

## EXECUTIVE SUMMARY

### Introduction

Already the fourth most densely populated city in the world, Dhaka is expected to grow its population from just under 19 million people in 2018, to over 27 million in by 2030. Rapid urban and population growth, which has not been matched by the provision of transportation infrastructure, is causing increasing traffic congestion, along with the attendant loss of productivity and health and environmental problems. In order to mitigate traffic congestion in the city and to enhance the mobility of the city's residents and visitors, on a sustainable basis in the long term, the Government of Bangladesh has begun implementing a mass transit system comprising 5 mass rapid transit (MRT) rail lines and two bus rapid transit (BRT) lines. The first metro rail line (MRT Line 6) is under construction, while the next two lines, Lines 1 and 5, are under planning and design.

To supplement and extend this system, and to enhance the transportation capacities provided by the proposed MRT and BRT routes, GOB has decided to build a subway (underground metro rail) system, to be known as the Dhaka Subway. To this end, the Bangladesh Bridge Authority has appointed TYPESA, in association with PADECO, BCL Associates Ltd., BETS, and KS Consultants, to provide "*Consultancy Services for Carrying out Feasibility Study and Preliminary Design for Construction of Dhaka Subway, Bangladesh*". This is a two-year project that began on 1<sup>st</sup> September, 2018. This Interim Report details the work done so far.

The overall study area for this project is taken as the "Dhaka Metropolitan Region", as defined by the Dhaka Structure Plan 2016-2035 to include the area currently under the planning jurisdiction of RAJUK. The TOR states that the main objective of the subway system would be: "*to integrate and seamlessly interface with the MRT lines being constructed and to be constructed in order to allow interchangeability and interoperability of train services of the MRT and the Subway systems*".

### TODs at Kamalapur, Gabtoli & Mohakhali

A public private partnership (PPP) is underway between Bangladesh Railways and the Japanese company Kajima Corporation, to redevelop the Kamalapur Railway Station. The new facility will include, on various levels, stations for MRT Lines 1, 2 and 4, platforms for conventional rail and a new airport rail line, intercity and local bus station, platforms for high speed rail lines, along with retail and other high-density land uses. The Motijheel station of MRT Line 6 will be connected to Kamalapur by means of a proposed "skywalk".

The scale of the proposed re-development of Kamalapur confirms its role as the pre-eminent land transport hub of central Dhaka, underscores its function as a modal interchange hub, and supports the idea that a direct Dhaka Subway connection from Sadarghat to Kamalapur, developed under this project and discussed in more detail in this report, would be one of the most important links in the proposed Dhaka Subway network, particularly given the fact that the proposed MRT network would not serve Sadarghat.

The TOR for the Dhaka Subway project includes conducting transit-oriented development (TOD) studies at the three bus stations; Gabtoli, Mohakhali, and Sayedabad, as well as the development of concept designs for the three bus stations, to convert them into commercial hubs which will generate revenue that will help to improve the financial status of the project. After the project began it came to light that TOD studies are already underway for Gabtoli and Mohakhali, under the auspices of DMTCL and RHD, respectively, with the latter being funded by the World Bank. In the light of this development, and since none of the proposed MRT lines will pass through Sadarghat, the Consultant proposed (and BBA approved) that instead of conducting TOD's at Gabtoli and Mohakhali, and given the importance of Sadarghat in terms of the number of people passing through this facility on a daily basis, that a TOD should rather be conducted for Sadarghat.



## Stakeholder Engagement

More than 40 stakeholders in the Dhaka Subway project have been identified, and engagement with the most important stakeholders, including DTCA, DMTCL, RAJUK, DSCC, DNCC, RHD, Bangladesh Railways, Ministry of Defence, and Dhaka Metropolitan Police, began early in the project, after the Chief Engineer of BBA addressed an introductory letter to each identified stakeholder, informing them about the Dhaka Subway project, and requesting their collaboration.

On the 26<sup>th</sup> May a meeting was held at Conference Room of BBA, attended by the Consultant, BBA, Panel of Experts of Dhaka Subway Project, and other relevant Stakeholders such as DTCA, DMCTL, RAJUK, etc. The Consultant presented the proposed Full Network of Dhaka Subway, along with the six networks of 90km. The Consultant then explained the methodology and the criteria that were considered to carry out the Multicriteria Analyses, as well as weights that were applied to the various criteria by the consultant, and the results of the evaluation, including the three most promising networks out of the six. Then Consultant then asked the audience if they would kindly express their opinions on the appropriate weights to be applied, via the online marking system that had been set up expressly for the purpose, and provided the link (URL) to access this system.

## Geotechnical Site Investigation

One of the most obvious problems when designing a tunnel under a densely populated city, where no accessible records of buildings foundations are available, is to find the usual foundation guidelines that allow the designer to decide on the depth of the tunnels.

In order to establish these guidelines, an investigation on the depth of buildings under construction has been carried out in various areas of Dhaka with different geological configurations, assuming that today's construction guidelines must necessarily be more conservative than in past times, and analysing these guidelines to find a direct relationship between surface geology, building height, foundation depth. This provides a basis for the design of the vertical alignment of the various subway lines through distinct geological formations, and under buildings of different heights and depths of piles.

The most important part of the geotechnical activity prior to the design is the obtaining of the necessary parameters for the design by developing a geotechnical site investigation valid for the whole extension of the project. As a first approximation to this investigation, what has been called Phase 1 has been developed during the months of February to May 2019. This is a small site investigation in which an attempt has been made to complete the existing general geotechnical data, to obtain a first set of valid parameters to start with the pre-design, to check the geotechnical companies and the working methods, and to amend the possible mistakes detected to avoid occurring during the general investigation. The Phase 1 geotechnical investigation included boreholes at 15 locations.

## Transportation Surveys

A number of traffic and transportation related surveys have been carried out to determine the travel patterns of Dhaka City and RAJUK residents during a typical weekday. Data collected from these surveys will be used to build a strategic multimodal transport demand model, and to calibrate it to the base year conditions. The survey campaign carried out so far included household interviews at 35,000 households, classified link traffic counts at 70 locations, origin/destination roadside interviews at 40 locations, and local bus route and onboard passenger surveys of 114 bus routes.

A number of other, more minor, surveys have been planned but have yet to be implemented. These include travel time and delay surveys (by car), and passenger counts and interviews at long distance public transport terminals including the Gabtoli, Mohakhali, and Sayedabad bus terminals, Sadarghat river port, and Kamalapur and Tongi Junction railway stations.

A zoning system has been developed, for use in the transportation surveys as well as the transport model that is to be developed, by dividing the study area into 185 internal traffic analyse zones (TAZ) and 21 external zones. The boundaries of each internal zone correspond to the administrative divisions of the RAJUK area into Wards and Unions. The external zones correspond to the access roads to RAJUK modelled area and long-distance public transport terminals.

### Development of Route Corridors and Networks

The MRT and BRT networks, being planned by JICA and included in the RSTP, have been taken as a given from the start of this project, and they are accepted as “pre-existing conditions” and constraints to the development of the Dhaka Subway network. The MRT network was evaluated in terms of the two key criteria of coverage and connectivity, and was found to provide good coverage, in parts of the city, but to lack connectivity, particularly in the east-west orientation. Potential Dhaka Subway lines, or corridors, were drawn, between MRT and BRT lines, to pass through areas of dense development, to connect up key transport connection points and points of interest, and to connect MRT lines. The routes for the Dhaka Subway network are being planned in such a way as to enhance and compliment the MRT and BRT networks, in terms of both coverage and connectivity, and in order to create a single, integrated mass transit system for Dhaka in the future.

From all the lines that were drawn across Dhaka, a “full network” was developed, that would be expected to provide close to full coverage to most of central Dhaka City. Also from all the lines, six distinct alternative networks of approximately 90km were developed, taking into account various factors and the constraints imposed by the proposed MRT and BRT lines. In this way, the Full Network will be the network from which each of the 6 network alternatives of 90km was derived, and it will also be the network into which any of the 6 network alternatives could be expanded.

Stations were located in densely developed areas, as far as possible, so as to maximize commuter capture, but in such a way as to reduce or minimize land acquisition, building demolition, resettlement, and impacts to traffic during construction.

### Evaluation of Route Corridors and Networks

A multi-criteria analysis, which is a decision-making tool using a weighted decision matrix, was conducted to evaluate the six network alternatives and to narrow them down to three. The networks were evaluated according to a number of criteria, or groups of criteria; coverage criteria, connectivity criteria, operational criteria and cost criteria.

Coverage criteria evaluate different existing and future activities within the influence area (500m buffer strip on each side) of each corridor, including land uses (residential, commercial, industrial, social services, mixed-use), points or areas of special interest (or key points), and areas of high population density.

Connectivity criteria evaluate the connectivity between different lines and places in the network, and include considering the number of interchange stations, with and without the MRT. More importantly, connectivity takes account of the performance of the network in terms of overall network connectivity, in terms of travel times between all origins and all destinations (with the objective of reducing travel times to a minimum), also with and without the MRT. Another important aspect of connectivity is represented by the number of direct connections between main multi-modal transport hubs such as Sadarghat, Kamalapur, and the three main bus stations. Operational aspects taken into account include line length and depot placement suitability. Cost criteria considered include total network length, potential physical constraints, and potential TOD locations.

The results of the multi-criteria analysis, which included the participation of relevant stakeholders in the process, indicated that the following networks are considered as the best solution for the Dhaka Subway and these will be subjected to further analysis by means of a multimodal transport model:



- Network D
- Network B
- Network A

### Integration of Sayedabad Bus Station into Subway Project

The current status of the Sayedabad bus terminal has been assessed, by means of a primary survey conducted by the study team, including an evaluation of the system of operation of the bus services, the operation and management of the terminal, and the condition of passenger services.

The terminal is reported to have a capacity of parking 500 buses. As many as 2,000 bus trips are generated from the terminal per day. The locational features of the Sayedabad Terminal as one of the most important road transport hubs of the capital are highlighted by the survey findings, which state that the terminal connects buses to 87 routes from Dhaka city to the southern regions of Bangladesh. The survey found that bus owners operate from inside the terminal as well as the surrounding area but close to the terminal.

There are more than 1,100 bus owners/operators with bus counters inside the Syedabad terminal, employing approximately 2,040 bus drivers and 4,300 staff as managers and helpers. There are five platform areas for passengers to purchase tickets and board the buses, none of which are up to even minimum standard requirements, lacking waiting rooms, and hygienic and proper toilets. There are approximately 1,400 bus owners/operators, operating from counters located outside the terminal area, in close proximity. They employ approximately 3,000 drivers and 5,160 staff as managers and helpers.

With planning for a multi-modal hub at Sayedabad, the entire station area will undergo changes in planning and design and make way for the placing of a modern transport facility. At the same time the surrounding area will be ready for implementation of a TOD to meet the future demand for investment and return.