla: Sonargaon, Dist: Naraynganj.	RL=5.9630 (SOB)	RL=5.9630 (SOB)
(4)	Gram Bhatulia	BM-0133.	North-South of the compound of Kamarpara School and college Building. Vill: Kamarpara, PS: Turag, Dist: Dhaka.	RL : 9.0667 (SOB).	RL.=10.302 (SOB)
(5)	Bhulta	GPS BM-5688.	West side of Kanchan bridge and Southwest corner of wing wall. Vill: Dakhin Barmhankhali, Thana: Rupganj, Dist: Narayanganj.	RL: 6.1925 m (SOB)	RL=5.082 (SOB)
(6)	Hemayetpur	BM-6193	Compound of Tetul Jhara Family Planning Centre, Vill: Tetul Jhara, Upazilla: saver, Dist: Dhaka.	RL=6.072 (SOB)	RL=7.03 (SOB)
(7)	Bhawal, Ati Bazar	BM-0107.	South - East corner of Ati Bhawal High School's playground. Vill: Boro Bhawal, Thana: Keraniganj, District: Dhaka.	RL: 5.787 (SOB)	RL =8.318 m (SOB)
(8)	Baipail	BM-641.	Compound of Mauchak Union Parishad at Kaliakair on Dhaka- Tangail highway. Vill: Mauchak, Upazilla: Kaliakair, Dist: Gazipur.	RL:12.1919 m (SOB)	RL=11.30 m(SOB)
(9)	Gazipur	BM-8019.	The pillar is situated South -West corner of play ground of porabari Shasufi Saifuddin high-school. It is 50 meter West from RAB office and 15m North from agriculture development horticulture centre. Vill: Porabari, PS: Gazipur Sadar, Dist: Gazipur.	RL: 13.2733 m (SOB).	RL= 14.397 (SOB)

	Location	Source (SoB)	Permanent Site		Project Site
			Location of the Pillar	TBM	TBM
(10)	Kanchan	BM-0176.	The pillar is situated in the West side of Kanchan bridge and Southwest corner of wing wall. Vill: Dakhin Barmhankhali, Thana: Rupganj, Dist: Narayanganj.	RL: 8.9901m (SOB)	RL=4.972 (SOB)

Based on the methodology, all the completed and semi-constructed buildings, temporary buildings, pucca and katcha roads, electric poles, ditches, ponds, canals, brick-fields, mosques, factories etc. of the areas of the projects were surveyed and details of survey are shown in Annex 6.1.

Maps and Drawings: The survey maps and drawings were prepared using AutoCad Map 3D 2019. All roads along with ground levels at various points, roads, structures and other descriptive features are shown on the map. The list of drawings thus produced is presented in Annex 6.1.

6.2 Geo-technical Survey

Dhaka is situated at the southern tip of a Pleistocene terrace, the Madhupur tract. Two characteristic geological units cover the city and surroundings *i.e.,* Madhupur clay of the Pleistocene age and alluvial deposits of recent age. The Modhupur clay is the oldest sediment exposed in around the city area with thickness ranging from 8 m to 45 m with an average thickness of 10 m. The rest of the area is covered by the flood plain of the Turag, Balu, Buriganga and Sitlakshya. The under lying layer is geologically known as the Dupi Tila which is composed of sand particles ranges from 100 m to 200 m with an average thickness of 140 m. The major geomorphic units of the city area – the high land or the Dhaka terrace, the low land or flood plains, depressions and abandoned channel. Low lying swamps and marshes located in around the city are other major topographic features.

The geo-technical exploration consisted of both field investigation and laboratory teats programs. The detail scope of the investigation for the proposed sites are described in location maps, bore log details, laboratory results and in the foundation design. The field and laboratory testing were broadly performed in conformance with applicable ASTM/AASHTO/BS or other acceptable international codes as indicated in Bangladesh National Building Code (BNBC) standards.

The sub-soil Investigations report including bore log for proposed sites and the general evaluation of geotechnical design parameters are enclosed in Annex 6.4.

6.2.1 Regional Seismic Effect

According to the global seismic hazard assessment program (GSHAP), Dhaka division is the moderate hazardous seismic effect in Bangladesh and the peakground acceleration (PGA) may be expected to be 0.2 g.The seismic zoning map of Bangladesh is shown in Figure 6.1.

6.2.2 Design of Foundation

During conceptual design stage, indicative foundation design of the proposed terminals was developed on the basis of the geotechnical investigation for the purpose of estimating costs

only. During detail design, more robust foundation design will be prepared. Foundation design of proposed bus terminal and deport are dependent on the physical properties of soil and corresponding surcharge load of land fill. The principles of design loads for foundation are taken from relevant international codes.

The site investigations were designed to obtain the parameters necessary for the determination of the structural load on bus terminal and deport. The proposed foundation design for the terminals will satisfy the requirements of construction, minimum settlement and earthquake resistance.

6.2.3 Geological Profiles of the Selected Sites

Based on the bore log results, it can be observed that the area of the proposed bus terminals and depots are composed of soft clayey silt layer at top (5 m thick), medium stiff clayey silt at mid depth (5 m thick) and medium dense silty sand (10 m thick) at the lower layerIt can also be inferred that the foundation level of 3-storied terminal buildings will generally rest on soft clayey silt layer (where ground water table is not found during dry or wet season). In general, SPT-N value of less than 4 signifies very loose soil, SPT-N value of 4 to 10 signifies loose soil and SPT- value of 10 to 30 signifies medium dense sandy soil.

6.2.4 Soil Improvement Techniques

The foundation design at the conceptual design stage is based on the sub soil investigation carried out on existing ground level (EGL). Accordingly, two types of foundation design i e pile /raft foundation for deep soft layers; and the column footings for improved soil layer (done by sand compaction piles for top soft layer) are proposed to cater for the imposed structural load of bus terminal and depot buildings.

The maximum column load of the bus terminal and depot buildings at conceptual design stage is estimated to be 3000 KN (for 10 m column grid in both direction). Assuming column footing size of 3.3 m x 3.3 m, the allowable bearing capacity of soil at foundation depth of 2.0 m is estimated to be 300 KN/m^2 i e 3 ton/ft^2 (possible with 4-5 m deep compacted local sand fill layers); otherwise raft foundation would be suitable to address of allowable settlement point. During detail design phase more elaborate investigation need to be carried out.

Since the soil in the areas of the projects are generally composed of soft layers, there is a need to improve the underlying soil**.** There are several approaches of soil improvement for mitigating settlement hazard which are outlined below:

Remove and Improve the soil: This approach involves mitigation of settlement hazards by removing or improving the soil. The factor of safety against settlement can be increased through densification of soil or by improving the drainage characteristics of the soil. This can be done using a variety of soil improvement techniques; such as removal and replacement compressible soil; in situ stabilization by grouting, densification and dewatering.

Build settlement resistant structures. For various reasons, such as the lack of available land, a structure may need to be constructed on settlement prone soils. It may be possible to make the structure settlement resistant by using mat or deep foundation system.

Preloading method. Instead of removing and re-compacting the soil, another approach is to use pre compression which is often an effective method of soil improvement for soft clays.

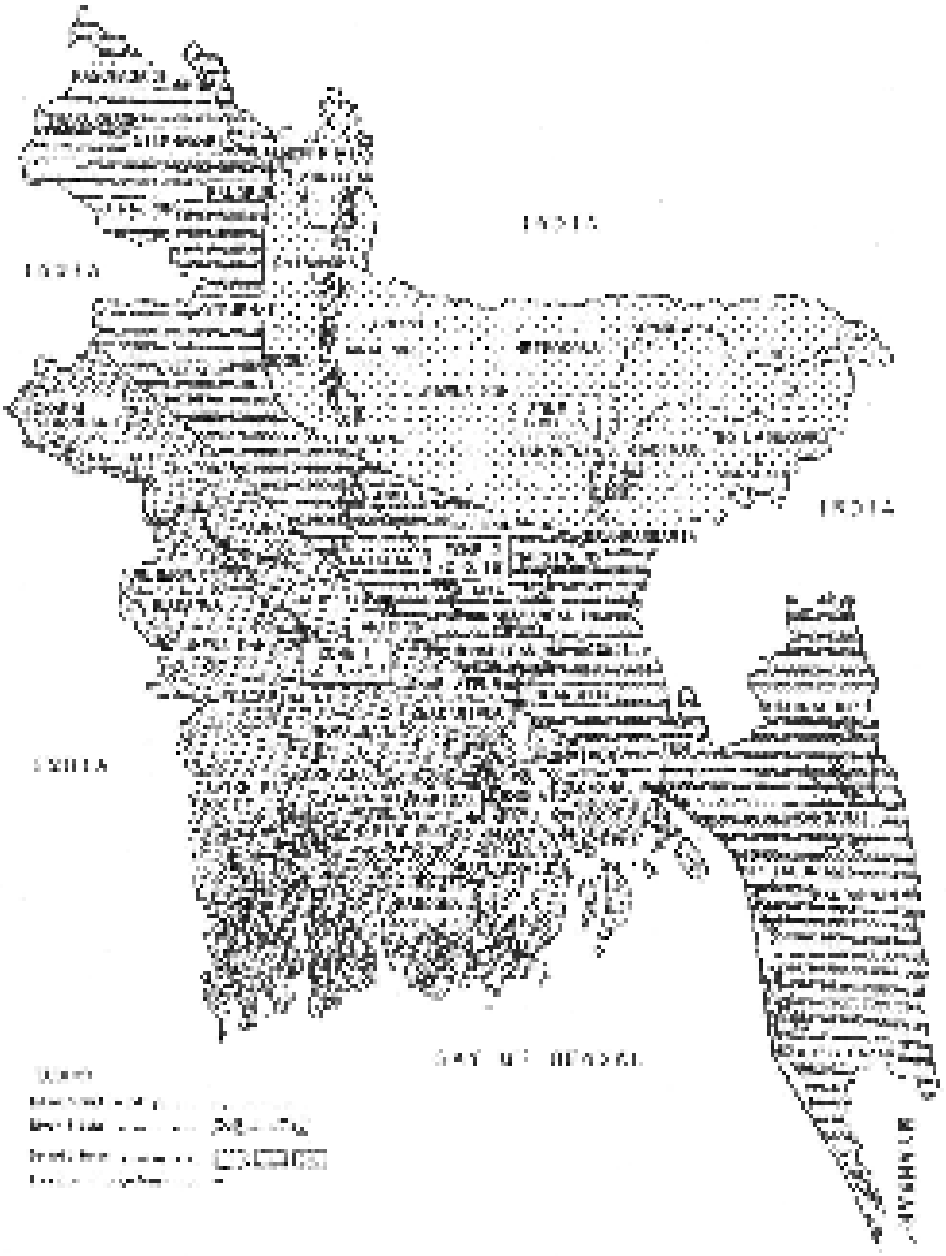
The process consists of temporarily surcharging the soil during the grading operations in order to allow the soils to consolidate, which reduces their compressibility and increase their shear strength. This process takes at least one year to attain desired settlement, as such has not been proposed in this case.

Sand compaction pile (SCP): Sand compaction piles are used where surcharge load of land fill areplanned instead of preloading. The effectiveness of sand compaction piles depends mainly on the engineering properties of soils namely soil permeability and coefficient of consolidation. The SCP seems to be most cost-effective soil treatment and the consultant has proposed this technique.

6.2.5 Seismic Measures

The seismic performance is generally influenced by seismic hazard, geological condition, structure design and type of construction. In broad sense, effect of earthquake on building can be grouped into two categories, namely ground shaking and ground failure. Based on performance records of buildings during past earthquakes, it is observed that damaging effect of ground failure is significantly higher than ground shaking. Ground acceleration value of 0.2 g was used for the design. It is expected that ground shaking will cause no damage.

Figure 6-1: Seismic Zoning Map of Bangladesh



6.2.6 Preliminary Design of Foundation

Based on sub soil data and past experiences, it is proposed that sand compaction piles of 0.3 m diameter and of 6 m length at an interval 1 m c/c (both grid) are sufficient for top 5-6 m soft soil layer improvement which will increase the SPT-N values. The installation of sand compaction piles is suggested in entire terminal/deport site area to attain uniform settlement. At the Gram Bhaturia site, sand compaction pile method is not feasible because of existence of very deep soft cohesive layer; precast piles or raft slab foundation is preferred here.

7 Social Impact Assessment

Social Impact Assessment is one of the critical aspects for project planning, implementation and monitoring and evaluation of Land Acquisition and Resettlement Plan. The SIA is prepared to mitigate the potentially adverse impacts of acquiring land and in some situations resettling households affected by the land acquisitions required for the proposed bus terminals/depots within Dhaka, Gazipur and Narayanganj districts.

For conducting SIA and and collecting primary socio-economic information of the project sites, several Focus Group Discussion (FGD) were arranged with project beneficiaries and project affected persons. A set of checklists and questionnaires were used for interviewing the Project Affected Persons (PAP). Both quantitative and qualitative techniques were applied.

7.1 Positive Impacts

The relocation of activities of the three existing bus terminals to the new proposed sites is expected to generate following positive impacts:

- Reduce traffic congestion in the city
- Save distance and time for bus operation and passenger travel
- Provide modern facility to the passenger
- Induce urban development of the surrounding areas
- Spur economic development through creation of jobs for terminal operation and new business opportunity (souvenir shops and food outlets)

7.2 Adverse Impacts

There will be adverse impacts at the existing terminals and at the proposed terminals. The existing bus terminals will function as city bus depots and the personnel currently engaged in terminal operation, security and cleaning and maintenance services may retain jobs mostly. However, there may also be job losses due to closure of shops and food outlets. At the proposed sites of the new bus terminals, the number affected persons is small (45 households and 250 persons) compared to the total size of land (271.76 acres) to be acquired. For the affected persons, adequate compensation packages will be provided based on the well-designed land acquisition and resettlement plan.

7.3 Gender Issues

For mainstreaming gender participation at national and grass root level, adequate attention was given in the planning and design of bus terminal. Following objectives were considered for improving wellbeing of women and girls:

- Minimize adverse impacts of the proposed bus terminal on women
- Provide adequate terminal facilities to women passengers

- Facilitate economic benefits to women during construction of terminal, operation and maintenance of terminal
- Create employment opportunities for women in the terminal
- Provide adequate safety and security in the terminal

The passenger survey carried out in the existing bus terminals revealed that the composition of women is about 24%. However, sufficient female facilities are not provided; therefore, in the proposed new terminals, the provisions of such facilities have been adequately taken care of.

7.4 Land Acquisition and Resettlement Plan (LARP)

The Land Acquisition and Resettlement Plan is based on the findings of the census of Project Affected persons, Socio-economic survey data and Focus Group Discussion (FGD). The survey covered the aspects of project impacts loss of land and immovable property and assets, the loss of livelihoods and incomes and other social and economic losses. Several visits were carried out by the consultant to conduct the socio-economic survey at the ten proposed terminal/depot areas. The survey questionnaire and the FGD protocol are attached in Annex 7. Further due to changed quantity of land for revised Hemayetpur terminal, the budget amount needs to be changed. Due to COVID-19 shutdown by the government, it was difficult to survey of the new land portion. However, the changed information was collected from the ward councilor-Savar online the details of which is shown in LARP report.

7.4.1 Social Impacts and Displacements

For the development of ten bus terminals/depots, 271.76 acres of land need to be acquired. Detail topographical survey and field survey were carried out to find out the possible impacts of the project development. A summary of project impacts and displacements of the surveyed households and persons is provided below:

Table 7-1: Summary of Social Impacts[50]

	To be affected (Social Impact)	Magnitude
(1)	Land	271.51 acres
(2)	Number of households/ structures	45 HHs: (25 buildings, 14 semi pucca + 5 thatched)
(3)	Number of HHs (based on SES income level)	45
(4)	Number of people	250
(5)	Total women household and disabled persons/HHs	18
(6)	Number of trees and crops	Tree 450

7.4.2 Project Affected Persons (PAPs)

As part of preliminary survey, 45 households including 250 members were surveyed and found to be affected in respect of loss of homesteads/ buildings, shops, brick-field offices, business shops and, tea stalls etc. Out of the total surveyed households, 154 were male and 96 female. Mostly, they are not title-holders and have taken sub-lease of land from the original lease-holders of GOB land. The people in the areas of the projects will be affected in

[50] These are calculated based on ten sites. The impacts will be less for the finally selected five sites.

various ways: land loss (brick fields, homesteads and business structures), income generating agricultural and livestock products (trees, crops, fishes), structures (residential and business) and loss of wage and income. Tables 7.2, 7.3 and 7.4 lay out summary of households and structures to be affected and types of losses to be incurred.

Table 7-2 : Population of the Surveyed Households[51]

	Name of Terminal/Depot	No. Of Surveyed households	Population		Total Population	Avg. Household Size
			Male	Female		
(1)	Baghair	7	17	13	30	5
(2)	Kanchpur South	2	15	5	20	5
(3)	Kanchpur North	2	19	6	25	10
(4)	Gram Bhatulia	0	0	0	0	0
(5)	Bhulta	0	0	0	0	0
(6)	Hemayetpur	13	61	18	79	7
(7)	Bhawal, Ati Bazar	0	0	0	0	0
(8)	Baipail	0	0	0	0	0
(9)	Gazipur	21	42	54	96	5
(10)	Kanchan	0	0	0	0	0
	Total	**45**	**154**	**96**	**250**	**5**

Table 7-3: List ofStructures to be Affected [52]

	Structure Types	HH No	%
(1)	Brick/cement built	25	56
(2)	Semi-Pucca	17	37
(3)	Thatched	3	7
(4)	Govt Own	0	0.00
(5)	Temporary	0	0.00
	Total	**45**	**100**

Mean: 33 HH:

[51] Socioeconomic Survey, Nov-Dec-2020
[52] do

Table 7-4:Land/Households/Population to be Affected by Types of Losses[53]

	Site	Name of Mouza, Upazilla/Thana	Type of Loss	Land Acres	Total Households non-titled
(1)	Baghair	Baghair, Teghoria union, Keraniganj	Homestead	33.63	7
(2)	Bhawal, Ati Bazar	Taranagor, Taranagar union, Keraniganj	Empty land	25.78	0
(3)	Kanchpur South	Fuler, Kanchpur south, Bandar Thana	Home steads	27.70	2
(4)	Kanchpur North	Kanchpur North, Sonargoan Thana	Water body, Roadside sheds	15.5	2
(5)	Gram Bhatulia	Gram Bhatulia, DNCC 53, Uttara Thana	Empty land	26.7	0
(6)	Bhulta	Golakandail, Bhulta ward 4,Rupgonj Thana	Closed brick field/shops at entry point	24.2	0
(7)	Hemayet -pur	Bilamalia, Tetuljhora union, Savarthana	Pucca building (4), Homestead, trees, road side shops, Mosque	45	13
(8)	Baipail	Dakhshin Panisail, GCC-1, Gazipurthana	Empty land	37.1	0
(9)	Gazipur	Tek Nagpur, GCC-18, Joydevpur Thana	Homestead, Insignificant Small size trees	11.7	21
(10)	Kanchan	NabarunJute Mill, Kanchan ward-7, Rupgonj Thana	Empty land	24.2	0
	Total			**271.51**	**45**

7.4.3 Socio Economic Profile

Socio economic profile of the Project Affected Persons covering the aspects of age structure, level of education, occupational pattern and health services were collected through survey in the areas of the projects. The average literacy rate in those areas were found to 84% for male and 89% for female; business is the major occupancy in the areas accounting for 21.4%. About 45% of the households are of middle-income group. The details are presented in the following tables:

Table 7-5: Age Structure of the Surveyed Household Members[54]

Age level (Years)	Male	%	Female	%	Total	Total (%)
1 to <=5 Yrs	28	18	7	7	35	14

[53] As above

[54] Socioeconomic Survey by the Consultant, Nov-Dec-2020

>5to 15 Yrs	44	29	17	18	61	24.40
>15 to 45 Yrs	43	28	48	50	91	36.40
>45 to 60 Yrs	15	10	11	11	26	10.40
Above 60 Yrs	24	16	13	14	37	14.8
Total	**154**	**100**	**96**	**100**	**250**	**100**

Table 7-6: Level of Education of the Household Population[55]

Educational status	Male	%	Female	%	Total pop.	%
Illiterate		0.00	1	1.12	1	0.58
Only can read	3	3.57	1	1.12	4	2.31
Can read and write	22	2.38	11	7.87	9	5.20
Child (under 5 years)	15	17.86	16	17.98	31	17.92
Primary (Class-I to Class-V)	43	27.38	27	30.34	50	28.90
Secondary	21	13.10	14	15.73	25	14.45
SSC/Equivalent	22	14.29	7	7.87	19	10.98
HSC/Equivalent	7	8.33	6	6.74	13	7.51
Degree/Honors	12	2.38	3	1.12	3	1.73
Masters and above	9	10.71	9	8.99	17	9.83
Others		0.00	1	1.12	1	0.58
Total	**154**	**100**	**96**	**100**	**250**	**100**

Table 7-7: Occupational Pattern of the Surveyed Household Members[56]

Occupation	Male	%	Female	%	Total Pop.	%
Business	18	11.68	0	0.00	18	7.2
Student	21	13.63	28	29.16	49	19.60
Unemployed	25	16.23	0	0.00	25	10
Other Service	75	48.70	8	8.33	83	33.20
Household Work	3	1.94	0	0.00	3	1.2
Housewife	0	0.00	48	50	48	19.20
Child <5 years	8	5.19	8	8.33	16	6.4
Retired/Handicapped	0	0.00	4	4.16	4	1.6
Total	**154**	**100**	**96**	**100**	**250**	

Table 7-8: Economic Status of the HH to be Affected[57]

Income Level	households	%
High Income (monthly more than 40,000)	10	22.22 %
Middle Income (monthly 20,001 – 40,000)	25	55.55 %
(10,001 – 20,000)	7	15.55 %

[55] as above
[56] as above
[57] Socioeconomic Survey, Nov-Dec-2020

Income Level	households	%
Low income (monthly 1001-5,000)	3	7 %
Total	**45**	**100%**

Table 7-9: Health Services in the Project Area[58]

	Name of the Site	No. of Health Services Available in the area	Distance (km)				Avg. Monthly Expenses ( )
			Hospital	Union Health clinic	Community clinic	Pharmacy etc	
(1)	Baghair	10				1	5,000
(2)	Kanchpur South	52	0.5			0.5	16,000
(3)	Gram Bhatulia						
(4)	Hemayetpur	64	0.1	0.1	0.1	0.1	11,000

7.4.4 Land Acquisition and Resettlement Cost

Land requirement for the sites is based on field visits and detail topographical survey out of 10 locations six sites are owned by government agencies and the four sites are owned by private groups. It is expected that the land percels belonging to GOB/other authorities can be resolved through signing of MOU (inter-ministerial order based on Transfer of Property Act, 1882). The details of land requirement, ownership, acquisition cost and resettlement cost for each terminal location is given in the following table.

The costs of land acquisition and resettlement have been estimated based on the procedures and entitlements provisions of Acquisition and Requisition of Immovable Property Act, (ARIPA) 2017, (Act No. of 2017) (10th July, 2017). Also, a number of documents of the implemented projects of Government of Bangladesh and similar projects (related) of RHD, DTCA and other autonomous body like LGED were reviewed during preparation of this document.

Table 7-10: Land Acquisition and Resettlement Costs

Terminal Sites		Baghair	Kanchpur South	Kanchpur North	Gram Bhatulia	Bhulta	Hemayetpur
Area	acres	33.63	27.7	15.5	26.5	24.2	45.15
Ownership		Khas	Private	RHD	Private	Khas	Private
Cost of Land	lakh	35,310	103,880	69,750	27,830	83,490	739,557
Cost of trees and structures	lakh	210	10	110	-	-	310
Resettlement Cost	lakh	45,530	13,400	9,030	3,580	10,750	7,350
Total		**81,084**	**117,318**	**78,906**	**31,437**	**94,264**	**130810**

[58] as above

Land cost is revised for three terminals (Baghair, Gram Bhatulia & Hemayetpur) based on recent market value perception and discussed with DTCA is given in the following table.

Table 7.10 A : Land Acquisition and Resettlement Costs New Table for Three locations

Terminal Sites		Baghair	Gram Bhatulia	Hemayetpur
Area	Acres	33.63	26.7	45.15
Ownership		Khas	Private	Private
Cost of Land	lakh	151,335	160,200	202500
Cost of trees and structures	lakh	210	-	310
Resettlement Cost	lakh	45,530	3,580	7,350
Total		**197,075**	**163,780**	**210,160**

7.4.5 Institutional Framework for RAP implementation

The Executing Agency will implement the LARP by NGO and set up a LA/Resettlement Unit (LARU) within the Project Implementation Unit (PIU)/PIC to be established for the project. The LA/resettlement unit will be under the overall responsibility of the Project Director, who will carry out the assignments of implementing the resettlement plan. The LA/RU will have one Deputy Director as Chief LA/Resettlement Officer (CLA/RO) assisted by one assistant director as LA/Resettlement officer (LARO) and the support staff in the field and in the HQs.LA/RU manpower will be trained after recruited and posted.

The Project Director will ensure the land acquisition with assistance of district administrations and LARO.Upon clearance of land acquisition proposal by Deputy Commissioner or Ministry of Land, a property valuation advisory team (PVAT) will be formed through government gazette to recommend replacement market value of land and other properties. PVAT will have representatives from DTCA in the chair, representative from the implementing agency (Consulting Agency) as the member secretary and representative from the DCs.

7.4.6 Grievance Redress Mechanism (GRM)

The GRM aims to answer querries, receive suggestions and settle complaints and grievances about issues raised related to the approved Resettlement Guideline. For this purpose a committee will be established with representatives from the Executing Agency, PAPs, women/vulnerable groups and local government. The PAPs can call upon the support of consulting agency to assist them in presenting their grievances or queries to the GRC.The CLARO will chair the GRC. Other than disputes relating to ownership right under the court of law, GRC will review grievances involving all resettlement benefits, relocation and other assistance.

Grievances are to be redressed within a month from the date of lodging the complaints. To ensure people participation, participants from local level union parishad leaders will be invited to attend the meeting.

7.4.7 Implementation of Land Acquisition and Resettlement Plan

The Land Acquisition and Resettlement Plan is proposed to be implemented from September 2021 over a period of five (5) years. The Executing Agency/DTCA will initiate some advance actions such as the establishment of the LA/Resettlement Unit (LARU), identification of LA/resettlement staff for the field. Formation of PVAT, GRCs, hire consultant to negotiate loan. The overall schedule of LA/RP implementation is based on the principle that the persons affected by land acquisition are paid their legal compensation and due resettlement benefits prior to relocation. Homestead transfer will be provided prior to or during relocation of the households from the right of way (ROW). The LA/RP implemented schedule may be revised as per field situation in consultation with and concurrence from DTCA and other Government bodies like city corporation authority.

7.4.8 Supervision of LARP

The land acquisition and resettlement specialist (or social safeguard specialist) working under the Project Implementation/Supervision Committee (PIC/PSC) will supervise, monitor and assist implementation of the LARP. The supervision and monitoring work will include the tasks like review of compensation payment for land and resettlement implementation, verification of the results of internal monitoring in the project area or Bus Terminal/Depot project areas. Monthly progress report will be prepared and submitted by the NGO to the Project Team Leader. During the implementation period till completion of the project, Project Team Leader will send project progress status report to the client/DTCA/or Assigned Body. The LA/resettlement specialist (or social safeguard specialist) will help in preparing the status report for project TL. Further, an external capable and efficient monitoring and evaluation agency will evaluate the LARP implementation completion and submit a final report.

7.4.9 Monitoring of LARP

The Consultant (hired by DTCA) will advise and assist DTCA in monitoring the effects of LARP. Monitoring will be a critical process to confirm that former subsistence levels and living standards are re-established and that corrective measures are applied when necessary. The main range of activities to be monitored will include:

- land acquisition and transfer
- compensation payments for land acquisition,
- construction of replacement houses for displaced households
- re-establishment of income levels.

The assigned consultant will assist in preparation of reports on land acquisition activities and monitoring of land owners/etc. The consultant will coordinate with all concerned government and private agencies, local bodies, the assigned NGOs and any affected parties for implementing the environmental and land acquisition mitigation measures. They will also assist the DTCA/executing agency in settling any disputes with any of the concerned organizations. The total activity of the land acquisition will be carried out between September 2021 to April 2022 (tentatively assumed by the present consultant) and the implementation of the project will be completed by November 2025 and go for operation in December 2025.

Based on comment from DTCA for 4 sites (Baghair, Hemayetpur, Gram Bhatulia and Kanchpur South) required extra land for service lane, the revised land cost is given in **Annex 7.7 (LARP)**.

8 Preliminary Assessment of Environmental Aspects

The general objective of this study is to determine the major environmental impacts resulting from execution of the proposed terminals and to recommend mitigation measures to avoid or reduce adverse environmental impacts and to enhance positive impacts. The specific objectives are to:

- assess the existing environmental conditions of the proposed terminals site and its influence area;
- identify and assess impacts resulting from the project during its construction phase and operation phase;
- develop an environmental management plan with recommendations for mitigating negative impacts and enhance positive impacts;
- summarize environmental monitoring requirements.

Environmental screening was performed for identifying the anticipated impacts due to the subproject intervention. According to the screening, environmental assessment is required to fulfill the regulatory requirement for Bus Terminals. The study methodology comprised the following activities:

(1) Desktop Study

(2) Field Investigation and Data Collection

(3) Data Analysis and Report Writing

(4) Identification of Key Environmental Issues of Proposed terminals Location

8.1 Categorization of Projects

Rule 7 of the 1997 [Environmental Clearance Rule (ECR)] provides a classification of industrial units and projects into four categories, depending on environmental impact and location. These categories are:

- Green;
- Orange A;
- Orange B; and
- Red

The ECR'97 also contains the procedures for obtaining Environmental Clearance Certificates from the Department of Environment for different types of proposed units or projects. A detail Environmental Impact Assessment (EIA) for the construction of the proposed bus terminals is to be carried out during detail design phase.

8.2 Policy, Legislative and Administrative Framework

Conservation of the environment and various environmental resources is a critical development issue of the Government of Bangladesh. These are a set of rules, promulgated under the ECA, 1995 and its amendments. The Environment Conservation Rules provide categorization of industries and projects and identify types of environmental assessment

required against respective categories of industries or projects. The rules are set for the following items:

- The National Environmental Quality Standards (NEQS) for ambient air, various types of water, industrial effluent, emission, noise, vehicular exhaust etc.;
- The requirement for and procedures to obtain environmental clearance; and
- The requirement for IEE and EIA according to categories of industrial and other development interventions.

8.2.1 GOB Environmental Policies, Regulations and Guidelines

Table 8.1 summarizes the major applicable national and local laws, regulations for environmental and social aspects. The Environmental Conservation Act 1995 (ECA '95) and the Environmental Conservation Rules 1997 (ECR 97) shall apply to environmental assessment for the construction of the proposed bus terminals. Department of Environment (DoE) is the regulatory body responsible for enforcing the ECA '95 and ECR '97.[59] The following is a list of the policies, rules, regulations and guidelines which shall be applicable for implementing the projects on the proposed sites:

(1) National Environmental Policy, 1992
(2) National Environmental Management Action Plan, 1995
(3) Environmental Conservation Act (ECA), 1995, (Amendment 2000,2002,2010)
(4) Environmental Conservation Rules (ECR), 1997 and Amendments
(5) Bangladesh Climate Change Strategy and Action Plan
(6) Bangladesh Labour Act, 2006
(7) Bangladesh National Building Code 2020

Table 8-1: Summary of Laws and Regulations Applicable to the Project

	Laws, Regulations and Standards	Brief Description	Responsible Agency	Relevance
(1)	Environment Conservation Act 1995	Provides for the conservation of environment, improvement of environmental standards and control environmental pollution. This act provides for (i) remedial measures for injury to ecosystem; (ii) discharge of environmental pollutants; (iii) inspection of any activity for testing any equipment.	Ministry of Environment and Forest DOE	The provisions of the act apply to the operational stages.
(2)	Environment Conservation Rules 1997	The Rules outline the processes and requirements of environmental clearances for specific type of projects. (i) Green, (ii) orange-A, (iii) orange–B and (iv) red. The rules specify the procedures	Ministry of Environment and Forest DOE	As per ECR-97, this subproject can be considered as Orange-B.

[59] under the Ministry of Environment and Forest (MoEF),

	Laws, Regulations and Standards	Brief Description	Responsible Agency	Relevance
		for issuing ECC for the various categories of projects.		
(3)	Bangladesh Labour Act 2006	The Bangladesh Labour Act, 2006 provides the guidance of employer's extent of responsibility and workmen's extent of right to get compensation in case of injury by accident while working.	Ministry of Labour	Provides for safety of work force during construction period.
(4)	The National Water Policy (1999)	• Protection and restoration of water resources; • Protection of water quality including strengthening regulations concerning industrial effluents; • Participation of local communities in water sector development.	Ministry of Water Resources	Discharge of the waste water from the terminal may degrade the quality of the surface water of the Chara adjacent to the terminal
(5)	National Biodiversity Strategy and Action Plan (2004)	• Conserve and restore the biodiversity; • Strategy and Action - Maintain and improve environmental stability of ecosystems.	Ministry of Environment and Forest (MOEF)	Discharge of the waste water from the terminal may degrade the quality of the surface water of the Chara adjacent to the terminal.
(6)	Environment Court Act, 2000 and subsequent amendments in 2002	GOB has given highest priority to environment pollution and passed Environment Court Act, 2000 for completing environment related legal proceedings effectively	MOEF	The provisions of the act apply to the construction stages if any non-compliances of the environmental issues.
(7)	Water Pollution Control Ordinance 1970	Prevents water pollution	Ministry of Water Resources	Discharge of the waste water from the terminal may degrade the quality of the surface water of the Chara adjacent to the terminal.
(8)	Vehicle Act 1927 and Motor vehicle ordinance 1983	Road/traffic safety Vehicular air and noise pollutions	BRTA	The provisions of the act apply to the operational stages.

	Laws, Regulations and Standards	Brief Description	Responsible Agency	Relevance
		Fitness of vehicles and registration		
(9)	The ground Water Management Ordinance 1985	Focuses on management of Ground Water Resources.	Ministry of Water Resources	The provisions of the act apply to the operational stages due to use of the ground water
(10)	Bangladesh National Building Code	Building Construction Safety Guidelines Labour safety Policy	RAJUK, PWD	The provisions of the act apply to the construction stages if any non-compliances of the Proper Construction guidelines.

8.2.2 Environment, Health and Safety Guidelines

The Environment, Health and Safety (EHS) Guidelines contain the performance levels and measures that are generally considered to be achievable in new facilities or project by existing technology at reasonable costs. In addition, there are also industry specific EHS guidelines. DTCA is committed protecting the health and safety of everybody involved with their activities, the persons who come into contact with their operations and the physical and natural environments in which they work. The requirements of health, safety and environmental standards strive to:

(1) Ensure that all operations comply with applicable health, safety and environmental laws and regulations;

(2) Implement controls to protect all personnel involved in activities to prevent pollution and to protect bio-diversity;

(3) Provide health, safety and environmental training to employees and actively promote awareness of health, safety and environmental issues;

(4) Ensure that contractors are aware of their policies and standards and where necessary, work with their contractors to raise their standards to meet them;

(5) Foster a culture where accidents and incidents are reported and investigated and the lessons learned are shared throughout the organization;

(6) Monitor performance and conduct regular audits to ensure controls are effective and that health, safety and environmental aspirations are being achieved;

(7) Set objectives and targets for improving health, safety and environmental performance and monitor and report openly on performance;

(8) Work with Government and regulatory bodies in the formulation or improvement of laws, policies, regulations and procedures aimed at protecting health, safety and the environment;

(9) Consult with and respond to the concerns of other stakeholders on health, safety and environmental performance.

8.3 Baseline Environmental Conditions

All of the proposed Terminals are located in Dhaka, Narayanganj, Gazipur, Savar, Keraniganj areas of Dhaka division. Under the feasibility study the consultant team visited the proposed terminals to monitor the existing condition. Some physical environmental situation collected from visit and secondary sources is discussed in the following sections.

8.3.1 Climate and Temperature

Under the Koppen climate classification, Dhaka has a tropical monsoon climate with an annual average temperature of 25 degrees Celsius and rainfall of about 2,000 mm. The climate is divided into hot and rainy period from May to October, cool and dry period from November to February and hot and dry period from March to April. About 80% of the annual rainfall occurs between May and September. The elevation of city corporation area varies from 2 m to 13m above the mean sea level. The most of the developed areas including the proposed project site are at an elevation of 6 to 8m above the mean sea level.

8.3.2 Topography and Geology

Dhaka is located in the southern tip of Madhupur tract (Pleistocene terrace). Two characteristic geological units of Madhupur Clay of the Pleistocene times and alluvial deposits cover the Dhaka city and surroundings. The major geomorphic units of the city are the high land or the Dhaka terrace, the low lands or floodplains and depressions and abandoned channels. The elevation of DCC area varies from 2 m to 13m above the mean sea level. The most of the developed areas including the proposed project site are at an elevation of 6 m to 8m above the mean sea level. The city area does not show any surface folding. However, a large number of faults and lineaments have N-S, E-W. NE-SW and NW-SE trends were recognized by interpreting air photos and the nature of the stream courses. All four sides of the city are bound by major faults.

It is surrounded by four major river systems. The southern part is alongside the Buriganga River. Truag flows on the western side. It is connected by a small Tongi Khal on the north. Alongside the eastern border, Balu River takes its route which is also hydrologically connected with Tongi Khal. The Dupi Tila sand aquifer is the main source of water in Dhaka city. The aquifer varies in thickness from 100 to 200m (average 140 m). Groundwater found at a depth of 25 to 30m in the central part of the city. In the surrounding areas, the groundwater table lies at a depth of 15 to 20m.

8.3.3 Water Resources and Hydrology

The groundwater storage reservoir has three divisions: upper clay and silt layer, a middle composite aquifer (fine to very fine sand) and a main aquifer consisting of medium to coarse sand. As per DPHE practice Drinking water is generally taken from deep tube wells with strainers set between depths of 120 metres to around 200 metres. The groundwater level is at or very close to the surface during the monsoon; whereas, it is at maximum depth during the months of April and May

8.3.4 Air Quality

The main air pollutants in Dhaka are Nitrogen Oxides (NOx), Sulfur Dioxide (SO2), Carbon Monoxide (CO), Ozone, Volatile Organic Compounds (VOCs) and Lead. The motor vehicles and traditional brick kilns contribute predominantly to the air pollution.

The motor vehicles are major source of PM (Particulate Matter) pollution that contributes to the risk of developing cardiovascular and respiratory diseases, as well as lung cancer. Most of the PM pollution (> 80%) comes from the diesel-run vehicles. Hundreds of brick kilns operate during the dry season from November to April in the low agricultural land surrounding Dhaka city and generate smoke dust including SO2, NOx and hydrocarbons that contribute to worsening the ambient air and damage of public health.

Emission inventory of mobile sources in Dhaka show that contributions of different vehicles dominate specific types of pollutants. Petrol-fueled light-duty vehicles and auto-rickshaws contribute to most of CO, while diesel-fueled buses and trucks contribute to most of NOx. Two and three-wheeled auto-rickshaws contribute to about half of hydrocarbon emission. PM emission comes mostly from diesel buses and trucks (45%) and auto-rickshaws (40%). Asper JICA study of Dhaka Urban Transport Network Development Project, February-2011, according to a study conducted by the Bangladesh Atomic Energy Commission, approximately 55% of the PM10 are attributed to suspended soil and motor vehicle (31%) and PM2.5 is mostly attributed to motor vehicles (29%) and natural gas/ diesel burning (46%)

8.3.5 Noise and Vibration

Under this study the consultant collected data of noise and vibration level of Dhaka city metropolitan area where three bus terminals exist. Level of noise in Dhaka city is now a major concern for the general people because it has exceeded the tolerance level. Long-term noise pollution might cause severe mental and physical health problems. Nearly 5 lakh motor vehicles and over 4lakh non-motorized vehicles are plying the roads and streets of the city. These vehicles on limited road surface cause extreme traffic congestion associated with noise pollution, especially near the bus terminals and bus stops.

Table 8-2: Standard for Ambient Noise[60]

	Category	dBa unit	
		Day	Night
A	Silent zone	50	40
B	Residential area	55	45
C	Mixed area	60	50
D	Commercial area	70	60
E	Industrial area	75	70

According to the category of the proposed terminal area, most part would fall under 'D' category, which is 'Industrial area". No data exceed the Bangladesh regulatory limit. [61]

8.3.6 Water Quality

Dhaka is surrounded by rivers and inter-connected canals which have formed a life-line for city residents. Absence ofinstitutional responsibility and poor monitoring have caused serious water pollution in surface water. There is only one sewage treatment plant at Pagla which is currently operating below the capacity because and also many factories are

[60]Reference of Standard: Ministry of Environment and Forest, Notification related to Environment Conservation Rules, 1997, Schedule 4 and subsequent amendments in 2006).

[61] Notes: The time from 6 a.m. to 9 p.m. counted as day time. from 9 p.m. to 6 a.m. counted as night time.

operating without effluent treatment systems in DMA. Almost all waste from the residents, industry, pesticides are dumped into Dhaka's surface water which also infiltrate to the ground and pollute the groundwater. The BOD (Biochemical Oxygen Demand) for Buriganga river is 10~30 mg/l where the standard limit is only 5 mg/l.

8.3.7 Natural Reserve

There are no nature reserves such as national park or wildlife sanctuary in RAJUK area. Two botanical gardens as natural classified area exist in DMA and are managed by forest department. National Botanical Garden, which is located in Mirpur, covers around 84 hectares of land with approximate 50,000 species of trees, herbs and shrubs including a large collection of aquatic plants. Baldha garden with about 136m in length and 76m in width is located close to Sayedabad terminaland holds around 15,000 plants representing 672 species. Many of the species at Baldha garden were collected from over 50 different countries. The consultant team has conducted detail environmental screening to prepare baseline environmental condition which is described in Annex 8.2.

8.4 Baseline Environmental and Social Conditions of Individual Sites

8.4.1 Baghair

	Details	Photographs
A. Project Site		
Densely populated?	No significant settlement. Some structures behind the project area.	
Heavy with development activities?	No	
Cultural heritage site	No significant cultural heritage site	
Protected Area	No environmentally protected area	
Wetland	Inside the proposed terminal area there are some low lands. These ditches were created due to unplanned earth excavation for the brick fields. Local inhabitants culture fisheries in the rainy season.	
Buffer zone of protected area	No buffer zone is found near the area.	
Special area for protecting biodiversity	No ECA is around the project area.	
Impacts on the sustainability of associated sanitation and solid waste disposal systems and their interactions with other urban services.	Some possibilities in future, but will be minimized by proper sanitation and solid waste management system.	
B. Potential Environmental Impacts		
Fauna and Flora	Simple green grass land with vegetation	
Deterioration of surrounding environment due to rapid urban population growth, commercial and industrial activity and increased waste generation.	Possibilities are there. But this can be minimizedby following EHS policy during construction and operation.	
Dislocation or involuntary resettlement of people (if any)	Not required	
Water resource problems (*e.g.* depletion/degradation of available water supply, deterioration for surface and ground water quality and pollution of receiving waters)?	Local inhabitants depend on ground water. Surface water supply facilities may be arranged during construction. Precautions will be taken for mitigating water pollution.	

	Details	Photographs
Air pollution due to urban emissions?	Currently air pollution occurs due to smoke emission from the brick fields.	
Possibilities of Road blocking and temporary flooding due to land excavation during rainy season?	During construction possibilities of temporary road blocking . No history of flash flood.	
Noise and dust from construction activities?	Yes.	
Traffic disturbances due to construction material transport and wastes?	Yes. Proper mitigation measure will be taken to minimize the impact.	
Hazards to public health due to ambient, household and water depletion and/or degradation?	Proper EHS activities will be followed to avoid the problem.	
Contamination of surface and ground waters due to improper waste disposal?	Environmental Management Plan will provide waste disposal guideline	
Existing Drainage System	No drainage system	

8.4.2 Kanchpur South

	Details	**Photographs**
A. Project Site		
Densely populated?	No	
Heavy with development activities?	No	
Cultural heritage site	No	
Protected Area	No protected area.	
Wetland	Seasonal wet land inside the proposed area.	
Buffer zone of protected area	No	
Special area for protecting biodiversity	No	
Impacts on the sustainability of associated sanitation and solid waste disposal systems and their interactions with other urban services.	In future	

	Details	Photographs
B. Potential Environmental Impacts		
Fauna and Flora	No endangered species found. But total area covered with marshy land, green grass land with typical trees.	
Deterioration of surrounding environmental conditions due to rapid urban population growth, commercial and industrial activity and increased waste generation.	Yes, during future construction it will be considered sincerely	
Dislocation or involuntary resettlement of people (if any)	Needs some resettlement of current temporary installations.	
Water resource problems (e.g., depletion/degradation of available water supply, deterioration for surface and ground water quality and pollution of receiving waters?	Currently local inhabitants use ground water.	
Air pollution due to urban emissions?	Yes. Due to brick-field and vehicular emission.	
Possibilities of road block and temporary flooding due to land excavation during rainy season?	Possibilities are there in future.	
Noise and dust from construction activities?	Yes. Vehicular noise disturbance	
Traffic disturbances due to construction material transport and wastes?	Currently no.	
Hazards to public health due to ambient, household and water depletion and/or degradation?	No significant component found.	
Contamination of surface and ground waters due to improper waste disposal?	No	
Existing Drainage System	No	

8.4.3 Kanchpur North

	Details	Photographs
A. Project Site		
Densely populated?	No, but the project is surrounded by road and residential areas	
Heavy with development activities?	No	
Cultural heritage site	No	
Protected Area	No	
Wetland	Yes, currently the site is is low land water body. Fisheries are cultured by few local inhabitants.	
Buffer zone of protected area	No	
Special area for protecting biodiversity	No	
Impacts on the sustainability of associated sanitation and solid waste disposal systems and their interactions with other urban services.	Yes, during future construction, it will be considered.	
B. Potential Environmental Impacts		
Fauna and Flora	No endangered species found there. Fishery activities are going on.	
Deterioration of surrounding environmental conditions due to rapid urban population growth, commercial and industrial activity and increased waste generation.	The major challenge is to clean up the area. Open waste dumped in the sitd. Some liquid wastes are directly discharged into the proposed land.	
Dislocation or involuntary resettlement of people (if any)	No.	
Water resource problems (e.g., depletion/degradation of available water supply, deterioration for surface and ground water quality and pollution of receiving waters?	During construction possibilities of ground water depletion are there.	
Air pollution due to urban emissions?	Dust problem	
Possibilities of Road blocking and temporary flooding due to land excavation during rainy season?	In future.	
Noise and dust from construction activities?	Yes.	
Traffic disturbances due to construction material transport and wastes?	Yes. In future during construction.	
Hazards to public health due to ambient, household and water depletion and/or degradation?	Currently no possibilities.	
Contamination of surface and ground waters due to improper waste disposal?	Yes, possibilities are there.	
Existing Drainage System	No	

8.4.4 Gram Bhatulia

	Details	Photographs
A. Project Site		
Densely populated?	No. But development activities for a residential project is going on adjacent the site.	
Heavy with development activities?	Construction work of MRT-6 depot is going on. Land filling for proposed new police line is going on.	
Cultural heritage site	No significant heritage site	
Protected Area	Dhaka Central Zoo and National Botanical Garden is located within 7.2 km	
Wetland	No.	
Buffer zone of protected area	No significant site	
Special area for protecting biodiversity	No significant site	
Impacts on the sustainability of associated sanitation and solid waste disposal systems and their interactions with other urban services.	Now two major construction projects are going on near the site. As per their information they will follow proper sanitation and solid waste disposal system. In future proposed terminal will follow the standard design to minimize impacts on land and environment.	
B. Potential Environmental Impacts		
Fauna and Flora	National Botanical Garden and National Zoo are close to the site. At site no significant Flora and Fauna is found. Most of the area is grassland.	
Deterioration of surrounding environmental conditions due to rapid urban population growth, commercial and industrial activity and increased waste generation.	Yes have, But by following proper mitigation measure can mitigate this. The unplanned land fill may create blockage the water body behind the site.	
Dislocation or involuntary resettlement of people (if any)	Not Required	
Water resource problems (e.g. depletion/degradation of available water supply, deterioration for surface and ground water quality and pollution of receiving waters?	No significant cause is found of water pollution.	

	Details	Photographs
Air pollution due to urban emissions?	The recent construction and land filling activities create dust.	
Possibilities of road blocking and temporary flooding due to land excavation during rainy season?	Yes have.	
Noise and dust from construction activities?	Yes have	
Traffic disturbances due to construction material transport and wastes?	Yes	
Hazards to public health due to ambient, household and water depletion and/or degradation?	No significant cause is found of water depletion.	
Contamination of surface and ground waters due to improper waste disposal?	Unplanned disposal will create some contamination.	
Existing Drainage System	No existing drainage system	

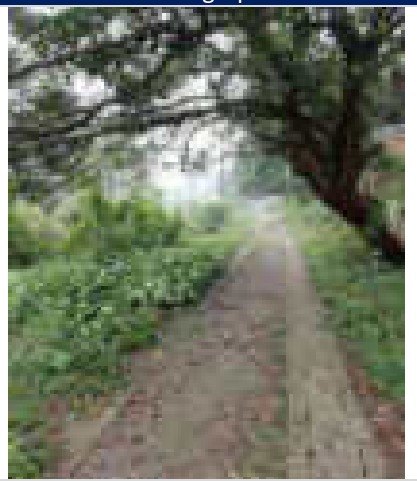
8.4.5 Bhulta

	Details	Photographs
A. Project Site		
Densely populated?	No. There is no shelter of brick field workers inside the project.	
Heavy with development activities?	No recent development activities.	
Cultural heritage site	No cultural heritage site near the project area.	
Protected Area	No	
Wetland	In the wet season, the ditch inside is filed up with water.	
Buffer zone of protected area	No	
Special area for protecting biodiversity	No	
Impacts on the sustainability of associated sanitation and solid waste disposal systems and their interactions with other urban services.	Will be considered in future for Construction period.	

	Details	Photographs
B. Potential Environmental Impacts		
Fauna and Flora	Low marshy land, green grass and portion used for vegetation.	
Deterioration of surrounding environment due to rapid urban population growth, commercial and industrial activity and increased waste generation.	Adverse effect of brick-field in environmental sustainability.	
Dislocation or involuntary resettlement of people (if any)	Required for brick field.	
Water resource problems (e.g., depletion/degradation of available water supply, deterioration for surface and ground water quality and pollution of receiving waters)?	During construction possibilities of ground water depletion.	
Air pollution due to urban emissions?	Adverse effect of brick field.	
Possibilities of Road block and temporary flooding due to land excavation during rainy season?	No flash flood history.	
Noise and dust from construction activities?	Noise disturbance due	
Traffic disturbances due to construction material transport and wastes?	Possibility of traffic disturbance during construction.	
Hazards to public health due to ambient, household and water depletion and/or degradation?	Currently no scope	
Contamination of surface and ground waters due to improper waste disposal?	Currently no scope.	
Existing Drainage System	No	

8.4.6 Hemayetpur

	Details	Photographs
A. Project Site		
Densely populated?	No. But some settlement is there.	
Heavy with development activities?	No	
Cultural heritage site	No	
Protected Area	Savar monument is located within 15.5 Km of the proposed site.	
Wetland	Low land with ditches.	
Buffer zone of protected area	No	
Special area for protecting biodiversity	No	
Impacts on the sustainability of associated sanitation and solid waste disposal systems and their interactions with other urban services.	This land is relatively low and needs land filling to make it suitable for bus terminal. In term of urban transport accessibility, it has good connectivity with city bus routes and planned MRT-5.	
B. Potential Environmental Impacts		
Fauna and Flora	Inside the project area some settlement along with mosque, shops, plastic product factory, car workshops. Some green grass land along with some fruit trees are also inside the project area. No significant forest area around the project area.	
Deterioration of surrounding environmental conditions due to rapid urban population growth, commercial and industrial activity and increased waste generation.	No significant issues with regard to deterioration of surrounding environment.	
Dislocation or involuntary resettlement of people (if any)	Required.	
Water resource problems (e.g. depletion/degradation of available water supply, deterioration for surface and ground water quality and pollution of receiving waters?	Local people Depends on Ground Water. No significant cause ground water contamination.	
Air pollution due to urban emissions?	There is a brick-field near the location area. Currently no other significant source found.	

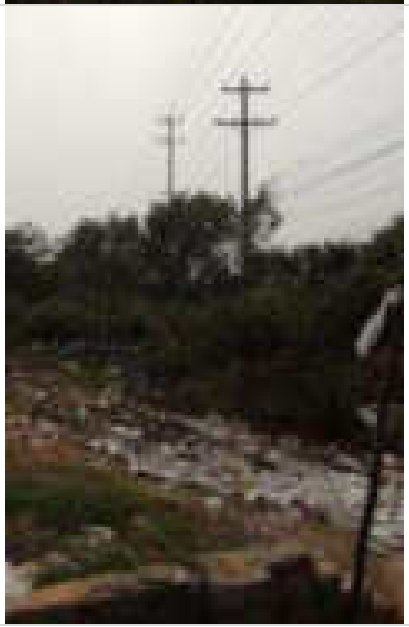
	Details	Photographs
Possibilities of Road block and temporary flooding due to land excavation during rainy season?	During construction work of the terminal possibilities of road block are there. No flash flood history is found.	
Noise and dust from construction activities?	Currently no significant source found.	
Traffic disturbances due to construction material transport and wastes?	Low possibilities, because it is located adjacent to the Highway N5.	
Hazards to public health due to ambient, household and water depletion and/or degradation?	Currently no significant source identified.	
Contamination of surface and ground waters due to improper waste disposal?	No possibilities.	
Existing Drainage System	No drainage system	

8.4.7 Bhawal, At i Bazar

	Details	Photographs
A. Project Site		
Densely populated?	No	
Heavy with development activities?	No development activities visible near the project area.	
Cultural heritage site	No significant cultural Heritage	
Protected Area	No environmentally protected area	
Wetland	No	
Buffer zone of protected area	No	
Special area for protecting biodiversity	No	
Impacts on the sustainability of associated sanitation and solid waste disposal systems and their interactions with other urban services.	Currently the area is used for agricultural activities. d land fill will be required for further development activities.	

	Details	Photographs
B. Potential Environmental Impacts		
Fauna and Flora	No significant species is found.	
Deterioration of surrounding environment due to rapid urban population growth, commercial and industrial activity and increased waste generation.	Proper treatment required before effluent discharge and as well as soli faecal sludge management required.	
Dislocation or involuntary resettlement of people (if any)	A poultry farm is located inside the project area. No other permanent or temporary structure inside the boundary.	
Water resource problems (*e.g.,* depletion/degradation of available water supply, deterioration for surface and ground water quality and pollution of receiving waters)?	Village people use Ground water. Possibilities of water pollution during Construction and Operation period	
Air pollution due to urban emissions?	Currently no possibilities of air pollution. But during construction, it may happen. Mitigation measures will be taken.	
Possibilities of Road blocking and temporary flooding due to land excavation during rainy season?	The proposed road will be 100 ft wide. After expansion of the road, the possibilities of road blocking will be minimized. Additional precaution will be taken for smooth communication of local villagers.	
Noise and dust from construction activities?	Construction activities will create disturbance to local inhabitants.	
Traffic disturbances due to construction material transport and wastes?	Yes.	
Hazards to public health due to ambient, household and water depletion and/or degradation?	If during construction ground water is used, there are possibilities of water depletion.	
Contamination of surface and ground waters due to improper waste disposal?	No significant cause of GW contamination.	
Existing Drainage System	No drainage system available.	

8.4.8 Baipail

	Details	Photographs
A. Project Site		
Densely populated?	No	
Heavy with development activities?	No recent development activities were found.	
Cultural heritage site	Nandan Park is within 6 km and Savar monument within 8 km	
Protected Area	No	
Wetland	No	
Buffer zone of protected area	No	
Special area for protecting biodiversity	No	
Impacts on the sustainability of associated sanitation and solid waste disposal systems and their interactions with other urban services.	No recent activities are running.	
B. Potential Environmental Impacts		
Fauna and Flora	Total area is covered by grass-land and common types of trees.	
Deterioration of surrounding environmental conditions due to rapid urban population growth, commercial and industrial activity and increased waste generation.	Currently no	
Dislocation or involuntary resettlement of people (if any)	No resettlement required	
Water resource problems (*e.g.* depletion/degradation of available water supply, deterioration for surface and ground water quality and pollution of receiving waters?	Local inhabitants depend upon ground water	

	Details	Photographs
Air pollution due to urban emissions?	No significant source is found	
Possibilities of Road blocking and temporary flooding due to land excavation during rainy season?	May be created during construction.	
Noise and dust from construction activities?	No	
Traffic disturbances due to construction material transport and wastes?	May be created during construction	
Hazards to public health due to ambient, household and water depletion and/or degradation?	May be created during construction.	
Contamination of surface and ground waters due to improper waste disposal?	No possibilities	
Existing Drainage System	No	

8.4.9 Gazipur

	Details	Photographs
A. Project Site		
Densely populated?	No	
Heavy with development activities?	No mega development activities	
Cultural heritage site	No	
Protected Area	Bangabondhu Safari Park is located within 19 km and Bhawal National Park within 6 km	
Wetland	No	
Buffer zone of protected area	No	
Special area for protecting biodiversity	No	
Impacts on the sustainability of associated sanitation and solid waste disposal systems and their interactions with other urban services.	Currently occupied by a truck terminal. No proper waste management system was found.	

	Details	Photographs
B. Potential Environmental Impacts		
Fauna and Flora	No significant species were found.	
Deterioration of surrounding environmental conditions due to rapid urban population growth, commercial and industrial activity and increased waste generation.		
Dislocation or involuntary resettlement of people (if any)	Yes. Required.	
Water resource problems (e.g. depletion/degradation of available water supply, deterioration for surface and ground water quality and pollution of receiving waters?	In future if the terminal will not use surface water, depletion of ground water will occur.	
Air pollution due to urban emissions?	Yes. Currently dusts create a problem.	
Possibilities of Road blocking and temporary flooding due to land excavation during rainy season?	Yes. It will increase in future.	
Noise and dust from construction activities?	Yes. Regular movement of trucks create noise.	
Traffic disturbances due to construction material transport and wastes?	Yes. It will increase in future.	
Hazards to public health due to ambient, household and water depletion and/or degradation?	Yes. It will increase in future.	
Contamination of surface and ground waters due to improper waste disposal?	Yes. The maintenance work of the truck is taken openly. Used Oil, lubricant creates pollution with surface run off.	
Existing Drainage System	No	

8.4.10 Kanchan

	Details	Photographs
A. Project Site		
Densely populated?	No	
Heavy with development activities?	No	
Cultural heritage site	No	
Protected Area	Zinda Park is located within 7 km on Eastern side of the site.	
Wetland	Yes. Inside the project area.	
Buffer zone of protected area	No	
Special area for protecting biodiversity	No	
Impacts on the sustainability of associated sanitation and solid waste disposal systems and their interactions with other urban services.	Currently no activities are found.	
B. Potential Environmental Impacts		
Fauna and Flora	Low marshyland, green grassland	
Deterioration of surrounding environmental conditions due to rapid urban population growth, commercial and industrial activity and increased waste generation.?	Currently no issue.	
Dislocation or involuntary resettlement of people (if any)	No	
Water resource problems (e.g., depletion/degradation of available water supply, deterioration for surface and ground water quality and pollution of receiving waters?	Inside the area no utility service available.	
Air pollution due to urban emissions?	No source is found.	
Possibilities of Road blocking and temporary flooding due to land excavation during rainy season?	Currently no source	
Noise and dust from construction activities?	Vehicle movements create noise.	
Traffic disturbances due to construction material transport and wastes?	Currently no	

	Details	Photographs
Hazards to public health due to ambient, household and water depletion and/or degradation?	If the terminal will depend on ground water, it may create a problem.	
Contamination of surface and ground waters due to improper waste disposal?	No source found	
Existing Drainage System	No	

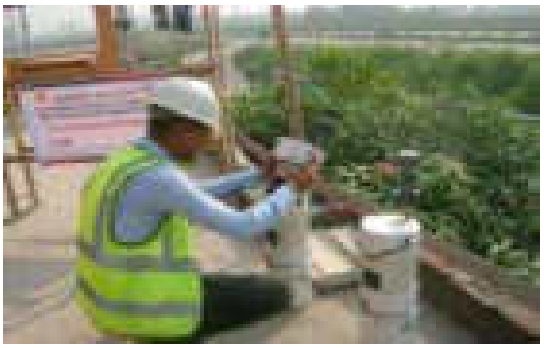
8.5 Environmental Monitoring Report

This report consists of Environmental Perimeter Tests (EPTs) which include sampling and analysis of the test results of different parameters.

8.5.1 Ambient Air Monitoring

Six samples from ambient air monitoring points of six proposed terminal locations were collected in December 2020 for analyzing PM_{10}, $PM_{2.5}$, SO_x, $NO_X$and Carbon Monoxide.The analyses of the parameters were done in Atomic Energy Commission Laboratory, Dhaka and results dated 13 December 2020 is included in the report.

Figure 8-1: Ambient Air Sampling and GPS Location Monitoring



Proposed Baghair Bus Terminal and Depot Points

Ambient Air Sampling and GPS Location Monitoring

Proposed Hemayetpur Bus Terminal and DepotPoints

Ambient Air Sampling and GPS Location

Department of Environment suggests ambient air standards in Bangladesh in different areas (see the following table).

Table 8-3: Standard for Ambient Air[62]

Air Contamination	Limit of Density	Average time
Carbon Monoxide	10 mg/m^3	8 hour
	40 mg/m^3	1 hour
Lead	0.5 µg/m^3	Yearly
Oxides of Nitrogen	100 µg/m^3	Yearly
SPM	200 µg/m^3	8 hour
PM_{10}	50 µg/m^3	Yearly
	150 µg/m^3	24 hour
$PM_{2.5}$	15 µg/m^3	Yearly
	65 µg/m^3	24 hour
O_3	235 µg/m^3	1 hour
	157 µg/m^3	8 hour
Sulphur di oxide	80 µg/m^3	Yearly
	365 µg/m^3	24 hour

Table 8-4: Ambient Air Monitoring Points and Locations

Location	Points	GPS Location
Baghair	Point1	23.66285^0 N 090.38154^0 E
Kanchpur North	Point6	23.70424^0 N 090.52578^0 E
Bhulta	Point5	23.78212^0 N 090.57652^0 E
Bhawal, Ati Bazar	Point 2	23.73101^0 N 090.31181^0 E
Hemayetpur	Point 3	23.79451^0 N 090.27679^0 E
Gazipur	Point4	24.01115^0 N 090.38406^0 E

Table 8-5: Ambient Air Monitoring Report[63]

Parameter forAnalysis	PM_{10}	$PM_{2.5}$	SO_X	NO_X	Carbon Monoxide
	microgram per cubic meter	microgram per cubic meter	microgram per cubic meter	microgram per cubic meter	milligram per cubic meter
Standards according to ECR 1997 and subsequent amendments in 2005	150	65	365	100	40
Point 1	119	57	25	0.062	<0.13
Point 2	141	58.4	31	0.055	<0.13
Point 3	225	142	42	0.076	<0.13
Point 4	296	190	47	0.075	<0.13
Point 5	132	58	43	0.064	<0.13
Point 6	322	138	45	0.067	<0.13

[62]Reference of Standard: Ministry of Environment and Forest, Notification related to Environment Conservation Rules, 1997, Schedule 2, and subsequent amendments in 16 July 2005

[63] Note: Ambient Air quality tested from Atomic Energy Commission.

Point 1 Baghair, Point 2 Bhawal, Point 3 Hemayetpur, Point 4 Gazipur, Point 5 Bhulta, Point 6Kanchpur North

The analysis results of ambient air are complying with DoE standard except three points of PM_{10} and $PM_{2.5}$ test results. The averaging time of NO_2 is different from the averaging time of DoE standard. Therefore, comparing the NO_2 level with the DoE standard is not possible. SO_2 test results are <18 microgram per cubic meter. <18 is below detection limit NO_2 test results are < 0.20 microgram per cubic meter. <0.20 is below detection limit. Carbon monoxide test results are < 0.13 milligram per cubic meter. <0.13 is below detection limit.

8.5.2 Noise Level Monitoring

Noises were monitored near proposed terminal locations in December 2020 to analyze noise level. The analyses of the parameters were done in Atomic Energy Commission Laboratory, Dhaka and results dated 13December 2020 is included in the report. Department of Environment suggest standards for different categories of areas (see the following table).

Table 8-6: Standard for Ambient Noise[64]

	Category of areas	dBa units	
		Day[65]	Night
A	Silent zone	50	40
B	Residential area	55	45
C	Mixed area	60	50
D	Commercial area	70	60
E	Industrial area	75	70

Figure 8-2:Noise level monitoring and GPS location monitoring

Proposed Baghair Bus Terminal and Depot Points

Ambient Noise Sampling and GPS Location Monitoring

[64]Reference of Standard: Ministry of Environment and Forest, Notification related to Environment Conservation Rules, 1997, Schedule 4and subsequent amendments in 2006).

[65] Note: 6 a.m. to 9 p.m. counted as day and from 9 p.m. to 6 a.m. counted as night

Proposed Bhawal Bus Terminal Points

Ambient Noise Sampling and GPS Location Monitoring

Table 8-7: Noise Level Monitoring Points and Locations

Location	Point	GPS Location
Baghair	Point 1	23.66285^0 N 090.38154^0 E
Kanchpur South	Point 10	23.68686^0 N 090.54507^0 E
Kanchpur North	Point 9	23.70424^0 N 090.52578^0 E
Gram Bhatulia	Point 4	23.89735^0 N 090.37949^0 E
Bhulta	Point 8	23.78212^0 N 090.57652^0 E
Hemayetpur	Point 3	23.79451^0 N 090.27679^0 E
Bhawal, Ati Bazar	Point 2	23.73101^0 N 090.31181^0 E
Baipail	Point 5	23.98285^0 N 090.26118^0 E
Gazipur	Point 6	24.01115^0 N 090.38406^0 E
Kanchan	Point 7	23.83102^0 N 090.56215^0 E

According to the area the most part would fall under 'D' category, which is 'Industrial area". No data exceeded the Bangladesh regulatory limit. The sampling points are listed in the table below.

Table 8-8: Noise Level Monitoring Report

	Points	Test Time	Bangladesh Standard dBa	Result
(1)	Baghair	Day	70	64.1±0.4
		Night	60	55.9±0.9
(2)	Kanchpur South	Day	70	62.6±0.7
		Night	60	54.1±0.3
(3)	Kanchpur North	Day	70	67.6±1.1
		Night	60	57.6±0.6
(4)	Gram Bhatulia	Day	70	65.2±0.9
		Night	60	54.1±0.4
(5)	Bhulta	Day	70	67.8±0.9
		Night	60	51.1±1.0
(6)	Hemayetpur	Day	70	62.1±1.1
		Night	60	56.1±0.7
(7)	Bhawal	Day	70	56.4±1.0
		Night	60	51.1±1.0

	Points	Test Time	Bangladesh Standard dBa	Result
(8)	Baipail	Day	70	65.1±1.1
		Night	60	54.7±0.6
(9)	Gazipur	Day	70	71.9±1.0
		Night	60	59.1±0.9
(10)	Kanchan	Day	70	68.8±0.8
		Night	60	54.1±0.4

Noise level was measured at ten different locations comprising of commercial area according to Bangladesh standards. In some places, noise level monitoring data is not compliant with the national noise level standard (ECR 1997). Because these roads are always busy with different types of vehicle during day time. On the other hand, at night time heavy duty vehicles are added on road together with intercity bus service. As result, the noise level is higher than ECR 1997 (Amendment - 2006)

8.5.3 Surface Water Monitoring

Two surface water samples were collected from Branch River Turag at Birulia Bridge and Shitalakshya River at Kanchpur Bridge, Narayanganj on 13 February 2021 to analyze TSS, TDS, salinity, conductivity, temperature, DO, BOD_5, COD, Phosphate, Nitrate, Chloride, total Coliform and faecal Coliform.The analyses of the parameters were done in Central Laboratory of DPHE, Dhaka and results on 23 February 2021 have been placed in the report.

Figure 8-3: Photographs of Surface Water Sampling and GPS Location Monitoring

Proposed Bhawal Bus Terminal Points Ambient Noise Sampling and GPS Location Monitoring

Table 8-9: Surface Water Quality Monitoring Points and Locations

	Location	GPS Location
Point 1	Branch River Turag at Birulia Bridge, Dhaka	23.782120 N 090.576520 E
Point 2	Shitalokha River at Kanchpur Bridge, Narayanganj	23.703670 N 090.518750 E

Table 8-10: Surface Water Quality Analysis Report[66]

	Parameter for Laboratory Analysis	Bangladesh Standard (Inland Surface Water)	SW1	SW2
1	BOD, mg/L	50	14	12
2	COD, mg/L	200	52	44
3	Chloride, mg/L	600	80	74
4	Faecal Coliform, MPN/100ml	-	60	48
5	Total Coliform, MPN/100ml	-	156	98
6	DO, mg/L	4.5-8	5.65	5.89
7	Conductivity, micromho/cm	1200	943	825
8	Nitrate, mg/L	10	17	31
9	pH	6-9	7.3	7.2
10	Phosphate mg/L	-	0.60	0.56
11	Salinity %	-	0.47	0.41
12	Temperature (^{0})	40	25.6	25.3
13	TDS, mg/L	2100	470	412
14	TSS, mg/L	150	15	12

The analysis result of the Surface water shows that all the parameter test results are within the Inland Surface Water standard limit. There are no inland surface water standards for Faecal Coliform, Total Coliform, Phosphate and Salinity prescribed by DoE.

8.5.4 Ground Water Monitoring

Ten ground water samples were collected from the vicinity of theproposed terminal locations in December 2020 to analyze Arsenic, Chloride, Faecal Coliform, Total Coliform, Iron, Manganese, SO_4 and TDS.The analyses of the parameters were done in DPHE Central Laboratory, Dhaka and results dated 15 December 2020 is included in the report.

[66]Reference of Standard: Ministry of Environment and Forest, Notification related to Environment Conservation Rules, 1997, Schedule 3.
Note: Water Quality Test from DPHE Central Laboratory
Sample ID
Point 1 (Branch River Turag at Birulia Bridge, Dhaka),
Point 2 (Shitalakshya River at Kanchpur Bridge, Narayanganj).

Figure 8-4: Ground Water Sampling and GPS Location Monitoring

Proposed Bhawal Bus Terminal Ground Water Sampling and GPS Location Monitoring

Proposed Bhulta Bus Terminal and Depot Ground Water Sampling and GPS Location Monitoring

Table 8-11: Test Parameter and Equipment/Method Details

	Parameters	Method/Equipment
1	TDS	Gravimetric
2	Chloride	Titrimetric
3	Arsenic	AAS-HVG
4	Iron	AAS - Flame
5	Manganese	AAS - Flame
6	SO_4	UV-Visible Spectrophotometer
7	Total Coliform	MFP
8	Faecal Coliform	MFP

Table 8-12: Ground Water Quality Monitoring Points and Locations

Location	Point	GPS Location
Baghair	Point1	23.66291^0 N 090.38165^0 E
Kanchpur South	Point10	23.68688^0 N 090.54507^0 E
Kanchpur North	Point9	23.70438^0 N 090.52586^0 E
Gram Bhatulia	Point4	23.89673^0 N 090.37940^0 E
Bhulta	Point8	23.78212^0 N 090.57652^0 E

Location	Point	GPS Location
Hemayetpur	Point3	23.79454^0 N 090.27673^0 E
Bhawal, Ati Bazar	Point2	23.73108^0 N 090.31186^0 E
Baipail	Point5	23.98309^0 N 090.26136^0 E
Gazipur	Point6	24.01221^0 N 090.38511^0 E
Kanchan	Point7	23.82844^0 N 090.56251^0 E

Table 8-13: Ground Water Quality Analysis Report[67]

	1	2	3	4	5	6	7	8
Parameter	**As**	**Cl**	**FC**	**TC**	**Fe**	**Mn**	**SO_4**	**TDS**
Bangladesh Standard (Drinking Water)	0.05 mg/l	150-600mg/l	0MPN/100ml	0MPN/100ml	0.3-1.0 mg/l	0.1mg/l	400 mg/l	1000 mg/l
GW1	0.001	13	0	0	0.39	1.89	1	145
GW2	0.003	16	0	0	0.40	3.54	1	274
GW3	0.001	12	0	0	0.23	0.11	1	142
GW4	0.001	15	0	0	0.51	0.03	1	201
GW5	0.001	13	0	0	0.40	0.03	2	148
GW6	0.001	12	0	0	0.58	0.24	3	140
GW7	0.001	86	0	0	0.31	0.03	3	267
GW8	0.001	51	0	0	0.43	0.03	1	239
GW9	0.001	190	0	0	0.15	0.08	1	560
GW10	0.001	70	0	0	0.33	2.63	1	396

The result of analysis of the ground water shows that all the parameters are within the drinking water standard limit except five points for manganese test result. Though as per World Bank standard allowable limit of manganese is 0.5 mg/l, as per discssuion with DPHE personnel regarding presence of Manganese higher than standard level they informed that recently they found higher rate of manganese in ground water all over the country. But yet not they trace out any specific reason.

8.6 Environmental Monitoring Plan (EMP)

As one of the key elements of the EMP, a two-tier monitoring program is proposed comprising compliance monitoring and effects monitoring. The main purpose of this monitoring program is to ensure that the various tasks detailed in the EMP particularly the mitigation measures are implemented in an effective manner and also to evaluate program impacts on the key environment and social parameters. Various types of EMP monitoring are discussed below.

Compliance Monitoring: The purpose of the compliance monitoring is to ensure that the contractor implements the mitigation measures given in the EMP effectively and timely. It will generally be carried out by the safeguard concern of DTCA with the help of checklists (will be given prior to the commencement of the work) prepared on the basis of the

[67]Reference of Standard: Ministry of Environment and Forest, Notification related to Environment Conservation Rules, 1997, Schedule 3.

mitigation measures. A simple checklist has been prepared for compliance monitoring by visual observation during construction phase.

8.7 Mitigation Measure of Identified Impacts

Each aspect of the project activities has the potential to impact the environment. Most of the potential adverse impacts can be reduced or even eliminated when appropriate mitigation measures are implemented. With the proper application of mitigation methods prescribed in the following table and best management practices, most if not all of the potential impacts can be eliminated or mitigated to insignificant levels

.

Table 8-14: Hierarchy of Environmental Mitigations for due Environmental Management

Mitigation Method	Definition
Avoid the impact	To “avoid” means to be able to change some aspect of the design, construction, or operation such that the impact no longer occurs.
Reduce the impact	To “reduce” means to implement measures that will lower the level of impact to an acceptable-levels (e.g., ensuring that construction equipment meets noise emission standards).
Rectify the impact	To “rectify” means to allow an impact to occur, then take measures to rehabilitate the environment to a level whereby the impact is within acceptable-limits afterwards (e.g., erecting the construction campsite but then reclaiming the site after construction activity is complete).
Compensate for the impact	To “compensate” means to allow the impact to occur, then provide non-monetary compensation (first priority) or monetary compensation (second priority) for losses created by the impact afterwards (*e.g.,* if a farmer must be resettled, the first compensation priority is to provide replacement land and housing. If replacement land and housing cannot be provided, the replacement value of losses must be calculated and provided to the farmer).

Table 8.17 describes mitigation measures required for limiting the negative impacts of the project activities with the aim of sustainable implementation and operation of the project ensuring environmental and community safety nature, spatial and temporal extent, reversibility and consequences.

Table 8-15: Identification of Significance of Impacts

		Ecological Impacts	Bhawal, Ati Bazar			Baghair			Gram Bhatulia			Bhulta			Bypail		
Construction	Ecological Impacts	◆ Felling of the trees	Significant ☐	Moderate ☑	Minor ☐	Significant ☐	Moderate ☐	Minor ☑	Significant ☐	Moderate ☐	Minor ☑	Significant ☐	Moderate ☐	Minor ☑	Significant ☐	Moderate ☑	Minor ☐
		◆ Clearing of the vegetation	Significant ☑	Moderate ☐	Minor ☐	Significant ☐	Moderate ☐	Minor☑	Significant ☐	Moderate ☐	Minor ☑	Significant ☐	Moderate ☐	Minor ☑	Significant ☐	Moderate ☐	Minor ☑
		◆ Potential impact on species of aquatic (i.e., water) environment	Significant ☐	Moderate ☐	Minor ☑	Significant ☐	Moderate ☐	Minor ☑	Significant ☐	Moderate ☐	Minor☑	Significant ☐	Moderate ☐	Minor ☑	Significant ☐	Moderate ☐	Minor ☑
	Physicochemical Impacts	◆ Noise pollution	Significant ☐	Moderate ☑	Insignificant ☐	Significant ☐	Moderate ☑	Insignificant ☐	Significant ☑	Moderate ☐	Insignificant ☐	Significant ☐	Moderate ☑	Insignificant ☐	Significant ☐	Moderate ☑	Insignificant ☐
		◆ Air pollution	Significant ☐	Moderate ☑	Insignificant ☐	Significant ☑	Moderate ☐	Insignificant ☐	Significant ☑	Moderate ☐	Insignificant ☐	Significant ☑	Moderate ☐	Insignificant ☐	Significant ☐	Moderate ☑	Insignificant ☐
		◆ Drainage congestion	Very likely ☐	Likely ☐	Unlikely ☑	Very likely ☐	Likely ☐	Unlikely ☑	Very likely ☐	Likely ☐	Unlikely ☑	Very likely ☐	Likely ☐	Unlikely ☑	Very likely ☐	Likely ☐	Unlikely ☑
		◆ Water pollution	Significant ☐	Moderate ☐	Insignificant ☑	Significant ☐	Moderate ☐	Insignificant ☑	Significant ☐	Moderate ☑	Insignificant ☐	Significant ☐	Moderate ☐	Insignificant ☑	Significant ☐	Moderate ☐	Insignificant ☑
		◆ Pollution from solid/ construction wastes	Significant ☐	Moderate ☑	Insignificant ☐	Significant ☐	Moderate ☑	Insignificant ☐	Significant ☐	Moderate ☑	Insignificant ☐	Significant ☐	Moderate☑	Insignificant ☐	Significant ☐	Moderate ☑	Insignificant ☐
		◆ Water logging	Significant ☐	Moderate ☐	Insignificant ☑	Significant ☐	Moderate ☐	Insignificant ☑	Significant ☐	Moderate ☑	Insignificant ☐	Significant ☐	Moderate ☐	Insignificant ☑	Significant ☐	Moderate ☐	Insignificant☑
	Socio-economic Impacts	◆ Traffic congestion	Very likely ☑	Likely ☐	Unlikely ☐	Very likely ☐	Likely ☑	Unlikely ☐	Very likely☑	Likely ☐	Unlikely ☐	Very likely ☐	Likely ☑	Unlikely ☐	Very likely ☑	Likely ☐	Unlikely ☐
		◆ Health and safety	Significant ☐	Moderate ☑	Insignificant ☐	Significant ☐	Moderate ☑	Insignificant ☐	Significant ☐	Moderate ☑	Insignificant ☐	Significant ☐	Moderate ☑	Insignificant ☐	Significant ☐	Moderate ☑	Insignificant ☐
		◆ Impact on archaeological and historical	Significant ☐	Moderate ☐	Insignificant ☑	Significant ☐	Moderate ☐	Insignificant ☑	Significant ☐	Moderate ☐	Insignificant ☑	Significant ☐	Moderate ☐	Insignificant ☑	Significant ☐	Moderate ☐	Insignificant ☑
		◆ Employment generation	Significant ☐	Moderate ☑	Insignificant ☐	Significant ☐	Moderate ☑	Insignificant ☐	Significant ☐	Moderate ☐	Insignificant ☑	Significant ☐	Moderate ☐	Insignificant ☑	Significant ☐	Moderate ☑	Insignificant ☐
Potential Environmental Impact during Operational Phase	Ecological Impacts	◆ Potential impact on species of the aquatic (i.e., water) environment	Significant ☐	Moderate ☐	Minor ☑	Significant ☐	Moderate ☐	Minor ☑	Significant ☐	Moderate ☐	Minor ☑	Significant ☐	Moderate ☑	Minor ☐	Significant ☐	Moderate ☐	Minor ☐
	Physicochemical Impacts	◆ Potential air and noise quality	Improvement ☐	Minor - improvement ☐	Deterioration ☑	Improvement ☐	Minor- improvement ☐	Deterioration ☑	Improvement ☐	Minor - improvement ☐	Deterioration ☑	Improvement ☐	Minor- improvement ☐	Deterioration ☑	Improvement ☐	Minor - improvement ☐	Deterioration ☑
		◆ Drainage congestion	Improvement ☑	Minor Improvement ☐	Deterioration ☐	Improvement ☑	Minor Improvement ☐	Deterioration ☐	Improvement ☐	Minor Improvement ☑	Deterioration ☐	Improvement ☐	Minor Improvement ☑	Deterioration ☐	Improvement ☑	Minor Improvement ☐	Deterioration ☐
		◆ Risk of Water pollution	Significant ☐	Moderate ☐	Minor ☑	Significant ☐	Moderate ☐	Minor ☑	Significant ☐	Moderate ☑	Minor ☐	Significant ☐	Moderate ☑	Minor ☐	Significant ☐	Moderate ☑	Minor ☐
		◆ Pollution from solid waste	Significant ☐	Moderate ☐	Minor ☑	Significant ☐	Moderate ☑	Minor ☐	Significant ☐	Moderate ☐	Minor ☑	Significant ☐	Moderate ☐	Minor ☑	Significant ☐	Moderate ☐	Minor ☑
	Socio-economic Impacts	◆ Traffic	Improvement ☑	No - improvement ☐	Adverse ☐	Improvement ☑	No - improvement ☐	Adverse ☐	Improvement ☐	No - improvement ☐	Adverse ☑	Improvement ☑	No - improvement ☐	Adverse ☐	Improvement ☑	No - improvement ☐	Adverse ☐
		◆ Safety	Improvement ☑	No - improvement ☐	Adverse ☐	Improvement ☑	No - improvement ☐	Adverse ☐	Improvement ☑	No - improvement ☐	Adverse ☐	Improvement ☑	No - improvement ☐	Adverse ☐	Improvement ☑	No - improvement ☐	Adverse ☐
		◆ Employment generation	Significant ☐	Moderate☑	Insignificant ☐	Significant ☐	Moderate ☑	Insignificant ☐	Significant ☐	Moderate ☑	Insignificant ☐	Significant ☐	Moderate ☑	Insignificant ☐	Significant ☐	Moderate ☑	Insignificant ☐

		Ecological Impacts	Gazipur			Hymayetpur			Kanchan			Kanchpur North			Kanchpur South		
Construction	Ecological Impacts	◆ Felling of the trees	Significant ☐	Moderate ☐	Minor ☑	Significant ☐	Moderate ☑	Minor ☐	Significant ☐	Moderate ☐	Minor ☑	Significant ☐	Moderate ☐	Minor ☑	Significant ☐	Moderate ☐	Minor ☑
		◆ Clearing of the vegetation	Significant ☐	Moderate ☐	Minor ☑	Significant ☐	Moderate ☐	Minor ☑	Significant ☐	Moderate ☐	Minor ☑	Significant ☐	Moderate ☐	Minor ☑	Significant ☐	Moderate ☐	Minor ☑
		◆ Potential impact on species of aquatic (i.e., water) environment	Significant ☐	Moderate ☐	Minor☑	Significant ☐	Moderate ☐	Minor ☑	Significant ☐	Moderate ☐	Minor ☑	Significant ☑	Moderate ☐	Minor ☐	Significant ☐	Moderate ☑	Minor ☐
	Physicochemical Impacts	◆ Noise pollution	Significant ☑	Moderate ☐	Insignificant ☐	Significant ☑	Moderate ☐	Insignificant ☐	Significant ☑	Moderate ☐	Insignificant ☐	Significant ☑	Moderate ☐	Insignificant ☐	Significant ☑	Moderate ☐	Insignificant ☐
		◆ Air pollution	Significant ☑	Moderate ☐	Insignificant ☐	Significant ☐	Moderate ☑	Insignificant ☐	Significant ☑	Moderate ☑	Insignificant ☐	Significant ☑	Moderate ☐	Insignificant ☐	Significant ☑	Moderate ☐	Insignificant ☐
		◆Drainage congestion	Very likely ☐	Likely ☑	Unlikely ☐	Very likely ☐	Likely ☐	Unlikely ☑	Very likely ☐	Likely ☐	Unlikely☑	Very likely ☐	Likely ☑	Unlikely ☐	Very likely ☐	Likely ☑	Unlikely ☐
		◆ Water pollution	Significant ☐	Moderate ☐	Insignificant ☑	Significant ☐	Moderate ☑	Insignificant ☐	Significant ☐	Moderate ☐	Insignificant ☑	Significant ☐	Moderate ☑	Insignificant ☐	Significant ☐	Moderate ☐	Insignificant ☐
		◆ Pollution from solid/ construction wastes	Significant ☐	Moderate ☑	Insignificant ☐	Significant ☐	Moderate ☑	Insignificant ☐	Significant ☐	Moderate ☑	Insignificant ☐	Significant ☐	Moderate☑	Insignificant ☐	Significant ☐	Moderate ☑	Insignificant ☐
		◆ Water logging	Significant ☐	Moderate ☐	Insignificant ☑	Significant ☐	Moderate ☐	Insignificant ☑	Significant ☐	Moderate ☐	Insignificant ☑	Significant ☐	Moderate ☑	Insignificant ☐	Significant ☐	Moderate ☐	Insignificant ☑
	Socio-economic Impacts	◆ Traffic congestion	Very likely ☐	Likely ☑	Unlikely ☐	Very likely ☐	Likely ☑	Unlikely ☐	Very likely ☐	Likely ☑	Unlikely ☐	Very likely ☑	Likely ☐	Unlikely ☐	Very likely ☐	Likely ☐	Unlikely ☑
		◆ Health and safety	Significant ☐	Moderate ☑	Insignificant ☐	Significant ☐	Moderate ☑	Insignificant ☐	Significant ☐	Moderate ☑	Insignificant ☐	Significant ☐	Moderate ☑	Insignificant ☐	Significant ☐	Moderate ☑	Insignificant ☐
		◆Impact on archaeological and historical	Significant ☐	Moderate ☐	Insignificant ☑	Significant ☐	Moderate ☐	Insignificant ☑	Significant ☐	Moderate ☐	Insignificant ☑	Significant ☐	Moderate ☐	Insignificant ☑	Significant ☐	Moderate ☐	Insignifican☑
		◆ Employment generation	Significant ☐	Moderate ☐	Insignificant ☑	Significant ☐	Moderate ☑	Insignificant ☐	Significant ☐	Moderate ☐	Insignificant ☑	Significant ☐	Moderate ☑	Insignificant ☐	Significant ☐	Moderate ☑	Insignificant ☐
Potential Environmental Impact during Operational Phase	Ecological Impacts	◆Potential impact on species of the aquatic (i.e., water) environment	Significant ☐	Moderate ☐	Minor ☑	Significant ☐	Moderate ☑	Minor ☐	Significant ☐	Moderate ☐	Minor ☑	Significant ☐	Moderate ☐	Minor ☑	Significant ☐	Moderate ☐	Minor ☑
	Physicochemical Impacts	◆Potential air and noise quality	Improvement ☐	Minor - improvement ☐	Deterioration ☑	Improvement	Minor - improvement ☐	Deterioration ☐	Improvement ☐	Minor - improvement ☐	Deterioration ☐☑	Improvement ☐	Minor - improvement ☐	Deterioration☑	Improvement ☐	Minor - improvement ☐	Deterioration ☑
		◆Drainage congestion	Improvement ☐	Minor Improvement ☑	Deterioration ☐	Improvement ☑	Minor Improvement ☐	Deterioration ☐	Improvement ☑	Minor Improvement ☐	Deterioration ☐	Improvement ☐	Minor Improvement ☑	Deterioration ☐	Improvement ☐	Minor Improvement ☑	Deterioration ☐
		◆Risk of Water pollution	Significant ☐	Moderate ☐	Minor☑	Significant ☐	Moderate ☐	Minor ☐	Significant ☐	Moderate ☐	Minor ☑	Significant ☐	Moderate ☐	Minor ☑	Significant ☐	Moderate ☐	Minor ☑
		◆Pollution from solid waste	Significant ☐	Moderate ☐	Minor ☑	Significant ☐	Moderate ☐	Minor ☐	Significant ☐	Moderate ☐	Minor ☑	Significant ☐	Moderate ☐	Minor☑	Significant ☐	Moderate ☐	Minor ☑
	Socio-economic impacts	◆ Traffic	Improvement ☑	No - improvement ☐	Adverse ☐	Improvement ☑	No - improvement ☐	Adverse ☑	Improvement ☑	No - improvement ☐	Adverse ☐	Improvement ☐	No - improvement ☐	Adverse ☑	Improvement ☑	No - improvement ☐	Adverse ☐
		◆ Safety	Improvement ☑	No - improvement ☐	Adverse ☐	Improvement ☑	No - improvement ☐	Adverse ☐	Improvement ☑	No - improvement ☐	Adverse ☐	Improvement ☑	No - improvement ☐	Adverse ☐	Improvement ☑	No - improvement ☐	Adverse ☐
		◆ Employment generation	Significant ☐	Moderate ☐	Insignificant ☑	Significant ☐	Moderate ☑	Insignificant ☐	Significant ☐	Moderate ☐	Insignificant ☑	Significant ☐	Moderate ☑	Insignificant ☐	Significant ☐	Moderate ☑	Insignificant ☐

Write up for crioteria

Legend: Continuous input

Discontinuous input

☑

Table 8-16: Measures of Mitigationof Environmental Impacts

	Items of Impacts	Mitigation Measures	
		Before/ during Construction	During Operation
1.	Air pollution	• Contractors of terminals project will be required to conduct daily routine equipment and machinery check-ups to ensure that these are in the optimum working conditions. • Regular preventive maintenance service of construction equipment and machineries will strictly comply with. • The proper work schedules should be considered not to concentrate the construction equipment at a certain point for long time. • To reduce the dust, periodical water spray should be taken. • If the residents and pedestrians complain about the dust and gas, the consultant of the supervision and contractors should reconsider the construction technique. • When the air pollution levels exceed significantly the environmental standards, the regulation on fuel quality, importing old cars and emission gas control should be prepared on necessity. • Burning of wastes generated at the construction sites, work camps and other project-related activities shall be strictly prohibited;	Movement of people will be very common at the bus terminals. Therefore, vehicle exhaust emissions and entrained dust will increase in the vicinity of the station. Losses of chemical cleaning fluids and odors from various sources will be present in the depot area. The impact will be very low at the operation phase. So, no mitigation measures are proposed. It is assumed that the increase of traffic and residents will cause the exhausted gas. Moreover, the operation will improve congestion of roads along the alignment and efficiency of the vehicle mobility. Consequently, increase in air pollution in major city may be mitigated as a positive impact.
2.	Water pollution	• Concrete poring and bus parking surfacing will be closely supervised to prevent spillage. • All formworks will be secured prior to pouring to ensure failure will not occur. • Temporary sanitation facilities such as portable toilets and garbage bins will be provided by the contractors to ensure that the domestic wastes to be generated by the construction personals are properly handled and not thrown into the drainage to prevent further pollution. • Regular preventive maintenance service of construction equipment and machineries will strictly comply with. • Contractors will be prohibited from washing the construction tools along the waters to	The main source of water pollution at the operation phase of bus terminals will be oil spillage during change of lubricants, cleaning and repair process, in the maintenance zone of the terminals. The mitigation measure of the water quality impact includes: • Collecting oil will be either auctioned or incinerated to avoid any ground water

	Items of Impacts	Mitigation Measures	
		Before/ during Construction	During Operation
		prevent further pollution. • Water quality parameters will be monitored at the construction period within regular basis.	contamination; • Promotion on awareness on water conservation and reducing water usage; • Promoting urinals and wash basins with automatic sensors
3.	Soil Pollution	• Spoil soil shall be disposed at designated dumping site • Soil quality Testing • Disposal of waste oil without leakage • Refueling place having concreted floor • Preserved in the tank surrounded with concrete fence • Equipment and vehicles are properly maintained • Batteries containing liquid inside shall be kept on impervious place	• Soil pollution only may occur in the terminals site due to the oil leakage so care should be taken so that spillage cannot take place. • If waste **oil** is a **lubricating oil**, e.g., from a vehicle, make sure you put it into a container (a **concrete tank**) that isn't damaged and has a secure lid. Don't dispose of these oils with normal household waste or recycling. They should be taken to local household recycling site for safe disposal • Waste oil is used and contaminated by physical or chemical impurities, such as tyre pyrolysis oil, plastic pyrolysis oil, crude oil, fuel oil, used engine oil, raw oil, waste washing oil, heavy oil etc. If they are not properly disposed, they will pollute the environment seriously. As the oil resources decrease, oil price is rising continuously. So, there is an urgent need for an alternative of oil resources. Based on the current situation, the **Waste Oil Rerefining to Base Oil Plant** is launched

	Items of Impacts	Mitigation Measures	
		Before/ during Construction	During Operation
			in the market to improve the environment, help relieving energy crisis as well as creating profits.
4.	Waste	• Contractor will be required to facilitate proper re-use and disposal plan and manage the construction waste. • Treatment is required if the soil contain poisonous substance prior to reuse and dumping; • Excavated soil need to be managed proper way • The consultant of supervision should monitor the waste disposal. • Select the proper dumping station with collaboration of different respective authority; • Suitability study need to be carried out for further use of the surplus soil; • Consultationis required with DNCC, DSCC, DMTCL, GCC, NCC, RHD, RAJUK, BWDB, DWASA TITAS Gas to know their development plan in and around the Dhaka city where the surplus soil might be used if it is suitable for use inland development and embankment construction • If the soil is suitable for brick manufacturing then the surplus soil could be used in the brick kiln of surrounding Dhaka city; • Surplus soil could be sold to the land developer depending upon the suitability	• Implementing agencies will provide proper number of garbage bins in every terminal user. • The waste in the operation stage should be properly collected and disposed or recycled in compliance with rules in respective City Corporations and District level authorities.
5.	Noise and vibrations	• The proper work schedules should be considered not to concentrate the construction equipment at a certain point for long time. • Noise suppressors such as mufflers will be installed whenever deemed necessary to maintain the noise generated from various heavy equipment's and other construction machinery within permissible limits. • Temporary noise barriers such as corrugated metal sheets will be installed around the construction sites to maintain noise level within permissible level if necessary. • High noise generating construction activities will be scheduled during daytime only (06:00 – 21:00) to avoid noise disturbance to adjacent residential and commercial areas and other noise-sensitive areas. • Contractors will be required to use low-vibration equipped machinery whenever it is	• At the terminal there is specific rule of "No Horn" system, during entry, exit and parking time every one should adopt the low/ no horn system. • Advertisement of varieties of products, social gathering, religious meeting through loud speaker is strongly prohibited at the terminal area. It is another main source of noise pollution. There is a specific display board and central announcing system for

	Items of Impacts	Mitigation Measures	
		Before/ during Construction	During Operation
		necessary. • To identify impact on the surrounding buildings, the vibration level and condition of the buildings should be monitored. • The explanation and consultation to the affected persons prior to the construction should be conducted to obtain the understanding about the potential impacts including information of the positive impacts such as promotion of the local socio-economic activity. If the local people complain about noise and vibration, the consultant of the supervision and the contractors should reconsider the construction technique.	promotional activities • Noise monitoring shall continue during operation phase to determine and install suitable noise reduction measures (*e.g.,* unobtrusive noise barriers on the edge of the stations); • The proper countermeasures to reduce noise, installation of sound barrier and adoption of expansion and contraction joint should be included in the plan and design.
6.	Ground Subsidence	• In the detailed design stage, the detailed geological surveys should be conducted. The proper structure design and construction technique should be considered on the basis of the survey results. • The consultant of supervision and contractor should monitor the ground subsidence. If the ground subsidence occurs, the consultant and contractors should reconsider the construction technique.	No mitigation measure is required
7.	Offensive odors	• Contractors will be required to conduct daily routine equipment and machinery check-ups to ensure that these are in the optimum working conditions. • Regular preventive maintenance service of construction equipment and machineries will strictly comply with.	• Regular cleaning of the station solid waste • Proper Management of Faecal Sludge management and Waste Water
8.	Bottom Sediment	• Take care when working near the water body • Check the oil spillage of the vehicle	No mitigation measure is required
9.	Biota and ecosystem	• Compensatory planting of shrubbery spices to the limited area around the terminal structures should be considered as necessary. • Afforestation should be done at the ratio of 1 (cut):4(new planting)	No mitigation measure is required
10.	Hydrology	• In the detailed design stage, the detailed hydrological surveys should be conducted. The proper structure design and construction technique should be considered on the basis of the survey results.	Do

	Items of Impacts	Mitigation Measures	
		Before/ during Construction	During Operation
11.	Wetlands	• Regular monitoring the water and soil Quality; • Check the oil spillage from the construction site;	No mitigation measure is required
12.	Ground water	• Proper maintain the vehicle • Regular check the water ground water quality • Check the oil spillage from any construction site • Monitor ground water level for 1 year after completion of construction work	No mitigation measure is required
13.	Involuntary Resettlement	• Conduct census survey and local stakeholder meeting • Prepare RAP involving the following measures - PAPs must be acknowledged as an eligible for compensation - Identify the eligibility of non-titled people at the census survey intended to PAPs and ensure the compensation and support - Refer the previous/on-going projects by other donors, determine the requirement for social vulnerability and compensate to them - Resettlement site must be prepared when PAPs need it • Establish external monitoring committee consisted by the third party	No mitigation measure is required
14.	Local economies such as employment, livelihood, etc	• Prepare RAP involving the following measure - Measure to restore PAPs' livelihood must be secured	Local economy will be enhanced due to the Bus terminals construction
15.	Land use and utilization of local resources	• Proper design should be prepared as the impact on land use will minimum • After completion of the construction get back the construction and labour camp in the previous condition	No mitigation measure is required
16.	Social service facilities	• Social service utilities such as power, water, drainage and communication line will be diverted before starting the construction activity	Make sure that people will get the utility connection after relocation of the facilities
17.	Social institution and decision making institutions	• Proper resettlement action Plan (RAP) • Provide adequate compensation in time to PAP.	No mitigation measure is required

	Items of Impacts	Mitigation Measures	
		Before/ during Construction	During Operation
18.	Misdistribution of benefits and damages	• Prepare RAP involving the following measure - Assessed compensation will base on the market price of the replacement value - Top up compensation method will be applied - Payment will be carried out before resettlement • Establish external monitoring committee by the third party	No mitigation measure is required
19.	Landscape	• Design on facilities which will harmonize with the surrounding landscape	No mitigation measure is required
20.	Local conflicts of interest	• Clear information about the needs of labor (number and qualification) should be provided with local people. • The job skills and the priority for the affected people shall be taken into account and the workers can be chosen.	Station access facilities such as stairs, escalators, elevators will be provided for both bounds
21.	Gender	• Affected female dependent households should include additional subsistence and relocation assistance, opportunity for skill training and income restoration, employment opportunity in civil work. • Women will be invited and join local stakeholder as well as male gender • Interviewing affected women while in census survey will be considered	• Keep provision separate female ticket counter in the station • Keep provision of designated seat for female in the train
22.	Children's Right	• Secure the accessibility to go to school/hospital when select resettlement places • Recruitment of childrem should be prohibited in the construction site	No mitigation measure is required
23.	Infectious diseases such as HIV/AIDS	• Contactor will be required to conduct a periodical health education to his personnel • Periodic awareness programshould be conducted for labour • Local public health center will conduct health education to new settlers	No mitigation measure is required
24.	Working Conditions	• Construction personnel will be provided with the necessary safety gears such as protective hard hat and safety belt • First aid stations supervised by the safety health officer of the contractor will be located within the construction site office • Emergency vehicles will be on stand-by within the construction site	• Proper safety instrument should keep in the station as well as office building • Arrange safety training to the worker periodically
25.	Accident	• A sound traffic management and detour plans duly approved by the concerned governmental agency will strictly implemented to minimize traffic congestions • Traffic enforcers and flagmen will be designated along these area to assist in directing	Traffic accident will decrease due to proper automated system at terminal area.

	Items of Impacts	Mitigation Measures	
		Before/ during Construction	During Operation
		traffic flow • Parking time of construction equipment such as dump track and agitator car along the major thorough fare will be limited, especially during peak hours to minimize traffic congestions • The height of the structures shall be designed as low as possible in terms of economic efficiency within the clearance which will mitigate the impacts. • The explanation and consultation to the affected persons prior to the construction should be conducted to obtain the understanding about the potential impacts including positive impacts such as promotion of the local socio-economic activity.	

Table 8-17: Compliance Monitoring by Visual Observation during Construction Phase

Monitored Parameter/ Issues	Monitoring Method/ Key Aspects	Location of Monitoring	Frequency of Monitoring	Responsible
Safety orientation and training of workers	Frequency of training and orientation of workers for safety	Subproject site	• Once in a month • Reporting: Once in a month	Contractor Monitoring- Primarily by City Corp., DTCA
Personal Protective Equipment	Ensure every single person involved in the activitieswear and use safety equipment	Subproject site	• Daily • Reporting: Once in a month	
Worker's health	Monitoring process of worker's health	Subproject site	• Daily • Reporting: Once in a month	
Sanitation and drinking water facility to the workers	Availability of safe drinking water and sanitation to the workers	Subproject site and work campsite	• Daily • Reporting: Once in a month	
Incident record and reporting	Documented record of all incident, accident, its remedial process	Subproject site	• Daily • Reporting: Once in a month	
Site security/ Fencing at the site	Isolation of site from general access by fencing, restriction of the un-authorized entry in the site.	Subproject site	• Daily • Reporting: Once in a month	
Bulletin/ announcement boards/ prohibition signs	Visible in good condition or not	Subproject site	• Daily • Reporting: Once in a month	

Monitored Parameter/ Issues	Monitoring Method/ Key Aspects	Location of Monitoring	Frequency of Monitoring	Responsible
Equipment /vehicles	-Switched-off diesel engines when not in use; -Search any possible leakage; -Fuelling.	Subproject site	• Daily • Reporting: Once in a month	
Dust	Dust is visible or not	Subproject site	• Daily • Reporting: Once in a month	
Oily waste generation and disposal	Quantity of oily waste, storage and disposal	Subproject site	• Daily • Reporting: Once in a week	
Solid waste generation	Quantity of solid wastes and disposal	Subproject site	• Daily • Reporting: Once in a month	
Gender equity	Direct survey in the field by interviews with the women in order to ensure that there is no discrimination between man and women regarding payment	Subproject site	• Daily • Reporting: Once in a month	
Child labor	No child will be engaged in the activities	Subproject site	• Daily • Reporting: Once in a month	
Handling of hazardous materials	Fuelling, storage, operation	Subproject site	• Daily • Reporting: Once in a month	

9 Hydrological Assessment

9.1 Project Peripheral River Network

There are numerous rivers/channels of varying size within the study area. Major rivers flowing in the study area are: Buriganga, Turag, Balu, Shitalakshya and Dhaleswari most of which are tidal. The river networks and hydrological data collected are shown in the following Map-9.1 and Tables 9.1 to 9.3

9.2 Other Waterways around the Study Areas

There is a canal inside Narayanganj city along the alignment which is about 10 km from Chasara to Demra and is called Narayanganj city canal which is operated by BWDB.In Mirpur area (beside Mirpur National Zoo) there is approximately 2km water body along the highway and is called Mirpur lake.

Table 9-1: General information of River networks[68]

River name	Length (km)	Width (m) maximum	Depth (m) maximum	Catchment area (sq. km)	Minimum flow (m3/s)	Maximum flow (m3/s)
Buriganga	45	265	14	253	50	1500
Balu	45	100	9.63	722	60	744
Turag	17	60	9.15	35	50	264
Shitalakhsya	110	280	14.89	3803	195	2742
Dhaleswari	168	697	18.6	7253	21	2330

Table 9-2: List of Proposed Bus Terminal and Depot[69]

	Location	Area	River Connectivity	Accessibility
(1)	Baghair	33.63	Buriganga Dhaleshwari	N8- Dhaka-Mawa Highway (Proposed Middle Ring Road)
(2)	Kanchpur South	27.70	Shitalakshya	Middle Ring Road and N1(Dhaka-Chattogram Highway)
(3)	Kanchpur North	15.50	Shitalakshya	N1 (Dhaka-Chattogram Highway) and Near N2 (Dhaka-Sylhet Highway)
(4)	Gram Bhatulia	26.7	Turag	Inner Ring Road, Circular Railway, Circular Waterway, MRT-6, MRT-4, Dhaka- Ashulia EE.

[68] Bangladesh Water Development Board (BWDB)
[69] As per site visit & Secondary Data

	Location	Area	River Connectivity	Accessibility
(5)	Bhulta	24.20	Shitalakshya Brahmaputra	Close to N2 (Dhaka-Sylhet Highway), Dhaka City bypass and Adjacent to R203 (Bhulta-Brahmanbaria Road)
(6)	Hemayetpur	45	Buriganga Dhaleshwari	N5 (Dhaka-Aricha Highway), MRT-5 (North) and Middle Ring Road in 800m
(7)	Bhawal, Ati Bazar	25.78	Buriganga Dhaleshwari	Ati Bazar- Kalatiya Road, Proposed Middle Ring Road
(8)	Baipail	37.10	Dhaleshwari	Nabinagar-Chandra Road, Dhaka-Ashulia EE.
(9)	Gazipur	11.70	Bongshi	N3 (Dhaka-Mymensingh Highway), BRT-3
(10)	Kanchan	24.20	Shitalakshya	Dhaka City Bypass

9.3 Rainfall

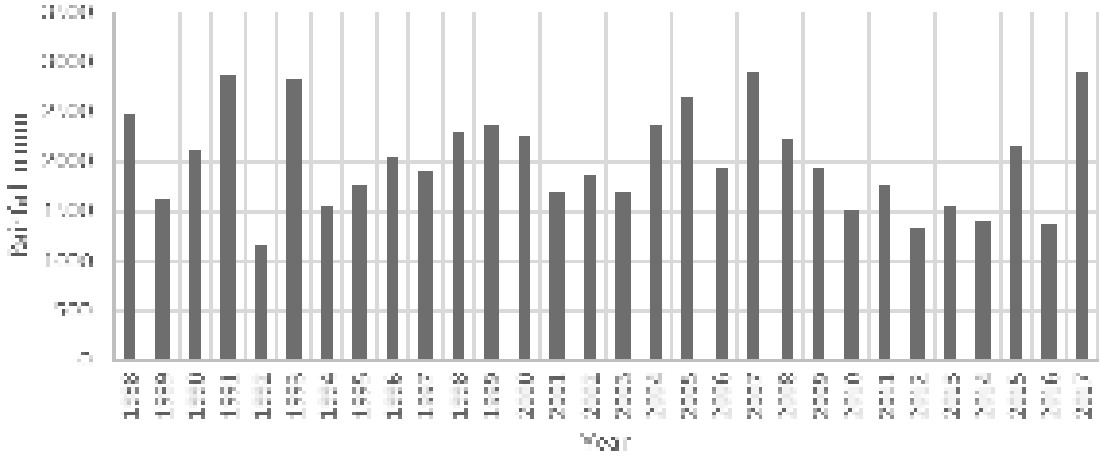
The climate of Dhaka city is called tropical savanna climate. The city has a distinct monsoon season, with an annual average temperature of 20° to 30°c. Daily precipitation data was collected from BMD, which is plotted in a bar chart to observe annual variation of rainfall

Maximum rainfall in a day 210 mm

One-month maximum rainfall 839 mm

One-year maximum rainfall 2892 mm

Figure 9-1: Rainfall in Dhaka[70]



9.4 Hydrological Station

BWDB has established hydrological station in river around the country and collects data for water level from their gauge stations. This is measured in meter with respect to mean sea level (msl). The water level is measured on daily basis around the year.

[70] Secondary Data

Table 9-3: Hydrological Stations List[71]

Station ID	River	Location	District	Period
SW 7.5	Balu	Sultana kamal bridge	Dhaka	1987-2017
SW 42	Buriganga	Mill Barak	Dhaka	1987-2017
SW302	Turag	Gabtoli bridge	Dhaka (Mirpur)	1987-2017
SW 299	Turag	Tongi Bridge	Gazipur	1987-2017
SW 179	Shitalakshya	Demra	Dhaka	1987-2017
SW 68 A	Dhaleswari	Jagir	Manikganj	1987-2017

9.5 Recently Experienced Flood Levels

The data on the flood levels experienced in the Dhaka and surrounding areas (within the project area) was collected from BWDB sources. The collected flood levels with their year of occurrences are shown in the table below. (Historically Observed flood level in reference with the estimated danger level).

Table 9-4: Historically Observed flood level around Project[72]

Station	River	Danger level of the respective rivers (m PWD)	Highest Flood Level (m PWD)	Year corresponding to HWL
Demra	Balu	5.75	7.13	1988
Mill barak	Buriganga	6.00	7.58	1988
Tongi	Turag	6.10	7.84	1988
Mirpur	Turag	5.95	8.35	1988
Demra	Shitalakhya	5.50	6.93	1988
Jagir	Dhaleswari	8.25	9.96	1988

9.6 Drainage

The existing internal drainage systems of urban area consists of storm sewer lines, surface drains or natural canals/open channels (locally known as Khals) that ideally carry the storm water as well as a part of waste water generated in that locality to the surrounding rivers. It may be mentioned that there were a good number of open channels in the same project areas, which play a vital role to provide storm water drainage to the city. There is sufficient low land around the project which acts as water retention area of the respective command area to retain the excess water.

The level of runoff flow (quantity) control required depends on the type of development proposed, new development or redevelopment. Local rainfall data were used to calculate pre-development allowable discharge limit for the whole study area.

[71] Bangladesh Water Development Board (BWDB)
[72] As above

9.7 Water-logging

Water logging is one of the major problems for the city residents, especially during the rainy season. The city is already densely populated and the volume of population will further increase in future. There is no specific rules and regulations for operation and maintenance of storm water drainage system. Existing drainage facilities of Dhaka and its surrounding cities are quite inadequate and most of the natural drains are not functioning properly due to blockage by dumping of debris, garbage and poor maintenance.

Some of the areas of Dhaka such as Shantinagar, Mirpur, Fakirapool, Motijheel etc. experience major water logging during rainy season. In order to avoid water logging around the proposed terminal, the terminals would be developed considering flood level and the storm water drainage system will be linked to the nearest river canal system. The drainage water will be treated at ETP (detail will be provided during detail design stage).

Map 9.1: Major Waterlogging Locations around DND Area[73]

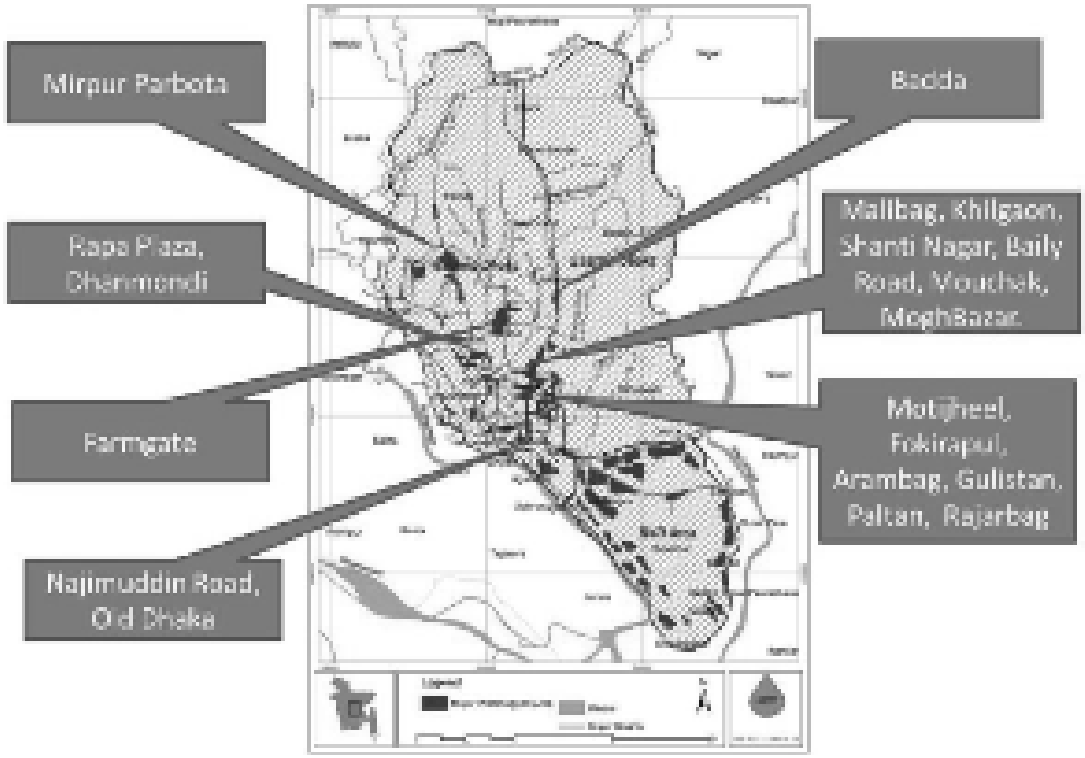


Table 9-5: Drainage of Water Bodies along the Proposed Sites

	Site	Highest Flood Level (1988) meter	Avg. Ground Level (G.L.) meter	Avg. Road Level (R.L.) meter	River Connecti-vity	Nearest water body	Distance (water body to the project) meter
(1)	Baghair	7.58	4.22	8.16	Buriganga	Hajir bazar Canal	240
(2)	Kanchpur	6.93	3.56	7.01	Shitalakshya	Kanchpur	230

[73] Drainage Master Plan, DWASA, May2016

	Site	Highest Flood Level (1988) meter	Avg. Ground Level (G.L.) meter	Avg. Road Level (R.L.) meter	River Connecti-vity	Nearest water body	Distance (water body to the project) meter
	South					boro khal	
(3)	Gram Bhatulia	8.35	4.68	9.89	Turag	Turag river	200
(4)	Bhulta	6.93	0.85	5.17	Shitalakshya	Golakanda khal	200
(5)	Hemayet-pur	9.96	6.12	8.08	Dhaleshwari	Buri khal	1500
(6)	Kanchan	6.93	6.84	7.24	Shitalakshya	Shitalakshya	170

Table 9-6: Flood Danger Levels[74]

Parameters		River	Guage Station	1998	1988
Danger level above PWD) datum	meter	Buriganga	Millbarak	6	6
		Turag	Mirpur	5.94	5.94
		Tongi Khal	Tongi	6.08	6.08
		Balu	Demra	—	—
Date of crossing –danger level at rising stage		Buriganga	Millbarak	26-07-98	29-08-88
		Turag	Mirpur	18-07-98	24-08-88
		Tongi Khal	Tongi	22-07-98	28-08-88
		Balu	Demra	—	—
The highest flood peak to arrive from Dhaka City to India – Bangladesh border	days	Bunganga	Millbarak	7	7
		Turag	Mirpur	6	6
		Tongi Khal	Tongi	6	6
		Balu	Demra	—	10
The highest flood peak to travel from India – Bangladesh border to Dhaka City	days	Buriganga	Millbarak	4	6
		Turag	Mirpur	4	6
		Tongi Khal	Tongi	5	6
		Balu	Demra	—	8
Height of peak flood level in meters above danger level	days	Bunganga	Millbarak	1.23	1.58
		Turag	Mirpur	2.03	2.41
		Tongi Khal	Tongi	1.46	1.76
		Balu	Demra	—	—
Duration of flood in days above danger level	days	Buriganga	Millbarak	56	22
		Turag	Mirpur	69	30
		Tongi Khal	Tongi	65	25
		Balu	Demra	—	—

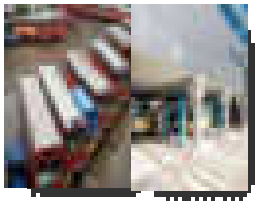
Due to the shortage of proper infrastructure, the inhabitants of city have been experiencing frequent water logging during monsoon. Some of the areas of Dhaka such as Shantinagar,

[74]Secondary Data

Mirpur, Fakirapool, Motijheel etc. are very well known for their flooding with monsoon rainfall.

9.8 The Finished Ground Level (FGL)

The exact FGL will be determined during detailed design phase on the basis of accurate flood level after the completion of hydrological data collection and detail analysis; then necessary depth of land fill using local sand with required degree and type of compaction can be proposed aiming for minimum settlement.



10 Assessment of Utilities and Social Infrastructure

Availability of utilities in the proposed bus terminal sites and proximity of social infrastructure is a key factor for the effective use and efficient operation of a bus terminal. During the conceptual design of the terminals, the utility provisions were reviewed and adequate provisions have been proposed in case of any lacking. The social infrastructure in proximity of terminal can be useful for the passenger, bus crew and staff of terminal operator. Table 10.1 gives detail information for each terminal site. Summary of the assessment is given below:

- Electricity is available near all terminals (1 from DESCO, 9 from BREB). Since electricity supply by BREB is not regular, provision of generator would be essential.
- Petrol pumps are located within one km of terminal locations
- Dedicated water supply not available, only water from tube well with pumping facility is available
- Presently, there is no dedicated storm water drainage facility in the area linking adjacent rivers (Buriganga, Dhaleswari, Sitalakshya). Some ponds are located close to the site. Untreated storm water is discharged at these places. Since discharge from bus terminals may be polluted (through washing of bus) special care was taken during design (Effluent Treatment Plant-ETP is proposed).
- Markets (more than one) are located within a distance of 1 to 5km
- Hospitals are located within a distance of 1km to 8 km
- Educational institutions (school and university) are located within a distance of 1.5 to 15 km.

Table 10-1: Availability of Utilities and Social Infrastructures[75]

Type	Baghair	Kanchpur South	Kanchpur North	Gram Bhatulia	Bhulta	Hemayetpur	Bhawal, Ati Bazar	Baipail	Gazipur	Kanchan
Distance from nearest market / Hat / Bazar	5.6 km from Keraniganj Bazar	400m from Madanpur Bus Stop Bazar	500m from Kanchpur Kacha Bazar	7 km from Abdullahpur Wholesale Fish Market	1 km from Gausia Market	200m from Hemayetpur Wholesale Market	2.5 km from Ati Bazar	Zirani Bazar 1.6 KM	Gazipur Chowrasta Bazar 2.5 KM	300m from Kanchan Bazar
	6 km from Postogola Bazar	4 km from Kanchpur Kacha Bazar	2.5 km from Chattogram Road Bus Stop Bazar	11 km from Mirpur Wholesale Market	1.2 km from Golakandail Hat	7.5 km from Gabtoli Wholesale Market	9 km from Gabtoli Wholesale Market	13 km from Baipail Kacha Bazar and Fish Market	15 km from Wholesale Fish Market, Abdullapur	6 km from Gausia Market
	16 km from Karwan Bazar	21 km from Karwan Bazar	18 km from Karwan Bazar	20 km from Karwan Bazar	26 km from Karwan Bazar	15 km from Karwan Bazar	11 km from Karwan Bazar	40 km from Karwan Bazar	33 km from Karwan Bazar	26 km from Karwan Bazar
Nearest Hospital (km)	8 km from Sir Salimullah Medical College Mitford Hospital	600m from The Barakah Hospital Modonpur Ltd	2.4 km from The Barakah Hospital Modonpur Ltd	3 km from EastWest Medical College and Hospital	800m from DKMC Hospital Ltd	6.5 km from Enam Medical College and Hospital	7 km from Al-Manar Hospital Ltd, Mohammadpur	Sheikh Fazilatunnessa Mujib Memorial KPJ Specialized Hospital and Nursing College 600m South	Apex Hospital (Private) 2.3 km South	Alhaj Sufi Mohammad Dayem Uddin Hospital is adjacent to the NorthWest side of the proposed terminal
	6.5 km from Ad-din Barrister Rafique-ul Huq Hospital, Postogola	18 km from Sir Salimullah Medical College Mitford Hospital	15 km from Sir Salimullah Medical College Mitford Hospital	5 km from Ahsania Mission Cancer and General Hospital	4.5 km from US-Bangla Medical College and Hospital towards Kanchpur	16 km from Dhaka Medical College and Hospital	13 km from Dhaka Medical and Hospital	Gonoshasthaya Kendra, Savar, 9 km South-West	Shaheed Taj Uddin Ahmad Medical Collage Hospital (Govt.) 8 km South-East	12 km from Ashiyan Medical College Hospital to the Kuril Highway
Nearest School/ College (km)	1.2 km from Baghair Govt. Primary School	Opposite of 31 Fulhor Govt. Primary School	1.3 km from Kanchpur Government Primary School	2.7 km from Dhour Government Primary School	1.5 km from Dorgaon Primary School	600m from Hemayetpur Govt. Primary School	300m from Ati Bhawal High School and College	BKSP 1.3 km North	BRTC Public School 400m South-West	600 m from Kanchan Government Primary School

[75]Google Map and site visit

Type	Baghair	Kanchpur South	Kanchpur North	Gram Bhatulia	Bhulta	Hemayetpur	Bhawal, Ati Bazar	Baipail	Gazipur	Kanchan
	8 km from Shyampur Govt.Model School and College	1.5 km from The Barakah Hospital Modonpur Ltd	Opposite of Kanchpur Omar Ali High School	2.2 km from Milestone College	2 km from Bhulta High School and College	7 km from Savar Government College	4 km from Kalatia University College	Abdullah Cadet School and College 1.5 km South	Gazipur City College 3.3 km South	1.5 km from Salimuddin Chowdhury University College
	13 km from University of Dhaka	18 km from University of Dhaka	15 km from University of Dhaka	12 km from Jahangirnagar University	6.4 km from Green University of Bangladesh Permanent Campus	11 km from Jahangirnagar University	12 km from University of Dhaka	Jahangirnagar University 11 km South-East	BSMR Agricultural University 3.5 km North	Opposite of Green University of Bangladesh Permanent Campus
Distance from existing/ proposed location for gas/ petrol station	M/S Anwara Filling Station is in 500m from the site and West side of Central Jail Boundary	Rafi Filling Station is inside of the Proposed site	SS CNG and Fuel Station is situated inside the proposed area	In 300m, there is a filling staion known as Sheba Green Filling Station	Bismillah Filling and CNG Station is in 1km from the Proposed site	There are three different fuel staion in 200m from the proposed site	R.T Filling Station and Vawal LPG Station is in 500m away to the East from proposed site	Jyoti CNG Filling Station is in the NorthWest of the proposed site area	Opposite of the proposed Gazipur Bus Terminal which is nearly 200m away.	There is a Filling Station in 800m towards Bhulta Bus Stop from the proposed location
Police Station	South Keraniganj Police Station is situated in 4.5KM towards Dhaka (Adjacent to N8) from the Proposed Bus Terminals and Depot	Bandar Police Station is situated in 12KM from the Proposed Bus Terminals and Depot	Sonargaon Police Station is situated in 12KM from the Proposed Bus Terminals and Depot	Uttara West Police Station (7.5KM) and Turag Police Station (3KM) from the Proposed Bus Terminals and Depot	Rupganj Police Station is situated in 9KM (Using Ferry) from the Proposed Bus Terminals and Depot	Savar Model Police Station is situated in 10.5KM from the Proposed Bus Terminals and Depot	Keraniganj Model Police Station is situated in 13KM from the Proposed Bus Depot	Joydebpur Police Station under Gazipur Metropolitan Police (29KM) and Ashulia Police Station (5KM)	Joydebpur Police Station under Gazipur Metropolitan Police is situated in 7KM from the Proposed Bus Terminals and Depot	Rupganj Police Station is situated in 9KM from the Proposed Bus Terminals and Depot
Fire Service & Civil Defence Station	Fire Service & Civil Defence Station, Postogola is situated in 6.5KM from the Proposed Bus Terminals and Depot	Fire Service & Civil Defence Station Adamjee EPZ (7.5KM), Demra (7.5KM) and Sonargaon (6.5KM)	Fire Service & Civil Defence Station Adamjee EPZ (4.5KM) and Demra (4.5KM)	Fire Service & Civil Defence Station, Sonargaon Janapath, Uttara is situated in 3KM from the Proposed Bus Terminals and Depot	Fire Service & Civil Defence Station, Purbachal is situated in 15KM from the Proposed Bus Terminals and Depot	Fire Service & Civil Defence Station Savar (4KM-Adjacent to N5) and Gabtoli (7KM-Near Gabtoli Bus Terminal)	Fire Service & Civil Defence Station Asadgate (8.5KM) and Hazaribagh Road (10KM-Opposte of Panna Group)	Fire Service & Civil Defence Station DEPZ (4KM) and Kashimpur Mini Fire Service (7KM)	Fire Service & Civil Defence Station, Gazipur is situated in 7.5KM from the Proposed Bus Terminals and Depot	Fire Service & Civil Defence Station, Purbachal is situated in 8.5KM from the Proposed Bus Terminals and Depot

Type	Baghair	Kanchpur South	Kanchpur North	Gram Bhatulia	Bhulta	Hemayetpur	Bhawal, Ati Bazar	Baipail	Gazipur	Kanchan
Electricity Supply	BREB	BREB	BREB	DESCO	BREB	BREB	BREB	BREB	BREB	BREB
Water Supply	Tubewell/ Submersible Pump	Tubewell/ Submersible Pump	Tubewell/ Submersible Pump	Tubewell/ Submersible Pump	Tubewell/ Submersible Pump	Tubewell/ Submersible Pump	Tubewell/ Submersible Pump	Tubewell/ Submersible Pump	Tubewell/ Submersible Pump	Tubewell/ Submersible Pump
Ground Water Level (m)	61	92	122	61	122	46	46	61	92	61
Storm water drainage	Canal to Buriganga and Dhaleswari River	Shitalakshya River	Wetland, Ponds	To Turag River	Shitalakshya River	Wetland to Canal to Karnatali River	Canal	Canal to Wetland to canal to Dhaleswari River	Not Available. Only local ponds	Wetland, Ponds

11 Preliminary Conceptual Design of the Proposed Terminals

The proposed bus terminals will be predominantly used for inter-city and intra-city movement to facilitate higher accessibility among various modes of inland transportation. These are the places with very high volume of pedestrians who might be looking for another transport mode to continue their journey to reach their destination. There are various functions associated with the bus terminals and a well-planned bus terminal must cater for:

(1) Concentration
(2) Dispersion
(3) Loading/unloading of the passengers
(4) Interchange of mode
(5) Stowage of passengers and vehicles
(6) Maintenance of vehicles
(7) Facilities and amenities for the users and crew
(8) Documentation of movement and
(9) Information system

Following points were considered for efficient workability of the terminals:

(1) Segregation of bus terminal traffic from highway traffic
(2) Segregation of pedestrian and vehicular movement
(3) Elimination of vehicular traffic conflicts
(4) Zoning for placement of related activities, parking and movement activities of city buses and
(5) Parking and movement activities of taxis/auto rickshawa/ private vehicles etc.
(6) Maximum commercial exploitation, within the framework of planning and building standards regulations, for increasing the viability of the project for development.

Primary segregation was done for the in-bound and out-bound passengers, as more than 90% in-bound passengers will be heading towards the city or another interdistrict bus terminal. The arrival sheds adjacent to the city bus departure can eventually segregate the pedestrian flow. Principles governing the planning of bus terminals are focused on ensuring enhanced passenger facility and level of service.

11.1 Design Criteria

The terminals were designed with some basic principles and criteria in consideration. Without them into place, the design may not be appropriate. Therefore, the design criteria were primary concerns for the design of the terminals:

Environmental Standards: Environmental issues addressed in the proposed terminals and depots as appropriate as possible. They are as following:

(1) Natural ventilation
(2) Use of maximum daylight

(3) Safe water supply source and safe ground water is ensured. Distribution of water supply networking all over terminal area is shown. Maintenance of both overhead and underground water tanks are proposed.

(4) Rain water harvesting, collection and reservations for uses are considered.

(5) Roadside and internal covered drainages for water drain out, slopes and to take measures to avoid water logging during heavy rain is thought. Surface water run off through gradation of earth to drains is proposed.

(6) Waste water management, Solid waste Management (SWM) is considered.

(7) Septic tanks/water treatment plants for faecal sludge, hazardous waste and clinical waste management as per code and regulations are outlined.

(8) COVID time safety codes management, care for Babies and senior citizens, care for different types of challenged persons is honored.

(9) Signs and signages are proposed.

(10) Public address system for both amusement and emergency announcements are listed.

(11) Children pass time events and items are proposed.

(12) Control of glare, dust and noise is addressed. Soft pavements, plantation and perforated screens in layers are proposed. Moisturisation, landscape, green walls and roof top vegetation are incorporated.

(13) Smoke detection, fire fighting within the terminals and compound are well considered.

(14) Treatment and management of spill over oil and fuels required to avoid penetration beneath the earth surface is thought. Finishing of warehouse walls, roofs and floors as in code to mitigate dust and noise from vehicles.

The design criteria considered basic infrastructural services such as power and water supply, sewerage network and storm water drainage.

Access and Approach: Access to the terminal will be seamlessly safe and sound, convenient, barrier free and facilitate streamlined internal circulation. Therefore, the Ingress and Egress Points will be so located that they are not in conflict with traffic circulation at the peripheral road network.

Location and Operational Parameters: The interdistrict bus terminals when integrated with depot functions work better in minimizing dead mileage. Operational parameters will be based on the following:

- Number of routes served and their peak frequency,
- Volume of waiting passengers,
- Spaces for bus stacking (idle parking)
- Assortment of terminating and passing passenger circulation

Capacity and Future Demand Estimation: Potential short-term and long-term capacity constraints was taken into the planning consideration.

Integrating multi-modal accessibility: Integrating provisions for feeder modes - like auto-rickshaws, buses, private vehicles etc. in the facility design were considered.

Integrating sustainable development practices: Sustainability practices will be followed considering green building technologies, which will reduce the overall carbon footprint and

adverse impact on the environment, both during the development and operational phase. Use of solar energy, higher reliance on natural lighting, waste and waste water management, rain water harvesting and other important issues will be integrated during the planning and design stage.

Architectural Aspects: It is time for smart cities to embrace a range of extremely advanced technologies including all automation and take bolder and more holistic approaches to the challenges related to modern quality of life, social equity and environmental sustainability. The design of the terminal will trace the circulation of passengers from arrival to departure ensuring that each juncture required in the movement of the passenger is as seamless as possible.

The bus terminal building should be visually appealing, open, spacious, well-lit and consistent with the environment, ultimately providing the people with services and amenities of modern life. The overall target is a 'State-of-the-Art' terminal, for which following key design objectives to be addressed while designing the interdistrict bus terminals:

(1) Attractive, modern, iconic architecture with civic distinction
(2) Planning to have good lines of sight, avoiding cross-flows and congestion
(3) Circulation to have adequate space and routes which are direct and obvious
(4) User-friendly facilities and services for convenience of users
(5) Special amenities for the physically challenged and special-needs passengers
(6) Entrances to be well coordinated with other forms of transport
(7) All public areas to be visually open, welcoming and well lit
(8) Retail and service areas to be up to date, victorious and well-coordinated in a hygienic and pleasant environment
(9) Utilize leading edge technologies and innovative services
(10) Sustainable environmental considerations in the development
(11) Commercial property development to be optimised and integrated within the overall design

Material usage strategy will also be guided by fire and life safety requirements including smoke generation and toxicity. Materials are proposed to be robust, hard wearing and of low maintenance requirement over a longlife span. Surface finishes should be vandal resistant and can easily be cleaned during the standard maintenance routine.

Operational Components: The following operational components of bus terminal area are envisaged:

(1) Departure terminal
(2) Arrival terminal
(3) Boarding bays
(4) Alighting or unboarding bays
(5) Interdistrict bus parking area
(6) City bus parking anddeparture bay
(7) Workshop for vehicles
(8) Vehicle washing facility
(9) Electrical charging facilities
(10) Amenities for bus crew: toilets, cafeteria, prayer space, accommodation etc.
(11) Landscaping the green area, waterscape and flag stand.

Functional Components: A terminal comprises of several functions apart from the physical facilities that are provided. In a modern bus terminal these functions are vital for comfort and attractiveness of passengers. The following functions shall be there in the proposed terminals:

(1) Cashless ticket counters
(2) Waiting lounge for passengers / visitors
(3) Male/female toilets for passengers
(4) Office space for bus staff association
(5) Office space for bus owners' association
(6) Terminal manager with attached toilet
(7) Assistant terminal manager with attached toilet
(8) Administrative officer and other Staff
(9) Toilet for office Staff
(10) Lockers for the staff
(11) Public addressing system
(12) BMS and CCTV room (may include other Security systems)
(13) Adequate way finding and Information signage
(14) Store rooms, lockers etc.
(15) Passenger amenities:

- Tea/coffee stall/fruit/ juice shops/kiosks, food court, souvenir shops, heritage component shops, foot massage, electrical body massage, children's games and mini videos.
- Prayer rooms for male and female
- ATM booths
- Prayer room with toilet and ablution
- Breast feeding area in waiting lounge
- Cloakroom
- Restaurant
- Stationary/ book shop/ newspaper stand
- Convenience/ general merchant stores/ department stores
- Dormitories

Design Speed: Speed of buses moving inside the terminal should be less than speed of adjacent highway. The design speed inside the terminal should be between 20 to 25 kph. The minimum offset between two adjacent buses while waiting in any bay must be at least 1.5 m, which is required for safe movement for the passengers and gives easy turning of the buses while entering or leaving the bay.

Dimensions of buses: The following dimensions of buses were considered:

(1) City transit buses have average lengths of 39'2" (11.95 m), widths of 8'4" (2.55 m), heights of 9'10" (2.99 m) and have a capacity of 29 seats with standing room for 76.

(2) Coach buses for inter-city travelling have average lengths of 39'4" (12 m), widths of 8'4" (2.55 m), heights of 12'6" (3.81 m) and have a capacity of 44-49 seats.

(3) Double-decker buses for inter-city travelling have average lengths of 39'4" (12 m), widths of 8'4" (2.55 m), heights of 15'3" (4.65 m) and have a capacity of 60-70 seats.

(4) Articulated buses have average lengths of 59' (18 m), widths of 8'4" (2.55 m), heights of 10'4" (3.13 m) and have a capacity of 48 seats with standing room for 100.

Turning Radius: The turning radiuses of buses are assumed as follows:

(1) Measuring the inner and outer radii of the 180° turn, a minimum inner radius of 28'4" (8.64 m) and minimum outer radius between 42'-43.5' (12.8-13.26 m) should be provided for 12m long rigid vehicles.

(2) Measuring the inner and outer radii of the 90° turn, a minimum inner radius of 23'7" (7.2 m) and minimum outer radius of 40'6" (12.4 m) should be provided for 12m long rigid vehicles.

Dimension of Driveways: Following dimensions of driveways are assumed:

(1) Driveway with right-angle parking on both the sides requires minimum width of 12m.

(2) Driveway with saw-tooth parking on both the sides with a one-way movement of the buses requires minimum width of 10m.

Bus Bays Requirements: Bus bays are required for boarding and alighting and for staying idle waiting for boarding. The following facts were considered for estimating bus bay requirements:

(1) The number of "Idle Bus Bays" largely depends on Dwell Time of Buses operating in the Terminal. The Lower Dwell Time will make the Terminal more efficient. Usually dwell time is considered less than 4 hours for an efficient Bus Terminal.

(2) The number of bays required for boarding and alighting is computed based on the trips in peak hour and the average boarding and alighting time for passengers. The average dwell time for alighting and boarding bays is adopted as 5 minutes and 10 minutes.

(3) Including circulation time, the average dwell time is adopted as 15 minutes. Based on these assumptions, number of boarding bays is provided in the departure terminal.

Passenger Amenities[76]: Modern passenger amenities are envisaged for these new terminals which will make a significant shift from the facilities in the existing terminals:

(1) Concourse: 1 sqm/person for total number of passengers in one trip from all the departure bus bays. The concourse will be used mainly by the departing passengers.

(2) Eateries: 1.5 sqm/person for 15% of total concourse occupancy.

(3) Vendor Zone: 4 sqm/vendor.

(4) Ticketing Area: 22 sqm/100 pax, otherwise one ticket counter for 50 persons of total concourse occupancy.

(5) Toilets (male): 4 WC for first 1000 persons and 1 for every subsequent 1,000 persons; 6 urinals for first 1000 persons and 1 for every subsequent 1,000 persons.

(6) Toilets (female): 5 WC for first 1,000 persons and 1 for every subsequent 2,000 persons.

One Indian-styled WC shall be provided in each toilet; 60 male to 40 female ratios is assumed. It should include differently-abled toilets, diaper changing stations and nursing station, (NBC 2010)

[76]Note: This Technical Data reproduced from "Bus Terminal Planning Guidelines for India" prepared by SG Architects, New Delhi. And the Technical Dimension is according to "Neufert Architects' Data, Fourth Edition, 2012.

Bus Bay Arrangements: The average dwell time for alighting bays is adopted as 5 minutes and including circulation time, the average dwell time for boarding bay is adopted as 15 minutes.

(1) Parallel Parking	• Requires excessive space • Buses must usually wait until first bus exits • Efficient at arrival bay for alighting passengers
(2) Right-Angle Parking	• Out-swinging bus door creates a barrier for passengers • Bus maneuvering difficult
(3) Saw Tooth Parking	• Efficient bus maneuvering • Passenger has direct approach to loading door • Baggage truck can operate between buses for side loading.

Considering the availability of space and vehicular and pedestrian maneuverability and area required per bay, Option 3 will provide a better solution for departure platforms at oblique angles layout of parking/placing. Option1 (parallel arrival bay) for alighting passengers has been considered in the conceptual design for the bus terminals. Catering to the arrival of passengers, the arrival shed is adjacent to the auto-rickshaw, taxi and city bus parking.

Parking:

(1) The inter-city buses that enter the terminal and drop off the passengers at the arrival bay/shed and then move to the respective idle parking.

(2) The city buses that enter their parking, adjacent to the arrival bay and drop off the passengers and then either move to their idle parking or pick the passengers heading for city center from the city-departure bay of the inter-city arrival shed.

(3) Parking for private vehicles, i.e., cars, ubers, micro-buses and auto-rickshaws, is proposed near the city bus parking.

Pedestrian Amenities:

(1) It is expected that, pedestrian traffic shall not conflict with other modes of transport. Key measures adopted to arrive at the ideal solution for smooth traffic circulation and pedestrian movement.

(2) Large scale barricading of road edges from pedestrian traffic will provide lot of relief to the motorized vehicular flow from the pedestrian movement. Simultaneously, dedicated channels for pedestrian flow from one zone to another shall ensure safe and well-ordered movement.

Drainage:

(1) The objective is to determine the required size of the Drain structures, related utilities and services to allow the estimated Surface water flow to be taken off from the bus terminal quickly and safely.

(2) Cross-slope is always preferable for quick dispersal of water from the pavement surface, but cross-slope is often a compromise between other considerations of design of the bus terminal.

(3) We have adopted a cross fall 0.5% for bus terminal. According to different guidelines and standard practices, this is considered enough to drain out the water from top of the pavement surface.

Other Structures in the Terminal Area: Dedicated space or building required for the following facilities:

(1) Separate dormitory building with facilities for the bus-crew
(2) Separate cafeteria, kitchen, prayer space for the bus-crew
(3) Maintenance workshop
(4) Bus/vehicle washing facilities
(5) Signage and Illumination

Electric Power Supply: Electrical system will be designed considering safety to personnel, ease of maintenance and in accordance with the latest technical code/standards, regulations and practices. Adequate level of uniform illuminations will be provided for heavy vehicles and pedestrian area with minimum glare. Use of high efficiency lighting fixtures with high lumen output and low power consumption is proposed.

Water Supply: The design includes demand estimation, source of water, treatment and storage and supply network.

Sewerage Network: Design parameters regarding Sewage collection system, Sewage generation, Self-cleaning velocity, Peak factor and hydraulic formula etc. are to be considered.

Storm Water Drainage System: Factors taken into consideration for planning of the storm water drainage system are:

- Pattern of natural slope of the site and its extent and direction.
- Storm water drains will be discharged in to a rain water harvesting pit/tank, either to store the harvested water for use or use the harvested water for recharging aquifer.
- Pipe culverts to be considered to ensure better drainage and control of soil erosion.

11.2 Key Transport Issues Addressed in the Design of Bus Terminal

11.2.1 Traffic circulation within terminal

Traffic circulation within terminal depends on the activities or purpose for which the terminal is used. There can be three possible purpose for which terminals can be used which are stated below:

- The terminal can be used for arrival and departure only, after dropping of passengers the buses leave the terminal for nearby bus depot where they wait and completes the associated activities (washing, small repair, resting of bus crew), and arrives at the departure bay at scheduled time. This option needs simplest traffic circulation system
- The terminal can be used for passenger arrival and departure, short waiting of bus prior to departure, bus washing and limited time for waiting, and facilities for bus crews. This option requires well planned circulation system to avoid conflict
- The terminal can be used for passenger arrival and departure, waiting of bus prior to departure, bus washing facility, facilities for bus crews, and sufficient space for bus parking (as bus depot). This option requires large amount of circulation area to manage conflicting movement

After discussion with DTCA and members of Bus Owners Association (BOA), second option was chosen as a compromise between availability of land and demand of bus operators. The proposed circulation is based on one way system. In order to ensure efficient and safe movement of large number of buses, a comprehensive traffic management system supported by CCTV camera and digital traffic signal operated from a traffic control center (within the terminal building) is recommended by the consultant. The traffic circulation system for the terminals is given in Annex 11.

11.2.2 Options for multistoried bus parking

The consultant explored the possible options for multilevel bus parking within the terminals. However, it is not found desirable to provide multilevel parking due to following reasons:

- For short time parking for the waiting buses, it is not convenient for frequent movement
- It is difficult to accommodate driveway ramp in the limited amount of area in the terminal
- It may impair the architectural view of the modern terminal building
- Mechanical parking (lift) is available for small size bus only
- Basement parking is not advisable for possible fire hazard (most of the bus use CNG/LPG as fuel)
- The flexibility of converting waiting area for arrival/departure bay (with increasing demand in future) will be lost)
- Due to higher weight of buses, a multi-storied parking would require very expensive foundation and structure. Hence it may not be economically feasible.
- Multi-level parking is not practiced generally (Delhi Transport Coordination took initiative years ago. But due to technical and financial challenge it was stalled)

Multilevel parking for bus depot may be considered where buses are parked for long hours (specially, night parking).

11.2.3 Pedestrian facilities

Pedestrian survey carried out in the three existing terminal reveals that about six percent uses walking mode in their travel to/from the terminals. The footpath adjacent to the terminal is used by city dwellers mostly and not by the passenger. Footpath network inside the terminal is proposed considering the safety aspects (by marking traffic signals and digital display to guide the pedestrians to specific area). More than 50% passenger (according to survey) carry heavy luggage as such they may be reluctant to use foot over bridge. During detail design possibility of underpass or skyway originating from the terminal supported by escalator or lift can be explored.

11.2.4 Transfer Facilities for Passengers

Efficient transfer facilities for arriving and departing passengers to city destinations are the key to the success of terminal operation. Since the new terminals are located away from the city center, the consultant in their design has provided sufficient parking spaces for city buses, taxis, auto-rickshaws, and shared bikes (numbers are based on modal share obtained from passenger survey at the existing terminals).

Separate entry and exit for these vehicles is proposed to avoid conflict in traffic circulation. According to survey more than 50% passengers carry heavy luggage, for this purpose special shuttle bus service would be preferable to collect and drop off passengers from dedicated bus stops. The consultant has proposed following preliminary routes for this purpose which can be further developed during detail design phase (route maps are shown in Annex 11).

11.3 Propsed City Shuttle Bus Service Routes

Baghair Terminal

Terminal to city and back 1- Terminal to Jhilmil (East Gate) to Keraniganj to Babu Bazar to Naya Bazar to Sadarghat to Nayabazar to Fulbaria to G.P.O to Gulistan and return to terminal

City to Terminal 2**-** Terminal to Jhilmil (South Gate) to Tegoria Bazar to Ekuria to Jurain Rail Gate to Dholaipar to Jatrabari to Saidabad to Kamlapur to Motijheel to Paltan to Gulistan

Terminal to city and back 3- Terminal to Teghoria Bazar to Bongram to Zazira Rail Station and return to Terminal

City to Terminal **-** Gulistan to Dainikbangla to Motijheel to Kamlapur to Saidabad to Jatrabari to Dholaipar to Jurain Rail Gate to Ekuria to Teghoria Bazar to Rajendrapur to Terminal

Hemayetpur Terminal

Terminal to city - Terminal to Amin Bazar to Gabtoli to Technical to Ansar Camp to Mirpur 1 to BIBM (Mirpur 2) to Mirpur 10 to Mirpur 13 and Mirpur 14.

City to terminal **-**Mirpur 14 to Mirpur 13 to Mirpur 10 to BIBM (Mirpur 2) to Mirpur 1 to Ansar Camp to Technical to Gabtaoli to Amin Bazar to the terminal.

Gram Bhatulia (Birulia-Uttara) Terminal

Terminal to MRT station and back 1 **-** Terminal to MRT Line 6 Uttara Central Station to the Terminal

*Terminal to city and back 2***-** Terminal to Dhour Circle to Prottasha Bridge Bus Stop to Kamarpara to Sluice Gate Bus Stop to Abdullahpur Bus Stop to House Building Bus Stop to Azompur Bus Stop to ZamZam Tower Bus Stop to Diyabari Bus Stop to MRT Line 6 Uttara North Station to Panchabati Bus Stop to the Terminal

Terminal to city and bakc 3- Terminal to Panchabati Bus Stop to Birulia Bridge Bus Stop to Akran Bus Stop to Khagan Bus Stop to Charabag Bus Stop to KhejurBagan Bus Stop to Ashulia Bus Stop to Dhour Circle to the Terminal

Terminal to city and back 4 **-** Terminal to Airport and back to the Terminal

Bhulta Terminal

Terminal to city and back 1-Terminal to Bhulta Circle to Borpa (US-Bangla MCH) to Borpa Bus Stop to Rupshi Circle to Rupshi Bazar to Gondobpur Bus Stop to Murapara Bus Stop to Mongolkhali Bus Stop to Makka Paper Mills to Bhulta and back to the terminal

Terminal to city and back 2-Terminal to Bhulta Circle to Kushabo Bus Stop (West) to Chan Textile Bus Stop (West) to Kanchan Bridge East Bus Stop to MRT Line 1 (Purbachal Terminal) to MRT Line 1 (Purbachal East Station) to Kanchan Bridge West Bus Stop to Kanchan Toll Plaza Bus Stop to Chan Textile Bus Stop (East) to Purbachal American City Bus Stop to Kushabo Bus Stop (East) to Bhulta Circle to the Terminal

Kanchpur North

Terminal to city: Terminal to MRT Line 2 Chittagong Road Station

City to terminal MRT Line 2 Chittagong Road Station to the Terminal

*Terminal to city and back 1***-** Terminal to Chittagong Road Bus Stop to Signboard Bus Stop to Matuail Bus Stop to Rayerbag Bus Stop to ShonirAkhra Bus Stop to Gulistan via Flyover to G.P.O to Gulistan to Dania Bus Stop via Flyover to Rayerbag Bus Stop to Matuail Bus Stop to Signboard to Chittagong Road Bus Stop to MRT Station to the Terminal.

Terminal to city and back **2-** Terminal to Kanchpur Bus Stop to Lovely Bus Stop to Jatramura Bus Stop to Bishwa Road Bus Stop to Tarabo Bus Stop to Demra Circle Bus Stop to Sarulia Bus Stop to Ranimohol Bus Stop to Golakata Bridge bus Stop to Chittagong Road Bus Stop to the Terminal

Kanchpur South

*Terminal to city***:** Terminal to MRT Line 2 Chittagong Road Station

City to Terminal: MRT Line 2 Chittagong Road Station to the Terminal

Terminal to city and back 1- Terminal to Keodhala Bus Stop to Langolband Bus Stop to Darikandi Bus Stop to Tripodri Bus Stop to Mograpara Bus Stop to Pirojpur Bus Stop to Mograpara Bus Stop to Meghna EPZ Bus Stop to Darikandi Bus Stop to Langolband Bus Stop to Keodhala Bus Stop to the Terminal

Terminal to city and back 2- Terminal to Ispahani Bus Stop to Dasergaon Bus Stop to Bondar Bus Stop to Modonganj Bus Stop to Bondar Bus Stop to Dasergaon Bus Stop to Ispahni Bus Stop to the Terminal

11.4 Basis of Design of BusTerminals and Depots

The terminal design is based on demand analysis of passenger trips and corresponding need of buses. Details of passenger arrival and departure (both daily and peak hour, corresponding bus number, parking requirement of interdistrict and city bus are provided in Table 11.1. Provision of parking space of buses and other vehicles is shown in Table 11.2. The areas allotted for different uses in the terminals and depots are given in Table 11.3. The consultant has reviewed international best practices and tried to adopt some of it. The passengers should be aware of the facilities provided in the terminal and should be well guide to use these facilities. In this respect, signs and symbols are commonly used as good practice in modern bus terminals.

Table 11-1: Data on Demand and Supply of Passenger and Bus

(a) Daily Passenger Arrival

Site	2025	2030	2035	2040	2045
Baghair	52,444	61,752	66,935	70,004	70,940
Kanchpur	92,846	116,783	133,837	145,753	150,999
Gram Bhatulia	98,314	121,909	138,275	149,608	154,504
Bhulta	55,042	64,453	69,693	72,822	73,779
Hemayetpur	45,662	54,107	59,368	62,888	64,289
Total	**344,308**	**419,003**	**468,107**	**501,075**	**514,510**

(b) Daily Bus Arrival

Site	2025	2030	2035	2040	2045
Baghair	1,554	1,830	1,983	2,074	2,102
Kanchpur	2,751	3,460	3,966	4,319	4,474
Gram Bhatulia	2,913	3,612	4,097	4,433	4,578
Bhulta	1,631	1,910	2,065	2,158	2,186
Hemayetpur	1,353	1,603	1,759	1,863	1,905
Total	**10,202**	**12,415**	**13,870**	**14,847**	**15,245**

(c) Peak Hour Bus Arrival (Inter-district)

Site	2025	2030	2035	2040	2045	Provided in Design
Baghair	186	220	238	249	252	540
Kanchpur South	330	415	476	518	537	540
Gram Bhatulia	350	433	492	532	549	480
Bhulta	196	229	248	259	262	339
Hemayetpur	162	192	211	224	229	936
Total	**1,224**	**1,490**	**1,664**	**1,782**	**1,829**	**2835**

(d) Estimated Demand for Bus Bay (Interdistrict)

Site	2025	2030	2035	2040	2045
Baghair	62	73	79	83	84
Kanchpur	110	138	159	173	179
Gram Bhatulia	117	144	164	177	183
Bhulta	65	76	83	86	87
Hemayetpur	54	64	70	75	76

(e) Peak Hour Passenger Arrival (interdistrict)[77]

Site	2025	2030	2035	2040	2045
Baghair	6,293	7,410	8,032	8,400	8,513
Kanchpur	11,141	14,014	16,060	17,490	18,120
Gram Bhatulia	11,798	14,629	16,593	17,953	18,540
Bhulta	6,605	7,734	8,363	8,739	8,854
Hemayetpur	5,479	6,493	7,124	7,547	7,715
Total	**41,317**	**50,280**	**56,173**	**60,129**	**61,741**

[77]*12% bus arrives at peak

(f) Estimated City Bus Demand per day[78]

Site	2025	2030	2035	2040	2045
Baghair	420	494	535	560	568
Kanchpur	743	934	1,071	1,166	1,208
Gram Bhatulia	787	975	1,106	1,197	1,236
Bhulta	440	516	558	583	590
Hemayetpur	365	433	475	503	514
Total	**2,754**	**3,352**	**3,745**	**4,009**	**4,116**

(g) Estimated City Bus demand in Peak hour

Site	2025	2030	2035	2040	2045	Provided in design
Baghair	56	66	71	75	76	132
Kanchpur	99	125	143	155	161	88
Gram Bhatulia	105	130	147	160	165	128
Bhulta	59	69	74	78	79	104
Hemayetpur	49	58	63	67	69	204

(h) Estimated Demand for Night Stay Bus Interdistrict[79]

Site	2025	2030	2035	2040	2045	Provided in design
Baghair	311	366	397	415	420	350
Kanchpur South	550	692	793	864	895	185
Gram Bhatulia	583	722	819	887	916	198
Bhulta	326	382	413	432	437	227
Hemayetpur	271	321	352	373	381	338

After 10/11 PM Idle Bus bay can be used as night parking which is about 70% of Bus capacity. Details are provided in section 11.6.

Table 11-2: Provision of Parking Space for Buses and Other Vehicles

Name	Area of the terminal acre	Interdistrict bus parking area sqm	Car parking, Auto-rickshaw, 2-wheeler area sqm	City bus parking area sqm
Baghair	33.63	11,065	1,130	2,318
Kanchpur South	27.7	3,852	720	2,128
Gram Bhatulia	26.7	5,472	2,000	1,750
Bhulta	24.28	7,320	1,030	1,250
Hemayetpur	45	6,690	1,570	3,000

The main terminal buildings are proposed as multi-storeyed, considering high land value and scarcity of land. Demand of functions and suitabilities are also considered. Keeping future provisions in mind, phasing of the construction is recommended. The main terminal holds

[78]*40% passenger use city bus

[79]*20% bus stays overnight

arrival and departure bays, which are both non-air-conditioned and air-conditioned with projected sheds. All terminals are designed with passenger friendly facilities, well illuminated, temperature controlled and well secured. Provisions for children, infants, elderly, physically and mentally challenged persons have been kept.

Escalators, walkalators, elevators and staircases are proposed. Interior is proposed with comfortable and functional spaces, information boards, vending machines, gazette charging, colorful plantation and water streams. Decorative sculptures, painting sand other displays are to be provided to reflect local and national heritage. Voids, glass roofs are proposed to carry an image of contemporary trends. Exterior and the total building are proposed as sustaining the environment. Buses are proposed to make surface parkings. Car and 2/3 wheelers are recommended to park at basement levels.

11.5 Layout Plans: Proposed Interdistrict Bus Terminals

11.5.1 Baghair

Baghair Interdistrict Bus Terminal (proposed) has an area of 33.63 acres alongside Dhaka-Mawa Highway. The design proposal includes 3 (three) bus bays that holds total 180 buses in arrival, departure and pick hour arrival-departure. Number of arrival and departure of city buses is 33. Parking for idle Interdistrict buses is 224. Total car, uber and microbus parking capacity is 46, parking capacity for auto-rickshaws 48, motor bikes 34. The proposed workshop has capacity for 14 inter-city buses and 11 electric charging facilities.

11.5.2 Hemayetpur

Hemayetpur bus terminal has a total area of 45 acres. Provisions have been kept for 6 interdistrict bus bays with total of 312 inclusive of arrival, departure and pick hour arrival-departure bay. Total car, uber and microbus parking capacity is 46, parking capacity for auto-rickshaws 48, motor bikes 34. The proposed workshop has capacity for 14 inter-city buses and 11 electric charging facilities.

11.5.3 Kanchpur South

Kanchpur South Interdistrict bus terminal is proposed on an area of 27.7 acres. The design proposes 4 interdistrict bus bays with total 180 arrivals departures. Number of city bus arrival and departure are 22, Idle Interdistrict buses 60, This site has parking for 25 cars, 45 auto-rickshaws and 28 motor bicycles. Proposed capacity of the workshop is 18 buses and electric charging 15.

11.5.4 Bhulta

Bhulta Bus Terminal is proposed on 24.2 acres. The design proposes 3 interdistrict bus bays with total 113 arrivals, departures and picks hour arrival and departure. Number of city bus arrival and departure are 26, Idle Interdistrict buses 156. This site has parking for 35 cars, 55 Auto-rickshaws and 45 motor bicycles. Proposed workshop capacity of intercity buses is 11, electric charging for 10 buses.

11.5.5 Gram Bhatulia

Gram Bhatulia bus terminal is proposed on total area of 26.7 acres. Provisions have been kept for 5 interdistrict bus bays with 160 arrivals, departures and peak hour arrivals and departures. Proposed parking capacity for city bus arrivals and departures is 32 and for idle interdistrict buses 86. There is parking provisions for 34 cars, 70 auto-rickshaws and 30 motor bikes. The proposed workshop has a capacity to cater for 14 interdistrict buses. Electric charging capacity for 12 buses is also proposed.

11.5.6 Kanchpur North Interdistrict Bus Terminal (Option 1 as Terminal)

Kanchpur North interdistrict bus terminal is proposed on an area 15.5 acres. As per the design, provisions for 3 interdistrict bus bays are there with 90 arrivals, departures and pick hour arrival and departure. Parking capacity proposed for city bus arrivals and departures is 18, for idle Interdistrict buses 42. The capacity of workshop is proposed to cater for 11 interdistrict buses. Electric charging capacity for 10 buses is proposed. Parking capacities for 25 cars, 45 auto-rickshaws and 30 motor bicycles are also proposed.

Figure 11-1.: Baghair Interdistrict Bus Terminal (proposed layout)

Baghair Interdistrict Bus Terminal (proposed layout) (Section details)

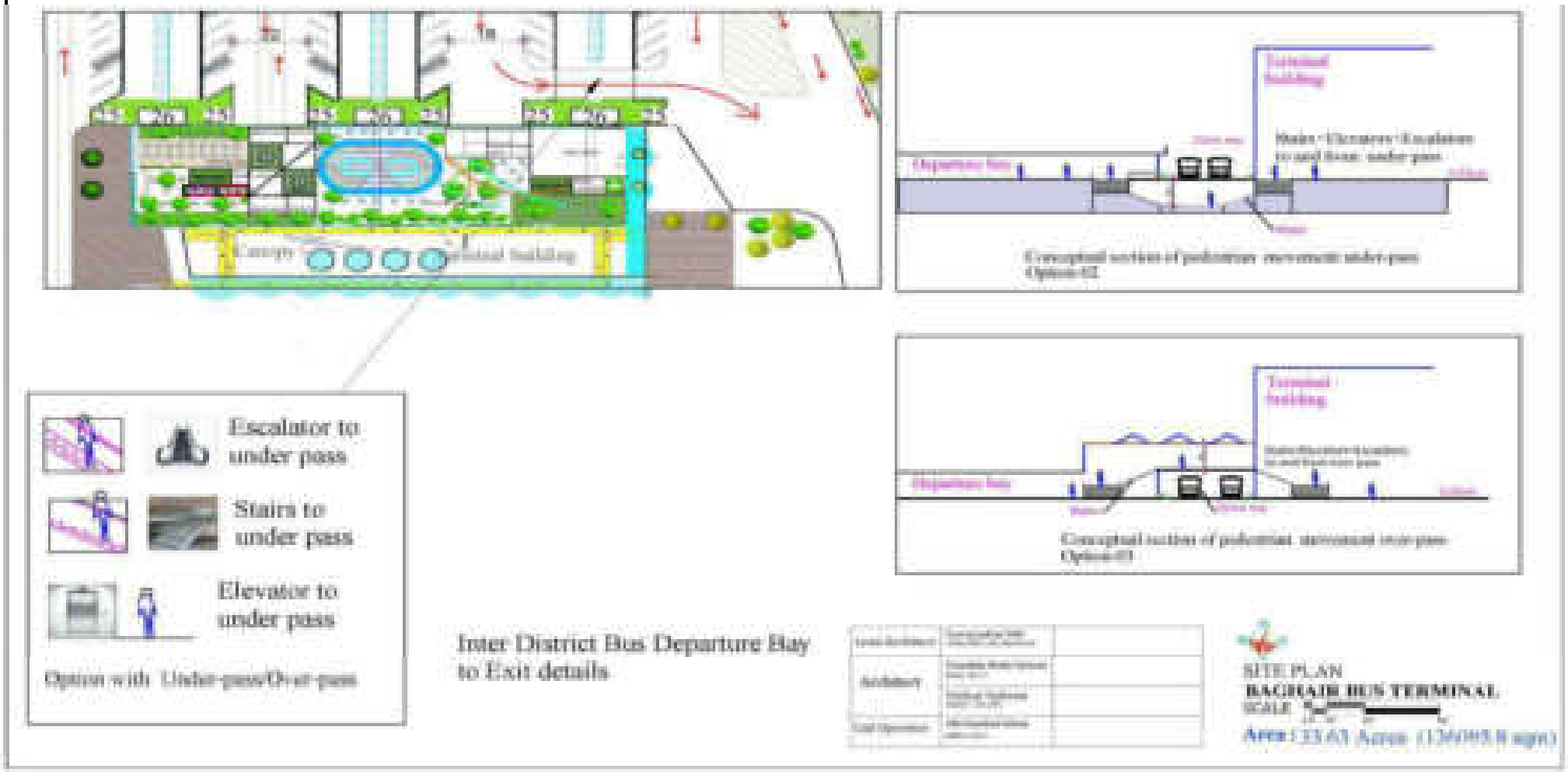


Figure 11-2.: Hemayetpur Interdistrict Bus Terminal (proposed layout) Option -1

Figure 11-3: Hemayetpur Interdistrict Bus Terminal (proposed layout) Option -2

Hemayetpur Interdistrict Bus Terminal (proposed layout) Option-2 (Section details)

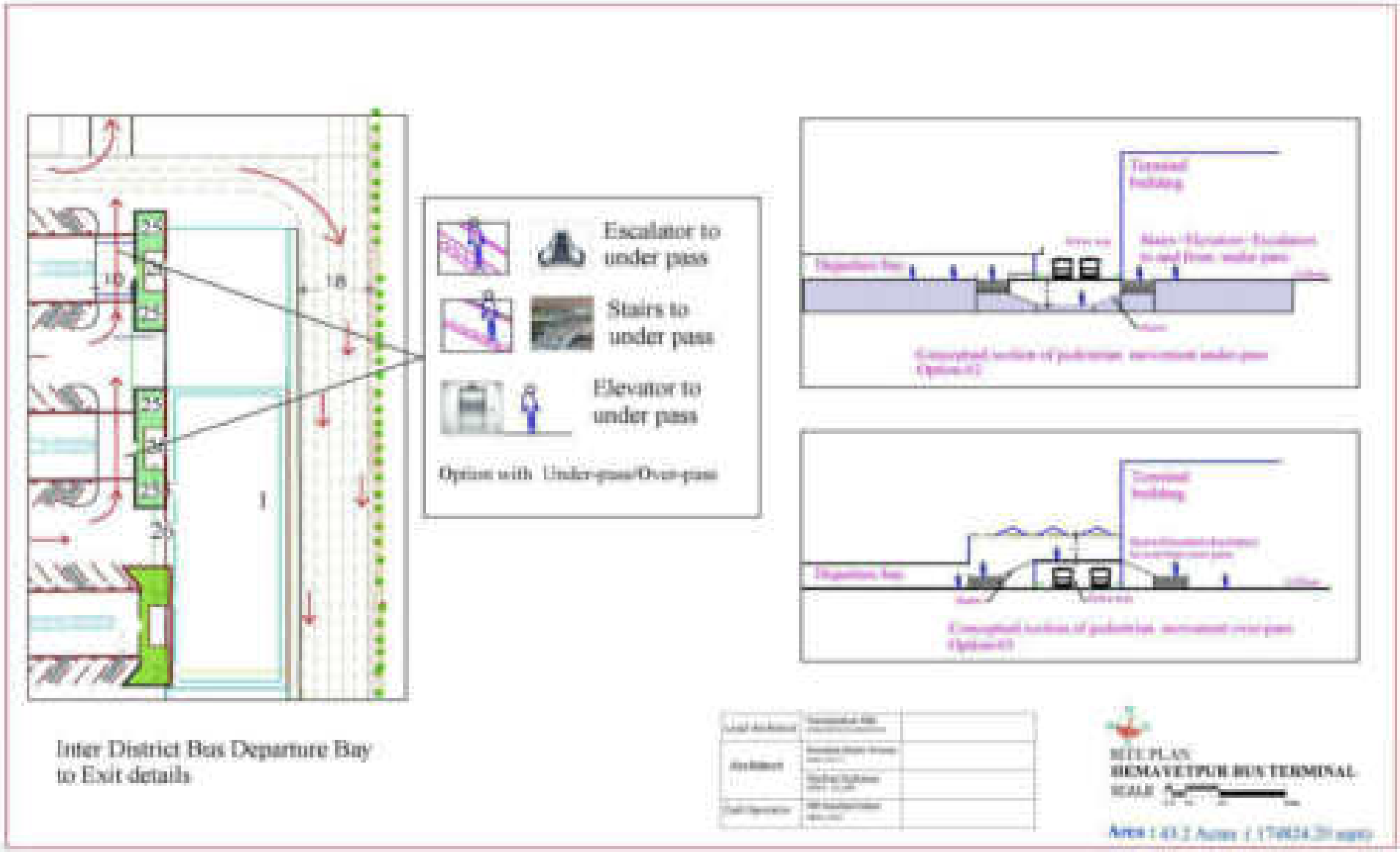


Figure 11-4: Kanchpur (South) Bus Terminal (proposed layout)

Kanchpur (South) Interdistrict Bus Terminal (proposed layout) (Section details)

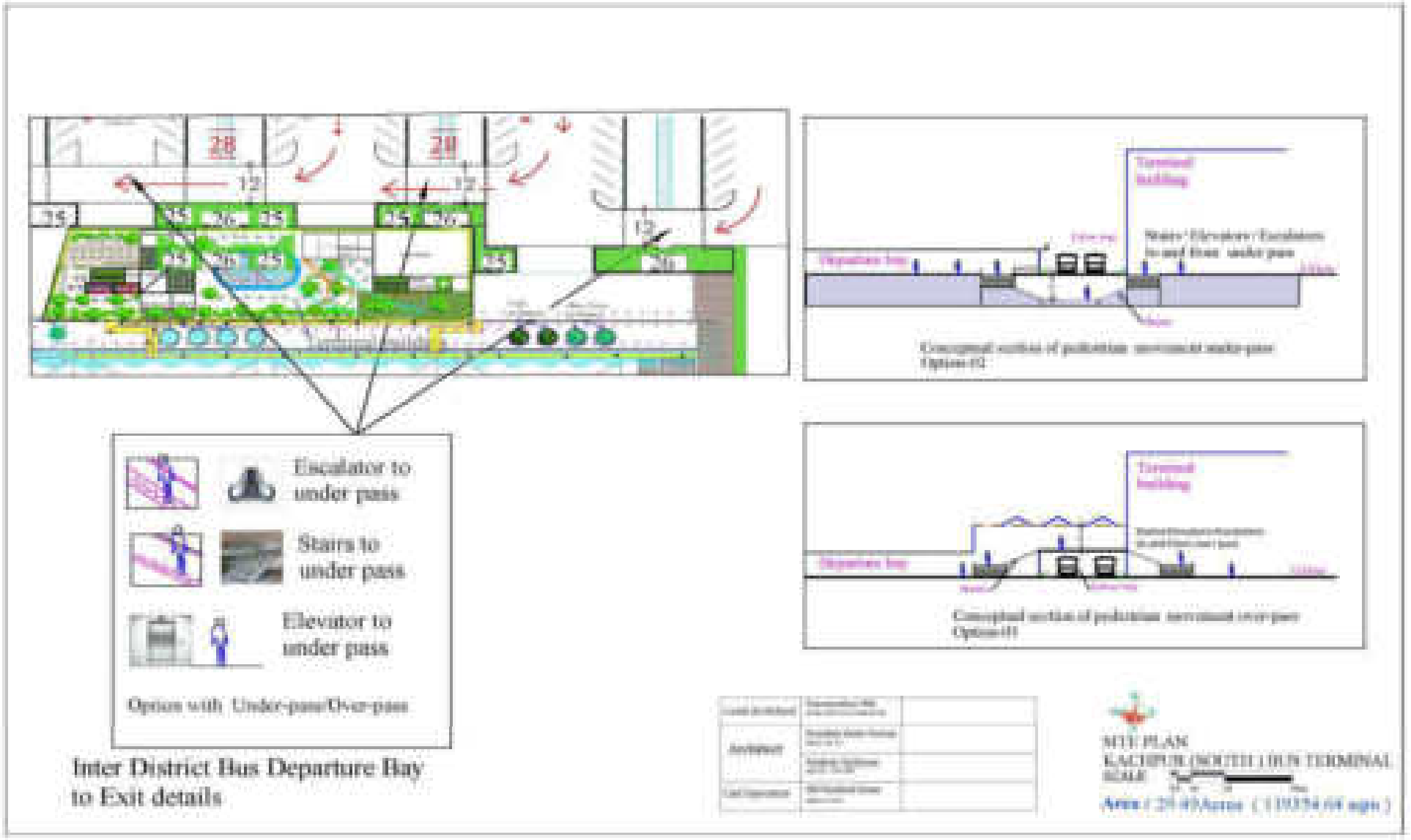
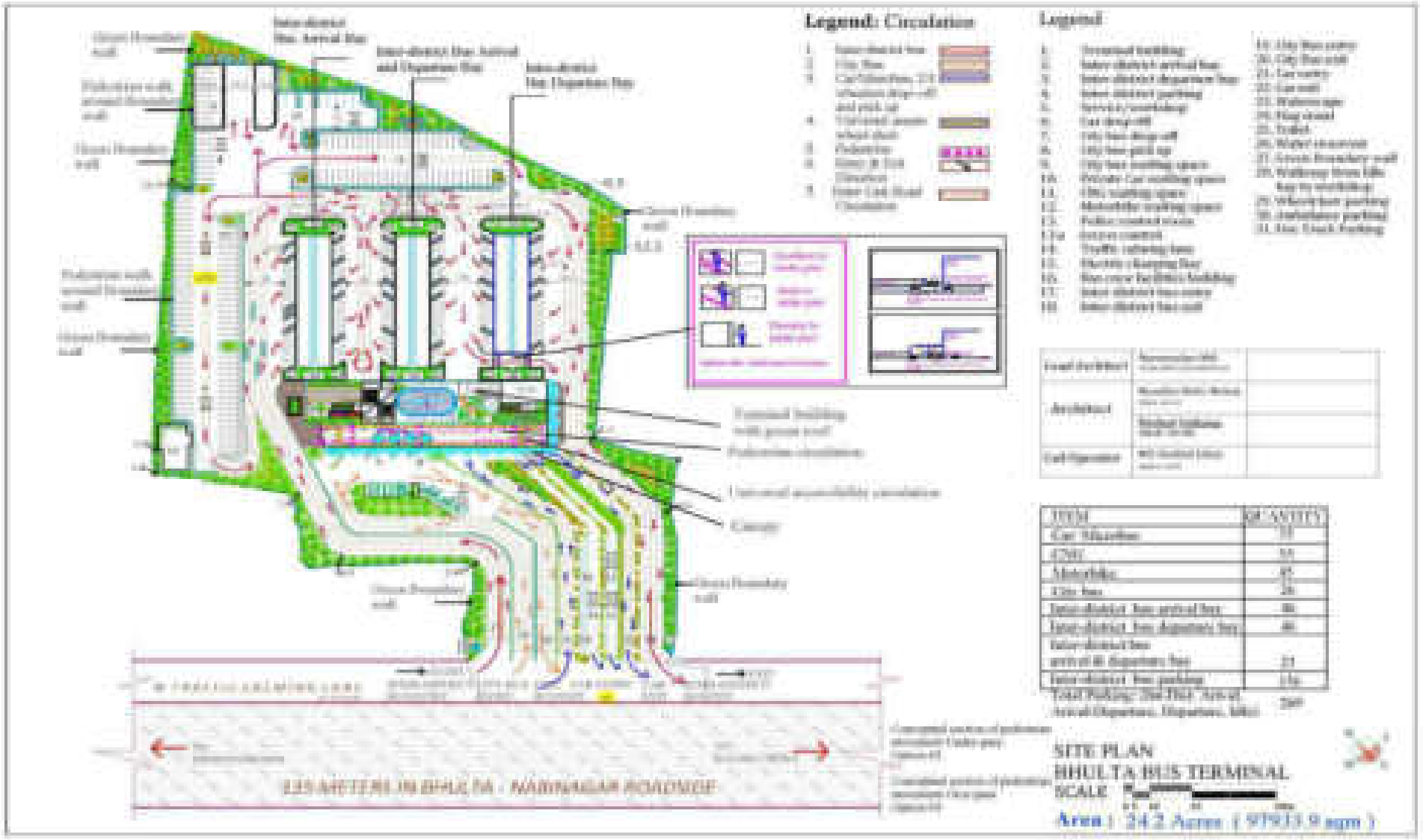


Figure 11-5: Bhulta Bus Terminal (proposed layout)



Bhulta Interdistrict Bus Terminal (proposed layout) (Section details)

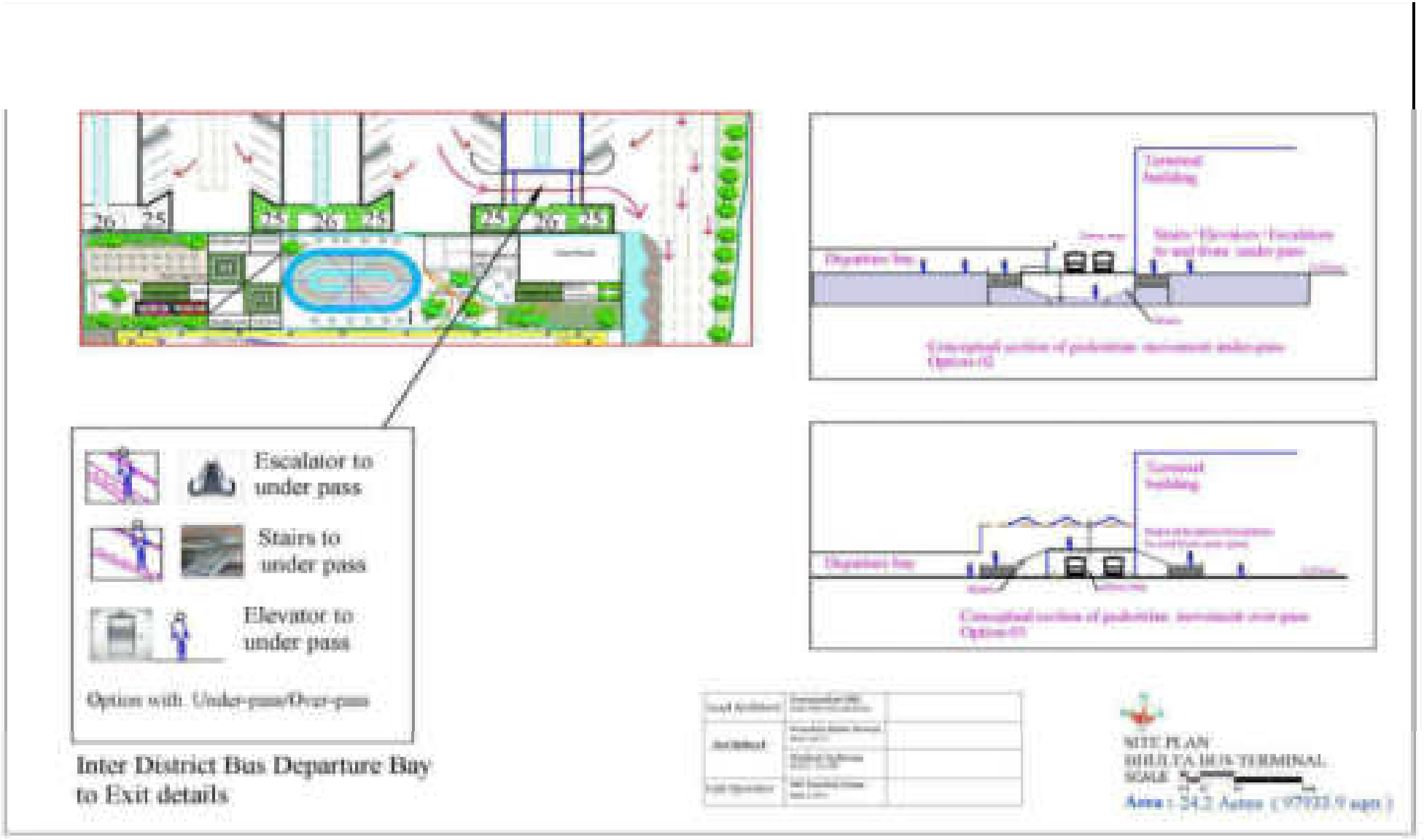


Figure 11-6: Gram Bhatulia Bus Terminal (proposed layout)

Gram Bhatulia Interdistrict Bus Terminal (proposed layout) (Section details)

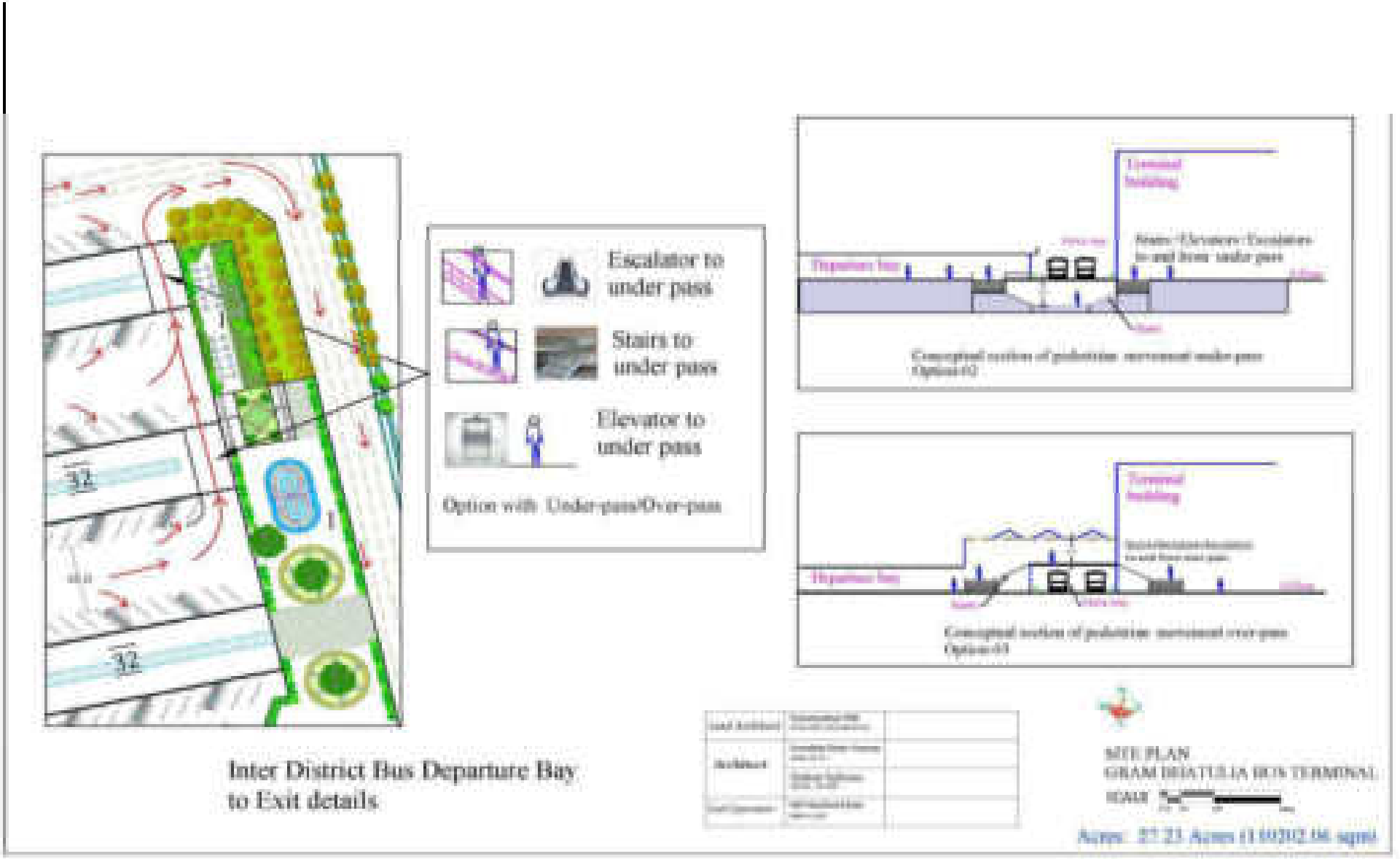
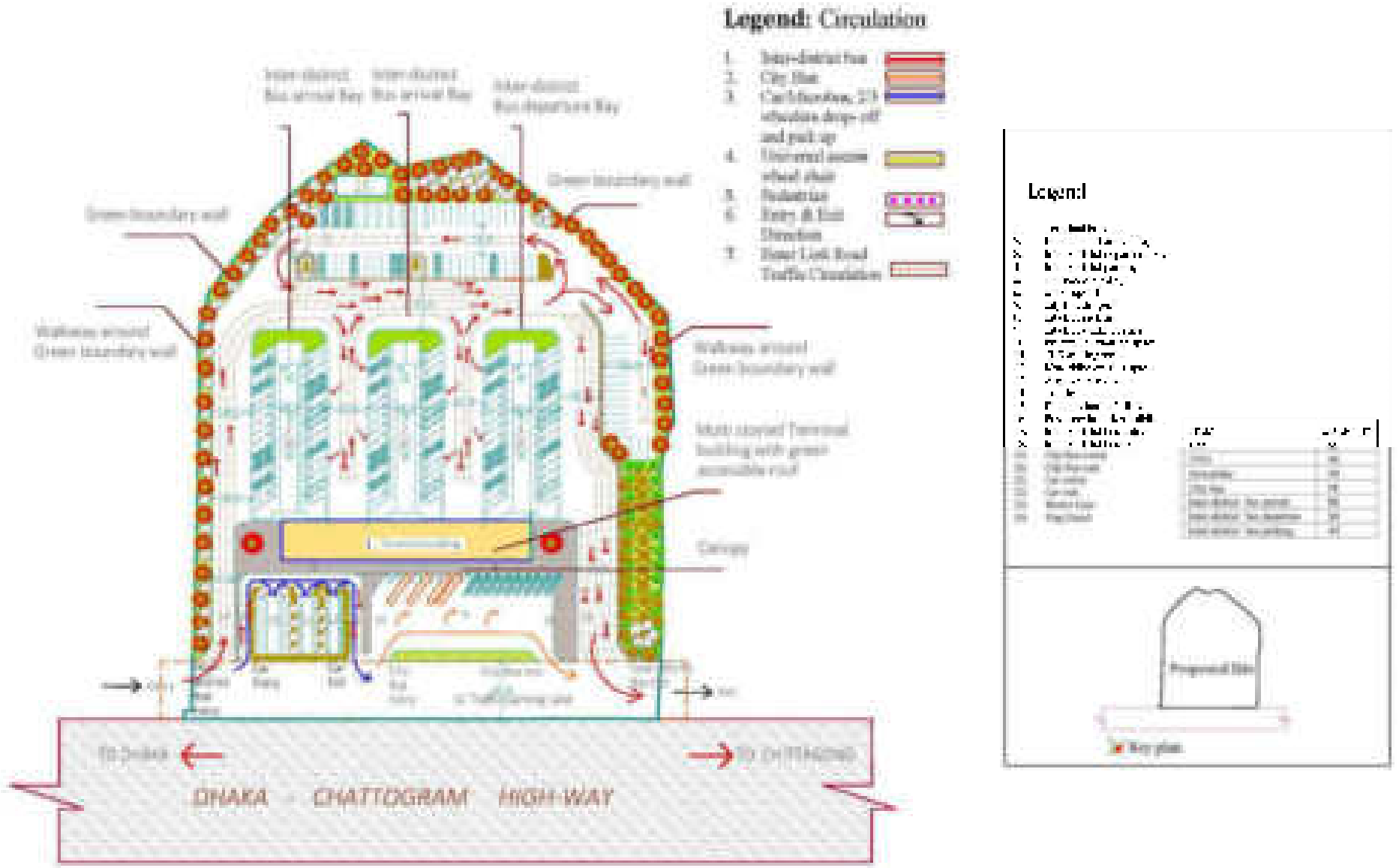


Figure 11-7: Kanchpur (North) Bus Terminal (proposed layout)



11.6 Layout Plans: Proposed City Bus Depots

Three bus depots are proposed: Kanchan North, Bhawal Atibazar Atibazar and Kanchpur North. They will have provisions for seamless security systems. Depots will iclude administrative office with parking, staff cafeteria, prayer space, toilets. Bus repair, washing, maintenance workshops, electrical charging facilities, driver's rooms, wash rooms are also proposed. Solid waste management system, safe drinking water, surface water drainage systems are incorporated. Landscape, soft pavements and moisterisation are proposed to reduce noise and dust generated by vehicles and workshop activities. Planning is also done for fire fighting systems, fast aid and emergency services. Provisions for parking spaces for at least 1 ambulance and 1 fire fighting vehicle (fire truck) have been kept.

11.6.1 Kanchan Bus Depot

The capacity of the depot, as designed, is to cater for 415 city buses (12 m) and 32 articulated buses (18 m), 17 Electrical buses. An administrative building with office spaces, toilets, prayer space and staff parking with facilities for 1 ambulance and 2 fire trucks have been provisioned for as part of the depot.

11.6.2 Bhawal, Atibazar

This depot, as proposed, has been designed with provisions to cater for 361 city buses (12 m) and 46 articulated buses (18 m), 8 Electrical buses. It will have administrative building with office spaces, toilets, prayer space and staff parking. There are also provisions for 1 ambulance and 2 fire trucks.

11.6.3 Kanchpur North Bus Depot (Option 2 as Depot)

This particular site has been designed as a depot to cater for 254 city buses (12 m) and 55 articulated buses (18 m), 11 Electrical buses. There are provisions for an administrative building with office spaces, toilets, prayer space and staff parking and facilities for staying 1 ambulance and 2 fire trucks.

Figure 11-8: Kanchan Bus Depot (proposed layout)

Figure 11-9: Bhawal, Ati Bazar Bus Depot (proposed layout)

Figure 11-10: Kanchpur North Bus Depot (proposed layout)

Table 11-3: Areas Provided for Different Components for Terminals and Depots

No.	Description of item	Unit	Baghair	Kachpur South	Gram Bhatulia	Bhulta	Hemayetpur	Kanchan	Kachpur North	Ati bazar
	Site area	**sqm**	33.63 acre/136095.78 sqm	27.7 acre/112097.9 sqm	26.7 acre/108392 sqm	24.28 acre/97933.9 sqm	45 acre/182,108.5 sqm	**24.2 acre 97933.93 sqm**	**15.5 acre 62726.27 sqm**	**25.78 acre 104327.96 sqm**
1	Boundary wall	m	1,515	1,778	1,652	1,503	2,028	1274.56	888.34	1866.79
2	Traffic calmimg lane	sqm	10,186	9,854	9,118	4,076	12,615	10369.66	5898.98	10810.91
3	Landscape and soft pavements	sqm	31,386	22,160	17,370	16,463	44,027	10498.45	6051.03	15826.38
4	Pavements area (RCC)	sqm	8,125	4,056	2,743	5,120	9,250	3209.70	2163.12	3507.00
5	Bay area (arrival and departure)	sqm	19,980	22,566	17,055	13,638	36,330	00	00	00
6	Internal road	sqm	43,649	39,256	42,052	41,380	55,371	40373.90	22624.23	41120.30
7	Terminal building	sqm	14,910	10,245	20,623	12,288	25,704	00	00	00
8	Interdistrict bus parking area	sqm	11,065	3,852	5,472	7,320	6,690	00	00	00
9	Car parking, auto-rickshaw, 2-wheeler	sqm	1,130	720	2,000	1,030	1,570	00	00	00
10	City bus parking	sqm	2,318	2,128	1,750	1,250	3,000	27670.60	21500.31	26061.00
11	Workshop	sqm	1,433	1,835	910	1,570	1,120	2980.00	2016.00	3314.00
12	Electric charging station	sqm	1,433	1,835	976	1,570	1,120	1000.00	1000.00	1000.00
13	Dormitory and facility	sqm	420 per floor x 4 floors	420 per floor x 4 floors	420 per floor x 4 floors	420 per floor x 4 floors	420 per floor x 4 floors	420x4 floors	420x4 floors	420x4 floors
1	Bus depot total city bus, articulated bus, electric bus. 18 meters, 12.5 meter									

11.7 Capacity of Proposed Terminals

Terminal locations were selected based on numerous factors. Land availability and connectivity were leading factors among them. A bus terminal generally have several components like bus bay for arriving and departing buses, waiting bus parking, terminal building with amenities for waiting passengers and bus crew. In current practice, bus terminals, in addition to its regular function of passenger-bus interaction, provides bus depot services to the interdistrict buses. Which occupies a significant area of the terminal. Since, availability of land are limited in all cases, we need to apply management measures to ensure that demand for depot does not impact on the performance of terminal functionalities. Exploring for operator owned bus depot could be an option. However, the demand for depot can be well balanced by fleet management and scheduling.

Terminals won't be busy equally all along the whole day. There are peaks that were identified by survey. With modern amenities and good accessibility a bus-bay can serve four buses per hour during peak hour. With such assumption, it is estimated that proposed design can accommodate more than estimated bus demand for efficient operations (table below). The unused bus bay can be used for bus parking or buses can be allowed to take longer time to board in passenger. With time, technology will come to manage bus bay and parking and terminal efficiency will increase. It is to note that, bus bays are designed as the terminals can accommodate all buses during peak arrival and departure time. During lean period of the day, buses can be allowed more space and overnight the bay can be used for parking.

Table 11-4: Operation Capacity of Proposed Bus Terminal

	Estimated Daily Bus Demand					Maximum Operational Capacity
Terminal	**2025**	**2030**	**2035**	**2040**	**2045**	
Baghair	1,554	1,830	1,983	2,074	2,102	7,344
Kanchpur South	2,751	3,460	3,966	4,319	4,474	7,272
Gram Bhatulia	2,913	3,612	4,097	4,433	4,578	6,528
Bhulta	1,631	1,910	2,065	2,158	2,186	4,152
Hemayetpur	1,353	1,603	1,759	1,863	1,905	12,732
Grand Total	**10,202**	**12,415**	**13,870**	**14,847**	**15,245**	**38,028**

Investigation on depot's use in all three bus terminal in Dhaka has revealed that 20% buses use terminal depot for overnight stay. Since land is an issue, the requirement of depot space was not possible to offer for all cases. Table below indicated that Kachpur and Birulia may face challenges in providing depot facilities for the required number of buses. For these location, private depot or fleet management or the both in combination can be applied.

Table 11-5: Estimated Demand for Night Stay Bus

		Night Stay Demand				
Terminal		**2025**	**2030**	**2035**	**2040**	**2045**
Baghair		311	366	397	415	420
Kanchpur South		550	692	793	864	895
Gram Bhatulia		583	722	819	887	916

		Night Stay Demand				
Terminal		**2025**	**2030**	**2035**	**2040**	**2045**
Bhulta		326	382	413	432	437
Hemayetpur		271	321	352	373	381
Grand Total		**2,040**	**2,483**	**2,774**	**2,969**	**3,049**

Table 11-6: Night/Long Stay Bus Capacity for Proposed Terminals

		Percentage of Demand (Night Stay)				
Terminal	**Design Capacity**	**2025**	**2030**	**2035**	**2040**	**2045**
Baghair	350	112.62%	95.65%	88.24%	84.37%	83.26%
KanchpurSouth	185	33.55%	26.67%	23.28%	21.37%	20.63%
Gram Bhatulia (Birulia)	198	33.99%	27.41%	24.16%	22.33%	21.63%
Bhulta	227	69.72%	59.54%	55.06%	52.69%	52.01%
Hemayetpur	338	125.06%	105.54%	96.19%	90.80%	88.83%
Average	**1298**	**74.99%**	**62.96%**	**57.39%**	**54.32%**	**53.27%**

Both Kachpur and Birulia can accommodate nearly one third of its demand. It parking charge could be set higher as private sector prompts for a private depot in the area. However, fleet management could be an option. Interdistrict bus fleet can be managed in such a way that number of overnight bus at Dhaka terminal are minimal and it meets the available capacity in the depots with terminal.

Capacity of a terminal is generally defined by number of buses it can operate daily, not by number of parking spot for buses. From this point, its capacity is beyond the estimated demand for next 20 years. However, relevant policy, management peformance and strategies influence the capacity. A well managed terminal with modern ITS infrastructure can manage a larger fleet size. Hence, in addition to efficient architectural design and convenience amenities, management of the terminals remain a critical factor to make these terminal effective for the purpose.

11.8 Capacity at Alternative Design

Interdistrict bus demand has been estimated from district level demography, employment and transport connectivity. Assignment of buses to terminal were based on optimization of travel-kilometer and hence emission. Demand for bus bay and other space requirement was estimated with data experiences from dwell time survey at all existing terminals. It has been found that interdistrict bus takes 15-20 minutes for disemberking and boardng. From that estimatiom, a bus bay can be used by 3 to 4 buses an hour. However, it has been assumed that a bus departing within next 2 hours wont park to depot rather will spend the time in arrival or departure bay. Theses idle bus bays can be used for night parking as well.

Suggestions received from stakeholders meeting are incorporated in the alternative design. Each terminal is proposed with an alternative design. These will be elaborated in final design stages. Car and microbuses are proposed at basement level of the terminal. Number of City bus parking is increased. Inter-district buses are reduced in number. Number of idle bus parking are increased. Arrival lounge is at ground level and departure lounge is proposed in upper floor, connected through moving escalators, elevators and stairs. Auto walk/travelator

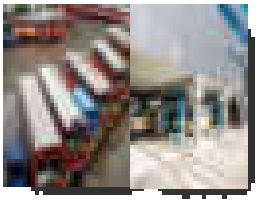
is proposed to cover distances within lounge. Wheel chair access and movement is proposed as per code.

Table 11-7: Estimated Bus Terminal Design Capacity in Alternative Design

	Bus Bay		
Bus Terminal Name	**Int-District Bus Terminal**	**Int. Bus Depot**	**City Bus**
Hemayetpur	112	236	145
Baghair	102	284	71
Kanchpur South	118	90	66
Gram Bhatulia	127	126	60

*A bus bay can be used by up to 3 city buses per hour. If we consider the rate for 12 hours a day, at least 36 city buses can be operate from a single bay

The alternative design sought for more space for city bus. To address that within given space number of bay for interdistrict can be reduced (as shown in alternative design). Along with demand and usage pattern, space allocation and management of the bus terminal largely depends on the policy decision. If bus terminals are to connect through high volume transit like MRT and BRT, number of city bus bay can be reduced. So, number of bay for interdistrict or city bus will depends on policy decision on issues for terminal and depot management, route franchising, privatization of terminal and depots, allow of inter district buses to inner city and more importantly connectivity with public transport network.



12 Financial and Economic Analysis

The broad objective of financial and economic analysis of the projects is to find out the viability and justification of the proposed investments.

12.1 Methodology

There are several measures to compare benefits to costs in a cost/benefit analysis. In this regards the Net Present Value (NPV) measure or the Benefit-Cost Ratio (BCR) and Break-Even-Point to compare benefits to costs. These three measures were used in the illustrative analysis in this project and are described herein.

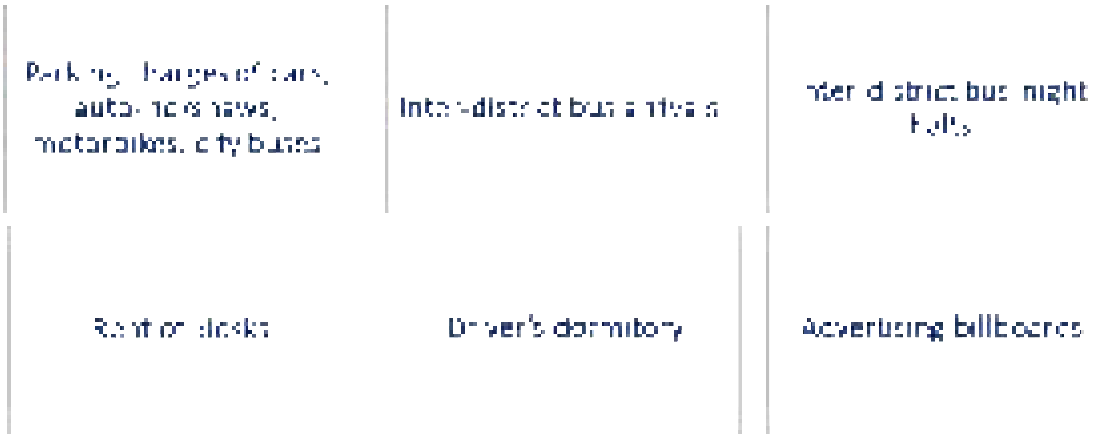
NPV: All benefits and costs over the project's life-cycle are discounted to present values and the costs are subtracted from the benefits to obtain the NPV, which must be a positive number for the project to be justified. When multiple project alternatives exist, the alternative with the largest NPV of net benefits is typically the preferred alternative, though sometimes, other factors including project risks and funding availability may play a role in the selection of an alternative with a lower, positive NPV.

BCR: The BCR is a ratio where the present value of benefits (including negative benefits or positive benefits) is divided by the present value of the initial project investment cost. When benefits exceed costs, the ratio is greater than one and implies that the project is worth pursuing.

Break-Even-Point: The break-even point is where a business' revenues equal its costs. The calculation for the break-even point can be done in one of two ways; one is to determine the number of units that need to be sold, or the second is the number of sales ( ) that needs to happen.

The break-even point allows a company to know when it, or one of its products, will start to be profitable. If a business's revenue is below the break-even point, then the company is operating at a loss. If it's above, then it's operating at a profit.

Figure 12-1: Sources of Direct Income of the Terminals



Economic evaluation methodology considers the magnitude of the impact of the construction of the proposed bus terminals and depots. The construction is expected to result in savings to the travelers in the form of reduced "Vehicle Kilometer Travel Savings (VKTS), Vehicle Hour Travel Time Savings (VHTTS), Passenger Hour Travel Time Savings (PHTTS) and Green House Gas (GHG) emission.

The results are expressed in Economic Internal Rates of Return (EIRR), BCR and NPV. These have been estimated for a period of 30 years including four years' construction period (2021-2022 to 2024-2025). Construction will be expected to start in the year 2021-2022 and the first year of operation of services from 2025-2026. Both of these analyses are illustrated separately below for the proposed bus terminals and depots.

12.2 Financial and Economic Assumptions

For financial and economic analysis, the following assumptions were made:

Yearly Incremental Rate %	5%
Total days in a year	365
Financial Break-Even Point (%)	12.%
Standard Conversion Factor (SCF)	0.903
Shadow Exchange Rate Factor (SERF)	1.05
Shadow wage rate factor for skilled labor	1
Shadow wage rate factor for Un-skilled labor	0.86
The Economic Opportunity Cost of Capital (EOCC)	12%
Shadow price factor for other non-tradable	0.903
Exchange Rates - US 1 =	85
Physical Escalation	5%
Price Escalation (Local Currency)	5%
Price Escalation (Foreign Currency)	1.4%
VAT and Tax for Works	15.%
VAT and Tax for Consultancy	27.%
Project Implementation Period (Year)	04
Project Life (Year)	30
Salvage Value/Residual Value	
a. Assets (Excluding Land)	2%
b. Land (10% Compounding)	10%

12.3 Financial Feasibility Analysis

The analysis aims at determining the financial feasibility of the construction and operation of the proposed bus terminals using the tools of Net Present Value (NPV), Benefit-Cost Ratio (BCR), Internal Rate of Return (IRR), Break-Even Point (BEP).

It determined the age of the project at the break-even value and sensitivity analysis to see the project feasibility level during the price changes.

12.3.1 Capital Cost of the Bus Terminals

The capital costs in financial terms are based on 2021 domestic prices. They are converted into economic values. Capital cost estimates were made based on field visits and field surveys according to the standard "scheduled rate of construction" which was used by PWD and other concerned agencies.

The total capital cost (CAPEX) at the financial prices of construction (in 1,120,068.32 lakh of option 1st) for all these bus terminals and was tabulated in the following table. If chose Option 2nd for construction then the amount will be added or deleted accordingly vice versa. Details are laid out in Annex 10.

Table 12-1: Capital Cost (CAPEX)[80]-Financial

lakh

Item	1st Option									2nd Option (Terminal)	
	Bus Terminal					Bus Depot			Total		
	Baghair	Kanchpur South	Gram Bhatulia (Birulia)	Bhulta	Hemayetpur	Kanchan	Bhawal, Ati Bazar	Kanchpur (North)		Hemayetpur -1	Kanchpur North
I. Investment Costs											
A. Civil Works											
1. Earth Works	21,045.45	16,991.02	17,622.17	15,376.91	25,906.07	12,976.51	15,741.67	10,750.93	136,410.72	11,859.30	10,750.93
2. Construction Works	38,899.19	35,867.00	38,686.24	31,178.54	56,448.80	14,528.71	16,589.96	10,065.33	242,263.76	29,321.98	23,543.93
3. Other Works	2,758.45	2,398.64	2,334.10	2,176.46	3,289.28	2,071.08	1,849.95	1,736.31	18,614.27	2,166.32	1,854.20
Subtotal Civil Works	62,703.09	55,256.66	58,642.50	48,731.91	85,644.15	29,576.30	34,181.58	22,552.56	397,288.75	43,347.60	36,149.05
B. Survey and Investigation	50.00	50.00	50.00	50.00	50.00	50.00	50.00	50.00	400.00	50.00	50.00
C. Consultancy (Design, Construction, Land acquisition and resettlement)	2,401.09	2,401.09	2,401.09	2,401.09	2,401.09	2,401.09	2,401.09	2,401.09	19,208.72	2,401.09	2,401.09
D. Environmental Management Plan (EMP)	200.00	200.00	200.00	200.00	200.00	200.00	200.00	200.00	1,600.00	200.00	200.00
E. Vehicle	500.00	500.00	500.00	500.00	500.00	500.00	500.00	500.00	4,000.00	500.00	500.00
F. Equipment	500.00	500.00	500.00	500.00	500.00	500.00	500.00	500.00	4,000.00	500.00	500.00
G. Furniture	517.65	517.65	517.65	517.65	517.65	66.00	66.00	66.00	2,786.25	517.65	66.00
H. Land Acquisition	35,311.50	103,875.00	27,825.00	83,490.00	73,955.70	127,050.00	27,069.00	69,750.00	548,326.20	56,511.00	69,750.00
I. Resettelment	4,574.15	13,411.28	3,582.99	10,749.86	7,660.44	16,358.21	3,485.10	9,134.85	68,956.89	7,661.13	9,134.85
J. Project Management Support Cost	2,401.09	2,401.09	2,401.09	2,401.09	2,401.09	2,401.09	2,401.09	2,401.09	19,208.72	2,401.09	2,401.09
Total BASELINE COSTS	109,158.58	179,112.77	96,620.33	149,541.60	173,830.12	179,102.69	70,853.86	107,555.59	1,065,775.53	114,089.55	121,152.08
Physical Contingencies	2,183.17	3,582.26	1,932.41	2,990.83	3,476.60	3,582.05	1,417.08	2,151.11	21,315.51	2,281.79	2,423.04
Price Contingencies	4,442.70	5,141.01	4,236.17	4,410.43	6,507.13	3,590.94	2,299.71	2,349.20	32,977.29	3,818.96	3,493.84
Total PROJECT COSTS	115,784.45	187,836.03	102,788.90	156,942.86	183,813.85	186,275.68	74,570.65	112,055.90	1,120,068.32	120,190.31	127,068.96

[80] Every bus terminal is required 2 (two) U-Loops and its estimated construction cost is 8,000.00 Lakh out of which 4,000.00 Lakh *i.e.,* one U-loop's cost considered in each of bus terminal's "Construction Works"; Detailed has been tabulated in Annex 10 (under Financial Detailed Project Costs: Table A4, B4, C4, D4, E4, I4 & J4).

Land acquisition cost is revised for three terminals (Baghair, Gram Bhatulia (Birulia) & Hemayetpur) based on recent market perception and discussed with DTCA tabulated in the following table.

Table 12-2 Capital Cost (CAPEX)[81]-Financial (New Table for three locations)

Item	Bus Terminal		
I. Investment Costs A. Civil Works	Baghair	Gram Bhatulia (Birulia)	Hemayetpur
1. Earth Works	21,045.45	17,622.17	25,906.07
2. Construction Works	38,899.19	38,686.24	56,448.80
3. Other Works	2,758.45	2,334.10	3,289.28
Subtotal Civil Works	62,703.09	58,642.50	85,644.15
B. Survey and Investigation	50.00	50.00	50.00
C. Consultancy (Design, Construction, Land acquisition and resettlement)	2,401.09	2,401.09	2,401.09
D. Environmental Management Plan (EMP)	200.00	200.00	200.00
E. Vehicle	500.00	500.00	500.00
F. Equipment	500.00	500.00	500.00
G.Furniture	517.65	517.65	517.65
H.Land Acquisition	151,335.00	160,200.00	202,500.00
I. Resettelment	4,574.15	3,582.99	7,660.44
J. Project Management Support Cost	2,401.09	2,401.09	2,401.09
Total BASELINE COSTS	109,158.58	96,620.33	173,830.12
Physical Contingencies	2,183.17	1,932.41	3,476.60
Price Contingencies	4,442.70	4,236.17	6,507.13
Total PROJECT COSTS	231,807.95	235,163.90	312,358.15

12.3.2 Operation and Maintenance (O&M) Cost of the Bus Terminals (Financial)

Operational costs start incurring once the construction of a facility is finished. Expenditures can be assumed based on the local conditions of existing bus terminals. The key operational costs comprise the cost of staff for the management and facility operation, utilities based on consumption, maintenance of the infrastructure, local government taxes and levies such as property tax and rent, other costs such as insurance and vacancy provisions. These operating cost assumptions were made as per prevalent existing bus terminal norms and typical market practices relevant to similar projects. Details are presented in Annex 10

[81] Every bus terminal is required 2 (two) U-Loops and its estimated construction cost is 8,000.00 Lakh out of which 4,000.00 Lakh *i.e.,* one U-loop's cost considered in each of bus terminal's "Construction Works"; Detailed has been tabulated in Annex 10 (under Financial Detailed Project Costs: Table A4, B4, C4, D4, E4, I4 & J4).

Table 12-3: Summary of O&M Cost (OPEX)-Financial lakh

Bus Terminal					Bus Depot				2nd Option (Terminal)	
Baghair	Kanchpur South	Gram Bhatulia (Birulia)	Bhulta	Hemayetpur	Kanchan	Ati Bazar	Kanchpur North	Total	Hemayetpur-1	Kanchpur North
4,232	3,859	4,028	3,533	5,380	2,349	2,579	1,997	27,957	3,264	2,903

12.3.3 Existing Standard Tariff Rate for Parking and Others

Tariffs are charged by relevant government authorities for meeting financial, economical and social objectives. The rates were collected from beneficiaries directly. In this regard the following standard tariff rates were used to estimate direct income to be generated by all bus terminals.

Table 12-4: Existing Standard Tariff Rate for Parking and Others ( )

Car-Commercial	Car Private	Auto-rickshaw	Motorbike	City Bus	Interdistrict Bus	Interdistrict Bus Parking (night)	Kiosk	Bus Washing	Driver Rest Room Fare	Advertising Billboard Point
50	75	20	10	50	400	400	50	100	50	50,000

12.3.4 Full CAPEX and full OPEX Recovery Using Proposed Tariff Rates

By using standard tariffrates we calculated the actual scenario of all bus terminals. These are indicating Variance, Financial Internal Rate of Return (FIRR), Benefit-Cost Ratio (BCR), Net Present Value (NPV), Sensitivity Indicator (SI) and Switching Values (SV). And then the following five scenarios have been prepared to ascertain "Proposed Tariff Rate" how to achieve a 12% Break-Even Point.

These scenarios are:

(a) Full capex and full opex recovery
(b) 80% capexand full opex recovery
(c) 60% capex and full opex recovery
(d) 40% capex and full opex recovery and
(e) 20% capex and full opex recovery.

A summary result of "Proposed Tariff Rates" at 40% capex and 100% opex recovery are given in the following table. Annex 10 provides it in details.

Table 12-5: 40% CAPEX Recovery and full O&M Cost Recovery using proposed Tariff Rate

	Item	Exsisting rate ( )	Proposed Recovery Rate ( )				
			Baghair	Kanchpur South	Gram Bhatulia (Birulia)	Bhulta	Hemayetpur
(1)	Car-Commercial	50	51	34	57	50	38
(2)	Car-Private	75	77	50	85	74	56
(3)	Auto-rickshaw	20	21	13	23	20	15

(4)	Motorbike	10	10	7	11	10	8
(5)	City Bus	50	51	34	57	50	38
(6)	Interdistrict	400	410	269	454	397	301
(7)	Interdistrict Bus Parking (night)	400	410	269	454	397	301
(8)	Kiosk	50	51	34	57	50	38
(9)	Bus Washing	100	103	67	113	99	75
(10)	Driver Rest Room Fare	50	51	34	57	50	38
(11)	Advertising Billboard Point	50,000	51,289	33,624	56,707	49,641	37,225

12.3.5 Terminal Capacity

Area-wise "vehicle parking and other capacities" of all terminal and depot is different in sizes which are mentioned below in the summary table. Direct income was calculated based on these capacities.

12.3.6 Direct Income calculation parameters

Direct income of terminals was calculated based on the considering following two inputs (*i.e.,* Terminal Capacities and Tariff Rates):

a. Terminal Capacities: Consist of car parking, auto-rickshaw parking, motorbike parking, city bus parking, interdistrict bus parking, kiosk/cabin, interdistrict bus washing, driver's restroom and advertising billboard.

b. Tariff Rates: Tariffs are set by government authority concerned to meet its financial, economic and social objectives. The rates were gathered from beneficiaries directly.

Table 12-6: Summary of Terminal Capacity

Sl.	Items	Terminal					Bus Depot			2nd Option (Terminal)	
		Baghair	Kanchpur (South)	Gram Bhatulia (Birulia)	Bhulta	Hemayet-pur	Kanchan	Ati Bazar	Kanchpur (North)	Hemayetpur-1	Kanchpur (North)
(1)	Car parking	46	25	34	35	46	0	0	0	25	25
(2)	Auto-rickshaw parking	48	45	70	55	48	0	0	0	45	45
(3)	Motorbike parking	34	28	30	45	34	0	0	0	28	30
(4)	City and articulated bus bay	33	22	32	26	33	355	369	250	18	18
(5)	Interdistrict bus arrival Bay	72	72	64	40	125	0	0	0	48	60
(6)	Interdistrict bus departure Bay	72	72	64	40	125	0	0	0	32	30
(7)	Multi-purpose Bay	36	34	32	22	62	0	0	0	0	
(8)	Dedicated Interdistrict bus parking (at night)	224	60	86	156	120	0	0	0	116	42
(9)	Total Overnight Parking	350	185	198	227	338	0	0	0	0	
(10)	Kiosk (number)	160	160	160	160	160	0	0	0	160	160
(11)	Workshop (Vehicle washing)	12	15	14	10	10	0	0	0	12	10
(12)	Driver Rest Rooms	120	120	120	120	120	0	0	0	120	120
(13)	Advertising Billboard Point	10	10	10	10	10	0	0	0	10	10

Car Parking Charge: 80% of the capacity of each terminal treated as commercial car (rent-a-car) and will stay ½ an hour subject to 50 parking charge and the rest 20% is treated as private car that will stay for an hour subject to 75 as parking charges respectively. If they exceed the mentioned time limit then the same charges will be applied.

Auto-rickshaw Entry Fee/Parking Charge: Auto-rickshaw entry fee @ 20 for an hour. If they exceed the mentioned time limit then the same charges will be applied for following every hour.

Motorbike Entry/Parking Fee: Motorbike entry fee @ 10 for an hour. If they exceed the mentioned time limit then the same charges will be applied for following every hour.
City Bus Parking Income: City bus entry fee @ 50 for ½ an hour. The vehicles can stay ½ an hour within 12 hours

Interdistrict Bus: Its Entry Fee @ 400 out of which 200 to be collected from each passenger by vehicle authority which will be charged on each passenger with a ticket @ 5 (Average occupancy of each bus 40 passengers (*i.e.,* 5*40). The vehicles can stay ½ an hour within 12 hours. There is no other charge that will be collected from passengers after get-down inside the terminal from the vehicle and they will avail modern terminal facilities like toilets, bathing and waiting rooms, mobile re-charging etc.

Interdistrict bus parking (at night): Night parking charges of each vehicle @ 400 per vehicle per night. No fraction time will be entertained.

Kiosk Rent: A total of 160 Kiosks will be there in each bus terminal and it will be rented @ 50 per sft

Interdistrict bus washing: Assumed 50% of interdistrict bus will be washing in terminal workshop subject to 100 washing charge of the bus each time.

Drivers' Rest Room: It will be 4-storied separate pucca building within the bus terminal campus and total 120 rooms will be on 1st, 2nd and 3rd floor (each floor contains 40 rooms). Rent will be charged @ 50 for 12 hours.

Advertising Billboard: 10 advertising billboard points of every bus terminal and will be leased out @ 50,000 per month per billboard.

Table 12-7: Summary of Direct Incomes lakh

Bus Terminal					Bus Depot			Total	2nd Option (Terminal)	
Baghair	Kanchpur (South)	Gram Bhatulia	Bhulta	Hemayetpur	Kanchan	Ati Bazar	Kanchpur (North)		Hemayetpur-1	Kanchpur (North)
5,213	4,745	4,518	3,330	7,928	1,143	1,183	836	28,896	2,597	2,872

12.3.7 At-a-Glance Financial Results

Considering the CAPEX, OPEX and direct Income, financial analysis was carried out and a summary of base case results is shown in the following table. The details are provided in Annex 10.

12.3.8 Financial Sensitivity and Switching Value Analysis (Baghair)

In this analysis, standard tariff rates have been assumed and sensitivities and switching values have been calculated. The calculations were carried out for variance, Financial Internal Rate of Return (FIRR), Benefit-Cost Ratio (BCR), Net Present Value (NPV), Sensitivity Indicator (SI) and Switching Values (SV).

The results of the sensitivity and switching value analysis are indicating five types of financial model/scenario like as mentioned in Sl no.1.1 to 5.1. We may consider financial model Sl no.4.1 where existing standard tariff rate (40% CAPEX and full OPEX recovered) and FIRR, BCR, NPV is 12.50%, 1.05 and 3,383.50 respectively as all are desirable positive indicators. Only proposed Baghair bus terminal is presented below as a sample analysis model and analysis of all other terminals along with detailed calculations are furnished in Annex 10.

12.4 Economic Analysis

Economic feasibility is assessed by using the discounted value of total capex, opex and direct and indirect benefits in economic values. In relation to feasibility, the value of benefits obtained must be greater than the costs incurred.

The purpose is to quantify the impact of the project on the economy. Similar to the financial analysis, it is also estimated return on investment but focusing particularly on the economy rather than the return to the investor. The economic analysis is important to demonstrate the rationale for public sector involvement in developing infrastructure and bringing economic benefits for the economy as a whole. The proposed bus terminal project facility is expected to generate and extend economic activities both at local and national levels as it would result in changes to relative prices in the economy. The most important indicator is the Economic Internal Rate of Return (EIRR) and Economic Net Present Value (ENPV). It indicates to take the decision on the feasibility of the project.

Table 12-8: Summary of Base Case Result at a glance (Financial)

Sl.	Viability Indicator	Bus Terminal					Bus Depot			2nd Option (Terminal)	
		Baghair	Kanchpur (South)	Gram Bhatulia (Birulia)	Bhulta	Hemayetpur	Kanchan	Ati Bazar	Kanchpur (North)	Hemayetpur-1	Kanchpur (North)
(1)	Capital Cost (Lakh)	115,784.45	187,836.03	102,788.90	156,942.86	183,813.85	186,275.68	74,570.65	112,055.90	120,190.30	127,068.96
(2)	O&M Cost (Lakh)	4,231.77	3,859.10	4,028.32	3,532.65	5,379.51	2,349.07	2,579.43	1,997.36	3,264.05	2,902.98
(3)	Benefit Cost Ratio (BCR @ 12%)	0.58	0.60	0.55	0.52	0.67	0.48	0.31	0.44	0.48	0.55
(4)	Net Present Value (NPV @ 12%) Lakh	-50,798.23	-72,783.07	-49,001.38	-72,820.63	-61,571.38	-89,170.56	-54,271.56	-60,357.86	-62,681.80	-55,565.02
(5)	Internal Rate Return (IRR %)	7.81%	9.12%	7.22%	8.49%	9.13%	8.82%	5.57%	8.28%	7.82%	8.74%

Table12-9: Summary of Base Case Result at a glance (Financial)- (New Table for three locations)

Sl	Viability Indicator	Bus Terminal		
		Baghair	Gram Bhatulia (Birulia)	Hemayetpur
(1)	Capital Cost (Lakh)	231,807.95	235,163.90	312,358.15
(2)	O&M Cost (Lakh)	4,231.77	4,028.32	5,379.51
(3)	Benefit Cost Ratio (BCR @ 12%)	0.58	0.55	0.67
(4)	Net Present Value (NPV @ 12%) Lakh	-50,798.23	-49,001.38	-61,571.38
(5)	Internal Rate Return (IRR %)	7.81%	7.22%	9.13%

Table 12-10: Sensitivity and Switching Value Analysis (Baghair Bus Terminal)

Sl.	Variables	Variance	FIRR %	BCR	NPV (Lakh)	Sensitivity Indicator (SI)	Switching Values (SV) %
(1)	Existing Standard Tariff Rate						
(2)	Existing Standard Tariff Rate (Full CAPEX and O&M Cost Recovery)		7.81%	0.58	(50,798)	-	-
(3)	Direct income Increased by + 10%	10%	8.24%	0.62	(45,784)	0.99	101.31
(4)	Direct income Increased by (+) %	101.31%	12.00%	1	-	10	10
(5)	Existing Standard Tariff Rate (80% CAPEX and O&M Cost Recovery)		8.88%	0.68	(32,738)	-	-
(6)	Direct income Increased by + 10%	10%	9.36%	0.73	(27,724)	1.53	65.29
(7)	Direct income Increased by (+) %	65.29%	12.00%	1	-	10	10
(8)	Existing Standard Tariff Rate (60% CAPEX and O&M Cost Recovery)		10.32%	0.83	(14,677)	-	-
(9)	Direct income Increased by + 10%	10%	10.89%	0.89	(9,663)	3.42	29.27
(10)	Direct income Increased by (+) %	29.27%	12.00%	1	-	10	10
(11)	Existing Standard Tariff Rate (40% CAPEX and O&M Cost Recovery)		12.50%	1.05	3,384	-	-
(12)	Direct income Increased by + 10%	10%	13.25%	1.12	8,398	(14.82)	(6.75)
(13)	Direct income decreased by (-) %	-6.75%	12.00%	1	-	10	10
(14)	Existing Standard Tariff Rate (20% CAPEX and O&M Cost Recovery)		16.89%	1.43	21,444	-	-

12.4.1 Benefit Cost Ratio

Benefit cost ratio (BCR) shows the relationship between benefits and costs of a proposed project. For undertaking new projects, it is often used to find out the relationship between probable benefits and costs, but both the benefits and costs are discounted in present values. If the benefit is higher than the cost, it indicates that the project is a good quality investment. At first, benefits and costs are discounted over the years, which is 0 to n and then sum of discounted benefit is divided by the sum of discounted costs. The rule for BCR is as follows:

$$BCR = \frac{\sum \frac{B_t}{(1+d)^i}}{\sum \frac{C_t}{(1+d)^i}}$$

Where i =0 to 30

B_t = the benefits of the project in 30 years (only direct benefits arc taken into account for financial viability; and all the direct benefit and some indirect benefits are taken into consideration for determining economic viability)

C_t= the costs of the project in year 30 (costs are calculated in direct form, where indirect or hidden costs are not taken into consideration) and

d = the discount rate which taken as the rate 12%.

12.4.2 Net Present Value

Net Present Value (NPV) is a measure of profitability to evaluate a project's potential return on investment. It considers the compounding of the discount rate over the duration of the project because of the time value of money. It shows how much revenue or cash inflow equals or exceeds the amount of investment capital needed to fund it. The higher value to NPV indicates that the project is more profitable. To calculate this, the computation of estimated cash inflow and outflow for each period is needed with the expected discount rate. If the value of NPV is greater than zero then the project is profitable and vice versa. The formula of Net Present Value (NPV)is given below:

$$NPV = \sum_{n=0}^{N} \frac{CF_n}{(1+r)^n}$$

Where C_F = Cash flow,
r = rate of interest i.e., 12%,
n = time period and
N~ total number of periods i.e., 30.

12.4.3 Internal Rate of Return

Internal rate of return (IRR) is the rate of return at which the NPV of a project equals to zero. It is the point at which the cash flows of a project equal to its costs. To compare with IRR a hurdle rate is set, which is the minimum rate of return accepted for a project. If the IRR is greater or equal to the hurdle rate, then the project can be accepted. The formula for IRR is:

$$IRR = \sum_{n=0}^{N} \frac{CF_n}{(1+r)^n} = 0$$

Here, the definition of C_P, r, n and N are same as mentioned above.

12.4.4 Investment/Capital Cost of Bus Terminals (Economic)

The economic cost of all bus terminals are tabulated below. Details are provided in Annex 10.

Table 12-11: Capital Cost (CAPEX)-Economic lakh

Item	Bus Terminal					Bus Depot			Total	2nd Option (Terminal)	
	Baghair	Kanchpur (South)	Gram Bhatulia (Birulia)	Bhulta	Hemayetpur	Kanchan	Bhawal, Ati Bazar	Kanchpur (North)		Hemayetpur-1	Kanchpur (North)
I. Investment Costs											
A. Civil Works											
1. Earth works	16,153.44	13,041.46	13,525.90	11,802.55	19,884.21	9,960.12	12,082.52	8,251.87	104,702.05	9,102.60	8,251.87
2. Construction of Works	30,570.45	28,185.18	30,406.64	24,501.84	44,376.35	11,404.43	13,013.09	7,898.78	190,356.75	23,040.03	18,505.76
3. Other works	2,170.77	1,887.61	1,836.82	1,712.76	2,588.50	1,629.84	1,455.82	1,366.39	14,648.50	1,704.78	1,459.16
Subtotal Civil Works	48,894.65	43,114.25	45,769.35	38,017.15	66,849.06	22,994.38	26,551.43	17,517.04	309,707.30	33,847.41	28,216.80
B. Survey and Investigation	45.15	45.15	45.15	45.15	45.15	45.15	45.15	45.15	361.20	45.15	45.15
C. Consultancy (Design, Construction, Land acquisition and resettlement)	1,582.77	1,582.77	1,582.77	1,582.77	1,582.77	1,582.77	1,582.77	1,582.77	12,662.20	1,582.77	1,582.77
D. Environmental Management Plan (EMP)	162.54	162.54	162.54	162.54	162.54	162.54	162.54	162.54	1,300.32	162.54	162.54
E. Vehicle	406.35	406.35	406.35	406.35	406.35	406.35	406.35	406.35	3,250.80	406.35	406.35
F. Equipment	406.35	406.35	406.35	406.35	406.35	406.35	406.35	406.35	3,250.80	406.35	406.35
G. Furniture	430.74	430.74	430.74	430.74	430.74	54.92	54.92	54.92	2,318.44	430.74	54.92
H. Land acquisition	28,697.66	84,419.21	22,613.38	67,852.32	60,103.80	103,253.54	21,998.98	56,685.83	445,624.70	45,926.49	56,685.83
I. Resettelment	3,717.41	10,899.34	2,911.90	8,736.41	6,225.64	13,294.32	2,832.34	7,423.89	56,041.26	6,226.20	7,423.89
J. Project Managent Support Cost	1,951.37	1,951.37	1,951.37	1,951.37	1,951.37	1,951.37	1,951.37	1,951.37	15,610.93	1,951.37	1,951.37
Total BASELINE COSTS	86,294.99	143,418.07	76,279.89	119,591.15	138,163.76	144,151.68	55,992.19	86,236.21	850,127.95	90,985.37	96,935.97
Physical Contingencies	1,725.90	2,868.36	1,525.60	2,391.82	2,763.28	2,883.03	1,119.84	1,724.72	17,002.56	1,819.71	1,938.72
Price Contingencies	-	-	-	-	-	-	-	-	-	-	-
Total PROJECT COSTS	88,020.89	146,286.43	77,805.49	121,982.97	140,927.03	147,034.72	57,112.04	87,960.93	867,130.51	92,805.07	98,874.68

Land acquisition cost is revised for three terminals (Baghair, Gram Bhatulia (Birulia) & Hemayetpur) based on recent market perception and discussed with DTCA tabulated in the following table.

Table 12-12: Capital Cost (CAPEX)-Economic lakh-New Table for three terminals

Item	Bus Terminal		
	Baghair	Gram Bhatulia (Birulia)	Hemayetpur
I. Investment Costs			
A. Civil Works			
1. Earth works	16,153.44	13,525.90	19,884.21
2. Construction of Works	30,570.45	30,406.64	44,376.35
3. Other works	2,170.77	1,836.82	2,588.50
Subtotal Civil Works	48,894.65	45,769.35	66,849.06
B. Survey and Investigation	45.15	45.15	45.15
C. Consultancy (Design, Construction, Land acquisition and resettlement)	1,582.77	1,582.77	1,582.77
D.Environmental Management Plan (EMP)	162.54	162.54	162.54
E. Vehicle	406.35	406.35	406.35
F. Equipment	406.35	406.35	406.35
G. Furniture	430.74	430.74	430.74
H. Land acquisition	125,449.75	132,798.43	167,863.19
I. Resettelment	3,717.41	2,911.90	6,225.64
J. Project Managent Support Cost	1,951.37	1,951.37	1,951.37
Total BASELINE COSTS	86,294.99	76,279.89	138,163.76
Physical Contingencies	1,725.90	1,525.60	2,763.28
Price Contingencies	-	-	-
Total PROJECT COSTS	184,772.99	187,990.55	248,686.42

12.4.5 Operation and Maintenance (OPEX) Cost of Bus Terminals (Economic)

Operational costs start once construction is completed. These can be assumed based on the local conditions of the existing bus terminals. The key operational costs comprise the cost of staff for the management and operation facilities, utilities based on consumption, maintenance of the infrastructure, local government taxes and levies such as property tax and rent, other costs such as insurance and vacancy provision. Financial OPEX was converted into economic OPEX by using Standard Conversion Factor (SCF). A summary of OPEXs is given below. Annex 10 lays out details of the same.

Table 12-13: Summary of O&M Cost (economic) lakh

Bus Terminal					Bus Depot			Total	2nd Option (Terminal)	
Baghair	Kanchpur (South)	Gram Bhatulia	Bhulta	Hemayetpur	Kanchan	Ati Bazar	Kanchpur (North)		Hemayetpur -1	Kanchpur (North)
3,123	3,073	3,206	2,815	4,273	1,875	2,057	1,597	22,018	2,602	2,318

12.5 Heads of Indirect Income

The existing bus terminals in Dhaka is featured with low speed due to traffic congestion. The proposed project will undertake to reduce the number of traffic jams in Dhaka, which will save the following parameters. In turn, the benefit of running the bus terminals shall generate several economic benefits including:

- Vehicle-km Travel (VKT) Savings Income
- Vehicle Hour Travel Time (VHTT) Savings Income
- Passenger Hour Travel Time (PHTT) Savings Income
- Savings of Green House Gas Emission

12.5.1 VKT Savings

After having new terminals at proposed locations, interdistrict buses will run lesser kilometer. VKT savings were estimated based on the bus's travel reduction due to new location. For example, for Gabtoli based buses, their new terminal will be Hemayetpur. Distance between Hemayetpur and Gabtoli is about 10 km. This distance and future bus number was multiplied to estimate the bus-km Savings for Hemayetpur. For terminals which will serve buses from two existing terminals, average value was used. For example, Bhulta will serve both Mohakhali and Sayedabad buses. Their average distance to Bhulta is 10 km.

	Terminal	VKT Saving Rate	VKT Savings				
			2025	2030	2035	2040	2045
(1)	Baghair	10	15,539	18,297	19,833	20,742	21,019
(2)	Kanchpur (South)	15	41,265	51,904	59,483	64,779	67,111
(3)	Kanchpur (North)	15	41,265	51,904	59,483	64,779	67,111
(4)	Gram Bhatulia	15	43,695	54,182	61,455	66,492	68,668
(5)	Bhulta	10	16,309	19,097	20,650	21,577	21,860
(6)	Hemayetpur	10	13,530	16,032	17,590	18,633	19,048

12.5.2 Travel Time Savings (Hr)

From the boarding-alighting survey, we know the travel time between the current location and the proposed location. That time was used as a time saving rate.

	Terminal	Time Saving Rate (hr)	Bus Travel Time Saving (hr)				
			2025	2030	2035	2040	2045
(1)	Baghair	0.5	777	915	992	1,037	1,051
(2)	Kanchpur (South)	0.35	963	1,211	1,388	1,512	1,566
(3)	Kanchpur (North)	0.35	963	1,211	1,388	1,512	1,566
(4)	Burilia	0.5	1,457	1,806	2,049	2,216	2,289
(5)	Bhulta	0.35	571	668	723	755	765
(6)	Hemayetpur	0.35	474	561	616	652	667

12.5.3 Passenger Hour Travel Time Savings (Hr)

	Terminal	Time Saving Rate (hr)	Passenger Travel Time Saving (hr)				
			2025	2030	2035	2040	2045
(1)	Baghair	0.5	26,416	31,104	33,715	35,261	35,733
(2)	Kanchpur (South)	0.35	32,737	41,177	47,190	51,391	53,241
(3)	Kanchpur (North)	0.35	32,737	41,177	47,190	51,391	53,241
(4)	Burilia	0.5	49,521	61,406	69,650	75,358	77,824
(5)	Bhulta	0.35	19,407	22,726	24,573	25,677	26,014
(6)	Hemayetpur	0.35	16,100	19,078	20,933	22,174	22,668

12.5.4 Savings in Green House Gas Emissions

Greenhouse Gas (GHG) emissions are external cost which is imposed on society and as must be taken into account. The basic assumptions used in the calculations are given in the following table:

Table 12-14: Greenhouse Gas Emission factors per litre of fuel consumed per vehicle[82]

Types of vehicles	Emission rate[83]
Car-Gasoline powered	2.4690
Bus-Diesel powered	2.7930
Truck-Diesel powered	2.7930
Diesel-electric locomotive	2.7930

[82]Victoria Transport Policy Institute, Climate Change Emission Valuation for Transportation Economic Analysis, 02 Jan 2009:

European Union Carbon Prices
€ 78.65 per ton
US 100 per ton
8500 per ton (Exchange rate: 85.00 as at 23 April 2019)

These factors were applied to the vehicle-km (bus, car and microbus)
83 Kg/litre CO_2 equivalent

12.5.5 Indirect Income

Based on the above incremental data of Vehicle-km Travel (VKT) savings, Vehicle Hour Travel Time (VHTT) savings, Passenger Hour Travel Time (PHTT) savings and Green House Gas Emission savings were computedforall bus terminals. A summary of indirect incomesfromall terminals is given in table no. 12.12 (Page no.201)

12.5.6 At-a-Glance Economic Analysis Results

The economic indicators are computed for aproject to judge its economic viability. These indicators include Net Present Value (ENPV), Benefit Cost Ratio (B/C Ratio) and Economic Internal Rate of Return (EIRR). The results of economic analysis are summarized in table no. 12.13 (Page no.201)

The results indicate that the proposed terminals are economically viable, as it secures a rate of return that exceeds 12%, *i.e.,* the opportunity cost of capital, presently used by all sectors of the economy in Bangladesh.

12.5.7 Sensitivity Analysis and Switching Values (Baghair)

The economic analysis of projects is generally based on future events and imperfect data. Certain risks are inherent in project planning and implementation. Therefore, a sensitivity analysis EIRR with variations in the levels of costs and benefits due to various uncertainties and risks involved in the project, were conducted for the project, based on sensitivity indicators and Switching Values of the project.

By switching values, it can be indicated that EIRR will remain the same for the opportunity cost of capital (12%), if the investment cost increases up to the percent indicated in the following table. The results of sensitivity analysis and switching values are summarized in the following table only for the proposed Baghair Bus Terminal as a sample model. Details of computations of all other terminals are furnished in Annex 10.

Table 12-15: Summary of Indirect Incomes

lakh

Sl.	Items	Bus Terminal					Bus Depot			Total	2nd Option (Terminal)	
		Baghair	Kanchpur (South)	Gram Bhatulia (Birulia)	Bhulta	Hemayetpur	Kanchan	Ati Bazar	Kanchpur (North)		Hemayetpur-1	Kanchpur (North)
(1)	Vehicle Kilometre Travel (VKT)	4,462.79	11,851.27	12,549.17	4,683.93	3,885.80	0.00	0.00	0.00	37,432.96	3,885.80	1,1851.27
(2)	Vehicle Hour Travel Time (VHTT)	1,904.52	2,360.18	3,570.28	1,399.20	1,160.76	0.00	0.00	0.00	10,394.94	1,160.76	2,360.19
(3)	Passenger Hour Travel Time (PHTT	8,009.43	9,925.72	15,014.77	5,884.30	4,881.55	0.00	0.00	0.00	43,715.76	4,881.55	9,925.72
(4)	Green House Gas Emission (GHG)	309.69	822.42	870.85	325.04	269.65	0.00	0.00	0.00	2,597.66	269.65	822.42
	Total	**14,686.43**	**24,959.59**	**32,005.07**	**12,292.47**	**10,197.77**	**0.00**	**0.00**	**0.00**	**94,141.32**	**10,197.77**	**24,959.59**

Table 12-16: Summary of Base Case Result at a glance (Economic)

Sl.	Viability Indicator	Bus Terminal					Bus Depot			2nd Option (Terminal)	
		Baghair	Kanchpur (South)	Gram Bhatulia (Birulia)	Bhulta	Hemayetpur	Kanchan	Ati Bazar	Kanchpur (North)	Hemayetpur-1	Kanchpur (North)
(1)	Capital Cost (Lakh)	88,021	146,286	77,805	121,983	140,927	0	0	0	92,805	98,875
(2)	O&M Cost (Lakh)	3,123	3,073	3,206	2,815	4,273	0	0	0	2,602	2,318
(3)	Benefit Cost Ratio (BCR @ 12%)	2.18	2.42	4.38	1.57	1.45	0	0	0	1.59	3.15
(4)	Net Present Value (NPV @ 12%) Lakh	108,999	200,520	284,130	68,402	64,326	0	0	0	55,584	209,028
(5)	Internal Rate Return (IRR %)	21.29%	20.83%	34.11%	15.78%	15.58%	0	0	0	16.20%	24.81%

Table 12-17: Summary of Base Case Result at a glance (Economic) New Table for three locations

Sl.	Viability Indicator	Bus Terminal		
		Baghair	Gram Bhatulia (Birulia)	Hemayetpur
(1)	Capital Cost (Lakh)	184,772.99	187,990.55	248,686.42
(2)	O&M Cost (Lakh)	3,123	3,206	4,273
(3)	Benefit Cost Ratio (BCR @ 12%)	2.18	4.38	1.45
(4)	Net Present Value (NPV @ 12%) Lakh	108,999	284,130	64,326
(5)	Internal Rate Return (IRR %)	21.29%	34.11%	15.58%

Table 12-18: Results of Sensitivity Analysis and Switching Values

Sl.	Variables	Variance	EIRR	NPV (Lakh Tk)	Sensitivity Indicator (SI)	Switching Values (SV) %
(1)	Base Case	-	21.29%	108,998.7	-	-
(2)	CAPEX Increased by + 10%	10%	20.15%	102,097.3	0.63	157.94
(3)	OPEX Increased by + 10%	10%	21.11%	106,692.9	0.21	472.71
(4)	Total project Cost Increased by + 10%	10%	19.98%	99,791.4	0.84	118.38
(5)	Direct income decreased by -10%	-10%	20.90%	103,984.5	0.46	217.38
(6)	Indirect incomet decreased by -10%	-10%	20.30%	95,966.5	1.20	83.64
(7)	Total Income decreased by -10%	-10%	19.90%	90,952.4	1.66	60.40
(8)	Total Cost Increased by + 10% and Total Income decreased by - 10%	Both	18.66%	81,745.2	2.50	39.99
(9)	Salvage/Residual Value zero	0%	20.87%	88,390.5	1.89	52.89

The results of sensitivity analysis presented above, show that in all cases, the calculated EIRR are above 12%. Based on the results of the sensitivity analysis, it can be concluded that the project is economically viable and therefore, recommended for implementation.

In conclusion, the analysis of the interventions and impact is that the project is technically feasible, financially sound, economically viable, socially acceptable and environmental-friendly. Therefore, the terminals are being recommended for implementation.

12.6 Cost Estimate of Bus Terminals and Depots

Costs for the development of terminals and depots were estimated on the basis of PWD rate (2018) and updated for 2021; for items where PWD rates are not available cost was based on market rate. The development cost includes cost of site development, cost of buildings, cost of drainage, cost of pavement for parking area, cost of utility, cost of safety features, cost of landscaping, and furniture cost for arrival/departure lounges and dormitory for bus crews. Development cost of elevated U Loop was estimated based on RAJUK's U-Loop project on Rampura road whereas cost of at-grade loop was estimated based on DNCC's U-Loop project on Airport Road Annex 10 gives estimated costs for terminal development. Cost of land acquisition and resettlement cost is given in Section 7 and LARP report

13 Public-Private Partnership Options

Government needs to procure infrastructure for providing terminal services. Rather than directly procuring the infrastructure, government may procure a private sector party that subsequently will procure the infrastructure and carry out the services through Public-Private Partnership (PPP) arrangement. As such government shifts lot of complexities in procurement and operation and maintenance to the private sector.

When assessing a project through a PPP process it is crucial to define the desired functionality or result for procurement on the basis of output specifications. Here, the client defines the service that is required. These output specifications are then included in a financial model to allow for comparability between the two forms of procurement: public and private. Should the PPP option be preferred, the client leaves certain design stages of the works necessary to deliver that service up to the private sector party that will be selected through the bidding process.

In some circumstances, due to policy or strategic reasons the design requirements may not be left entirely to the discretion of the private sector party and in these cases the client may specify some inputs. The preferred approach however is to ensure that projects are driven substantially by the private sector party and thereby greater value for money for the government is achieved.

Table 13-1: Advantages and Disadvantages of PPP

Advantages	Disadvantages
• Ensures the necessary investments injected into public sector and more effective public resources management • Ensures higher quality and timely provision of public services • Mostly investment projects are implemented in due terms and do not impose unforeseen public sector's extra expenditures • A private entity is granted the opportunity to obtain a long-term remuneration • Private sector expertise and experience are utilized in PPP projects implementation • Appropriate PPP project risks allocation enables to reduce the risk management expenditures • In many cases, assets designed under PPP agreements could be classified off the public sector balance sheet	• Infrastructure or services delivered could be more expensive • Government payments obligations to PPP projects postponed for the later periods can negatively reflect future public sector fiscal indicators • PPP service procurement procedure is longer and more costly in comparison with traditional public procurement • PPP project agreements are long-term, complicated and comparatively inflexible because of impossibility to envisage and evaluate all particular events that could influence the future activity

Though PPP is typically defined as a long-term contract between public and private sector, there is a spectrum of PPP models depending upon various levels of private sector involvement, starting from just a service contract to full privatisation.

- *Service Contracts*
- *Management Contracts*
- *Lease contracts*
- *Concession Models*
    - Design-Build-Finance– Own – Operate – Transfer (DBFOOT)
    - Design-Build – Finance-Operate – Maintain and Transfer (DBFOMT)
    - Design-Build-Finance– Own – Operate (DBFOO)
    - Design-Build-Finance and Transfer (DBFT)
    - Design-Build -Finance– Transfer and Operate (DBFTO)

- *Joint Venture Agreement*

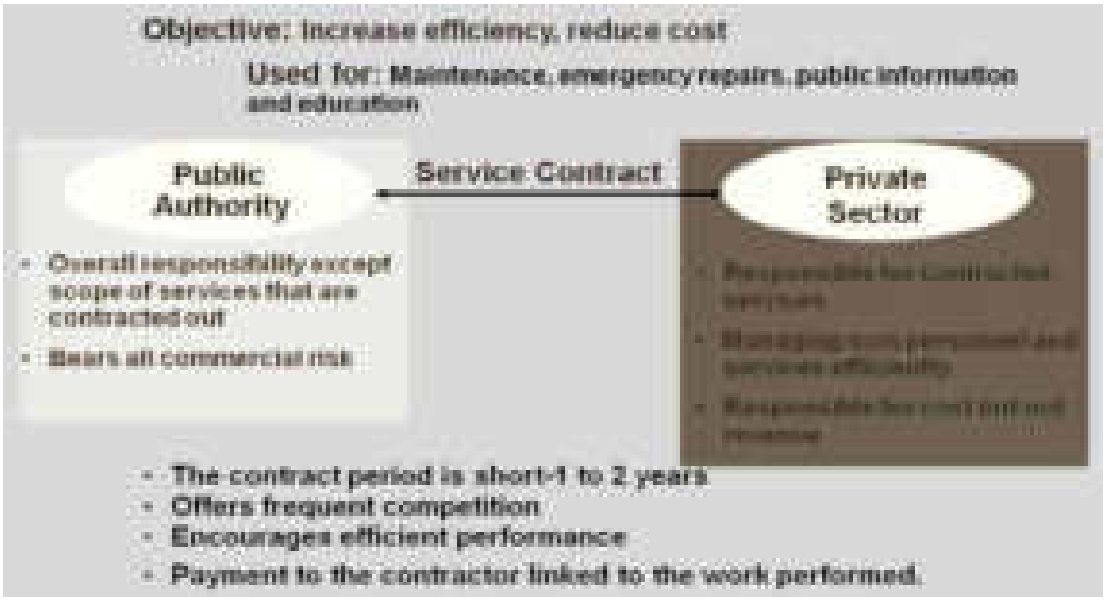
13.1 Service Contracts

Service contract is a business agreement between an executing agency and the private sector covering discrete and a fraction of the overall function, typically the maintenance and servicing of equipment over a specified period. In this contract arrangement government may provide responsibility of services like maintenance of certain portions of the terminal like ICT, air conditioning etc, marketing, security etc to private sector.

The terminal owner as a public regulatory authority will undertake overall responsibilities including contracting services to interested private entities, providing regulatory services (*e.g.* trade license, permissions), monitoring of regulatory guidelines provided by them, revenue collection and will bear all the commercial risks within its sphere. In this model, private sector party would not be responsible for making a significant capital investment.

Service contracts are provided usually for 1-2 years with provision for renewal or replacement by another private sector entity or the executing agency *i.e.,* GOVERNMENT takes up the responsibilities of the service back to its own. The following figure summarises the features of a service contract.

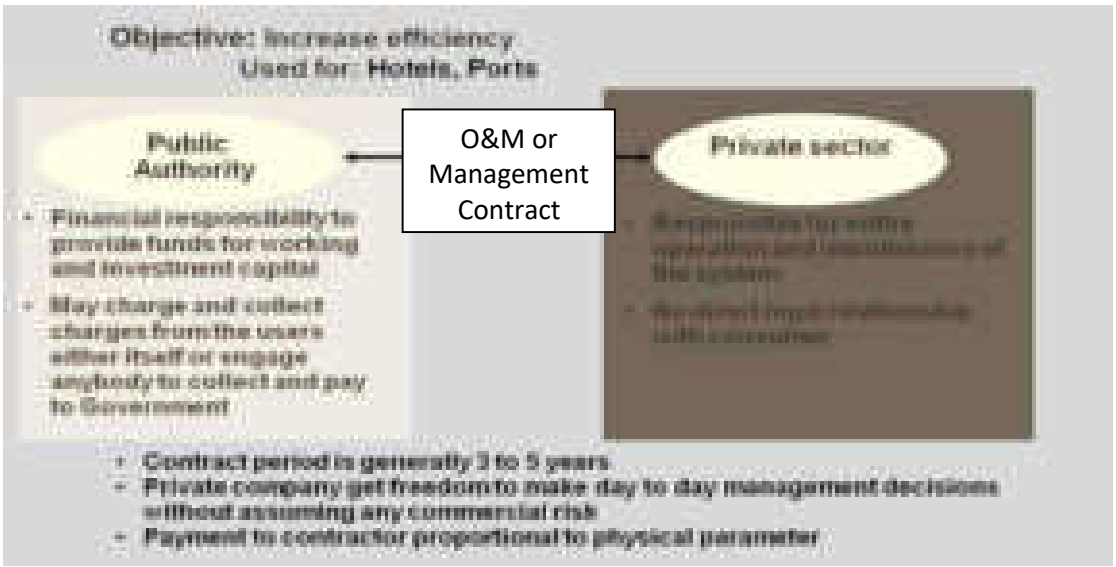
Figure 13-1: Service Contracts



13.2 O&M Contract or Management Contract

An O&M or management contract is an arrangement under which operational control of an existing facility (*e.g.,* an existing terminal) is vested by contract to a separate private sector party that performs the necessary managerial functions in return for a fee. This model fits in a situation, where government has already a facility, which may not be running with desired level of efficiency. In this model, private sector would not be responsible for making a significant capital investment, except for some minor renovations of the facilities if necessary, for carrying out its services. The following figure shows the arrangement in brief:

Figure 13-2: O&M Contract or Management Contract



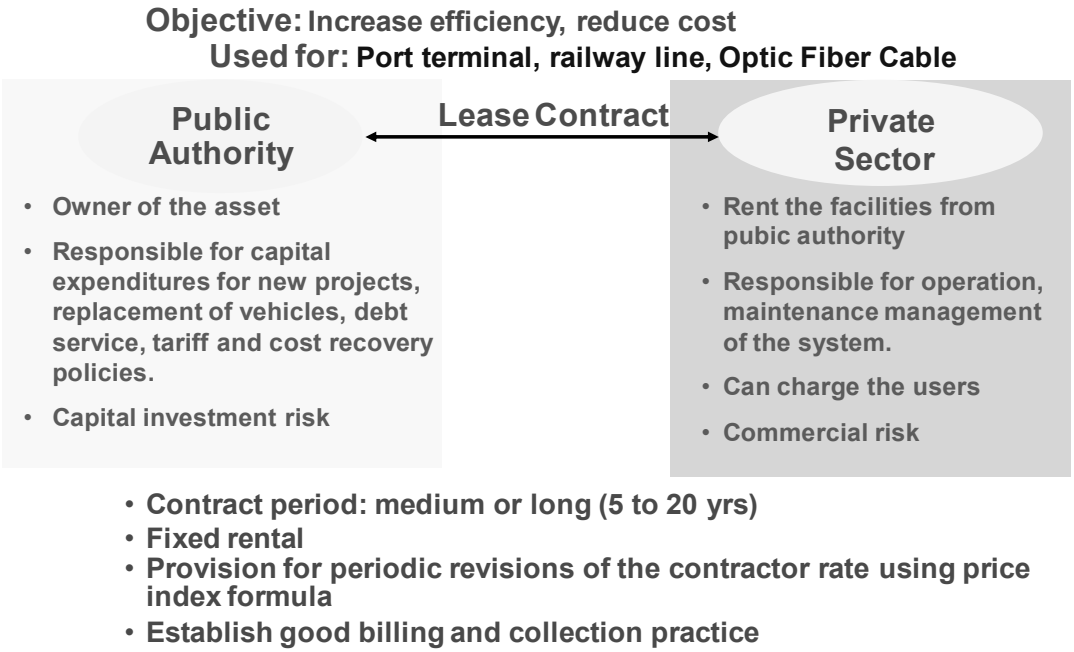
In this arrangement, the private sector will be responsible for management of the facilities. However, the private sector will not be allowed to receive money from the services directly.

Management contracts are provided for short term periods (3 to 5 years), with provision for renewal or replacement by another private sector entity or the terminal owner *i.e.,* government, may take up the management back to its own. Management contracts are generally provided with respect to hotels, port facility, terminals etc.

13.3 Lease Contract

A lease is a contract in which one party agrees to rent property or an asset owned by another party. It allows the lessee or the tenant to use the property for business or otherwise and guarantees the lessor or the property owner or landlord, regular payments from the lessee for a specified number of months or years. The following figure shows the arrangements around a lease contract:

Figure 13-3: Lease Contract



In a lease arrangement, the government may provide the bare land on lease (as a land-lord) and allow it to make necessary investment by the private sector on the land for establishing and operating a terminal. The private sector will provide services on its own. Unlike other rental arrangements, the land owner, in this case the government after land acquistion, may not be able to allow the lessee to do businesses on its land other than terminal operation. The lease would allow more efficient and profitable use of the government land.

In any case, it is unusual in a lease arrangement that a private sector entity would be interested to build a facility with its own investment for building a facility on a land, in case the ownership of the land belongs to the government entity, because the lease arrangement allows the land-lord to terminate the contract with a very short notice without any provision of compensation for the facilities installed on the land.

13.4 Concession Models

Unlike previous PPP models, concession models involve a long-term contract between public sector and private sector with a significant amount of private sector investment. This

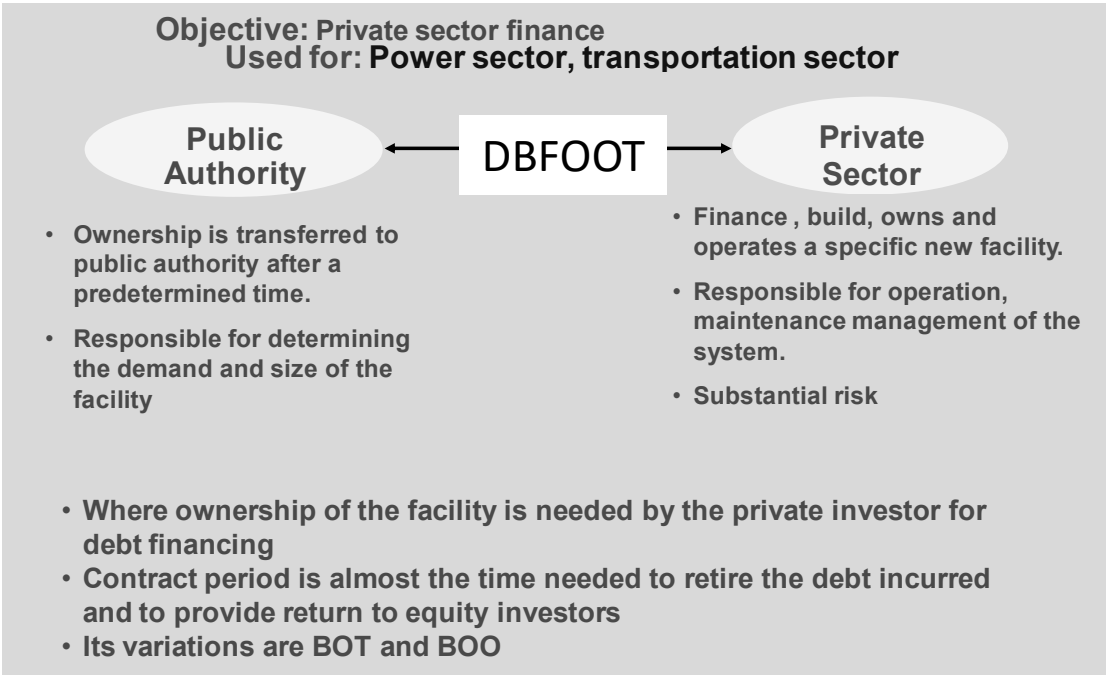
investment element differentiates concession models with other PPP models. The following varieties of concession models can be seen as a matter of discussion:

13.4.1 Design-Build-Finance– Own – Operate – Transfer (DBFOOT)

To overcome the drawback of lease arrangement, concession models like DBFOOT is preferred. *DBFOOT is a PPP model in which a private sector entity conducts a large development project under contract with a government agency like a city corporation or other local government authorities. In DBFOOT the facility installed by the private sector will be owned by the private sector, while land would be owned by the government.* Unlike lease, in concession models like DBFOOT, the private sector is not allowed to build whatever facility it wants to build.

Rather government would provide broad functional parameters of the facilities to be built. A DBFOOT project is often seen as a way to develop a large infrastructure with private funding and then allowing the private party to also operate the facility under a long-term contract. At the end of the term, the facilities are transferred to the government at a price. DBFOOT arrangements provide more comfort to the financiers as the ownership of whatever facility the private sector installs remains with the private sector until transfer of the facilities to the government at the end of the term.

Figure 13-4: Design-Build-Finance– Own – Operate – Transfer (DBFOOT)

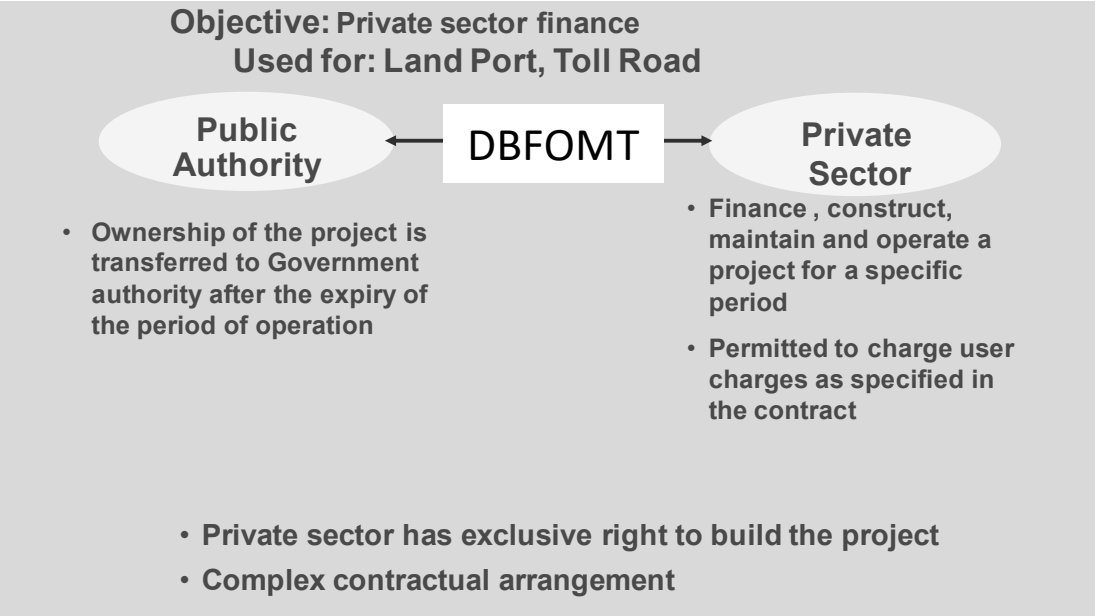


13.4.2 Design-Build – Finance-Operate – Maintain and Transfer (DBFOMT)

A variant of concession contracts is BOT. In this case, *the private sector is not allowed to own anything that it builds over the land. Rather whatever is built on the land automatically goes to the ownership of the land owner i.e. the relevant authority.* This arrangement provides more comfort to the government than in case of DBFOOT, but creates difficulty in securing credit financing by the private party, due to lack of ownership in the facilities that the private sector would build.

Like DBFOOT, concession models like DBFOMT, does not allow the private sector to build whatever facility it wants to build. Rather government would provide broad functional parameters of the facilities to be built. A DBFOMT project is also often seen as a way to develop a large infrastructure with private funding and then allowing the private party to also operate the facility under a long-term contract. At the end of the term, the facilities are transferred to the government, free of cost.

Figure 13-5: Design-Build – Finance-Operate – Maintain and Transfer (DBFOMT)



Bangladesh Sthala Bandar Kartripakkha adopted the DBFOMT model for developing few of its land ports on DBFOMT. Some of it was successful while some turned to be not tenable. Government earmarked and acquired the land and provided concession to private party for development and operation of the land ports. Broad design and layout was provided by BSBK. Contract Term was 25 years. Provision was made for the government to receive from the private party a periodic fixed royalty and variable royalty (depending upon volume of business).

Gulistan-Jatrabari Flyover project is also on DBFOMT basis, where government provided the right of way to the private sector entity and private sector invested in constructing the flyover in consideration of pre-fixed rates of tolls directly charged by the private sector entity to the flyover users.

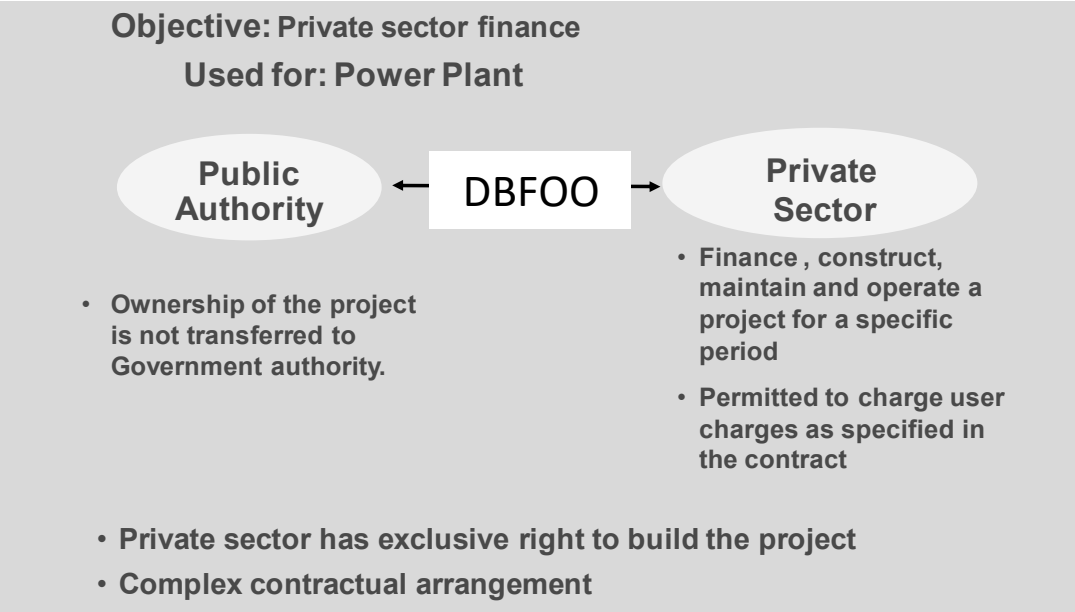
13.4.3 Design-Build-Finance– Own – Operate (DBFOO)

Under this arrangement, at the end of the term there would be no transfer to the government of the assets that was installed by the private sector. Rather at the end of the term, the private sector would unbolt the facilities that it created to whatever extent it can recover and demolish the civil structure and make the land as it was. DBFOO type contracts are usually suitable for power sector, where the government does not want to receive the facilities built by the private sector or the private sector does not want to give the facilities

to the government, due to various reasons and unbolting the facilities is easier than in civil dominated facilities.

At this moment, government would not consider worth forgoing the provision of the transfer of the facilities to its jurisdiction. Therefore, DBFOO is a remote possibility for the government for the terminal sites.

Figure 13-6: Design-Build-Finance– Own – Operate (DBFOO)



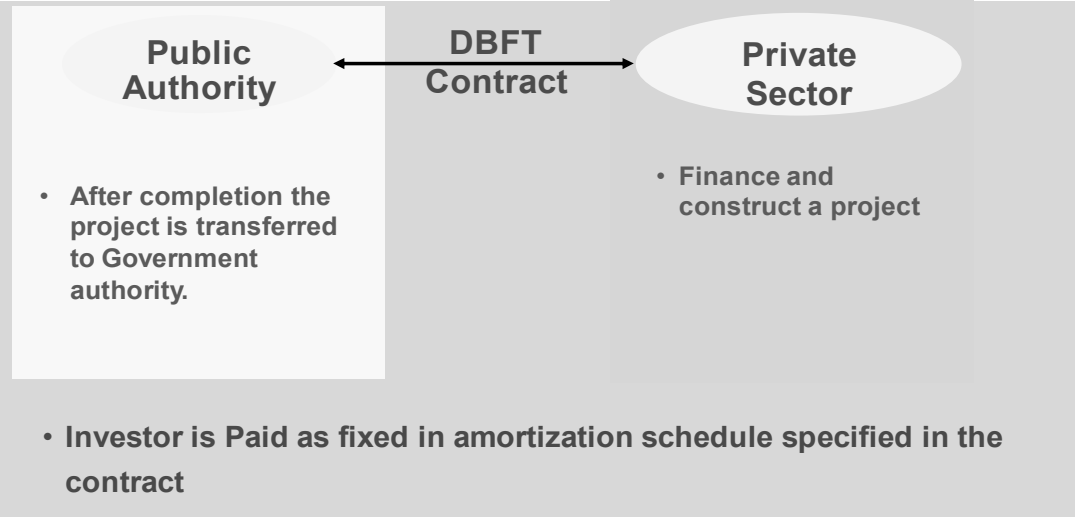
The Independent Power Producer (IPP) contracts in Bangladesh are mostly BOO type contracts between private sector parties and PDB. PDB signed power purchase agreements with these parties for different sites and receives power generated by these IPPs at a predetermined rate. However, PDB would not claim the assets (i.e. power plants) developed by the IPPs, rather the IPPs are supposed to unbolt the power plants and give back the bare land to the government at the end of the term.

13.4.4 Design-Build-Finance and Transfer (DBFT)

Design-Build-and-Transfer is a contractual arrangement whereby the private party undertakes the financing and construction of the infrastructure and upon its completion hands it over to the government. Government after at the end transfer, takes charge of the facility for operation and maintenance. The private party would be paid on a periodic basis from the income of the facility. In DBFT private party's interest would be minimal, as it in fact builds the facility from its own fund as a financier, and then waits for government to pay-back with some additional incentive.

Government intends to start the new terminal sites with a fresh and modern business out-look. In this model, government's objective of capturing the private sector's business acumen and efficiency would not be served. The following figure shows the arrangement.

Figure 13-7: Design-Build-Finance and Transfer (DBFT)

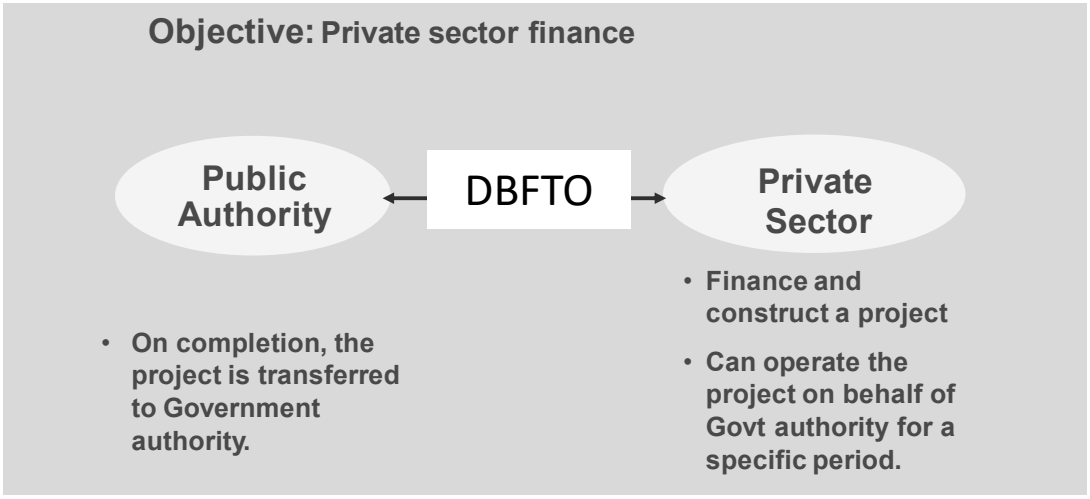


In India, the initial trend of road sector PPP deals was dominated by DBFT contracts, which in other words termed as annuity contracts. This model was particularly useful for attracting private sector in investing in roads, where government ensured a fixed annuity payment to the private sector entity, while taking the traffic risk on its own.

13.4.5 Design-Build -Finance– Transfer and Operate (DBFTO)

DBFTO is a contractual arrangement whereby government would contract out the construction of the facilities on the site to a private party to construct it on a turn-key basis, assuming cost overruns, delays and specified performance risks. Once the construction is completed, it would be transferred to government on a predetermined price. After that, the private sector party is given back the facilities with the right to operate it and provide services on its own. The title of the project always would remain with the government in this arrangement. In this case, the private sector performs as a short-term financier as well as an operator of the facility. However, government may not be in a position to pay for the facility at the end of the construction period. Therefore, a long-term payment schedule is preagreed and government pays the money to the private sector accordingly irrespective of demand of services. The following figure illustrates the arrangement.

Figure 13-8: Design-Build -Finance– Transfer and Operate (DBFTO)



DBFTO contracts are not usual in the PPP arena. However, this is more a theoretical model, which can be adopted, by the government who is capable of buying the facilities from the private sector entity at the end of the construction or capable of paying according to a pre-agreed payment schedule.

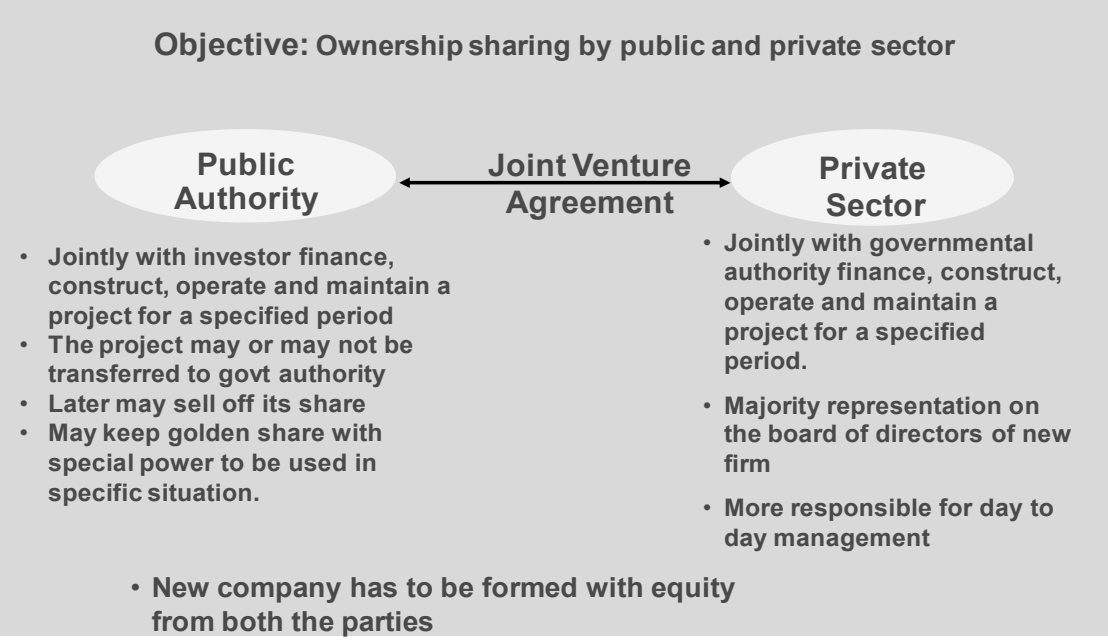
13.5 Joint Venture Agreement

A joint venture agreement is an arrangement where two entities (i.e., government and the private sector entity) form a new entity to their mutual benefit. It normally involves an equity sharing in the new company at different levels of majority or minority. However, such equity sharing may also accompany management, personnel, expertise or intellectual property sharing. Unlike other concession agreements, in JV agreement the two parties, being and remaining as separate entities, does not bind themselves through a bi-party contract. Rather, the two parties become a **two-in-one** entity where mutual responsibilities are shared on an almost non-binding basis, as both parties will work for their own benefit.

A JV agreement would allow government to claim equity against the land it owns and additional expertise and efficiency of the private sector party, that government may not have. For example, if a government entity does not have a research lab or research and development expertise that the venture requires, it would benefit from an already established lab or already existing research and development expertise in the private company, by forming JV with the private company. In this case, government would be likely to be benefited by claiming ownership in a new textile mill through contributing land and there would be significant benefit in terms of learning business acumen by involving itself in the way private sector operates.

In JV agreement both parties share the risk of profitability. Should the venture not become profitable, both parties bear the loss. However, forming a successful joint venture effort requires time. Both parties will often come to the potential venture with different goals. The culture of each party would be different and the integration of both cultures may be difficult or take a long time. Another problem could be that one or both parties don't commit enough resources to achieve a successful venture.

Figure 13-9: Joint Venture Agreement (JVA)



There is an element of conflict of interest in most joint ventures, as contribution of each party to the JV, may not be reflected in the financial reward each party receives. Also, conflict may arise in decision making in terms of dominance and veto power etc. These conflicts, which in many cases become so much irresolvable, especially when the private party may not be in a strong position to decide, that JV arrangements become untenable.

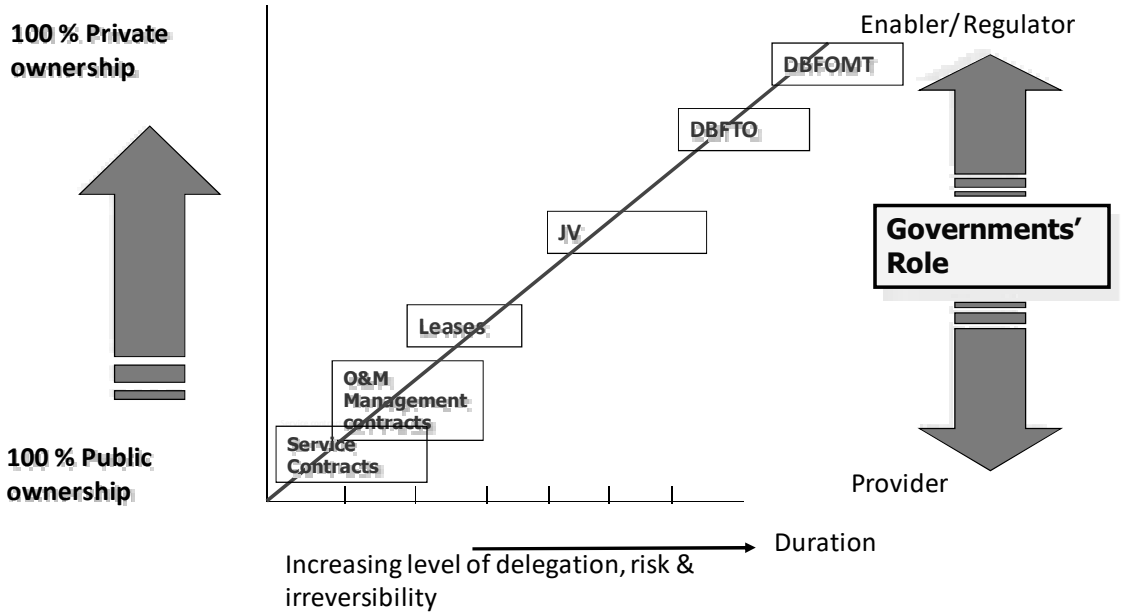
Bangladesh Biman once went through such an exercise, where private sector was to be invited for adding new planes to the fleet of Biman, add necessary expertise to Biman management and in consideration will receive a majority share in the national airlines. However, the process was stalled due to various reasons.

Table 13-2: Comparison of Different PPP Options

	Aspects of PPP	Service Contract	O&M or Management Contract	Lease Contract	DFBFOMT	DBFTO	Joint Venture
(1)	Main Objective of PPP	Improve operating efficiency	Improve operating efficiency	Improve operating efficiency	Mobilize private capital	Mobilize private capital	Mobilize private capital
(2)	Financial Risks of the Private Sector Party	Low	Low	Medium	High	High	Shared
(3)	Duration or tenure of the contract (Year)	2	5	10	30	30	30
(4)	Responsibility for Setting Rates	Contract	Contract	Contract	Contract	Contract	Contract
(5)	Method of Payment	Periodic, Monthly or Quarterly Fees to the Private Sector Party	Periodic, Monthly or Quarterly Fees to the Private Sector Party	Fixed rental, monthly or quarterly to the government	Upfront payment fixed and variable royalty to the government	Periodic, Monthly or Quarterly Payments to the Private Sector Party	Dividend proportional to shareholding
(6)	Responsibility of upfront investment	Government	Government	Private Sector	Private Sector	Private Sector	Government and Private Sector
(7)	Method of Recovering Public Expenditure	User Tariffs	User Tariffs	Lease rentals	Not Applicable	Not Applicable	User Tariffs

The following figure shows the spectrum of PPP options with level of investment and risks between public sector and private sector in those different PPP options.

Figure 13-10: Varying Degrees of Public Sector and Private Sector Involvement



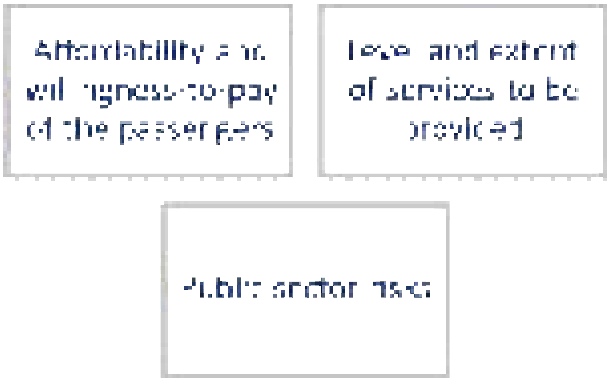
1

13.6 Suitability of a Particular PPP Option with respect to Bus Terminals and Depots

An optimum PPP option for a bus terminal or depot depends upon a number of factors. The government has to weigh between advantages and disadvantages in each options. The following factors shall determine the suitable option for PPP for bus terminals or depots:

- Affordability and willingness-to-pay of the passengers (a PPP option will always be more expensive to the passengers)
- Level and extent of services to be provided (in PPP the level of services is expected to be higher than in purely government financing options)
- Public sector risks (in PPP a broad spectrum of risks like delay in construction, cost overruns and lack of demand etc may be transferred to private sector)

Figure 13-11: Factors to be Considered in Determining a Suitable PPP Option



Amongst the above considerations, affordability and willingness-to-pay of the passengers significantly influence the decision of the government with respect to PPP. As public services are especially seen as the services for the majority and it will subsequently depend upon the purchasing power of the majority. With the pace of development at the macro-economic levle, purchasing power of the passenger increases and with that expectation for higher level of public amenities. However, in all PPP cases the terminal services will be more expensive unless the private sector party is provided scope for alternative cost recovery options like commercial spaces on rental, rest house facilities etc as income enhancing measures. In all PPP options, it is assumed that government will invest in and acquire the land of the terminal and provide unencumbered land or the relevant facilities as appropriate to the private sector party on which the private sector would construct or operate certain facilities or provide some services.

Option A (Service Contract): Shows that in service contracts the risks and responsibilities on the government is the highest although it allows shifting a discrete part of responsibility to private sector. Government has to make investment in land and construction of the facilities. However, it is a relatively easier option to involve private sector with less complex contracting conditions. Government is currently practicing the mode, in many of the existing terminals like in outsourcing ticketing for parking facilities. Security services are also usually outsourced to private sector.

Option B(O&M or Management Contract): O&M or management contract is a higher form of service contract, where the whole management of the terminal would be handed over to a private sector party. In this option, government has greater control of day-to-day management of the terminal as the performance indicators are fixed before-hand and provison of penalties will be there. However, government's capability of supervising performance of the private sector party, in this case, has to be enhanced and dealing with the private sector party has to be transparent if a private sector party has to be attracted with a win win deal.

Option C (Lease): Lease of bare land of the terminal is not a suitable option for terminals, as in such deal government has little option to regulate and guide the lessee about the nature of construction works and design of the terminal that is required for a well functioning terminal services. Government can also provide the terminal buildings and facilities on lease after investment in land and construction. However, such deal has also limited scope of guiding and regulating the private sector party in terms of day to day performance of the lessee, as it can be established in management contract.

Option D (Joint Venture): The relevant city corporation, pourashava or local government body may enter into a joint venture contract with a selected private sector party to form a terminal construction and operating company. The company will be responsible for investment, construction and operation and maintenance of the facilities. In the JV company both government and private sector party will make investment in equity by certain level of equity sharing. This may be a suitable option, if government provides responsibility of operation and maintenance to the private sector party, while remaining as a silent partner with regard to day-to-day operation and maintenance of the facilities, except making policy decisions in the meeting of the board of directors. It may be recommended model of PPP for the bus terminals and depots.

Option E (DBFTO): Design-Build -Finance– Transfer and Operate model can be a suitable option, if government is willing and committed to pay according to a pre-agreed payment schedule to the selected private sector party. However, given the demand situation unpredictable the government may not be in a position to pay off the private sector party from the revenue charged from the passengers.

Option F (DBFOMT): Design-Build – Finance-Operate – Maintain and Transfer model is the most conventional PPP option, that is practiced in roads and ports. This is a heavy-handed private sector participation model, where most of the responsibilities including investment in construction and operation and maintenance are provided to the selected private sector party. However, for the complexity of terms and conditions and uncertainities involved this can be the most challenging option in terms of engaging a private sector party. In transport sector, Dhaka Elevated Expressway and Mayor Hanif Flyover are examples of this PPP model applied in Bangladesh. However, there are not many examples of PPP in transport sector in Bangladesh, compared to those in power generation, as the complexities are more in civil structure dominated deals with more terms, which cannot be perfectly defined.

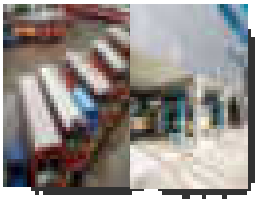
13.7 Recommentations with respect to PPP

(1) Option B (O&M or Management Contract) or Option D (Joint Venture) may be a suitable option, if the relevant government entity partners with some foreign competent terminal O&M contractors. There are examples of such companies like sea or river port operators in Bangladesh (in Chattogram port there is short term cargo handling and O&M contractors at different jetties) and elsewhere.

(2) A detailed PPP suitability study is recommended as a followup of this study, if government is interested to take any of the PPP options

(3) As part of that study a large stakeholder workshop is also recommended to understand the broad terms and conditions and parameters of the terminal to be offered on PPP.

(4) Selection of an appropriate private sector party as a counterpart to the government will always be determining factor for the success of PPP.



14 Institutional Issues

14.1 Operation and Management of Existing Terminals

The existing terminals are owned by city corporations. Terminal managers one for DSCC and one for DNCC are posted. Private sector terminal operators are chosen through leasing process. The lease is for one year. A city corporation office is located at each terminal but is occasionally visited by the staff. Drainage facility and cleanliness seems inadequate and overall maintenance is poor. CCTV surveillance system does not function which has put the security system at risk. Absence of modern fleet management and very low terminal charges (40 per day) encourages bus operators to park vehicles for hours thereby creating congestion in the terminal. Abundance of hawkers and too many ticket selling booths reduces the effective terminal space and hinders safe movement of the passengers. Parking fee is collected by DSCC and DNCC and other fees are collected by terminal operator.

The present annual revenue of the Gabtoli terminal is 4.27 crores, Mohakhali terminal 1.89 crores and Sayedabad terminal 2.59 crores which seems low compared to the size of the terminals. Terminal operators play very little role in managing traffic, as such, representatives of Bus Owners Association (BOA) have partly taken over this responsibility of traffic control management within the terminal premises. Rationalization of terminal fee, better fleet management and regular monitoring of service quality can improve the existing situation to a great extent.

14.2 Institutional arrangement of the proposed new terminals and depots

14.2.1 Ownership and management by current jurisdiction

Presently, the three existing city interdistrict bus terminals are owned by two City Corporations (DSCC and DNCC). The ownership of the proposed ten terminals/depots (expected to be developed by public sector) is described in table below. In case, some of the terminals are developed by private developers or through PPP then the ownership will be transferred accordingly.'

Table 14-1: Ownership of Proposed Terminals

Terminals/Depots	Area (acres)	Responsible City Corporations /Pourasavas
Bhagair	33.63	Keraniganj Upazilla
Hemayetpur	45.0	Savar Thana
Gram Batulia	26.7	Dhaka North City Corporation
Bhawal, Atibazar	25.78	Keraniganj Upazilla
Kanchan	24.2	Rupgonj Thana, Naryangonj
Bhulta	24.2	Sonargaon Upazilla, Naryangonj
Gazipur	12	Gazipur City Corporation
Baipail	37.1	Gazipur City Corporation
Kanchpur North	15.5	Sonargaon Upazilla
Kanchpur South	27.7	Bandar Thana, Narayanganj

14.2.2 Construction

After the approval of the feasibility study report, DTCA is expected to prepare a DPP for the development (including preparation of detail design) of the proposed terminals. DTCA and other stakeholder agencies (DSCC, DNCC and other local government bodies) will be involved in the development of the proposed terminals, as such project management structure needs to be designed carefully to avoid duplication of activities among different agencies. A collaborative approach can be taken where a Project Coordination Unit (PCU) may be established at DTCA to coordinate and oversee the total project; and several Project Implementation Units (PIUs) can be established at respective city corporations and Pourasavas who would be the owners of the terminals and will be responsible for their development.

14.2.3 Management

In urban areas, space is scarce and expensive. Therefore, reserving large areas for public transport terminal becomes difficult. Efficient terminal management system can optimize terminal capacity and space utilization, reduce carbon emission and travel time. The terminal management system of the existing terminals is very inefficient and needs to be overhauled thoroughly to augment its capacity till the proposed terminals are developed. The consultant has reviewed the functional issues of the existing terminals and taken into consideration in their design. Salient features of an efficient terminal management system are described below:

(1) Drivers can be guided all the way in and out of the terminal
(2) Passenger information displays (including apps and web services) keeps track of arrival and departure time and also informs about the bays used by each bus route
(3) Use of Intelligent Transport System (ITS) can ensure safety, security and access control; and keep unauthorized traffic away (through surveillance camera) and avoid disturbances
(4) With the help of the dynamic platform/bay allocation system traffic, of a terminal can be assigned systemically and gates can be used efficiently

The details of Modern Terminal Management System (including Fleet Management) will be prepared during the Detail Design stage.

14.2.4 Monitoring of Terminal Activities and Service Quality

Monitoring of terminal management and service quality is essential for efficient management of terminal and for ensuring satisfaction of passengers. Although, city corporations and other local government bodies (as owners of the terminal) will be responsible for day to day monitoring of the proposed terminals, a third party monitoring cell may be established at DTCA for setting out the performance standard of terminal operators; and periodical monitoring of service quality of terminal operators. In this regard it can be mentioned here that DTCA has already set up a cell for monitoring performance of city bus operation and is in the process of setting up Company to oversee the city bus operation.

14.2.5 Human Resource Development

Effective terminal management is key element for the optimization of terminal capacity and utilization of space. Unfortunately, at present there is a dearth of qualified terminal managers in the country. During detail design stage, further detail institutional review needs to be carried out to ascertain the types and number of terminal management expert (including detail organogram and their training plan).

14.3 Rationalization of Bus Routes

Presently, interdistrict bus routes and number of buses for each route are controlled by Bangladesh Road Transport Authority. The consultants have observed that routes and bus numbers are changed quite frequently by the bus operators depending on supply and demand without the knowledge of BRTA which creates difficulties for terminal operators to provide required arrival and departure facilities for buses at the terminals.

A brief showed that out of 200 bus operators at Gabtoli only 9 are owning more than 50 buses, at Mohakhali 14 out of 120 and at Sayedabad only 7 out of 150 operators. In total out of total 470 operators only 30 are owning more than 50 buses (6.4 % only). This gives a picture about fragmentation of bus operation. According to traffic survey, about 39% of interdistrict buses use terminals, out of the remaining, some of the bus drops passenger and return and big operators mostly have their own terminal at different locations in the city. They often occupy busy roads creating traffic congestion.

It is difficult for small operators to maintain timely arrival/departure schedule and due to limited number of vehicles they wait for long hours in the city for their next trip. Some small operators have given their buses to big operators for managing the trips, however their numbers are negligible. The whole process of enlisting bus operators and routes can be better formalized through a bus route rationalizing and franchising system by BRTA. This will increase efficiency, ensure arrival/departure time schedule and enhance quality of service.

14.4 Stakeholder Consultation

Urban transport projects are in general complex since it requires interaction among many urban development agencies. For the successful completion of the study, discussion with various stakeholders (both government agencies and user groups) and their feedback are essential.

DTCA has already arranged or facilitated several stakeholder consultation meetings (including one Project Implementation Committee –PIC meeting) with major stakeholder agencies:

- RHD
- RAJUK
- BRTA
- DMP
- DSCC
- DNCC
- Other city corporations and Pourasavas of greater Dhaka Area (under the jurisdiction of DTCA).

The beneficiaries are members of Bus Owners Association with whom consultation was also carried out. Interaction with PAPs provided valuable information on socioeconomics aspects which was useful for the design of Resettlement of Action Plan. The participants of the meetings provided valuable input for the terminal design.

15 Conclusions

15.1 Interdistrict Terminals

After carefully analyzing the existing routes, trip demand and corresponding shortest distance for origin and destination, five interdistrict terminals are proposed at the following locations:

(1) Hemayetpur (3) Kanchpur South (5) Gram Bhatulia
(2) Baghair (4) Bhulta and

Because of the immediate demand, all the five interdistrict terminals are proposed to be developed in Phase I. Kanchpur North is considered both for Interdistrict terminal and City Bus Depot. Preferrable recommendation by consultant team is for City Bus Depot. Baipail and Gazipur location are considered for future truck/bus depot use.

Rectangular shape is ideal for efficient use of terminal area. The land selected by RAJIK and DTCA focused mainly on vacant land as such in some cases the shape is not regular. Originally, for the proposed Hemayetpur terminal 34.5 acres were allocated, however during the course of the study the area was downsized to 20.5 acres to provide space for 30 m wide RAJUK road and NRT 5 terminal depot which has resulted in an irregular shape. Therefore, efficient use of space in the terminal has been hindered. Additional land should be acquired in future for this terminal for better efficiency.

15.2 City Bus Depots

After the relocation of the three existing terminals to the proposed new sites, the three existing terminals will be used as city bus depot. Since demand of night parking for city bus depot cannot be accommodated at the three existing terminals, three new additional city bus depots are proposed at the following locations:

(1) Atibazar (phase-I) (2) Kanchpur North (phase-I) (3) Kanchan (phase II).

The Atibazar depot will facilitate passenger transfer at Baghair terminal and Kanchpur-North city bus depot will facilitate passenger transfer at Kanchpur South terminal. The city depot at Kanchan is proposed to be developed in phase II (in 2030) when Purbachal is expected to be fully developed.

15.3 Interdistrict Bus Parking Facilities

According to transport survey carried out at the existing terminals, about 20% of the interdistrict bus at the terminal (both arrival and departure) use night parking facilities. The consultant has tried to provide night parking facilities at the proposed five terminals. The Requirement of night parking for the proposed five terminals in the year 2025 (opening year) is 2040 parking space Against which about 75% could be provided in the year 2025, and for the year 2045 about 53% parking space could be provided, However, about 2,000 buses can be parked after 11:00 p.m.in the bus bays if proper fleet and terminal management could be ensured. Beyond 2035, sufficient space would not be available for

night parking. As such additional land close to the terminals will be required for interdistrict bus depots.

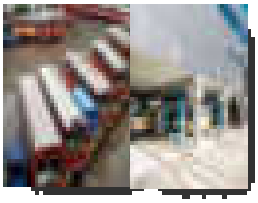
Capacity of a terminal is generally defined by number of buses it can operate daily, not by number of parking space for buses. Relevant policy, fleert management strategies influence the capacity of a terminal. A well managed terminal with modern ITS infrastructure can manage a larger fleet size. Hence, in addition to efficient architectural design and amenities for passengers, management of the terminals remain a critical factor to make these terminal efficient and effective.

15.4 Financial and Economic Viability

Financial and economic analysis of the sites of the proposed terminals and depots resulted the following returns:

	EIRR	FIRR
Baghair	21.29%	7.81%
Kanchan South	20.83%	9.12%
Gram Bhatulia	34.11%	7.22%
Bhulta	15.78%	8.49%
Hemayetpur	15.88%	9.13%

EIRR of the proposed terminals are in the range of 13.40% to 24.11% and FIRR ranges between 7.22% and 9.13%. EIRR in all cases are found to be more than 12% benchmark. Therefore, it can be concluded that they are economically viable.



16 Recommendations

For optimising efficient use of terminal space through modern fleet management and reducing passenger trip demands following principles of Transport Demand Management (TDM) are to be followed:

(1) Ensure multimodal integration of interdistrict passenger trips by increasing railway services between different districts and Dhaka city
(2) Introduce commuter train services to sub-urban destinations to reduce dependence on bus service
(3) Extend MRT to sub-urban districts, if economically viable
(4) Carry out a study for route rationalization and franchising of bus operation
(5) Carry out institutional review of terminal operation and management
(6) Provide modern training on terminal operation and management to terminal managers
(7) For strengthening financial management, reduce cash transactions and Introduce electronic system for collection of terminal fees and parking charges
(8) Since terminals have limited capacity for bus parking, process should start to find additional land close to the terminals
(9) Strengthen monitoring of terminal management and service quality, if required establish monitoring cell at DTCA.

Deceision from the workshop and work done according to that is briefly discused in the following table

Draft Final Report (10 June):

Decision	**Work done**
A) The consulting firm should organize separate meetings with all stakeholders especially DMTCL, RHD, BBA, BRT.	All data (map, design, and figure) will be given as Annex.
B) Connectivity between inter-district buses and other means of transport (city bus, private car, CNG, MRT etc.) should be considered in the terminals.	Addressed in Architectural Design Part (Chapter 11) and a table containing Shuttle Bus Service information from terminal to city and city to terminal.
C) It is proposed to have modern facilities for passengers and drivers in the terminals.	Addressed in Architectural Design Part (Chapter 11)
D) In addition to the proposed Kanchpur (South), Madanpur bus terminal, Kanchpur (North) should also be considered as an inter-district bus terminal. Considering the traffic flow, the entry and exit routes of Kanchpur (North) bus terminal should be designed so that the traffic flow on the highway is not disrupted.	Kanchpur (North) is considered for both as Inter District Terminal & City Bus Depot. Preferable recommendation is for City Bus Depot.

Final Report (21 September):

Decision	Work done
A) Land acquisition activities should be started after completion of feasibility study project.	Land acquisition, compensation & consultancy is proposed in report (Chapter 7 & Annex 7). Further action will be taken by related authority.
B) Design should be done in such a way that there is no obstruction in the entry and exit of vehicles.	Every terminal and depot design have been completed with the sustainable Entry/Exit design as Addressed in the Architectural Design Part (Chapter 11)
C) In addition to the terminal, try to keep the depot facility as much as possible.	Drawing is changed after discussion.
D) To organize a technical workshop. Architectural design needs to be reconsidered to provide separate facilities for passengers of arrival and departure.	Arranged already.

Final Report (30 September):

Decision	Work done
A) U-loop cannot be used in all cases unless special requirement, at grade uterine should be used. For entry and exit of Hemayetpur bus terminal U-turn should be done at grade as per the recommendation of RHD.	U-loop design are changed as per discussion. Existing system and proposed system both are given so that design consultant can compare.
B) Grade Separated Lounge design for Passenger Arrival and Departure, the turning radius should reduce and increase usable space for depot. Arrival and departure facilities for city buses at the terminal should be kept as required.	Drawing is changed after discussion.
C) Proposal for acquisition of land required for construction of separate road / lane for arrival and departure of bus terminal / depot should be included in the report.	Already addressed the issue (Annex 7).
D) Detailed directions of traffic circulation should be displayed in the proposed layout plan. A related animation should be attached to the report.	Addressed in Architectural design part (Chapter 11) with animation.
E) In the final report, from conceptual design to detailed design, considerations and things to be done should be mentioned in detail.	TL Sir may assist this as he agreed to DTCA to be an advisor of TOR preparation for Detail Design.

Major issues and Recommendations

From the analysis of 3 workshops and one meeting with DNCC, consultant reached in some decision for the betterment of this project. Consultant has done their feasibility study and conceptual design for the proposed bus terminals and depots. Initially 4 proposed locations are selected for the Bus Terminal and Depot and rests 6 out of 10 locations are selected for phase wise accomplishment. As consultant has done the initial location selection and conceptual design, consultant given some recommendations which can be adopted in the detail design part of the project.

Major issue and Recommendation from Workshop 1:

Based on the discussions in the Workshop 1 on 10 June 2021, consultant Engr. Nurul Islam (Geotechnical Engineer) described that the proposed Kanchan, Bhulta and Gram Bhatulia locations have very poor SPT value which will increase the construction cost. TL of this project suggested to the project authority to avoid the sites or doing deep analysis in detail design phase.

Major issue and Recommendation from Meeting in DNCC:

The meeting was held on 12 September 2021 at Meeting room of DNCC Mayor. From the discussion in the meeting, Bus Owners Association asked for deferent depot space in possible nearest location for proposed Gram Bhatulia Bus Terminal as the current land is not enough to feed the traffic demand. Honorable Mayor DNCC requested to RAJUK for a depot space in possible nearest location or take necessary steps to make arrangement the Terminal and Depot facilities near Ashulia where the land is not developed. TL of this project replied to the meeting authority that, the project time is very close to end and requested to DTCA for apply the possible changes in Detail Design Phase.

Major issue and Recommendation from Workshop 2:

No issue was recommended for the Detail Design phase from this Workshop.

Major issue and Recommendation from Workshop 3:

This Workshop 3 was considered for seeking opinion from the Technical Committee of this project. Only connectivity and architectural design issues were discussed.

MRT Lines:

TL quoted that 'MRT 5 North Line information can be collected for considering in proposed Hemayetpur Bus Terminal and Depot but it can be considered in detail design as we are out of time and emphasizing on revised final report submission.'

Highway Connectivity:

From the speech of Engr. Sabuj Uddin Khan (ACE, RHD, Dhaka Circle), he highlighted on the connectivity with the highways and he suggested to design any U-turn facility on at grade under an overpass. He also discussed about proposed terminal location and said the 3 terminals are connected with highways, middle and outer ring road but the proposed Gram Bhatulia is inside of the Dhaka which will create traffic congestion on Inner Ring Road and affect this area's traffic circulation. He also said that, the area also can't feed the depot service and depot service must be near to the location and if the terminal and depot service

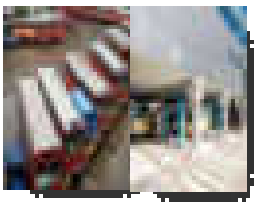
are along together near inner ring road the traffic circulation system maybe collapsed. He suggested to think for alternative location near Middle and Outer Ring Road. TL of this project agreed to the points and requested to DTCA for considering this issues in detail design.

Architectural Design:

From the Architectural design discussion, TL agreed to the points and suggested to Lead Architect for considering the possible amount of correction in the revised report and rests for the detail design such as

a) Grade separation design adaptation
b) 3D video animation
c) Waste water network and management
d) complete passenger and inner traffic circulation design
e) Different facilities in detail related to public health and environmental safety

The above issues and recommendation are drived from workshop meeting minutes from the consuntant part. The minutes are given in Annex-12.



References

(1) BDA, 2017, Architectural and Urban Design for Developing Inter State Bus Terminal (ISBT) at Baramunda, Bhubaneswar, Bhubaneswar Development Authority

(2) Bangladesh Economic Review, 2020, Ministry of Finance, GOB Planning Commission, GOB, 2015, Seventh Five Year Plan, FY 2016-2020.

(3) 7^{Th} Five Year Plan, 2016-20, Planning Commission, GoB

(4) Sector Assessment (Summary): Transport, 2016, ADB available at www.adb.org

(5) World Development Indicators Database 2019-20; available at https://databank.worldbank.org/source/world-development-indicators

(6) Hasan, T. and Hoque, A. M., 2002, Gravity model for estimating interdistrict passenger, Journal of Civil Engineering, Vol.CE 30, No.1, The Institute Engineers, Bangladesh

(7) Xu, Zang and Gao, 2011, Linear Regression Prediction Model of Prefecture level Highway Passenger Transport Volume, 2011 International Conference on Electronic and Mechanical Engineering and Information Technology

(8) Alin, el al, 2019, Forecasting Passenger Traffic for a Regional Airport, Sciendo, DOI 10.2478/sbe-2019-0028, SBE no. 14(2) 2019

(9) Marsousi, N. and Pourebrahim, K., Locating intra city bus terminals using fuzzy logic with emphasis on city development and community alliance: case study of Tasuj, Vol 142, The Sustainable World, WIT Transactions on Ecology and the Environment

(10) BBS, 2011, Population Census 2011, Bangladesh Bureau of Statistics

(11) BBS, 2013, Economic Census of Bangladesh, Bangladesh Bureau of Statistics

(12) BBS, 2016, Population Projection Of Bangladesh - Dynamics and Trends 2011-2061, Bangladesh Bureau of Statistics

(13) E. Cuylits, 1972, Intercity bus terminal location criteria, MSc thesis, School of Community and Regional Planning, the University of British Columbia

(14) JICA, The Preparatory Study on The Dhaka Mass Rapid Transit Development Project (Line 1 and Line 5), Draft Final Report 2, Japan International Cooperation Agency

(15) SG Architects, *nd*, Bus Terminal Design Guidelines,

(16) Smit, M., 2014, Exploring the demand for bus transport, Masters Thesis, Civil Engineering and Management, University of Twente, The Netherlands

(17) BBS, 2013, Economic Census 2013, Bangladesh Burea of Statistics.

(18) BBS, 2003, Economic Census 2003, Bangladesh Burea of Statistics.

(19) Shakti, 2015, Bus Termoinal Design Guidelines, Shakti Sustainable Energy Foundation, SGA Architects, India

(20) Hasan, T. and Hoque, M, 2002, Gravity Models for Estimating Interdistrict Passenger and Commodity Trips, Journal of Civil Engineering, The Institute of Engineers, Bangladesh, Vol. CE 30, No,.1, 2002

(21) JICA, 2015, Revision and Updating of the Strategic Transport Plan for Dhaka, Urban Transport Policy, Dhaka

Annexures