SMEC DerCon ACE BANGLADESH In association with COWI

Feasibility Study

Dhaka - Ashulia Elevated Expressway including 2 separate flyovers at Nabinagar and Chandra

August 2016

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1.1. Project Overview and Description

The Dhaka – Ashulia Elevated Expressway Project (DAEEP) is proposed to be an elevated expressway to minimize the existing traffic congestion in the northern part of Dhaka more specifically in and around Dhaka-Ashulia area. The Bangladesh Bridge Authority also envisages that the expressway will be a part of Asian Highway route in Bangladesh and is vital for establishing an improved transport link on the Trans-Asian highways.

The Project (Construction of Dhaka-Ashulia Elevated Expressway) has been in-principle approved by the Cabinet Committee on Economic Affairs (CCEA) on 20 July 2011. A pre-feasibility study was carried out by BUET in 2012 for technical assessment of the project. On 22 January 2015, BBA signed a memorandum of understanding (MoU) with Chinese company China National Machinery IMP. & EXP. Corp. (CMC) to construct the elevated expressway under government to government basis.

The project addressed by this feasibility study is for a 24 km long elevated tolled expressway from just south of the Airport Roundabout to approximately 2 km north of Baipayl. With the exception of the first 4 km where the expressway is following the railway line, the expressway will follow existing main roads so as to minimise land acquisition. An integral part of the project is connection to the now under construction 19.7 km long Dhaka Elevated Expressway Project (DEEP) which will run from immediately south of the airport roundabout to the Dhaka Chittagong Highway at Kutubkhali.

Associated with DAEEP is the upgrading to four lanes of the existing at-grade road between Highway N3 at Abdullahpur and Baipayl.

The project envisages a major toll plaza development on flood-prone land between Dhour and Ashulia.

1.2. Surveys

Geotechnical, traffic and topographic surveys were undertaken as part of the feasibility study.

1.2.1. Traffic Surveys

An extensive series of classified traffic counts is undertaken regularly by RHD in the vicinity of the project and this data was available to the consultant. To supplement that data, weekday and weekend classified turning movement counts were undertaken at the following intersections

- Baipayl (intersection of N302 and R505)
- Nabinagor
- Chandra (intersection of highway N4 and R505)

1.3. Design Criteria

The design criteria used for the preliminary design were set out in the project inception report are the same as used for the Dhaka Elevated Expressway which is now under construction by the Italian Thai Joint Venture. Commonality of design standards is crucial because ultimately the projects will meet just south of the Airport Railway Station and vehicles will be able to travel from one expressway section to the next in making a journey from Ashulia to Mohakhali.

1.4. Preliminary Design

Preliminary design of the Dhaka Ashulia Elevated Expressway was undertaken as part of the feasibility study

The proposed route for the Dhaka Ashulia Elevated Expressway follows existing highways and main roads for the most part. The exception is the southern section which follows the railway line from the northern end of the Dhaka Elevated Expressway to just south of the Turag River at Tongi. At that point the elevated expressway turns west and follows Highway N302 / N501 R505 from Abdullahpur to Baipayl. An open tolling system is proposed for DAEEP.

1.4.1.1. Connection to DEEP

Discussions were held with the DEEP concessionaire regarding the form of structure being used for that project. This was done so that the structures proposed for DAEEP would match aesthetically those of DEEP even if not exactly identical.

1.4.1.2. Crossings of Railway

The DAEEP will have two crossings of the railway line. The concept design has allowed for the railway to be widened to four tracks by use of portal frames. The concept design allows for BR's required clearance of 11.0 m between rail level and the soffit which is consistent with that used for the contiguous DEEP.

1.4.1.3. Crossing of BRT – Gazipur to Airport Roundabout

The crossing of the BRT has been examined and it is found that with early design action and coordination with the BRT project, there is potential to reduce the structural depth of the beams crossing the BRT project if a pier can be constructed at the southern end of the Abdullahpur BRT station. That section of the BRT also comes under the Bangladesh Bridge Authority and there is high potential for a shorter span arrangement to be achieved.

1.4.1.4. Toll Plaza / Construction across Turag River Flood Plain

The preliminary design has been based on the elevated expressway being built on pier foundations across the Turag River flood plain from chainage 10 000 to 13 000. This requirement applies to the toll plaza, associated buildings and the road works for the at-grade road.

1.4.2. Connections

The following locations are proposed as connections between the Dhaka Ashulia Elevated Expressway and the adjacent road network. In addition to geometric and weaving considerations, the selection of interchange locations was constrained by the availability of land and the cost of compensation for assets that would have to be removed.

- Dhaka Elevated Expressway
- Abdullahpur
- Baipayl
- Highway N 302 (at-grade road) – Dhour and Ashulia
- Nabinagor
- Chandra

1.5. Tolling System

Consideration was given to both open and closed (distanced-based) tolling systems. An open tolling system is recommended for reasons of compatibility with the DEEP and for simplicity. The length of 24 km is similar to that of the 20 km long DEEP. Using an open system means each driver only has one transaction. It would be possible to go to free- flow tolling in future.

Collection of tolls can be electronic or cash with electronic being preferred for reasons of transaction speed and security of the funds received.

1.5.1. Number of Toll Booths

Having sufficient toll booths is essential for safe and efficient operation of the expressway. The design number of toll booths is driven by the need to provide sufficient cash lanes for the early years of operation.

1.6. Safeguards

1.6.1. Initial Environmental Examination

An Initial Environmental Examination (IEE) was prepared for the project. The IEE received in-principle approval at the government's Environmental Clearance Certificate Committee's 399th meeting held from 22 to August 2016 to 4 September 2016.

1.6.2. Environmental Impact Assessment

Formal notification Department of the Environment's approval of the terms of reference to be used for preparation of the EIA was issued in a letter from Department of the Environment (DoE) dated 8 September 2016. The Environmental Impact Assessment (EIA) attached as Appendix H has been prepared in accordance with the DoE terms of reference

1.6.3. Environmental Management and Monitoring Plan

An outline environmental management and monitoring plan (EMMP) is included in the EIA and is an update of the EMP contained in the initial environmental examination.

1.6.4. Consultations

There have been extensive consultations with key project stakeholders in the course of preparing this feasibility study. The most significant of these were:

- **Initial stakeholder consultation** An initial stakeholder consultation was held at the BBA conference room on 9 June 2016
- **Safeguards consultations.** Two community level consultation meetings were held on 30 July 2016; at Vatuliya, Kamarpara and later that day at Ranadola Beribadh. Five focus group discussions were held on 31 July with representative members of groups likely to be affected by the project. These comprise: landowners, business groups, wage labourers, residential land owners and female groups. The meetings were arranged to best suit availability of the local people.

1.6.5. Cutoff Date

The census survey was carried out on 23 July 2016 and this should be considered as the cut-off date for the project.

1.6.6. Resettlement Action Plan

A resettlement action plan (RAP) has been prepared.

1.6.7. Land acquisition

Including the existing highway, a total of 89.1 acres (36.07 ha) of fresh land acquisition is required for construction of the Dhaka Ashulia Elevated Expressway. The total impact on land acquisition compared to the development of this area is minimal and only 374 landowners will lose their land due to the project intervention. According to the census and inventory of losses survey, four main categories of land will be affected, these accounting for over 95% of the affected land *viz* homestead, vita/high land, crop land and commercial use.

#	Type of Land	Area (acre)				%
		DNCC	Gazipur Sadar	Savar	Total	
A	Homestead	0.3700	1.0395	8.7610	10.1705	17.60
	Vita / High land	0.5000	4.0000	4.7045	9.2045	15.92
	Crop land	0.5539	3.9030	10.3129	14.7698	25.55
	Commercial	0.4018	2.0000	16.7979	19.1997	33.22
	Other	0.8100	0.7330	2.9120	4.4550	7.71
	Subtotal (A)	2.6357	11.6755	43.4883	57.7995	***100***
B	Existing land for highway	nil	6.9309	22.8065	29.7374	
C	Vita/High Land (Others GoB. office)	1.5767	nil	nil	1.5767	
	Total A+B+C	**4.2124**	**18.6064**	**66.2948**	**89.1136**	

1.6.8. Displacement and Impact of the Project

The census survey showed a total of 1,299 households (5,440 persons) would be affected. The main adverse impacts of the project were loss of land and structures (residential and business premises).

The total estimated cost of implementation of the RAP is BDT20.43 billion which is equivalent to USD261 million.

Category of losses	DC Budget (BDT)	Additional budget (BDT)	Total Budget (DC plus additional)		%
			BDT	USD	
Total of IOKL including INGO budget	8,181,215,491	12,819,812,009	21,001,027,500	269,243,942	90.2
DC Contingency @ 2%	163,624,310	nil	163,624,310	2,097,748	0.7
Subtotal	***8,344,839,801***	***12,819,812,009***	***21,164,651,810***	***271,341,690***	***90.8***
Contingency 10% of the total	834,483,980	1,281,981,201	2,116,465,181	27,134,169	9.1
Total	**9,179,323,781**	**14,101,793,209**	**23,281,116,990**	**298,475,859**	**100**

1.6.9. Grievance Redress Mechanism

Grievance redress is a very important part of resettlement project implementation. According to the grievance redress mechanism proposed in the RAP, grievance redress committees (GRCs) will be established at two levels: *viz* union/municipal level and project level

1.6.10. Land Acquisition Plans

Land acquisition plans have been prepared based on the concept designs.

1.7. Project Cost Estimate

Project costs have been estimated based on a detailed quantity take-off from the feasibility level designs, mostly using the RHD rates schedule (2015). Where there is no rate in the RHD schedule the cost has been estimated based on the Consultant's assessment of market rate for that particular item. The estimates include an allowance of 3% for physical contingency and 6% for price contingency.

Item	Cost	
	BDT (million)	USD(million)
Four lane elevated expressway (23.971 km)	60,386.5	774.2
Ramps	1,805.6	23.2
Four lane at-grade road (15.28 km widening) plus two 2 lane bridges (2.74 km)	7,769.0	99.6
Toll plazas	1,403.5	18.0
Land acquisition and resettlement (36.07 ha private) including NGO and INGO	23,281.0	298.5
Drainage and duct for utilities	2,705.2	34.7
Four lane Nabinagar flyover with ramp (0.71 km)	1,279.3	16.4
Design	2,070.4	26.5
Construction Supervision	1,380.3	17.7
TOTAL	**102,080.8**	**1,308.8**

1.8. Economic Evaluation

The following two alternatives and generated annual cash flows were over a period of 30 years:

- Base Case Alternative: Road user costs along the existing road network being the alternative to the Investment Alternative,
- Investment Alternative: Road user costs on the Dhaka – Ashulia Elevated Expressway and the road sections on N302 being widened from two lanes to four lanes.

1.8.1. Data Collection and Assumptions

The data used for the economic evaluation were obtained from various sources including from the bridge and road authorities. More data has been collected from similar studies recently carried out in the Dhaka region. The following inputs were considered for the economic evaluation.

- technical specification for investment and maintenance alternatives
- cost estimates for investments
- cost estimates for maintenance strategies
- vehicle operating costs
- time values for passenger and freight traffic
- vehicle characteristics
- traffic surveys and GDP growth forecasts
- traffic diversion scenarios
- travel speed observations and travel speed design
- accident records
- others including economic development perspectives
- AADT at Sub-sections along the Project Road Alignment (2016)

	SECTION 1: (Six lanes -4.2 km) Airport - Abdullahpur Junction on R301	SECTION 2: (Two lanes 5.4 km) Abdullahpur Junc. on N302 to R501 junc.	SECTION 3: (Two- lanes, 12.5 km) Junction N501 on N302 – Baipayl Junction N302/R505	SECTION 4: (Four lanes, 2.0 km) Baipayl Junc. N302/R505 - Chandra
Total vehicular traffic	29,799	10,281	16,629	27,000

1.8.2. Willingness to pay and time value

The toll rate as preliminarily determined for the financial analysis is based on an average BDT9.4 per km or USD0.121 per km for a medium-sized truck, however, coordination with the outcome of toll decisions from the DEEP will eventually be considered. Other vehicle types will pay more or less than this, depending on their size and subsequent toll multipliers.

1.8.1. Anticipated Diverted Traffic along the DAEE

To allow for the uncertainties of the eventual toll levels and the road users willingness to pay for using the tolled expressway, three traffic diversion scenarios were examined with respectively 40%, 50% and 60% diverted vehicular traffic.

1.8.2. Maintenance Strategies

The construction of the Dhaka – Ashulia Elevated Expressway and the widening of the road sections on road N302 from two lanes to four lanes are part of the economic analysis, where the future road user costs are compared to the future road user costs of the existing road network as a result of motorised and non-motorised travellers. Accordingly, maintenance strategies for the two scenarios are provided for the analysis and estimated effects made in the HDM model. The HDM model used estimated maintenance requirements and costs on the existing defined sub-sections, being the alternative to the widening of sections and the Elevated Expressway. The maintenance strategies for the existing sections (base case alternative) and the investment alternative are selected as responsive treatments, and their impact will ensure a sufficient quality of the road sections over the lifetime of the project analysis as compared to the initial physical stage.

1.8.3. Results of Economic Evaluation

A discount rate of 12% was applied for the calculation of the net present value (NPV) and all costs are measured in economic prices and expressed in USD. The economic evaluation period is set to 30 years. The economic evaluation has been carried out separately for each of the road four road sub-sections on the existing road network that form the alternative to the DAEE. The overall economic project viability of EIRR 11.4% is slightly below the threshold of 12% for the medium traffic scenario.

Project	Traffic growth scenario	NPV (USD million)	EIRR (%)	NPV /COST
DAEE + Widening of existing road section on N302 from 2 to 4 lanes	High Traffic (+20% growth)	106.0	13.1%	1.13
	Medium Traffic	-53.8	11.4%	0.94
	Low Traffic (-20% growth)	-226.1	9.4%	0.73

Component / Growth Scenario	NPV (USD million)
Medium Traffic Growth	
Net Investment Costs	-826.3
Maintenance Costs	-2.96
VOC	173.3
Travel time costs	592.6
Accident Costs	2.0
NMT	7.6
NPV	-53.8

1.9. Sensitivity and Risk Analysis

Parameter	NPV (USD million)	EIRR
Base Case Results	-53.8	11.4%
Investment costs +20%	-219.0	9.9%
Investment costs -20%	111.5	13.4%
Diverted traffic 60%	-47.5	11.5%
Diverted traffic 40%	-62.2	11.3%
Vehicle operating costs +20%	-17.6	11.8%
Vehicle operating costs -20%	-90.0	11.0%
Value of travel time +20%	64.7	12.7%
Value of travel time -20%	-172.3	10.0%
Traffic growth +20%	106.0	13.1%
Traffic growth -20%	-226.1	9.4%

1.9.1. Economic Analysis Conclusions

The overall economic project viability of EIRR 11.4% is slightly below the threshold of 12% for the medium traffic scenario.

The DAEEP is for reasons of improved traffic management and corridor improvements for road user and trade etc. a considerable influencing factor for the future industrial development opportunities in and around Dhaka that is even further expected to generate additional benefits to the project thereby justifying its implementation. Furthermore, the DAEEP and the on-going DEEP should be seen as integrated projects with mutual benefits that even further justifies the projects.

It has been observed from other similar road and highway studies in Bangladesh that a discount rate of 12% has been applied, however such level is not specifically mentioned in the ToR of this project. Therefore, if lower discount rates are used for the economic analysis of e.g. 10%, the project would according to the quantifiable benefits alone automatically indicate economic viability.

Project	Traffic growth scenario	NPV (USD million)	EIRR (%)	NPV / Cost
DAEE + Widening of existing road section on N302 from 2 to 4 lanes	High Traffic (+20% growth)	106.0	13.1%	1.13
	Medium Traffic	-53.8	11.4%	0.94
	Low Traffic (-20% growth)	-226.1	9.4%	0.73

1.10. Financial Analysis

1.10.1.1. Proposed Toll Structure

The proposed toll levels for the different vehicle categories have considered the experience from the DEE Project and the Dhaka – Chittagong Expressway Project. The toll rate as preliminarily determined for the financial analysis is based on an average of 9.4 BDT per km or USD 0.121 per km for a medium-sized truck, however, coordination with the outcome of toll decisions on the DEEP will eventually need to be considered. Proposed toll levels used for the financial analysis were as follows.

Item	Car / taxi	Pickup / 4WD	Minibus	Medium bus	Large bus	Small truck	Medium truck	Heavy truck	Motor cycle / rickshaw
Toll multiplier between vehicles	1	1	3	3	3	1.5	1.5	2	0.5
Toll level per km (BDT)	6.27	6.27	18.80	18.80	18.80	9.40	9.40	12.53	3.13
Toll level per km (USD)	0.08	0.080	0.241	0.241	0.241	0.121	0.121	0.161	0.040

These toll levels are tentative and, depending on the outcome of the final toll level negotiations, the impact on travel demand and subsequent financial viability will vary accordingly. Therefore, the financial analysis has provided viability indicators for varying toll levels and traffic diversion in order to show the break-even project viability for combinations of toll levels and traffic, and subsequently what will be required to make the DAEE Project financial viable and potentially attractive to private financiers and operators.

1.10.2. Results of Financial Analysis

The result of the financial analysis of the tolled is DAEE based on the assumptions taken with regard to toll levels and diverted traffic. The capital expenditure (CAPEX) used for the analysis is without the cost of land and resettlement which will be financed by the GoB. The results indicate that the project is positive financial viability reaching a FIRR of 6.5 % which is above the financial discount factor of 5 % initially assumed for the analysis. The results indicate that the project is showing a positive financial viability reaching a FIRR of 6.2 % before taxes, which is above the financial discount factor of 5 % initially assumed for the analysis. The FIRR is 3.8% after taxes.

Medium Traffic Growth Rates and 50% Diverted Traffic to DAEE

Net Present Value (2016)	(USD million)
Cost of DAEE construction	-560
Cost of construction of toll plazas	-13
Cost of maintenance	-14
Cost of toll operations	-10

Medium Traffic Growth Rates and 50% Diverted Traffic to DAEE

Net Present Value (2016)		(USD million)
Revenues from toll stations		755
Total		**158**
Revenues in % of total costs		126%
discount factor	Financial NPV	**158**
5%	Financial IRR	**6.15% (before taxes)**
5%	Financial IRR	**3.8% (after taxes)**

1.10.3. Sensitivity Analysis

The financial viability of the DAEE Project is considered before and after taxes, and is still maintained after taxes if the some annual compensation by e.g. BAA is made to the toll operator or that a lower financial discount rate than 5% e.g. 3% is used for the financial analysis resulting from lower cost of finance. Still it is assumed that more than 50% of the estimated traffic needs to be diverted to the DAEE.

1.10.1. Financial Analysis Conclusions

Based on the available information, the conclusion of the financial analysis is that the DAEE Project is found financial viable showing an FIRR of 6.2% before taxes by further assuming that land and resettlement costs will be financed by the Government of Bangladesh, and the capital expenditures associated to the DAEE will be the responsibility of the private financer/operator.

After taxes, the financial viability is reduced to an FIRR of 3.8%. A lower financial discount rate of e.g. 3.5% would make the project financially viable to the operator after taxes.

Depending on the eventual project cost of finance, the financial project viability may consequently require annual financial compensation from e.g. BBA to make it attractive from a toll operator's point of view.

The after taxes considerations for the project is based on the requirements that more than 50 % of the existing road users decide to use the expressway in the future based on their willingness to pay an average toll fee of USD 0.147 per km or BDT 11.5 per km.

Driving the full distance on the expressway would for all vehicle types on average correspond to USD 3.5 or BDT 275, and this being less for cars and more for trucks and buses.

Different composition of vehicle categories may end up with traffic diversion scenarios most likely favouring heavy traffic rather than passenger vehicles. Such a proportion will also likely have positive impacts on the generated revenues from toll collections.

2. ABBREVIATIONS AND ACRONYMS

Table 2.1: Abbreviations and Acronyms

Abbreviation/ Acronym	Description
AASHTO	American Association of State Highway and Transportation Officials
ADB	Asian Development Bank
AFD	Agence Française de Développement
AP	Affected person
BADC	Bangladesh Agricultural Development Corporation
BBA	Bangladesh Bridge Authority
BBS	Bangladesh Bureau of Statistics
B:C	Benefit cost (ratio)
BDT	Bangladesh taka
BMD	Bangladesh Meteorological Department
BNBC	Bangladesh National Building Code
BPW	Bank protection work
BRT	Bus rapid transit
BSO	Bangladesh Survey Organisation
BTCL	Bangladesh Telecommunications Limited
BTM	Bangladesh Transverse Mercator
BUET	Bangladesh University of Engineering and Technology
BWDB	Bangladesh Water Development Board
CAGR	compound annual growth rate
CCEA	Cabinet Committee on Economic Affairs
CCL	Cash compensation under law
CIA	Central Intelligence Agency
CMC	China National Machinery Import and Export Corporation
CNG	A thee wheeler vehicle fuelled by compressed natural gas -
the Consultant	the joint venture of SMEC International, DevConsultants and ACE Consultants in association with Cowi A/S
CPI	consumer price index
DAEEP	Dhaka-Ashulia Elevated Expressway project
DC	Deputy commissioner
DCC	Dhaka City Corporation
DEE	Dhaka elevated expressway
DESCO	Dhaka Electric Supply Company
DNCC	Dhaka North City Corporation
DPDC	Dhaka Power Distribution Company
EIA	Environmental impact assessment
EMP	Environmental management plan
EP	Entitled person
EWEE	East-West Elevated Expressway
FGD	Focus group discussion
FNPV	Financial net present value
FYRR	First year rate of return

Abbreviation/ Acronym	Description
GDP	gross domestic product
GoB	Government of Bangladesh
G to G	government to government
HDM-4	Highway Development and Management Model 4
HFL	Highest flood level
HGV	heavy goods vehicle
HH	household
IEE	Initial environmental examination
IOL	Inventory of losses
IRC	Indian Roads Congress
IRR	Internal rate of return
LAP	Land acquisition plan
LWL	Lowest water level
m	metre/s
MOU	memorandum of understanding
MRT	Mass rapid transit
NGO	Non-government organisation
NPV	Net present value
O-D	Origin and destination (survey)
pcu	passenger car unit
PIR	Poverty impact ration
PPP	public private partnership
PPP	purchasing power parity
PV	Present value
PVAC	Property valuation advisory committee
PVB	Present value of benefits
PWD	Public Works Department
RAP	Resettlement action plan
REB	Rural Electrification Board
RHD	Roads and Highways Department
ROW	Right of way
RP	Resettlement plan
RPF	Resettlement policy framework
SASEC	South Asia Subregional Economic Cooperation
SCM	Suggestions and complaints mechanism
SDAJV	SMEC International, DevConsultants and ACE Consultants joint venture
SIMF	Social impact management framework
TBM	Temporary benchmark
TOR	Terms of reference
USD	United States Dollar
VOC	Vehicle operating cost
vph	vehicles per hour
WACC	Weighted average cost of capital
WASA	Water and Sewerage Authority

3. INTRODUCTION

3.1. Project Overview

The Dhaka – Ashulia Elevated Expressway Project (DAEEP) is proposed to be an elevated expressway to minimize the existing traffic congestion in the northern part of Dhaka more specifically in and around Dhaka-Ashulia area. The Bangladesh Bridge Authority also envisages that the expressway will be a part of Asian Highway route in Bangladesh and is vital for establishing an improved transport link on the Trans-Asian highways.

3.2. Project Background

The Project (Construction of Dhaka-Ashulia Elevated Expressway) has been in-principle approved by the Cabinet Committee on Economic Affairs (CCEA) on 20 July 2011. Subsequently a pre-feasibility study was carried out by BUET in 2012 for technical assessment of the project. Since 2011 the PPP Office was trying for project development and transaction advisory services for the project with request from BBA. Meanwhile, on 22 January 2015, BBA signed a memorandum of understanding (MoU) with China National Machinery IMP. & EXP. Corp. (CMC) to construct the elevated expressway on a government to government basis.

BUET considered two alignments (Alignment 1 and Alignment 2). These are shown Figure 3.1.

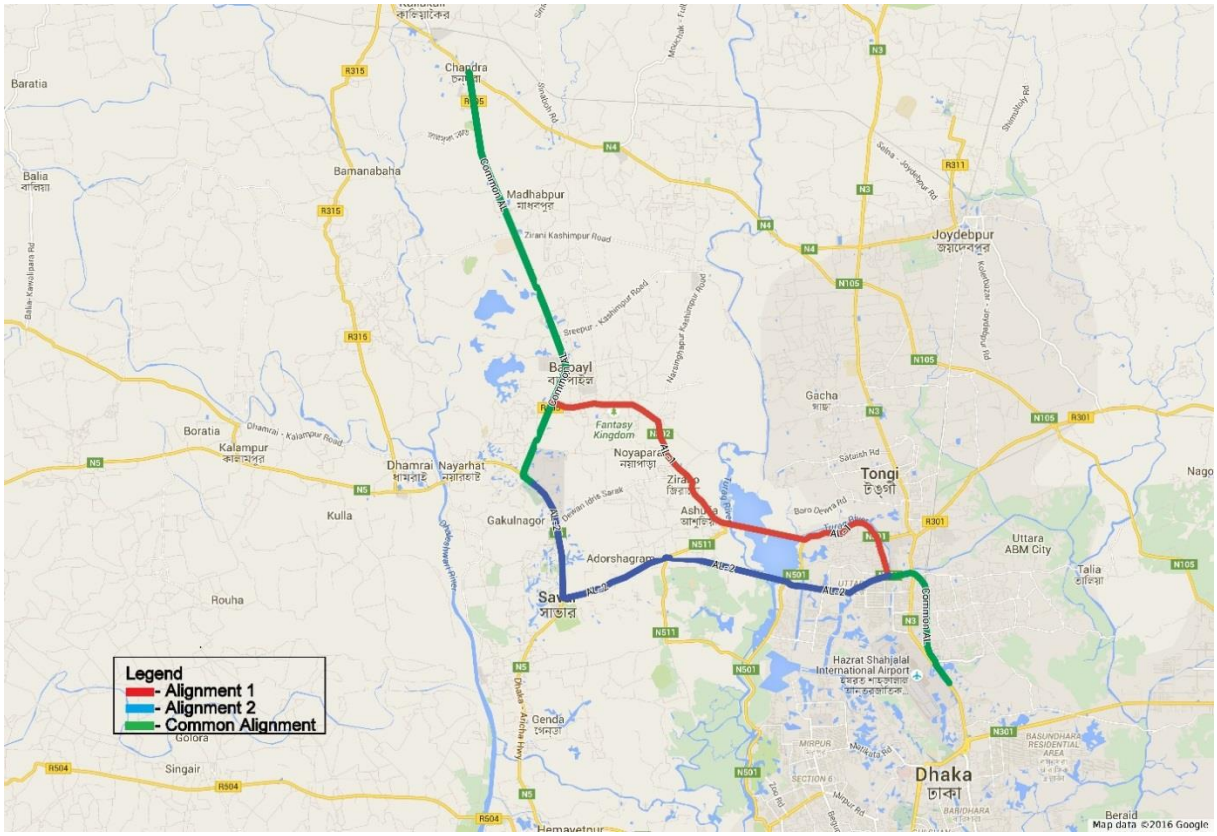


Figure 3.1: Proposed Alignment Location of Dhaka Ashulia Elevated Expressway by BUET

Both start at Hazi camp close to the airport railway station, diverge after 4.8 km and return to a common alignment at Nabinagar. BUET suggested Alignment 2 as the more viable option but noted that there would be difficulties in land acquisition and resettlement as well as environmental impact.

Reasons for favouring Alignment 2 were

- likelihood of attracting more traffic
- direct connections from Savar to Dhaka and Savar to EPZ

BUET stated - "*Alternative 2 is considered as a potential candidate, since it will connect Savar which a rapidly growing Upazila with huge population, economic activities and most importantly with its enormous economic growth potential. The Upazila is being urbanised fast owing to expansion of manufacturing and real estate development by commercial, housing companies, development of residential accommodation and promotion retail activities*."

Table 3.1 compares the major features of the two options and shows Alignment 2 is 3.5 km longer than Alignment 1.

The total ramp length for Alignment 1 is 8.34 km using I girders and 8.9 km using box girders. For Alignment 2, the use of box girders would increase the length of the ramps (10.3 km using I girders and 10.9 km using box girders).The length of ramps is greater for Alignment 2 as that alternative requires two additional ramps.

Table 3.1: Comparison of BUET Alignments 1 and 2

Item		Alignment 1	Alignment 2
Main viaduct		35.0 km	38.5 km
Number of ramps		31	33
Ramp length	I girder	8.34 km	10.30 km
	Box girder	8.90 km	10.90 km
1st common part		**4.8 km** Hazi Camp to Sluice Gate bus stand, Abdullahpur	
Separate part		**14.8 km** Abdullahpur to Baipayl	**18.3 km** Abdullahpur to Nabinagar via Savar
2nd common part		**3.0 km** Nabinagar to Baipayl	
3rd common part		**15.4 km** Baipayl to Chandra	
Connection Points	Direct Connection	Hazrat Shah Jalal International Airport	Hazrat Shah Jalal International Airport
		Turag	Abdullahpur
		Abdullahpur	Baipayl
		Baipayl	Ashulia
		Ashulia	Savar
		EPZ	Chandra
		Chandra	Zirani
		Zirani	N5
		Savar Martyr's Monument	
		N5	
	Indirect Connection	Kashimpur Road	
		Kaliakoir	
		N3,N4	
Land acquisition		67.76 acres (21.42 ha)	123.27 acres (49.89 ha)

Table 3.2: Estimated Costs of BUET Alternatives

Item	Cost (BDT million)	
	Alternative 1	**Alternative 2**
Land Acquisition Cost	7,110	12,940
Resettlement Cost	4,000	8,000
Total Cost for utilities shifting	2,000	3,000
TOTAL	17,110	22,940
Total estimated capital cost (I-girder system)	83,639	90,733
Total estimated capital cost (box girder system)	93,121	101,251
Total estimated project cost (I-girder system)	136,537	162,500
Total estimated project cost (box girder system)	149,394	176,763

Based on review of the current situation and considering the primary project objective of providing a connection between the various highways, the Consultant's Inception Report recommended selection of a modified form of BUET Alignment 1. The modification reduces the length to about 24 km (excluding ramps) instead of the 35 km proposed by BUET.

The existing road between Nabinagor to Chandra via EPZ is now four lanes with a wide median. It was not in place during pre-feasibility study conducted by BUET. Considering this, the consultant proposed to drop the 3 km long Nabinagor to Baipayl and the 10.8 km EPZ to Chandra links and replace them with two separate overpasses; one at Nabinagor and another at Chandra of length about 700 m each. The traffic volume of those sections could be accommodated by the existing road. The area of land required for this will be much less than the land required for BUET Alignment 2. From the above table, the cost of construction of expressway for Alignment 1 is much less than BUET Alignment 2 and a modified form of BUET Alignment 1 was examined for the feasibility study.

3.3. Description of the Project

The project developed in this feasibility study is for a 24 km long elevated tolled expressway from just south of the Airport Roundabout to approximately 2 km north of Baipayl. With the exception of the first 4 km where the expressway is following the railway line, the expressway will follow existing main roads so as to minimise land acquisition. The route of the expressway is shown in Figure 3.2 as are the locations of the entry / exit ramps and the toll plazas.

An integral part of the project is connection to the now under construction 19.7 km long Dhaka Elevated Expressway Project (DEEP) which will run from immediately south of the airport roundabout to the Dhaka Chittagong Highway at Kutubkhali. The concessionaire is the Italian Thai Development Public Company Limited and the SPV is the First Dhaka Elevated Expressway (FDEE) Co. Ltd. The concession period is 25 years including the 3 ½ year construction period.

Associated with DAEEP is the upgrading to four lanes of the existing at-grade road between Highway N3 at Abdullahpur and Baipayl.

The project envisages a major toll plaza development on flood-prone land between Dhour and Ashulia. This toll plaza complex will allow vehicles on the surface road network to enter the elevated expressway system as well as being the single tolling point for all vehicles travelling on DAEEP. A further toll plaza is to be built toward the southern end of DAEEP in order to collect tolls from vehicles that connect directly to DEEP as that project has not allowed for a toll plaza to collect tolls from southbound vehicles that enter that expressway from the new DAEEP.

Operation and maintenance facilities are to be built at the major new toll plaza between Dour and Ashulia.

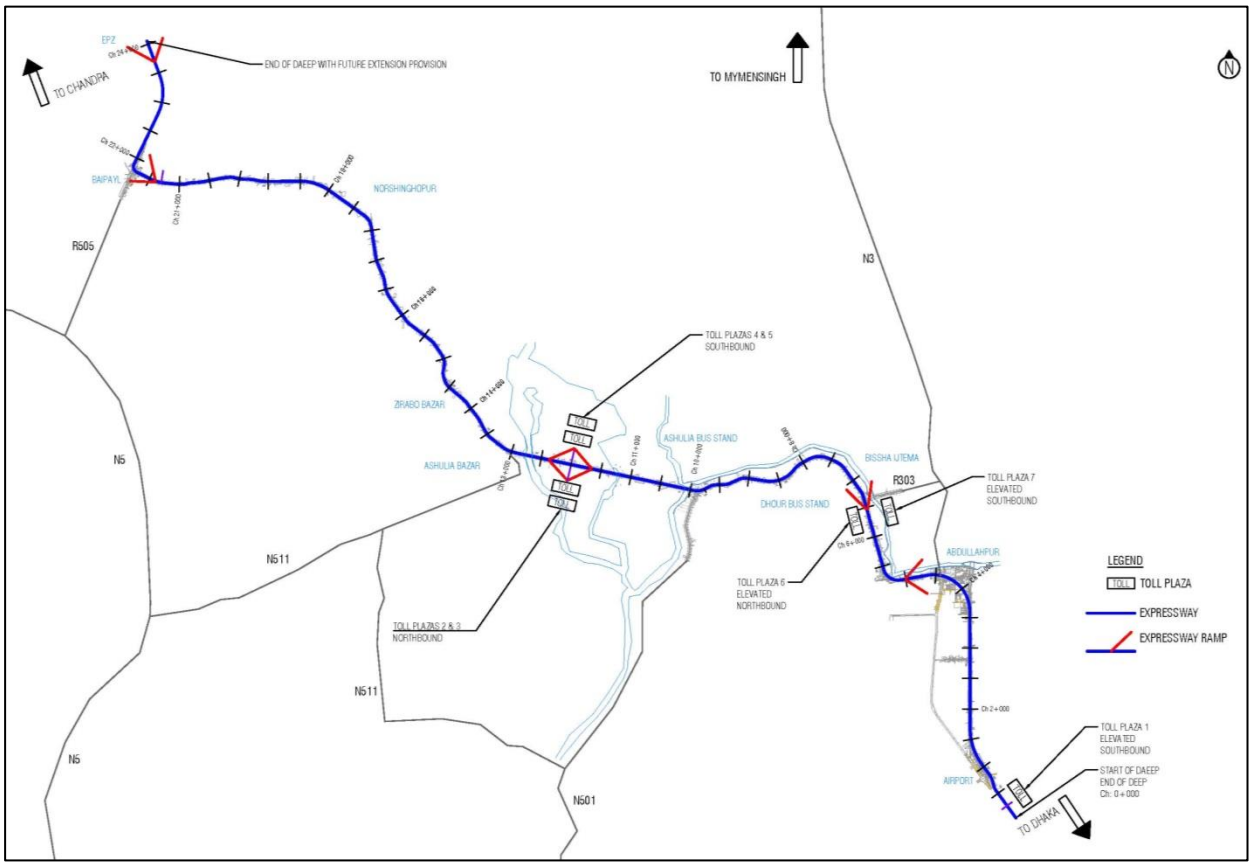


Figure 3.2: Alignment of Dhaka – Ashulia Elevated Expressway Project (DAEEP)

Other highway improvements covered by this project are the construction of a flyover at Nabinagar and improvement of the intersection of R505 with Highway N 4 at Chandra.

3.4. Objectives of the Assignment

The assignment objectives are given in the Terms of Reference attached as Appendix A.

The benefits of the project will flow through to all road users including urban transport as well as trade.

4. REVIEW OF OTHER PROJECTS

4.1. Overview

As is shown in Section 11, Bangladesh is undergoing a rapid transformation and there is widespread recognition of the need for better transport infrastructure to allow for more efficient movement of goods and people. The following gives a brief summary of current or proposed projects that are likely to have some

4.2. Dhaka Chittagong Expressway

A feasibility study is currently being conducted to examine the development of an expressway between Dhaka and Chittagong as a PPP project. The study is being undertaken by SMEC for the Roads and Highways Department.

The northern end of the expressway would terminate at Joydebpur on Highway N3. It is unclear what effect that expressway would have on traffic volumes on the DAEEP but the greater freedom of traffic movement may increase traffic along the DAEEP corridor.

The timing for commencement of the Dhaka Chittagong Expressway is unknown and will be subject to government decision.

4.3. BRT – Gazipur to Airport Roundabout

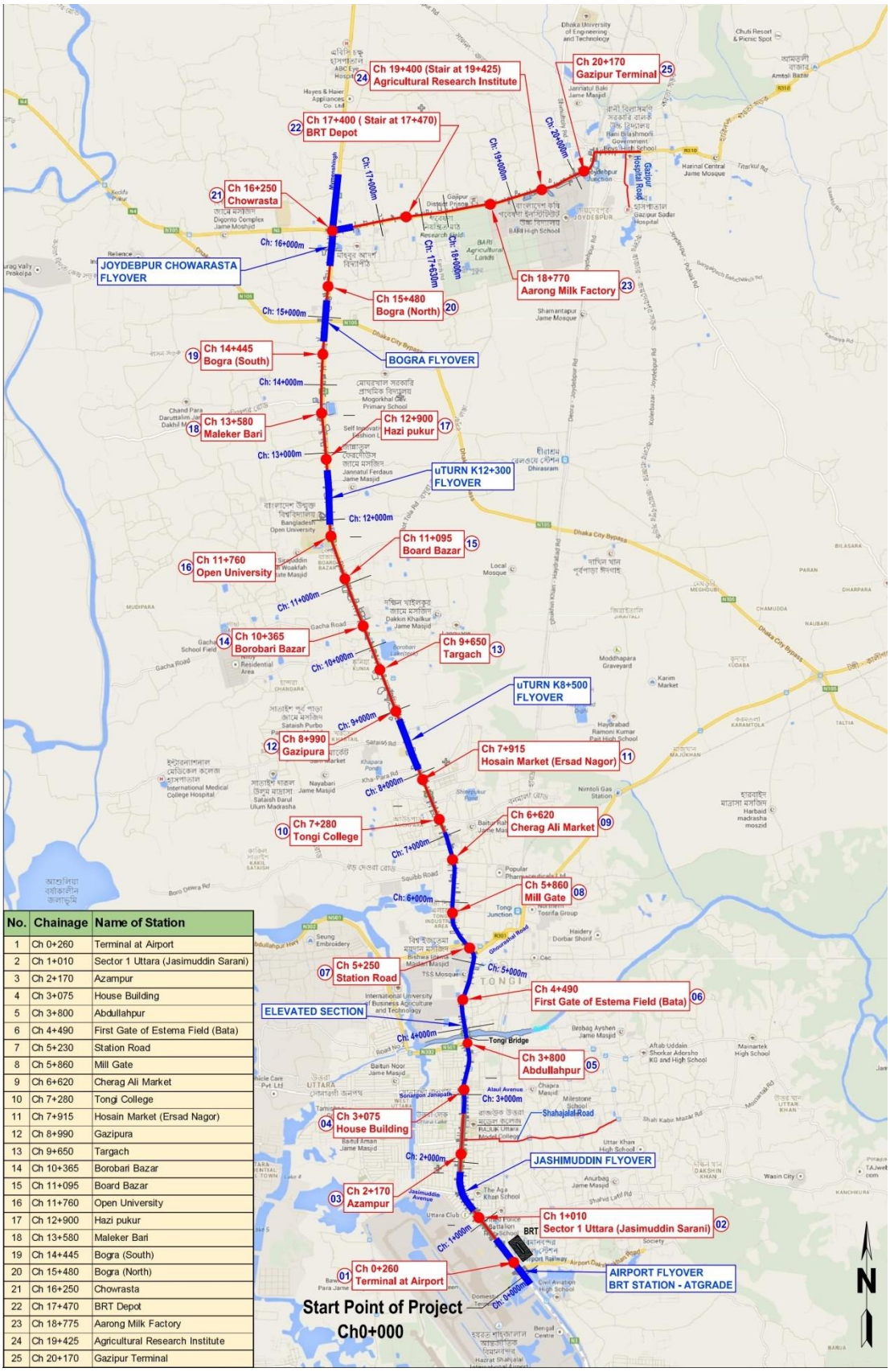
Construction of the bus rapid transit (BRT) project from Gazipur to the Airport roundabout commenced in mid-2016 at the Gazipur depot. The alignment of the BRT is shown In Figure 4.1.

The BRT will be located in the centre of Highway N3 and originally is being funded by the Government of Bangladesh with assistance from the Asian Development Bank and Agence Française de Développement. The original proposal was for the BRT to connect with another section of BRT funded by the World Bank with that section of BRT extending southwards from the Airport Roundabout along Airport Road (Highway N3). Whilst the World Bank has withdrawn funding from that project, the ADB and AFD have reaffirmed their commitment to construction north of the Airport roundabout. The contract for construction of the elevated section of the BRT route is expected to be let in late 2016 and construction will take approximately three years.

Of relevance to the DAEEP is the proposed construction of an elevated section of the bus rapid transit (BRT) between House Building and Cherag Ali market including replacement of the existing bridge over the Turag River at Tongi (Abdullahpur). The DAEEP will cross the BRT immediately south of the Turag River at Tongi and thus there is a crucial need for coordination of the design of the two projects at this location. Land acquisition and operational constraints preclude moving the Abdullahpur bus station (chainage 3800) and thus the BRT cannot easily be moved.

At the point where the elevated expressway is to cross the BRT, the BRT and associated road works take up a width of some 80 m, which would necessitate a large box girder span for the elevated expressway. Such a span would be approximately 2 m deeper than the adjacent 40 m expressway spans and therefore would lift the expressway, increasing the project cost on the approach spans as well as requiring a very expensive one-off box girder. Review of the BRT design drawings has shown that it should be possible to install a pier at the end of the Abdullahpur BRT station, thereby halving the required span, simplifying elevated expressway construction and reducing elevated expressway costs.

There needs to be close coordination between the BRT and DAEEP designers and construction contractors to allow an economical design for the DAEEP where it crosses the BRT at Abdullahpur. This cannot wait until the BRT is built as the opportunity to minimise costs will have been lost.



No.	Chainage	Name of Station
1	Ch 0+260	Terminal at Airport
2	Ch 1+010	Sector 1 Uttara (Jasimuddin Sarani)
3	Ch 2+170	Azampur
4	Ch 3+075	House Building
5	Ch 3+800	Abdullahpur
6	Ch 4+490	First Gate of Estema Field (Bata)
7	Ch 5+230	Station Road
8	Ch 5+860	Mill Gate
9	Ch 6+620	Cherag Ali Market
10	Ch 7+280	Tongi College
11	Ch 7+915	Hosain Market (Ersad Nagor)
12	Ch 8+990	Gazipura
13	Ch 9+650	Targach
14	Ch 10+365	Borobari Bazar
15	Ch 11+095	Board Bazar
16	Ch 11+760	Open University
17	Ch 12+900	Hazi pukur
18	Ch 13+580	Maleker Bari
19	Ch 14+445	Bogra (South)
20	Ch 15+480	Bogra (North)
21	Ch 16+250	Chowrasta
22	Ch 17+470	BRT Depot
23	Ch 18+775	Aarong Milk Factory
24	Ch 19+425	Agricultural Research Institute
25	Ch 20+170	Gazipur Terminal

Figure 4.1: Proposed BRT – Gazipur to Airport Roundabout

4.4. SASEC - Joydebpur to Elenga

The SASEC (South Asia Subregional Economic Cooperation) project under RHD is upgrading Highway N4 between Joydebpur where it meets Highway N3, and Elenga. DAEEP and SASEC have a common point of interest at Chandra where there is a heavily congested intersection. Initial concepts for the Dhaka Ashulia Elevated Expressway intended that DAEEP upgrade the Chandra intersection of Highway N3 and R505 by building a flyover at Chandra for the elevated expressway.

But, the SASEC project design included a flyover for Highway at Chandra and that has been included in one of the SASEC construction contracts. The DAEEP was not known to the designers of the SASEC project and the elevated expressway may increase traffic volumes at Chandra beyond those allowed for in the SASEC design, which considered intersection signalisation as a means of improving traffic operations below the Chandra flyover.

BBA has suggested that the design of the intersection of highway N4 and R505 be modified to allow for construction of a roundabout below the N4 flyover at Chandra. Initial review of that suggestion shows that it would be quite straightforward to implement. RHD's managers of the SASEC project have been made aware of this possible requirement.

4.5. MRT

Several MRT lines have been mooted for Dhaka and one of these is proposed for a north south corridor to the west of the DAEEP, terminating somewhere in Uttara, south of the Turag River.

Little information is available for the proposal and the Consultant has not been able to detect any potential for conflict between the MRT and DAEEP.

4.6. Underground Rail

The consultant is aware that the government is considering carrying out feasibility study/ies for a series of underground rail lines in Dhaka. The consultant has not been able to find out the corridors being considered for these lines and therefore is not able to offer comment on how the proposals might affect DAEEP.

5. SURVEYS AND INVESTIGATIONS

5.1. Traffic Surveys

An extensive series of classified traffic counts is undertaken by RHD in the vicinity of the project and this data was available to the consultant. To supplement that data, weekday and weekend classified turning movement counts were undertaken at the following intersections

- Baipayl (intersection of N302 and R505)
- Nabinagor
- Chandra (intersection of highway N4 and R505)

For ease of comparison of total data, the counts have been converted to passenger car units and are presented in Figures 5.1 to 5.3.

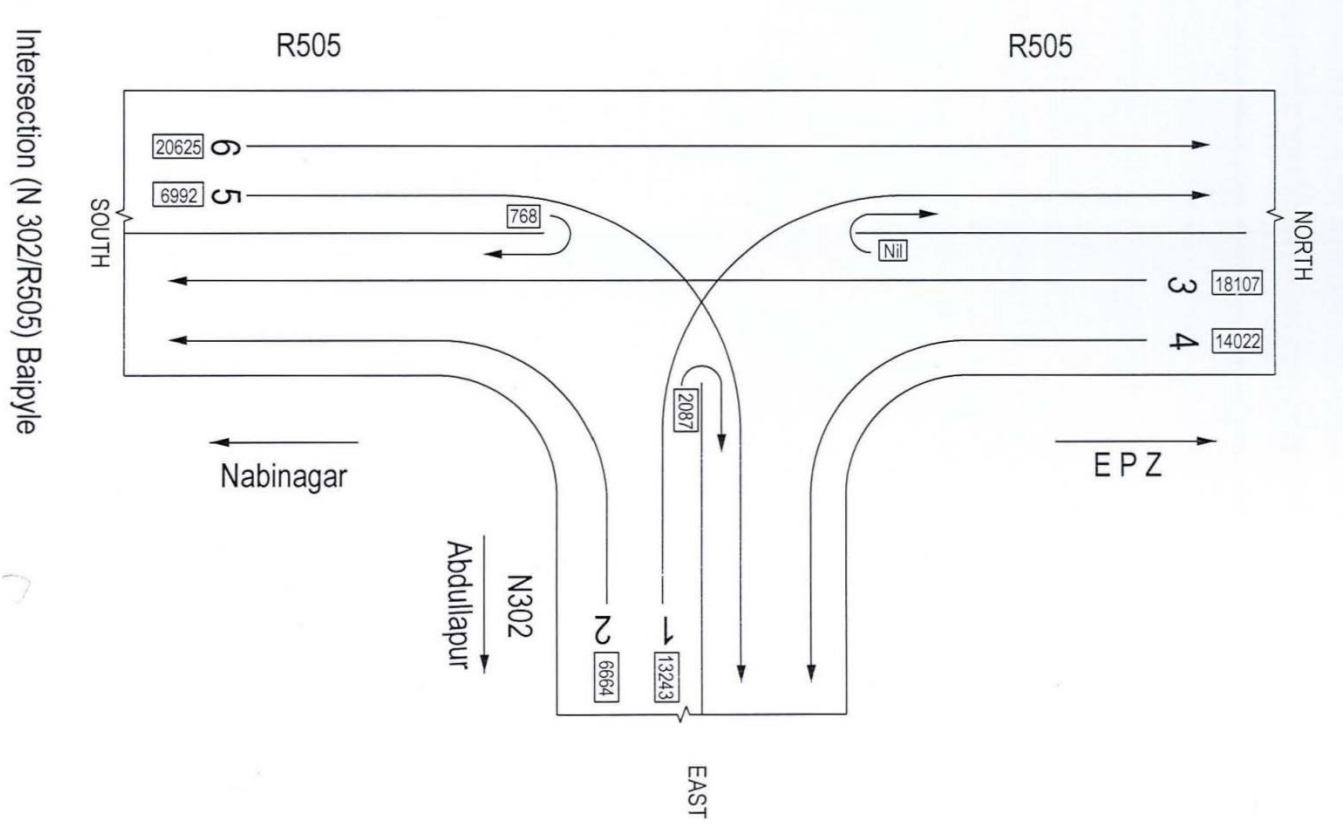


Figure 5.1: Baipayl (N302/R505) Weekday Turning Movement Count

Full results of the traffic counts are provided in Appendix B.

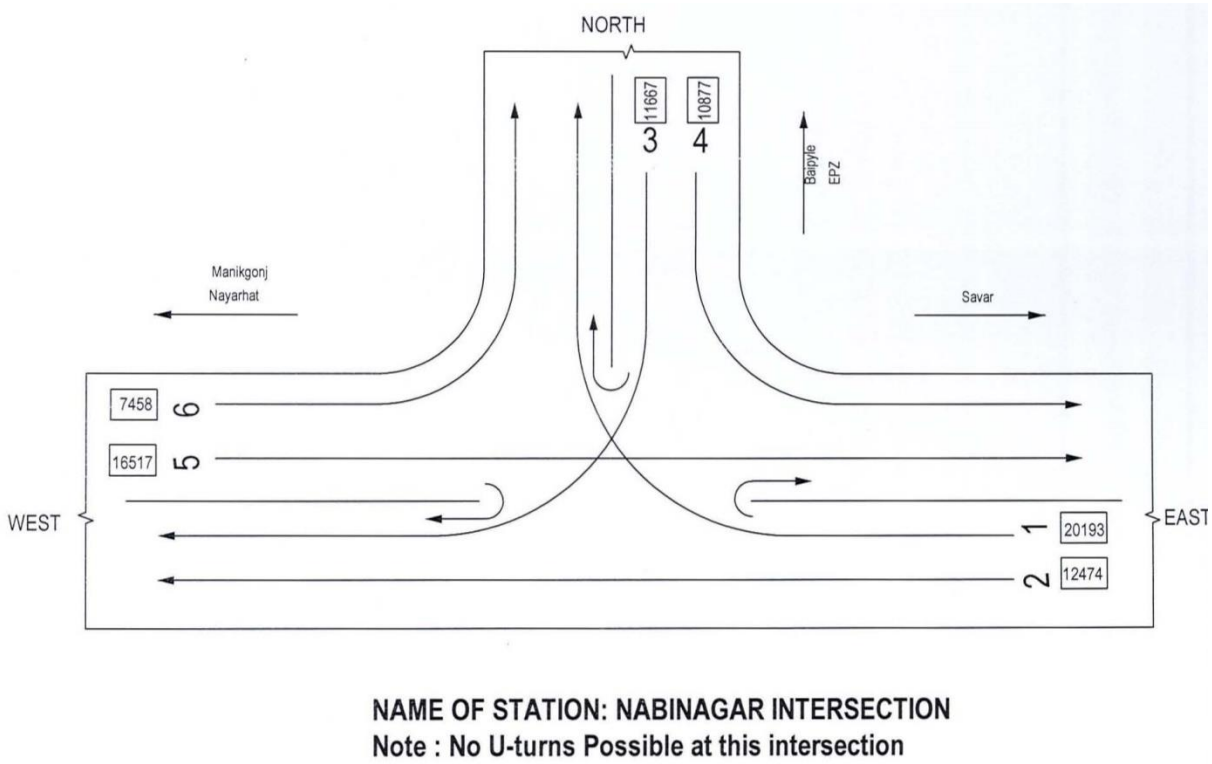


Figure 5.2: Nabinagor - Weekday Turning Movement Count

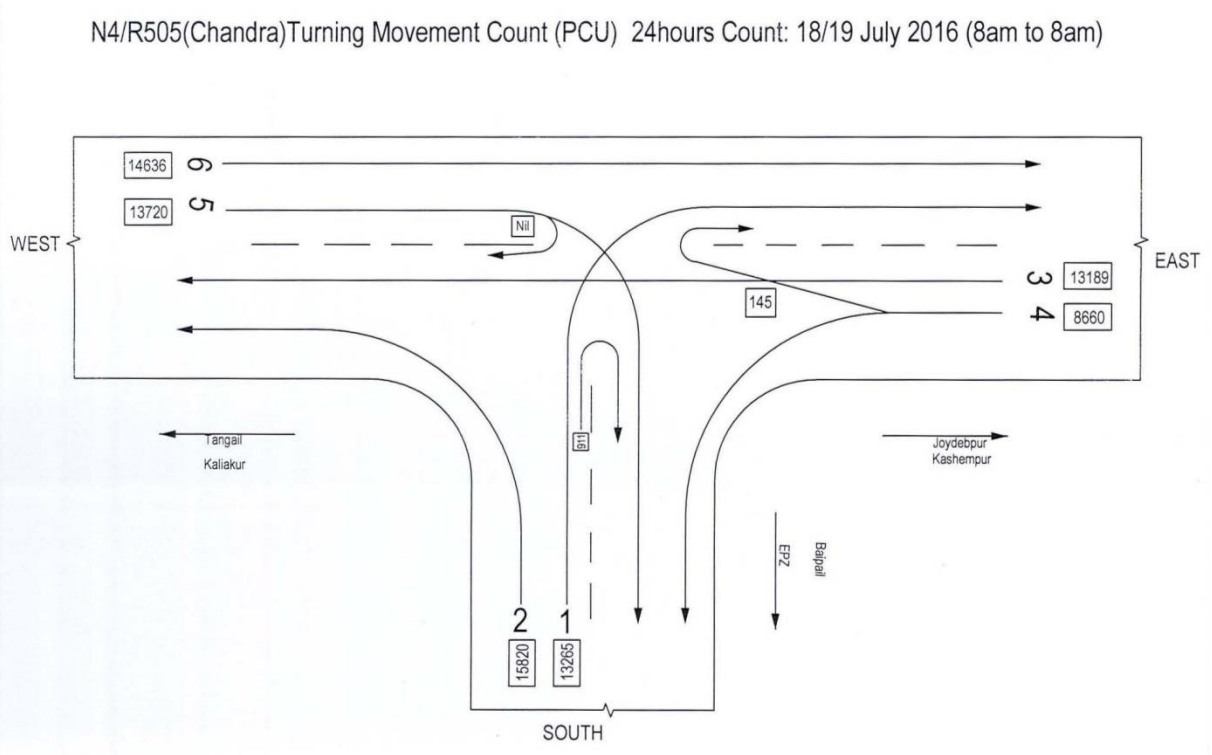


Figure 5.3: Chandra Weekday Turning Movement Count

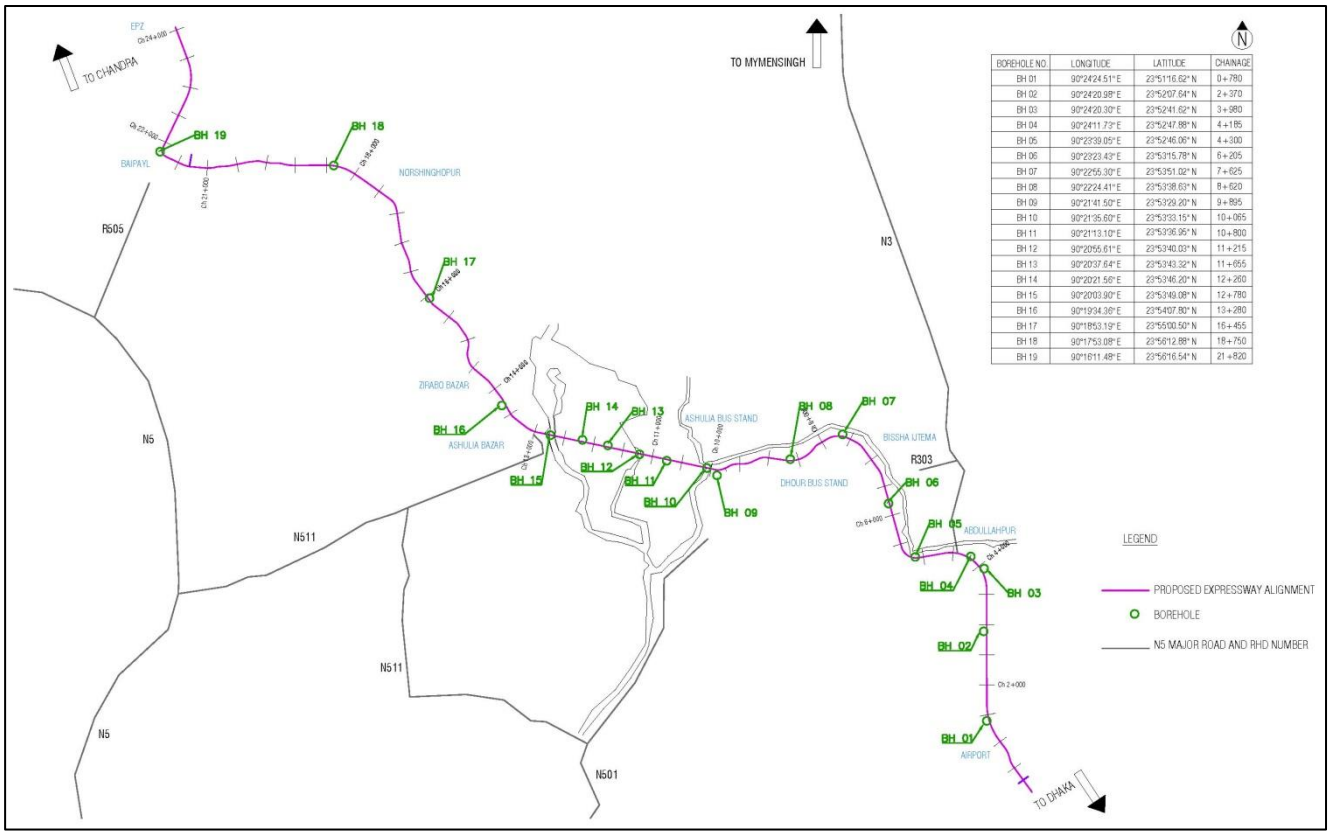
5.2. Topographic Survey

Topographic survey was undertaken of the project alignment by Bangladesh Survey Organisation (BSO).

5.3. Geotechnical Investigations

5.3.1. Summary

Figure 5.4 shows the locations of boreholes specifically drilled for the Dhaka Ashulia Elevated Expressway project. Data from boreholes from the current bus rapid transit (BRT) Gazipur to Airport roundabout project and from the SASEC project, both of which were undertaken by some members of the consultant team were taken into account in assessing likely subsurface conditions for concept design of foundations for the elevated expressway.



BOREHOLE NO	LONGITUDE	LATITUDE	CHAINAGE
BH 01	90°24'24.51" E	23°51'16.62" N	0+780
BH 02	90°24'20.98" E	23°52'07.64" N	2+370
BH 03	90°24'20.30" E	23°52'41.62" N	3+980
BH 04	90°24'11.73" E	23°52'47.88" N	4+185
BH 05	90°23'39.05" E	23°52'46.06" N	4+300
BH 06	90°23'23.43" E	23°53'15.78" N	6+205
BH 07	90°22'55.30" E	23°53'51.02" N	7+625
BH 08	90°22'24.41" E	23°53'38.63" N	8+620
BH 09	90°21'41.50" E	23°53'29.20" N	9+805
BH 10	90°21'35.60" E	23°53'33.15" N	10+065
BH 11	90°21'13.10" E	23°53'36.95" N	10+800
BH 12	90°20'55.61" E	23°53'40.03" N	11+215
BH 13	90°20'37.64" E	23°53'43.32" N	11+655
BH 14	90°20'21.56" E	23°53'46.20" N	12+260
BH 15	90°20'03.90" E	23°53'49.08" N	12+780
BH 16	90°19'34.36" E	23°54'07.80" N	13+280
BH 17	90°18'53.19" E	23°55'00.50" N	16+455
BH 18	90°17'53.08" E	23°56'12.88" N	18+750
BH 19	90°16'11.48" E	23°56'16.54" N	21+820

Figure 5.4: Geotechnical Borehole Locations

5.4. Seismic

Dhaka is a known area of seismic hazard and, from time to time is subjected to tremors arising in the Himalayas. These have been quite modest and have only caused minor damage within Dhaka. Even so, the Bangladesh National Building Code classifies Dhaka as a high risk zone and gives guidance on the allowance to be made for seismic loading. Any design for the elevated expressway must be carried out in accordance with the BBC requirements.

6. DESIGN STANDARDS

6.1. Design Criteria

The design criteria used for the preliminary design were set out in the project inception report are the same as used for the Dhaka Elevated Expressway which is now under construction by the Italian Thai Joint Venture. Commonality of design standards is crucial because ultimately the projects will meet just south of the Airport Railway Station and vehicles will be able to travel from one expressway section to the next in making a journey from Ashulia to Mohakhali. Differences in design standards may confuse drivers and will not assist road safety. Additionally different standards will make more difficult the transition from one section to the next both in construction and in operation.

Table 6.1 sets out the standards used for the preliminary design of the elevated expressway

Table 6.1: Design Standards

Expressway Component	Value
Main Viaduct	
Road Type	Urban expressway
Design speed	80 km/hr
Curve radius (minimum)	250 m
Single lane carriageway width	3.65 m
Two-lane carriageway width	7.30 m
Four-lane carriageway width	14.60 m
Median width	0.76 m
Inner shoulder width at each side of median	0.30 m
Outer shoulder width at each side of Median	0.30 m
Service road width	(same as DEE) 1.80 m
Side safety barrier width(each side)	0.50 m
Single Lane Ramp,	total width 4.65 m (being 3.65 + 0.5*2)
4-Lane, total width	20.56 m (being 7.3*2 +0.76 + 0.3*2 +1.8*2 + 0.5 *2
Crossfall	2%
Side friction	0.15
Superelevation	6% (max)
Vertical Grade	
ascending	3.5 to 4.0% (max)
descending	4.5 to 5.0% (max)
Vertical clearance	
over roads	5.7 m (min)
over rail	11.0 m (min) (but possibly as low as 23’ 7” (7.2 m) according to BR web site)
Entry and Interchange Ramps	
Design speed	50 km/hr
Curve radius (minimum)	90 m (min)
Number of lanes	1.5
Lane width	3.65 m
Carriageway width	5.50 m
Shoulder width (inner and outer)	0.30 m
Side safety barrier width	0.50 m
Overall width	7.1 m

7. PRELIMINARY DESIGN

7.1. Overview

The proposed route for the Dhaka Ashulia Elevated Expressway follows existing highways and main roads for the most part. The exception is the southern section which follows the railway line from the northern end of the Dhaka Elevated Expressway to just south of the Turag River at Tongi. At that point the elevated expressway turns west and follows Highway N302 / N501 R505 from Abdullahpur to Baipayl. Refer to Figure 3.2 and the separate volume of drawings for more information.

The selection of the tolling system is fundamental to much of the design of the elevated expressway as it affects the space required at each toll collection point and where entry and exits can be made from the system As DAEEP is proposed to be a toll road and given that it will connect directly to the DEEP, it will be crucial for the two elevated expressways to use complementary tolling systems. The system for the DEEP has already been determined and is included in the financial agreement for that project – it is to be an open system with tolls levied according to the point at which a vehicle enters the expressway system. No account is taken of how far a vehicle travels on the system; that is, there is no distance charge. Tolls will vary according to vehicle type. The tolling system will allow for both cash and electronic tolling. An open tolling system is proposed for DAEEP.

A major feature of the DAEEP is the construction of a large toll plaza and interchange in about the middle of the project where there is a large area of flood prone land. That area will allow for development of a central system and the storage of recovery and maintenance vehicles required for the day to day operations of the expressway.

7.2. Features

7.2.1. Structures

Being an elevated roadway for its entire length, the major features of the elevated expressway are structural. The concept design has taken account of the practicalities of building the elevated expressway through a congested urban area, with an eye on minimising the costs and disruption associated with land acquisition and resettlement of affected persons.

7.2.1.1. Connection to DEEP

Discussions were held with the DEEP concessionaire regarding the form of structure being used for that project. This was done so that the structures proposed for DAEEP would match aesthetically those of DEEP even if not exactly identical. Given that the lane width parameters are the same for the two projects and that the structures for both projects are designed in accordance with AASHTO standards, the differences are small.

The consultant's concept design for DAEEP proposes a desired span length of 30.0 m and also 40 m (centre of pier to centre of pier). The main difference is that the Consultant proposes 9 girders for the normal cross section whereas the DEEP proposed 10 girders. The difference will be barely noticeable in elevation, and very few people ever look at the girder arrangements from underneath, meaning that the change will not be noticed by the general public.

7.2.1.2. Crossings of Railway

The DAEEP will have two crossings of the railway line. The concept design has allowed for the railway to be widened to four tracks by use of portal frames. The concept design allows for BR's required clearance of 11.0 m between rail level and the soffit which is consistent with that used for the contiguous DEEP. These clearances will exceed those required for crossings of roads. Initially there

was an indication that the required rail clearance would be more than 11.0 m but verbal advice has been that 11.0 m is sufficient. Written confirmation is awaited from Bangladesh Railway.

7.2.1.3. Crossing of BRT – Gazipur to Airport Roundabout

The crossing of the BRT has been discussed in Section 4.3 where it noted that with early design action and coordination with the BRT project, there is potential to reduce the structural depth of the beams crossing the BRT project if a pier can be constructed at the southern end of the Abdullahpur BRT station. That section of the BRT also comes under the Bangladesh Bridge Authority and there is high potential for a shorter span arrangement to be achieved. This may require some minor redesign of the BRT project and will certainly require some modification of the BRT construction contract to allow for the construction of the DAEEP pier whilst the BRT is being built. The suggested outcome is that the DAEEP pier be built by the BRT construction contractor with the works being observed by the DAEEP contractor.

7.2.1.4. At-grade roads

West of Abdullahpur the elevated expressway follows an existing road which has numerous intersections with other roads. The proposed concept design has placed the piers so that adequate provision is made for traffic on the at-grade road network.

7.2.1.5. Toll Plaza / Construction across Turag River Flood Plain

BBA has stated that for various reasons including minimising rectification work arising from differential settlement and to avoid interference with flood flows that the elevated expressway be built on pier foundations across the Turag River flood plain from chainage 10 000 to 13 000. This requirement applies to the toll plaza, associated buildings and the road works for the at-grade road.

Use of piles will give some certainty to the construction programme and the large number of piles will generate some economies of scale.

7.2.2. At-Grade Road

The existing at grade from Abdullahpur to Ashulia is proposed to be upgraded as part of the project so there is a viable alternative to the proposed tolled elevated expressway. This is consistent with good PPP practice.

7.2.3. Connections

The following locations are proposed as connections between the Dhaka Ashulia Elevated Expressway and the adjacent road network.

- Dhaka Elevated Expressway - a direct connection to this expressway which is now under construction
- Abdullahpur
- Baipayl
- Highway N 302 (at-grade road) – Dhour and Ashulia
- Nabinagor
- Chandra

In addition to geometric and weaving considerations, the selection of interchange locations was constrained by the availability of land and the cost of compensation for assets that would have to be removed.

7.2.3.1. Chandra and Nabinagar

The improvements at Nabinagor and Chandra are separate from the main part of the Dhaka Ashulia Elevated Expressway but are part of the terms of reference for this feasibility study. A concept design has been prepared for a flyover at Nabinagor and this has been costed separately.

A flyover is about to be built on Highway N4 at Chandra under the SASEC project. The N4 flyover will greatly improve conditions at the existing intersection which was proposed to be signalised. But that improvement will make difficult the construction of a further flyover dedicated for the movement between the south and north-west which is understood to be the prime reason for this TOR requirement. Difficulties would arise because of third road level required for a new flyover at Chandra, which would put the new flyover some 20 m above existing ground level and the significant land acquisition in a major garment sector complex required to accommodate this additional flyover. Discussions were held with BBA and RHD about this matter and The Consultant has recommended that the spans of the N4 flyover be made slightly longer to allow for the reinstatement of a roundabout at the R505/N4 intersection at Chandra

7.3. Toll Plazas

7.3.1. Tolling System

Consideration was given to both open and closed (distanced-based) tolling systems. As noted in Section 7.1 an open tolling system was selected for reasons of compatibility with the DEEP and for simplicity. The length of 24 km is similar to that of the 20 km long DEEP.

Using an open system means each driver only has one transaction. It would be possible to go to free-flow tolling in future but the supporting registration and licensing infrastructure is not considered adequate in the short to medium term to prosecute offenders. An effective system requires good vehicle registration, driver licensing, personal addresses and infringement notices delivery systems in order to deter persons who try to avoid paying tolls.

Collection of tolls can be electronic or cash with electronic being preferred for reasons of transaction speed and security of the funds received. Electronic tolling can take several forms including contact cards and RFID systems. Given the need to ensure tolls are collected, a system of toll booths with associated barriers will be required.

At least one cash booth will be required at each toll plaza, with it being quite feasible to convert such booths to electronic in the future.

7.3.2. Number of Toll Booths

Having sufficient toll booths is essential for safe and efficient operation of the expressway. If the number of booths is too low there are real risks of vehicle queues extending into high speed zones resulting in high speed rear-end accidents. The usual remedy adopted when dangerous tailbacks occur is to allow a period of no-charging of tools until the tailback clears. Obviously this has adverse financial implications if repeated frequently.

Comprehensive guidance on throughputs at toll plazas is given in the advice note - *Design Manual for Roads and Bridges Vol. 6: Road geometry. Section 3: Highway features. Part 6: The layout of toll plazas. February 2008 Publication Number TA 98/08.* This reflects practice throughout the United Kingdom and is published by The Stationery Office on behalf of The Highways Agency, Transport Scotland, Welsh Assembly Government and the Department for Regional Development Northern Ireland. The data is considered contemporary and relevant to the situation for DAEEP. Guideline throughputs from TA98/08 are given in Table 7.1.

Table 7.1: Toll Lane Throughput

Method	Explanation	Car Throughput (vph)	HGV * Throughput (vph)
Electronic toll collection	Transponders, contactless reading of bar code stickers / proximity cards, tags (low speed automatic – vehicles reduce speed, barrier lifts when transponder card/tag is read)	450-900	300-500
Card payment	Credit, Debit or Charge cards (vehicles stop – barrier lifts when card is passed through reader and has been verified – receipt may be given) Note throughout will reduce if driver is required to enter a PIN to verify the transaction	200-350	150 - 250
Coin bin	Cash machines / coin baskets (Vehicles stop – barrier lifts when cash has been verified – change and receipts may be given)	300-500	200-350
Manual	Card / cash / voucher / token. (vehicles stop – barrier operated by attendant; change and receipt may be given)	250 - 550	200-300

*HGV = heavy goods vehicle. *Source: Highway Agency - Design Manual for Roads and Bridges Vol. 6: Road geometry. Section 3: Highway features. Part 6: The layout of toll plazas. February 2008 Publication Number TA 98/08*

In Bangladesh, the use of card payments and coin bins is impractical with many people not having credit / charge / debit cards and there being few coins in general circulation. Taking into account that there will be some heavy goods vehicles using the elevated expressway during the peak hours, the following throughputs were adopted to reflect the likely mix of traffic and somewhat conservative estimate of the transaction speeds. As noted earlier, undersizing of the toll plaza gives rise to serious safety and operational concerns. A plaza that is somewhat too big is far less of a concern than one that is too small.

The Indian Roads Congress (Manual of Specifications and Standards for Expressway IRC:SP:99-2013 (Indian Roads Congress 2013)) suggests toll booths be designed with throughout of 240 vph for semi-automatic toll lanes with manual money collection, 360 vph for smart card lanes and 1200 vph for electronic toll collection where there is a self-adhesive tag on the vehicle windscreen capable of being read by transceivers at the toll plaza gantry.

Based on TA98/08 the following passenger car unit throughputs were considered applicable for the concept design of toll plazas on DAEEP.

- Cash booth - 240 pcu per hour
- Electronic booth - 500 pcu per hour

Toll plaza design has to cope with the expected daily peak traffic flows. The analysis assumed that the peak hour traffic is 10% of the daily traffic. It was assumed that there would be a high proportion of cash transactions when the expressway is opened but that these would reduce over time as people become used to electronic tolling. The use of discounts would hasten the transition from a cash system to electronic.

Toll plaza design also has to take account of the near certainty that not all toll booths will be available all the time. There will be equipment breakdowns / malfunctions/ drivers that become entangled in the system without means of payment, need for maintenance and operator illness. The analysis has assumed that there will be a need for one spare booth in each direction to accommodate such events.

Table 7.2 shows the calculation of require number of toll booths for the main project toll plaza. It is clear that the design number of toll booths is driven by the need to provide sufficient cash lanes for the early years of operation.

Table 7.2: Calculation of required number of toll booths for main toll plaza

Dhaka Ashulia Elevated Expressway

Estimation of Required Toll Booth Numbers

Variables

Toll booth rate (pcu/hr)		Peak hour factor	10%
Cash booth	240		
ETC booth	500		

Carriageway	Year	Traffic per day (pcu)	Traffic (pcu/hr) pcu	pcu ratio cash:total	cash	ETC	Toll booths requ'd cash	ETC	Spare	Carriageway Total (Cash + ETC	Direction Total (Expressway plus At-grade) Year	Booths (all types)
N'bound Expressway												
" "	2019	10,000	1,000	80%	800	200	4	1	1	6		
" "	2024	11,000	1,100	50%	550	550	3	2	1	6		
" "	2029	12,000	1,200	25%	300	900	2	2	1	5		
" "	2034	15,000	1,500	5%	75	1,425	1	3	1	5		
" "	2039	18,000	1,800	0%	-	1,800	0	4	1	5		
N'bound At-grade												
" "	2019	3,000	300	80%	240	60	1	1	1	3	2019	9
" "	2024	3,500	350	50%	175	175	1	1	1	3	2024	9
" "	2029	4,000	400	25%	100	300	1	1	1	3	2029	8
" "	2034	4,500	450	5%	23	428	1	1	1	3	2034	8
	2039	5,000	500	0%	-	500	0	1	1	2	2039	7
S'bound Expressway												
" "	2019	10,000	1,000	80%	800	200	4	1	1	6		
" "	2024	11,000	1,100	50%	550	550	3	2	1	6		
" "	2029	12,000	1,200	25%	300	900	2	2	1	5		
" "	2034	15,000	1,500	5%	75	1,425	1	3	1	5		
" "	2039	18,000	1,800	0%	-	1,800	0	4	1	5		
S'bound At-grade												
" "	2019	3,000	300	80%	240	60	1	1	1	3	2019	9
" "	2024	3,500	350	50%	175	175	1	1	1	3	2024	9
" "	2029	4,000	400	25%	100	300	1	1	1	3	2029	8
" "	2034	4,500	450	5%	23	428	1	1	1	3	2034	8
" "	2039	5,000	500	0%	-	500	0	1	1	2	2039	7

7.3.3. Toll Plaza Layout

Proven regional guidance for dimensions and geometry to be used in design of toll plazas is given in the Manual of Specifications and Standards for Expressway IRC:SP:99-2013 (Indian Roads Congress 2013). The geometry in these standards is somewhat tighter than used elsewhere around the world, but reflect the regional practicalities of shortage of land. The standards are proven in practice and are considered applicable for design of the DAEEP.

Proposed dimensions of the toll plazas are shown in the separate volume of concept design drawings.

7.4. Drainage

7.4.1. Elevated Expressway

Construction of the elevated expressway will not markedly increase the stormwater runoff along the route. A minor increase may occur as the surfaces of the expressway will be impervious whilst there are some pervious surfaces along the route and the runoff is lower from a pervious surface.

The elevated expressway will be constructed with drainage grates at regular intervals –most likely at every one to two spans (that is, 30 to 60 m). The location of these will be determined at the detailed design stage, with care being needed on curves to ensure there are no flat-spots which may cause ponding of water and aquaplaning for road vehicles. Water will be discharged by downpipes

connected to the piers and from there the water will be directed to the existing pipe/channel stormwater system. Where there is no such existing provision, the water will be discharged to the road surface and will flow to current discharge points. Ultimately the at-grade road below the elevated expressway will be upgraded and any outstanding drainage should be connected to the at-grade road drainage system at that time.

7.4.2. Urban Area

The elevated expressway will not interfere directly with stormwater drainage of the surrounding urban area. Some upgrading of that system may be undertaken when the at-grade road is upgraded. The likely arrangement will be installation of a 1,500 to 1,800 mm diameter pipe culvert along one side of the at-grade road to take drainage from the road, expressway and adjacent developments.

Cross drainage will not be affected directly by the elevated expressway

7.5. Casting Yards

For many reasons including minimising disruption to traffic, several casting yards may be required for the beams and other elements to be used in the construction of the elevated expressway. Locations for casting yards identified by an inspcection are shown in Figure 7.1. Of these, one is being established for the Dhaka Elevated Expressway Project and is extremely close to the southern end of the Dhaka Ashuilia Elevated Expressway. Depending on the timing of completion of DEEP, that yard could be used for DAEEP. The other two yards would need to be acquired by BBA specifically for DAEEP. The social safeguards survey and land acquistion plans have allowed for this.

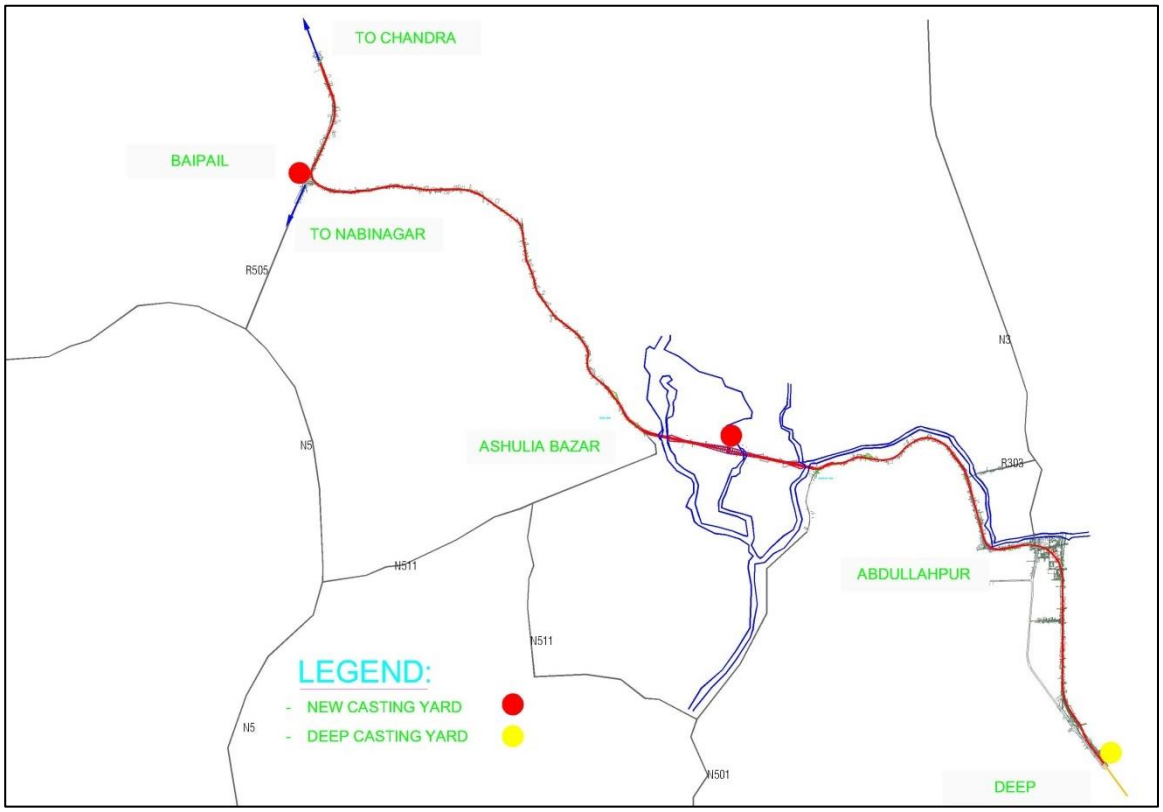


Figure 7.1: Identified Potential Casting Yard Locations

7.6. Utility Services Relocations

Some utility service relocations will be required to allow for construction of the elevated expressway. And more will be required for upgrading the construction of the at-grade road. The positioning of the elevated expressway in the middle of existing roads will minimise the need for utility service relocations for the expressway as most of the services tend to be at the outer edges of roads. Trunk services expected to require relocation are 11/33 kV power lines, some sections of gas main, water main and telecommunications. The utility service providers have been unable to provide much guidance on where their services are located, what the services are and the extent of relocation work required as they require detail design drawings to provide this advice.

The utility service cost estimates contained in this feasibility study are based on the Consultant's experience of the likely order of costs.

7.7. Noise Barrier

The elevated expressway will pass though long sections of existing residential and commercial development, especially at the southern end. Traffic noise from an elevated expressway can be a major nuisance for people in adjacent multi-storey buildings. Therefore the project concept provides for the installation of noise barriers on the outer crash barrier on each side of the elevated expressway from its starting point to chainage 10 000. A further length of noise barrier is proposed in the vicinity of Ashulia bazar. To be effective, noise barriers should be continuous and without gaps, both below panels and between panels. Little can be done about the gaps that occur where there are entry and exit ramps.

7.8. Grade Separations for Pedestrians

In existing urban areas of Dhaka footbridges are preferred to underpasses for reasons of cost, pedestrian security, safety and speed of construction, removal of project risk related to uncertain location underground services and the removal of potential for an underpasses to become flooded.

The northern part of DAEEP traverses an area with a high density of garment factories and consequently there are large movements of pedestrians, especially at the start and end of work shifts. The existing four footbridges that cater for these pedestrians can be retained as the elevated expressway is to be at a level sufficiently high to allow for the footbridges to pass below the elevated expressway. The concept allows for a clearance of 5.7 m between existing road level and footbridge soffit plus a further 4 m to allow for footbridge deck thickness and headroom above pedestrian using the bridge. The project cost estimate allows for a further five footbridges to be constructed in addition to any footbridges which are retained.

One underpass is proposed at Kamarpara, as the grading of the expressway cannot be made compatible with a footbridge at that location.

An elevated footway was considered between Baipayl and the EPZ but was not recommended as there is little room to allow for this footway.

7.9. Road Safety Plan

Road safety is a concern during both the construction and operation phases of the elevated expressway.

7.9.1. Construction Phase

The prime road safety concerns during construction of the elevated expressway are the potential for traffic congestion arising from construction work to cause driver frustration and erratic / illegal manoeuvres such as travelling on the wrong side to the road. This is a matter that must be addressed

by strong site supervision and insistence on traffic management plans being reviewed and approved before works start.

Apart from the section over the railway line for which a portal frame must be used, the concept design proposed in this feasibility study mostly has central piers to support the expressway. That will tend to concentrate most construction work in the centre of existing roads making it far safer for pedestrians to move safely in the vicinity of the works. Lifting of precast beams should occur at night when there are fewer pedestrians around.

7.9.2. Operational Phase

The operational phase of DAEEP will see the removal of many vehicles from the existing road network which will improve road safety for pedestrians and drivers alike. Ultimately the conversion of the existing single two-way carriageway will improve road safety by reducing potential for head-on accidents and making turning movements easier as vehicles will only have to cross one road carriageway at a time.

The performance of the upgraded road should be monitored from time to time to see if intersections are performing properly / need changes. Also the need for further pedestrian footbridges should be reviewed.

The detailed design of the expressway and the at-grade road must include road furniture and linemarking. Signs of themselves should not be relied upon to provide a safe road environment and to remove driver confusion / errors. Those come from proper engineering design in which the road alignment is clear as is the need for decisions.

7.10. Bridges over Turag River between Baipayl and Dhour

The three existing highway bridges along the Dhaka Ashulia Highway (Road N302) between Ashulia (N511 intersection) and Dhour (Mirpur Road) will need to be demolished and replaced as part of the construction of the elevated expressway. The proposed design provides for Class III navigation clearance at two of these bridges, with the central bridge not being replaced. At the central area all roads and buildings such as the toll plaza and administrative buildings will be elevated on piles rather than fill so as to allow for unimpeded flow of water on the flood plain.

7.11. Lighting

The Dhaka Ashulia elevated expressway is located in an urban area on the northern fringes of Dhaka. Conventional practice is to provide streetlighting for the full length of urban expressways whereas for rural expressway only the interchanges are lit. There is a 3 km section in a rural area as the expressway crosses the flood plain of the Turag River between Dhour and Ashulia. This is where the main toll plaza is to be sited and there are many complicated traffic movements that will happen in that area. Therefore streetlighting should be provided for the full length of the elevated expressway and ramps.

Energy efficient LED streetlighting is now becoming economically viable and can be powered by solar panels mounted on each pole. The payback period for such installations is in the order of eight years. Solar powered LED street lighting should be adopted for the full length of the Dhaka Ashulia Elevated Expressway Project.

All rigid barrier systems require space called “working width” for the rolling of the design truck. This effect is shown in Figure 7.2. The implication of the working width requirement is that for a truck design speed of 80 km/hr, light poles should be mounted so that the face of the pole is at least 700 mm from the point where the barrier meets the road if the road slopes towards the barrier and 500 mm from the barrier if the road slopes away from the barrier. Given that the median barrier is

760 mm wide, this means that light poles should be mounted on blocks on the outside of the outer crash barrier so that a working width of 700 mm can be achieved.

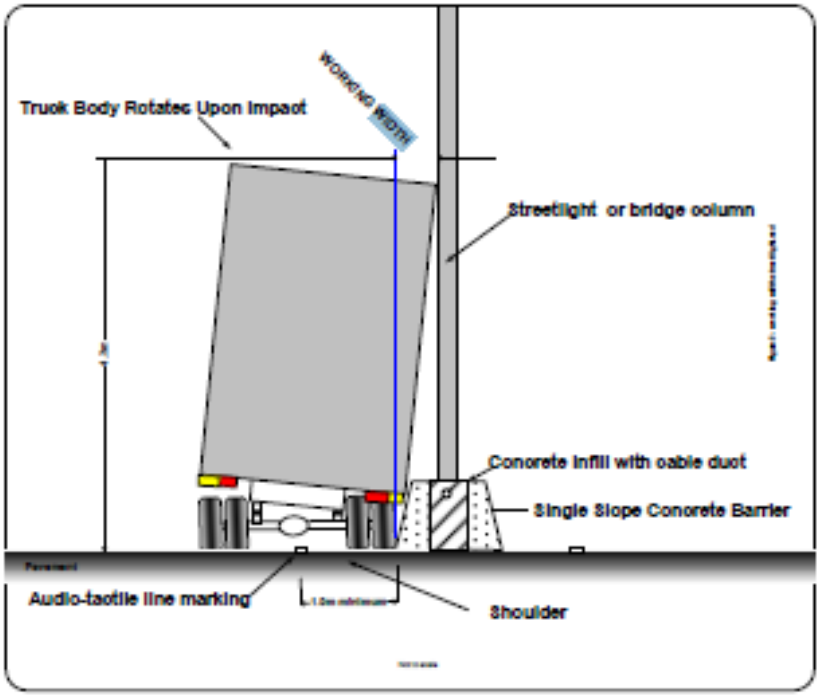


Figure 7.2 Working width of rigid barrier

8. SAFEGUARDS

8.1.1. Consultations

There have been extensive consultations with key project stakeholders in the course of preparing this feasibility study. The most significant of these are outlined below:

8.1.1.1. Initial stakeholder consultation

An initial stakeholder consultation was held at the BBA conference room on 9 June 2016. Attendees included senior officers of the Bangladesh Bridge Authority (including the Secretary and the Chief Engineer) as well officers from DTCA, Gazipur City Corporation, BRTA, BIWTA, RAJUK, DMRTDP, DMP BPDB, Titas Gas, Bangladesh institute of Planners, Bangladesh Railway, LGED, Savar Municipality and BWDB.

8.1.1.2. Safeguards consultations

Two community level consultation meetings were held on 30 July 2016; at Vatuliya, Kamarpara and later that day at Ranadola Beribadh. Five focus group discussions were held on 31 July with representative members of groups likely to be affected by the project. These comprise: landowners, business groups, wage labourers, residential land owners and female groups. The meetings were arranged to best suit availability of the local people. Details are to be found in the Resettlement Action Plan included as Appendix H.

In addition to impact and mitigation measures, minimizing private land acquisition and optimum use of available government land, policy of compensation and resettlement benefits for affected structure and other assets, people's preferences about mode of compensation, potential social and environmental impacts and mitigation measures, business restoration, income generating alternatives for vulnerable households, gender issues, scope of work for local people especially poor and vulnerable affected people in project civil work etc were discussed at the consultation meetings. They were also informed that during project implementation period, a RAP Booklet will be prepared in Bangla to be distributed locally among the affected persons (APs).

8.1.1.3. Cutoff date

The census survey was carried out on 23 July 2016 and this should be considered as the cut-off date for the project.

8.1.2. Environmental Assessment

8.1.2.1. Initial Environmental Examination

The Initial Environmental Examination (IEE) prepared for the project was considered at the government's Environmental Clearance Certificate Committee's 399th meeting held intermittently from 22 to August 2016 to 4 September 2016. After discussing the detailed scope of work of the proposed project's environmental impact assessment (EIA) the committee approved the project in principle whilst keeping provision for correction / revision. This decision has been promulgated on the Department of the Environment's web site.

8.1.2.1. Environmental Impact Assessment

Formal notification Department of the Environment's approval of the terms of reference to be used for preparation of the EIA was issued in a letter from Department of the Environment (DoE) dated 8 September 2016. The Environmental Impact Assessment (EIA) attached as Appendix H has been prepared in accordance with the DoE terms of reference

8.1.2.2. Environmental Management and Monitoring Plan

An outline environmental management and monitoring plan (EMMP) is included in the EIA and is an update of the EMP contained in the initial environmental examination.

8.1.3. Resettlement Action Plan

A resettlement action plan (RAP) has been prepared and is attached as Appendix I. The RAP applies to full or partial, permanent or temporary physical displacement (relocation, loss of residential land, or loss of shelter) and economic displacement (loss of land, assets, access to assets, income sources, or means of livelihoods) resulting from acquisition of land and dislocation of any shops/businesses due to construction of elevated expressway. The key objective of the RAP is to provide mitigation measures in terms of compensation for land, and other assets at replacement cost, and other necessary assistance to ensure that displaced persons (DPs) are better off in the post-project period.

The RAP establishes the provisions for payment of resettlement assistance to affected households (AHHs), roadside shops and business and income restoration assistance to the poor and vulnerable households, provides a description of socio-economic characteristics of AHHs; sets out the implementation schedule, and provides the budget and cost estimate for implementation.

The main matters addressed in the RAP are discussed below.

8.1.3.1. Land acquisition

Including the existing highway, a total of 89.1136 acres (36.06 ha) of fresh land acquisition is required for construction of the Dhaka Ashulia Elevated Expressway. The total impact on land acquisition compared to the development of this area is minimal and only 347 landowners will lose their land due to the project intervention. According to the census and inventory of losses (IOL) survey, four main categories of land will be affected, these accounting for over 92% of the affected land:

- homestead
- vita/high land
- crop land
- commercial use

Table 8.1: Land requirement by usage

#	Type of Land	Area (acre)				%
		DNCC	Gazipur Sadar	Savar	Total	
A	Homestead	0.3700	1.0395	8.7610	10.1705	17.60
	Vita / High land	0.5000	4.0000	4.7045	9.2045	15.92
	Crop land	0.5539	3.9030	10.3129	14.7698	25.55
	Commercial	0.4018	2.0000	16.7979	19.1997	33.22
	Other	0.8100	0.7330	2.9120	4.4550	7.71
	Subtotal (A)	2.6357	11.6755	43.4883	57.7995	***100***
B	Existing land for highway	nil	6.9309	22.8065	29.7374	
C	Vita/High Land (Others GoB. office)	1.5767	nil	nil	1.5767	
	Total A+B+C	**4.2124**	**18.6064**	**66.2948**	**89.1136**	

Source: Census and IOL survey conducted by DevConsultants Ltd. July-August, 2016

8.1.3.2. Displacement and impact of the project

The project impacts for this package have been assessed based on a census survey conducted within the ROW areas on non-land physical assets using the acquisition boundary as shown on the final concept design. The census survey was conducted in July and August 2016. The impact assessment was carried out both at household and community levels through various field surveys and stakeholders' consultation meeting. The surveys included a census where household level data of all affected households were collected. The questionnaires established an inventory of losses of each affected household, which included details of potentially affected structures (i.e. residential houses), crop land, trees and other assets belonging to each household. The survey also included inventory of businesses structures (small scale local grocery, furniture and poultry shop) as well as public and community structure on the Project right-of-way.

The survey showed a total of 1,299 households (5,440 persons) would be affected. The main adverse impacts of the project were loss of land and structures (residential and business premises). The impacts on income and livelihood were found to be minimal. Table 8.2 summarises the impacts, particularly focusing on land acquisition, displacement of residential, business (shops) and community properties.

According to the census data 101 households are considered vulnerable based on their income level (below poverty line). Of these 30 are female-headed households (FHH). Only 28 community property (CPR) i.e. educational institution, mosque, health centre and eid-gah will be affected by the project. The project will affect 2,767 trees (excluding bamboo and bananas) on private and GoB land.

Table 8.2: Displacements and Other Impacts

Impacts/Types of losses		DNCC	Gazipur Sadar	Savar Upazilla	Total
A	**Alignment Length and Required Land Acquisition**				
1	Total length of alignment				24 km
2	Total land required for the project (acre)	68.0636	21.514	108.8685	198.4461
3	Required land Acquisition (acre)	2.6357	11.6755	43.4883	57.7995
4	Required land Acquisition for Existing Highway (acre)	nil	6.9309	22.8065	29.7374
5	Required land Acquisition for Gob. Others office (acre)	1.5767	nil	nil	1.5767
Total Required land Acquisition (acre)		4.2124	18.6064	66.2948	89.1136
B	**Number of Affected entities without CPR**				
1	Affected Residential HHs only	230	5	38	273
2	Affected Residential cum Commercial HHs only	37	nil	47	84
3	Affected roadside shops and business HHs only (small scale)	323	48	527	898
4	Affected roadside business HHs only (large scale)	8	2	55	65
5	Number of affected vendors	49	4	310	363
6	Number of HHs losing secondary structures only	8	nil	35	43
7	Only trees affected HHs	1	nil	nil	1
C	**Number of affected units other than B**				
1	Affected CPRs	19	nil	9	28
2	Affected GoB organization	13	nil	5	18
3	Others (NGO office etc)	7	nil	8	15
D	**Additional data by categories (already embedded in A, B and C)**				

Impacts/Types of losses		DNCC	Gazipur Sadar	Savar Upazilla	Total
1	Number of total affected entities (B+C)	695	59	1,035	1,789
	Number of total affected households	599	53	647	1,299
2	Number of total affected population	2,565	183	2,692	5,440
3	Average HH size	4.28	3.45	4.16	4.19
4	Total no. of trees on private land (Excluding banana/bamboo)	68	19	327	414
5	No of trees affected on government land (excluding banana/bamboo)	1,863	79	411	2,353
6	Total no. of banana and bamboo	5,223	33	58	5,314
8	Total quantity of primary structure affected (In sq ft)	338,170	11,482	1,378,553	1,728,205
9	Total quantity of secondary structure affected (In sq ft / rft / no)	390	4	1,451	1,845
10	Number of wage labourers affected	287	7	1,937	2,231
11	Number of affected residential tenants	249	nil	176	425
	Number of affected commercial tenants	124	2	8178	1,004
E	**Total number of vulnerable HHs**				**101**
	Number of female headed HHs affected	27	nil	3	30
	Number of male headed Vulnerable HHs affected	47	9	15	71

Source: Census and IOL survey conducted by DevConsultants Ltd. July-August, 2016

8.1.3.3. Socio-economic profile of affected persons

Of the affected households 91.07% are male-headed meaning that 8.9% are female-headed Most of the population are between 15 and 59 years old with population profile decreasing sharply after 60 years of age.

8.1.3.4. Entitlement and Compensation

For private sector investments undertaken through Infrastructure Promotion and Financing Facility (IPFF), Bangladesh Bank (BB) prepared adopted an environmental and social management framework (ESMF) in July 2011. The ESMF is a handbook on environmental and social safeguard policy compliance of private sector and PPP projects which follows the World Bank's operational policies on safeguards (environmental and social) and takes into account laws and policy on land acquisition in Bangladesh. The acquisition of private land and resume of public lands from private users will lead to loss of assets and displacement of peoples of various extents and categories. Land acquisition is governed by the Acquisition and Requisition of Immovable Property Ordinance, 1982 (Ordinance II of 1982 with amendments up to 1994).

The Government of Bangladesh has promulgated the Dhaka-Ashulia Elevated Expressway (Land Acquisition) Act 2011 to avoid unexpected situations in the process of land acquisition for the project. In October 2013 the Government of Bangladesh decided to follow the guidelines contained in the ESMF for IPFF of the Bangladesh Bank for resettlement and rehabilitation of the project affected persons.

Eligibility to receive compensation and assistance will be limited by the cut-off date (see section 8.1.1.3) which is applicable to those identified on the project right of way land proposed for acquisition at the time of census. Any households or persons identified on the project right of way during this process will be eligible for compensation and assistance from the project. People who settle within in the affected areas (ROW) after the cut-off date will not be eligible for compensation

although they will be given sufficient advance notice to vacate premises and dismantle affected structures prior to project implementation.

An entitlement matrix has been prepared on the basis of census and inventory of losses survey conducted for the households, shops and common/community properties affected within the project right of way. The matrix is included in the Resettlement Action Plan and identifies the categories of impact based on the census and IOL and shows the entitlements for each type of loss. The matrix describes the units of entitlements for compensating the loss of land, structure, business and various resettlement benefits. The resettlement benefits for indirect losses will be directly paid by BBA through a RAP implementing NGO (INGO). The INGO will be engaged to assist the BBA in this respect. The displaced persons will be allowed to fell and take away trees and salvaged materials of affected structures free of cost without delaying the project works. Crop owners will be given one month prior notice to harvest the crops if they are at or near harvesting stage. If the project damages the standing crops, the actual owners of crops will be entitled to compensation for crops at market price.

Some local people have planted different species (fruit bearing and timber) of trees within the government land. As per engineering design, if the trees are be felled for the project work the actual owners of the trees will be entitled for compensation for only bamboo bush and fruit bearing trees without timber such as banana groves, guava, lemon, papaya, etc. The policy has kept provision of compensation for such types of trees planted on the government land by the local people. The INGO will assist the BBA in preparation of necessary papers (ID cards, EP / EC, indent, debit voucher, etc.) for making payment of additional compensation and resettlement benefits to the entitled persons (EPs).

8.1.3.5. Costs and Budget

Table 8.3 shows the estimated costs for land acquisition and resettlement at 2016 market prices together with the necessary supplements for replacement cost, physical assets and businesses with assessed replacement cost for the same year, and additional assistance for loss of income and vulnerabilities as per the resettlement policy framework. This budget is indicative of outlays for different expenditure categories assessed by census (July-August, 2016) for physical assets and estimates of land for acquisition.

These costs will be updated and adjusted once the land acquisition boundaries will be finalized and the government adopts a price of land and other assets based on recommendations of PAVC for replacement cost prior to implementation. Replacement cost of land and property will be updated annually if the PAVC at the district level justifies the same at the time of dispossession for any considerable price escalation.

The total estimated cost of implementation of the RAP is BDT23.3 billion which is equivalent to USD298 million.

Table 8.3: Estimated Budget for Compensation and Resettlement

#	Category of losses	DC Budget (BDT)	Additional budget (BDT)	Total Budget (DC plus additional)		%
				BDT	USD	
A.1	Compensation for land	4,949,169,425	11,118,045,017	16,067,214,442	205,989,929	69.0
A.2	Compensation for land for existing highway	1,250,168,081	nil	1,250,168,081	16,027,796	5.4
A.3	Compensation for land (in dec.) for others GoB Office	440,156,933	348,193,068	788.350,000	10,107,317	3.4
B.	Other Resettlement Benefits for land	nil	241,746,707	241,746,707	3,099,317	1.0

#	Category of losses	DC Budget (BDT)	Additional budget (BDT)	Total Budget (DC plus additional)		%
				BDT	USD	
C.1	Compensation for Primary structure	1,516,266,876	758,019,724	2,274,286,600	29,157,521	9.8
C.2	Compensation for Secondary Structure	24,454,616	12,225,474	36,680,090	470,258	0.2
D.	Other Resettlement Benefits for structure	nil	217,821,050	217,821,050	2,792,578	0.9
E	Compensation for trees on private land	999,560	nil	999,560	12,815	0.0
F	Compensation for Trees on Gob. Land	nil	4,979,620	4,979,620	63,841	0.0
G	Other Resettlement Benefits for trees	nil	112,350	112,350	1,440	0.0
H	Other Resettlement Benefits	nil	48,669,000	48,669,000	623,962	0.2
I	Implementation cost for INGO	nil	50,000,000	50,000,000	641,026	0.2
J	External Monitoring Agency	nil	20,000,000	20,000,000	256,410	0.1
	Total of A to I (BDT)	8,181,215,491	12,819,812,009	21,001,027,500	269,243,942	90.2
	DC Contingency @ 2%	163,624,310	nil	163,624,310	2,097,748	0.7
	Subtotal	***8,344,839,801***	***12,819,812,009***	***21,164,651,810***	***271,341,690***	***90.8***
	Contingency 10% of the total	834,483,980	1,281,981,201	2,116,465,181	27,134,169	9.1
	Total	**9,179,323,781**	**14,101,793,209**	**23,281,116,990**	**298,475,859**	**100**

8.1.3.6. Grievance Redress Mechanism

Grievance redress is a very important part of resettlement project implementation. According to the grievance redress mechanism proposed in the RAP, grievance redress committees (GRCs) will be established at two levels:

- union/municipal level
- project level

GRCs will be formed with representatives from BBA at the community level (union/municipal), local elected representatives from the local government institutions (LGI), affected persons representatives (women representative in case of women APs), and RAP implementing NGO. GRC decisions will be publicized among the local communities on a majority basis. Where the complaining parties are not satisfied with the GRC decisions, they can approach the project officer (BBA level) for resolution. The proposed process is outlined in Figure 8.1

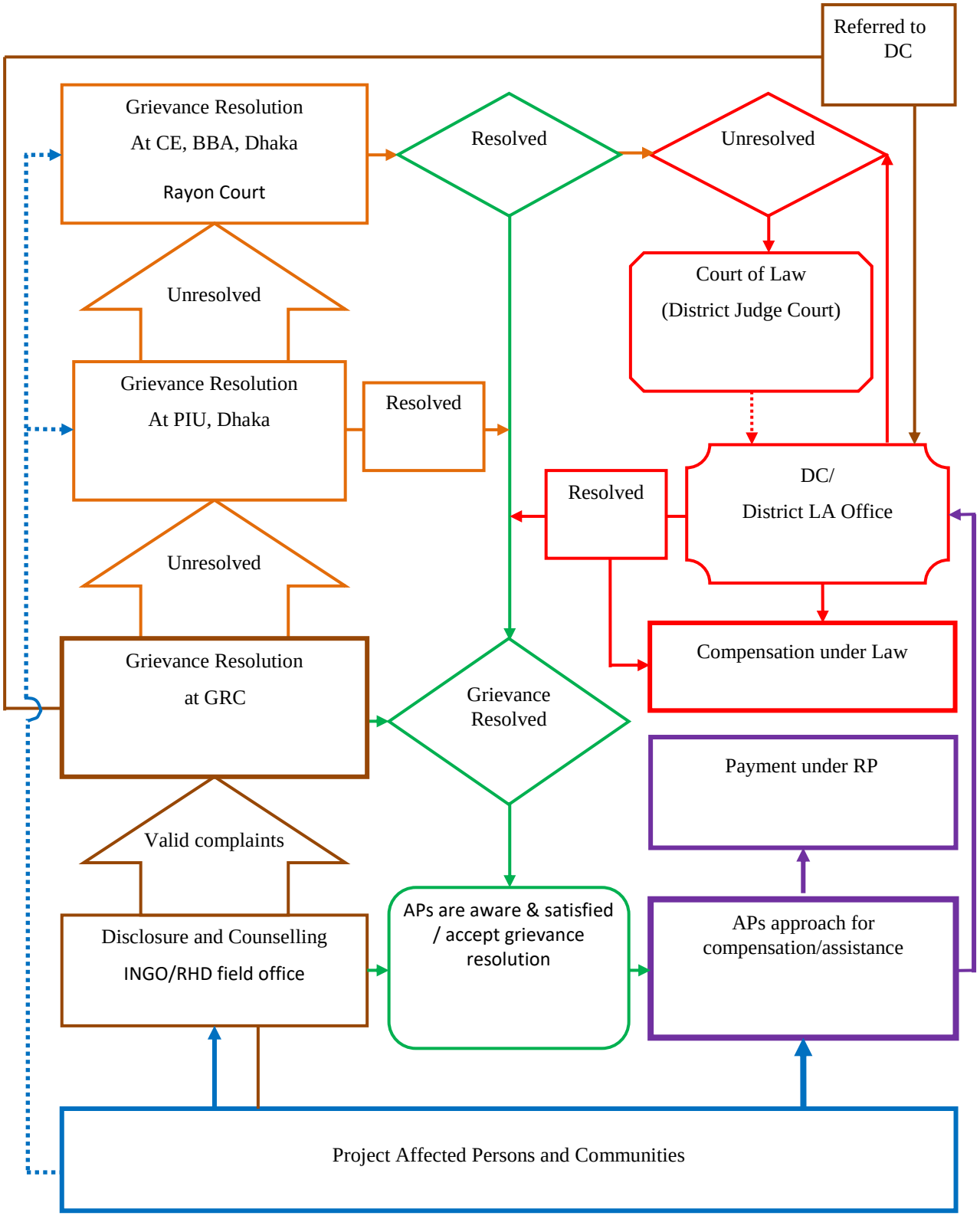


Figure 8.1: Proposed Grievance Redress Process

8.1.3.7. Implementation Arrangements

The project is being implemented under a public-private-partnership (PPP) between the government of Bangladesh represented by BBA and the government of China, represented by the Dhaka Ashulia Elevated Expressway Project, which, as per the concessionaire agreement, is responsible to finance design, and construct the Expressway, operate it and transfer after expiry of the 25 year concession agreement. BBA is responsible for financing land acquisition, the resettlement of project affected persons and the provision of land for construction.

The DAEE and BBA will jointly engage an independent engineer (IE) for design and construction supervision. An Engineering and Procurement Constructor (EPC) will be engaged by DAEE for procurement of goods and civil works construction. The PPP Office under the Prime Minister's Secretariat is providing coordinating and policy support for execution of the concessionaire agreement. BBA will engage an experienced NGO for services in management of land acquisition and resettlement.

Implementation of the RAP will begin prior to the commencement of engineering works.

8.1.3.8. Monitoring and Evaluation

The chief resettlement officer and additional project director will be responsible for executing the monitoring and evaluation of the RAP implementation with monitoring being continued until the end of the RAP implementation.

8.1.4. Land Acquisition Plans

Land acquisition plans have been prepared based on the concept designs and form Appendix G. The plans include plot schedules for each mouza. Should the final design make changes to land take requirements set out in the concept design drawings, the land acquisition plans and plot schedules will need to be updated to be suitable for use for land acquisition.

9. EXPRESSWAY OPERATION AND MAINTENANCE

9.1. Introduction

Like any major facility, an expressway and in particular an elevated tolled expressway in an urban area requires a degree of activity to ensure its smooth operation. Such activity can be broken down into operational and maintenance components. The responsibility for these will depend on the agreements struck by BBA for the expressway. But regardless of which organisation ends up being responsible the important thing is that the operation and maintenance activities occur in a regular and coordinated manner. The following sections set out some of the major components.

9.2. Operation

9.2.1. Patrol

A key part of expressway operation is regular patrolling of the expressway and associated facilities such as ramps. Patrols will be looking for:

- Stranded motorists / breakdowns
- Hawkers / people loitering
- Stray animals
- Obstructions such as items that have fallen from trucks

As they move along the expressway, the patrols will be undertaking inspections and providing emergency support as the need arise. These activities require that patrol vehicles be equipped with signs, lights, tools and equipment to deal with the above matters or make a situation safe until other equipment can be mobilised.

9.2.2. Control Room

A crucial part of the operation of the expressway will be a fully equipped control room from which the major operations can be observed and which can be a focal point for dealing with both routine and unexpected situations. Good communications are an essential part of this control room and the facilities to which it relates.

9.2.3. Incidents

The expressway operations team must be able to quickly mobilise ambulance and crane/ tow truck to deal with accidents or damage. Being able to repair minor to moderate damage is a critical part of expressway operation and can prevent a small item contributing to a much more serious situation.

9.2.4. Training

All expressway operation and maintenance personnel must be trained in how to do their job, to do it safely and to recognise when further assistance is required.

9.2.5. Reporting

Accurate and on-time reporting is essential to proper operation of the expressway. This will allow trends to be detected and for the expressway operator to show that work is being done and that actions were taken as required. The reports must be read by personnel with overall responsibility for the expressway operation.

9.3. Maintenance

9.3.1. Programmed Maintenance

Maintenance related to routine, predictable matters can be programmed well in advance and should be able to minimise expense through letting of periodic maintenance contracts for items such as resheeting of road surfaces, replacement of light fittings, painting, reinstatement of Linemarking etc. A reactive approach will tend to be far less economic and will result in facilities deteriorating to unacceptable levels before action is taken.

9.3.2. Ad-hoc maintenance

There will inevitably be items that require maintenance outside a regular pattern. This may include services to toll plazas such as electricity and water supplies, air conditioners, sewerage system, tolling equipment, potholes some road sections. The maintenance crew should be equipped to deal with these evens which whilst predictable will occur at unknown times

Dealing with accident damage will be a crucial part of maintenance activities and start to overlap with the patrol activities. Likely situations are damage to crash barriers, noise barriers, signs and toll plaza buildings and gates. Training as noted in 9.2.4 and 9.2.5 will be needed here as well.

10. PROJECT COST ESTIMATION

10.1. Overview

Project costs have been estimated based on a detailed quantity take–off from the feasibility level designs and using the RHD rates schedule (2015). This approach is realistic given that the work is of a straightforward nature and the estimators are highly experienced in preparing estimates of this nature. The estimates have been compared with those from detailed design for other road projects and on all-up rates, eg cost of elevated roadway on a per square metre basis.

The estimates include an allowance of 3% for physical contingency and 6% for price contingency, plus design and construction supervision costs.

10.2. Data and Summary Expressway

The detailed cost estimate is given in Appendix D. The tables below summarise the major components and the cost estimate.

Table 10.1: Information Data – Elevated Expressway

#	Item	Quantity	Unit
1	Length (excluding toll plazas)	22,031	m
2	Width	20.56	m
3	Ramp length	3,892	m
4	Ramp width	7.1	m
5	Ramps	12	no.
6	Toll plazas	3	no.
7	Area of main toll plaza	97,092	m^2
8	Single piers excluding toll plaza	538	no.
9	Portal frames	131	no.
10	Length of portal frame for elevated expressway	3,466	m
11	No. of 30 m girders	5,954	no.
12	No. of 40 m girders	1,514	no.
13	Length of box girders	2,108	m

Table 10.2: Information Data – Four Lane- At Grade Road

#	Item	Quantity	Unit
1	Length	15.28	km
2	Width	14.6	m
3	Two-lane bridge length (2 nos.)	2,740	m
4	Two-lane bridge width	10.9	m
5	Drainage pipe (1500 to 1800 mm dia.)	15.28	km
6	Single piers in bridges	84	no.
7	Size of ducts for utilities (2.20 m* 1.5 m)	3.30	m^2
8	Length of ducts for utilities	19,200	m.
9	U-turns	2	no.
10	length of U-turns	1,300	m
11	U-turn width	10.9	m
12	Footbridges	5	no.
13	Underpasses	1	no.

Table 10.3: Cost Estimate Summary

#	Item	Cost	
		BDT (million)	USD (million)
1	Four lane elevated expressway (23.971 km)	60,386.5	774.2
2	Ramps	1,805.6	23.2
3	Four lane at-grade road (15.28 km widening) plus two 2 lane bridges (2.74 km)	7,769.0	99.6
4	Toll plazas	1,403.5	18.0
5	Land acquisition and resettlement (36.07 ha private) – incl NGO and INGO	23,281.0	298.5
6	Drainage and duct for utilities	2,705.2	34.7
7	Four lane Nabinagar flyover with ramp (0.71 km)	1,279.3	16.4
8	Design Cost	2,070.4	26.5
9	Supervision Cost	1,380.3	17.7
	TOTAL	**102,080.8**	1,308.8

11. SOCIO ECONOMIC ASSESSMENT

11.1. Introduction

This section shows various socio-economic indicators for Bangladesh. The focus is on changes in gross domestic product (GDP) and the flow-on effects for greater industrial production and demand for transport both across the country and within Dhaka.

11.2. Country Overview

The People's Republic of Bangladesh lies in the north-eastern part of South Asia and is bounded by India on the north and west, Myanmar on the southeast and the Bay of Bengal on the south. The country cover 147,600 km^2 and consists mostly of low, flat and fertile land. There are hilly regions in the northeast and southeast and some areas of high lands in the north western part. A network of rivers, and especially the Padma, the Jamuna, the Teesta, the Brahmaputra, the Surma, the Meghna, the Karnaphuli, is important for navigation, drainage, water supply and as a source of sand for construction.

As shown in Table 11.1, the country is divided into divisions, and subdivided into 64 districts and 489 police stations (upazilla/ sub districts) for administrative and development purposes. For the purposes of local government, the country is divided into upazillas, thanas and union councils.

According to the UN (2014) its human development index (HDI) score was 0.515. While poverty reduction in both urban and rural areas has been significant, 31.5% of the population live below the national poverty line of US$2 per day. This proportion is higher in the rural areas where it is 35.2% compared with 21.3% for the urban population

Table 11.1: Administrative Units of Bangladesh

Administrative Units	Number
Division	8
District	64
Upazilla	489
Union (Rural)	4,550
City corporation	11
Pourashava (Municipality)	323

Source: LGRD & Police Head Quarters, BBS_2012,P-33, and
http://www.bangladesh.gov.bd/site/view/division-list/List-of-Divisions , date: 9/8/16

11.3. Demography

11.3.1. Population

More than 161 million people were estimated to live in Bangladesh in 2016, making it one of the most densely populated countries of the world, with 1,237 persons per km^2. Men account for 50.5% of the population and women 49.5%. In 2016 the annual population growth rate was 1.2 %. There were 32.1 million households in the country distributed over 59,229 mouzas (BBS 2012). A more detailed breakdown is given in Tables 11.2 and 11.3 as well as Figures 11.1 and 11.2

In the ten years from 1990 to 2000 the population compound annual growth rate (CAGR) was 2.2%. This is slowing; with it being 1.7% for the 5 years from 2000 to 2005 and 1.2% for 2010 to 2015, CAGR is 1.2%. These figures confirm the country's steps taken towards the population control as well as reflecting the improved economic conditions (countries with higher GDP have lower birth rates).

The government's long term aim is to limit population growth to 1.0%.

Table 11.2: Population, Density and Growth Rate in Bangladesh / Dhaka

Year	Pop'n (million)	Pop'n growth rate (%)	Pop'n density	male % of total)	Female % of total	Rural			Urban			Dhaka City (million)	Dhaka City growth rate %
						Pop'n (million)	Pop'n as % of total	Pop'n growth %	Pop'n (million)	Pop'n as % of total	Pop'n growth %		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
2000	131.3	2.0	1008.5	51.0	49.0	100.3	76.4	1.4	31.0	23.6	3.6	10.3	
2001	133.8	1.9	1027.7	51.0	49.0	101.5	75.9	1.2	32.2	24.1	4.1	10.7	4.0
2002	136.2	1.8	1046.5	51.0	49.0	102.5	75.2	0.9	33.7	24.8	4.6	11.1	3.6
2003	138.6	1.7	1064.8	51.0	49.0	103.4	74.6	0.8	35.2	25.4	4.5	11.5	3.6
2004	140.8	1.6	1082.0	51.0	49.0	104.1	73.9	0.7	36.8	26.1	4.4	11.9	3.6
2005	142.9	1.5	1098.0	50.9	49.1	104.6	73.2	0.5	38.3	26.8	4.2	12.3	3.6
2006	144.8	1.3	1112.7	50.9	49.1	105.0	72.5	0.4	39.9	27.5	4.0	12.8	3.6
2007	146.6	1.2	1126.2	50.8	49.2	105.2	71.8	0.2	41.4	28.2	3.9	13.2	3.6
2008	148.3	1.1	1138.9	50.7	49.3	105.3	71.0	0.1	42.9	29.0	3.8	13.7	3.6
2009	149.9	1.1	1151.6	50.6	49.4	105.4	70.3	0.1	44.5	29.7	3.7	14.2	3.6
2010	151.6	1.1	1164.8	50.6	49.4	105.4	69.5	0.1	46.2	30.5	3.7	14.7	3.6
2011	153.4	1.2	1178.5	50.5	49.5	105.5	68.8	0.1	47.9	31.2	3.7	15.3	3.6
2012	155.3	1.2	1192.7	50.5	49.5	105.6	68.0	0.1	49.7	32.0	3.7	15.8	3.6
2013	157.2	1.2	1207.3	50.5	49.5	105.7	67.2	0.1	51.5	32.8	3.6	16.4	3.6
2014	159.1	1.2	1222.1	50.5	49.5	105.8	66.5	0.1	53.3	33.5	3.6	17.0	3.6
2015	161.0	1.2	1236.8	50.5	49.5	105.8	65.7	0.0	55.2	34.3	3.5	17.6	3.6
CAGR* (5 Years)	1.2%		1.2%			0.1%			3.62%			3.6%	

Data Source World Development Indicators, Last Updated Date : 7/22/2016 http://data.worldbank.org/country/bangladesh

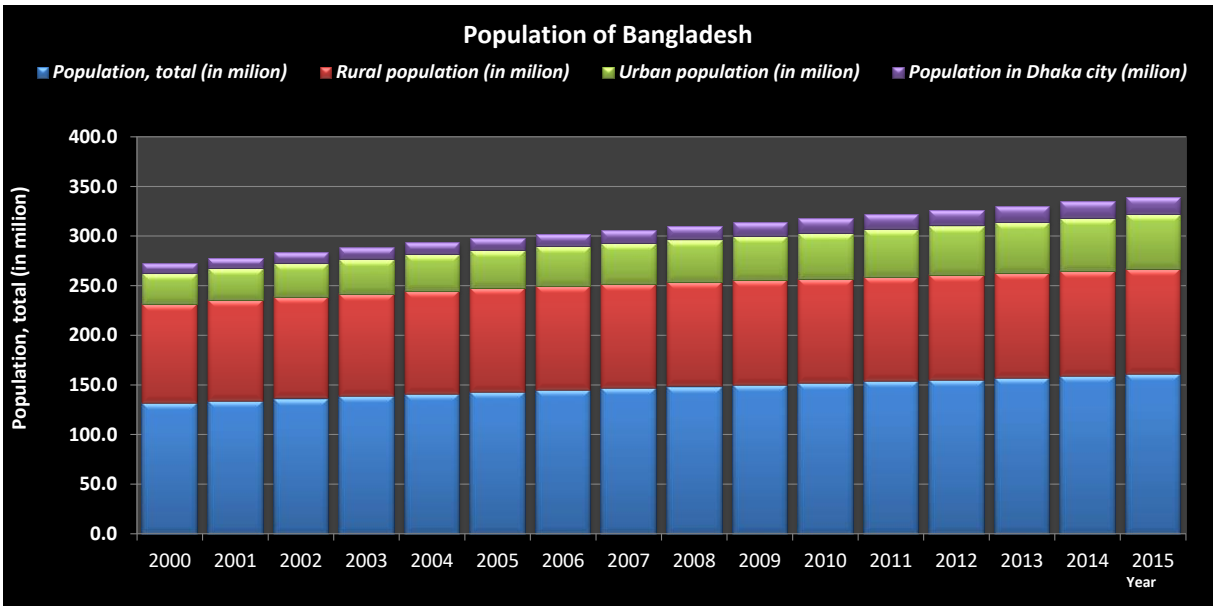


Figure 11.1: Population of Bangladesh – 2000 to 2015

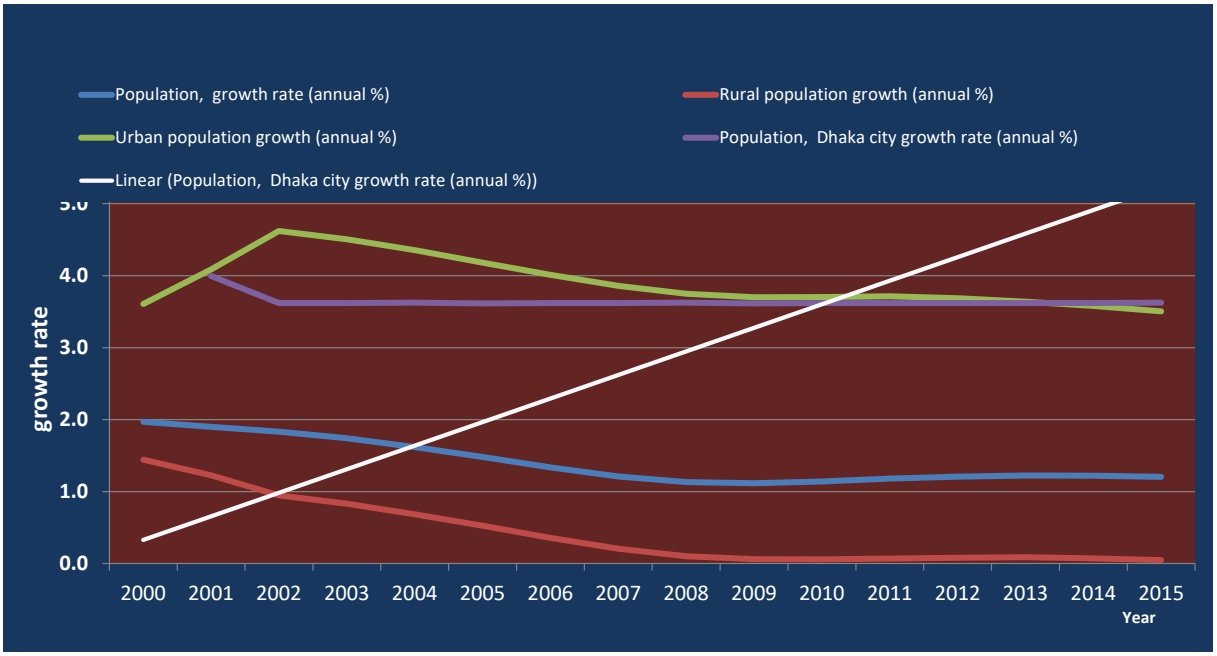


Figure 11.2: Bangladesh Population Growth Rate – 2000 to 2015

Table 11.3: Bangladesh Population by Division

Division	Total Households (million)	Population (million)				
		Urban	Rural	Total	Male	Female
Barisal Division	1.9	1.4	7	8.3	4.1	4.2
Chittagong Division	5.6	6.9	21.5	28.4	13.9	14.5
Dhaka Division	10.8	15.6	31.8	47.4	24.2	23.3
Khulna Division	3.7	2.8	12.9	15.7	7.8	7.8
Rajshahi Division	4.5	3.3	15.2	18.5	9.3	9.2
Rangpur Division	3.8	2.1	13.7	15.8	7.9	7.9
Sylhet Division	1.8	1.5	8.4	9.9	4.9	5.0

Data source: The Statistical Yearbook of Bangladesh 2012/P-35/T-2.03, Population and Housing Census, 2011

The demographic characteristics by divisions of the country show higher population concentrations in Dhaka, Chittagong and Rajshahi.

11.3.2. Occupation

More than 65.7% of the country's population lives in the rural areas and is dependent mainly on the agriculture and fishing. Trading and industrial activities are becoming increasingly important sectors in the country. Production of readymade garments and knitwear for export has become a major economic activity. This sector offers considerable employment opportunities in general and particularly to women. There is only a very small mining sector. Figure 11.3 shows historic data for employment by profession.

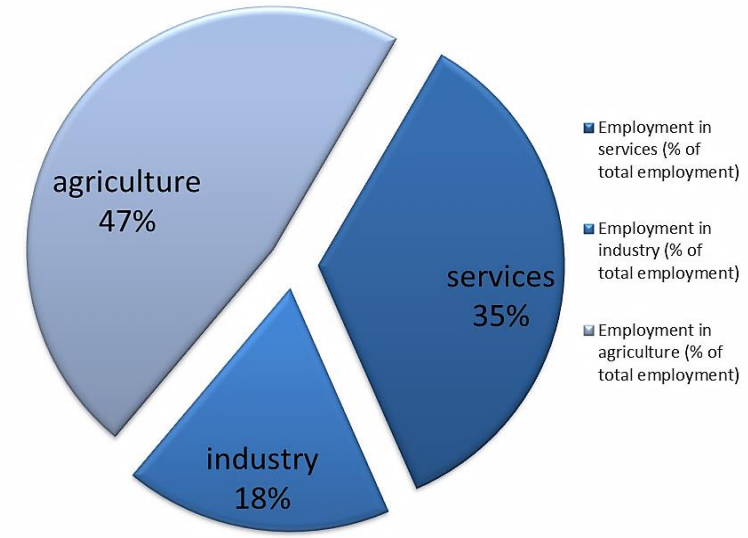
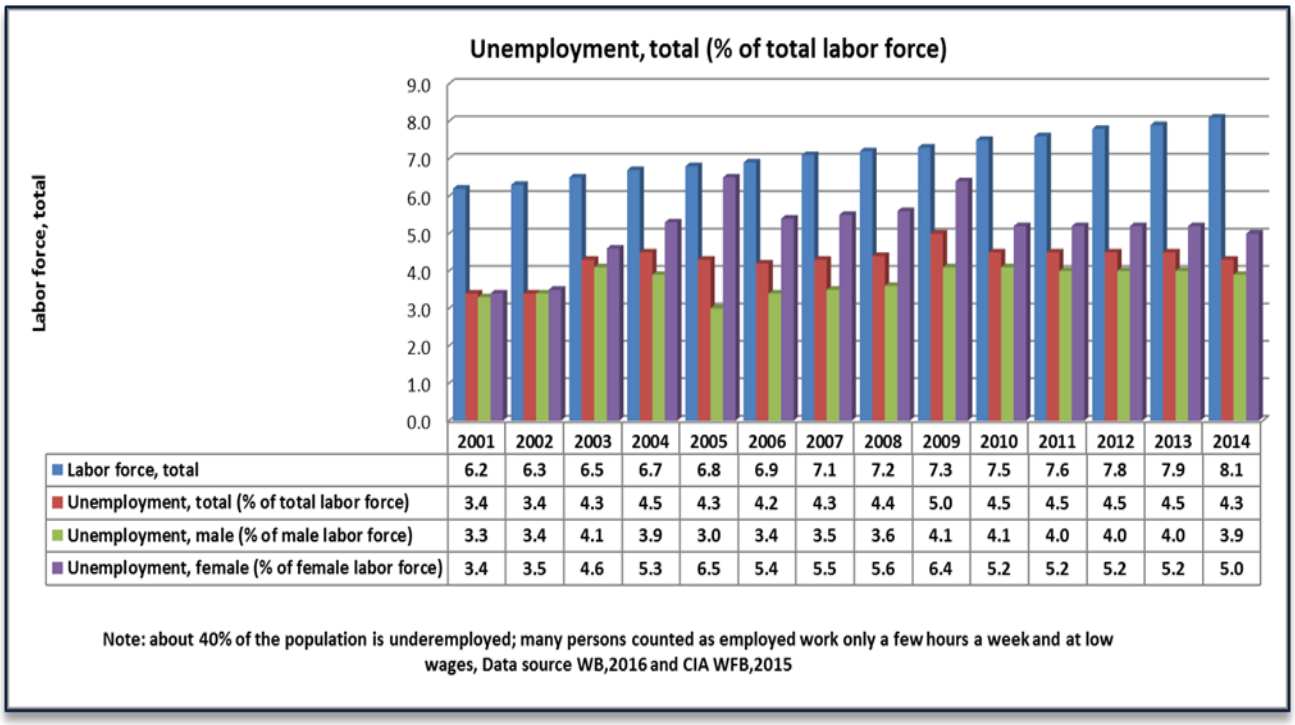


Figure 11.3: Employment by Profession in 2010 Source: data.worldbank.org/country/bangladesh)

11.3.3. Unemployment

The unemployment rate is 4.3% of the population with this being slightly higher for women (5.0%) than for men (3.9%) in 2014. Refer to Figure 11.4. These figures refer to the simple activity rate of the economically active population. One of the positive developments in the employment scenario of the economy has been the increase of female participation in the labour force. The GDP growth of the economy has not been complemented by satisfactory employment creation and the number of unemployed people has increased over the years. The World Bank (2016) reports that Bangladesh is

the only country in South Asia where the growth in the labour force touched growth in employment during the last decade.



	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Labor force, total	6.2	6.3	6.5	6.7	6.8	6.9	7.1	7.2	7.3	7.5	7.6	7.8	7.9	8.1
Unemployment, total (% of total labor force)	3.4	3.4	4.3	4.5	4.3	4.2	4.3	4.4	5.0	4.5	4.5	4.5	4.5	4.3
Unemployment, male (% of male labor force)	3.3	3.4	4.1	3.9	3.0	3.4	3.5	3.6	4.1	4.1	4.0	4.0	4.0	3.9
Unemployment, female (% of female labor force)	3.4	3.5	4.6	5.3	6.5	5.4	5.5	5.6	6.4	5.2	5.2	5.2	5.2	5.0

Figure 11.4: Level of Unemployment in Bangladesh

11.3.4.Urbanisation in Dhaka

Covering an area of 300 km^2, Dhaka is located in central Bangladesh on the eastern bank of the Buriganga River (Figure 11.5) and the upper reaches of the Ganges Delta. In total the city has 130 wards and 725 mohallas. The Dhaka District has an area of 1,464 km^2 and in 2016 had a population of 17.6 million. Further statistics are provided in Table 11.4.

Tropical vegetation and moist soils characterize the land, which is flat and close to sea level. Its low relief leaves Dhaka susceptible to flooding from heavy rainfall and cyclones during the monsoon season.

Table 11.4: Dhaka Key Statistics

Dhaka at a glance	Dhaka Division	Dhaka District(Zilla)	
		2011	2001
Population	4,74,24,418	1,20,43,977	85,11,228
Male	2,41,72,317	65,55,792	47,12,330
Female	2,32,52,101	54,88,185	37,98,898
Urban	1,27,15,797	74,23,137	77,34,825
Other Urban	28,69,038	18,93,906	59261
Rural	3,18,39,583	27,26,934	7,17,142
Annual growth rate	1.93	3.48	3.84
Sex Ratio			
Total	104	119	124
Urban	116	125	127
Other Urban	112	118	111
Rural	99	107	98

Dhaka at a glance	Dhaka Division	Dhaka District(Zilla)	
		2011	2001
Households (HH)			
Total	1,08,49,315	27,86,133	17,96,950
Urban	29,10,693	16,84,986	16,39,806
Other Urban	6,69,994	4,52,261	12719
Rural	72,68,628	6,48,886	1,44,425
Average HH Size			
Total	4.3	4.2	4.7
Urban	4.3	4.3	4.6
Other Urban	4.2	4.2	4.5
Rural	4.4	4.2	4.9
Area sq. km	31177.74	1463.6	1459.55
Area sq. mile	12037	565	563
Density per sq. km	1521	8229	5831
Density per sq. mile	3940	21313	15103
Urbanization (%)	32.86	77.36	91.57
Literacy (%)			
Both Sex	54.2	70.5	64.8
Male	57	73.6	69.6
Female	51.3	66.9	58.7
School Attendance (5 to 24 years) (%)			
Both Sex	50.7	47.3	38.2
Male	52.5	49.6	40.1
Female	48.9	44.8	36.2
Population (Adjusted)			
Both Sex	4,93,21,688	1,25,17,361	90,36,647
Male	2,51,40,072	68,13,453	50,03,350
Female	2,41,81,616	57,03,908	40,33,297
Administration			
Upazilla/Thana	163	46	27
Union	1256	86	75
Mouza	15517	974	1019
Village	25213	1,999	1,864
City Corporation	1	1	1
City Ward	92	92	90
City Mahalla	855	855	731
Pourashava	85	3	2
Paura Ward	795	27	18
Paura Mahalla	2499	133	99
Share of Occupation		Agriculture 10%, industry 25%, Service 65%	
Main fruits		Mango, jackfruit, papaya, guava, olive, coconut, kul and banana	
Main crops		Paddy, jute, wheat, potato, peanut, onion, garlic, chilly,	

Dhaka at a glance	Dhaka Division	Dhaka District(Zilla)	
		2011	2001
		ginger, betel nut, pulse, corn, sugarcane and vegetables. Extinct or nearly extinct crops are asha kumari and koulgi paddy, linseed, sesame, jute, cotton, mustard seed, china, chhola and kaun.	
Annual Average Temperature and Rainfall		Maximum 34.5°C, minimum 11.5°C and rainfall 1931 mm.	
Major Communication Hubs		Hazrat Shahjalal International Airport, Kamalapur Railway Station, Sadarghat Launch Terminal and the bus stands at Saidabad, Gabtoli and Mohakhali.	
Manufacturing Industries		Ceramic, beverage , garments , foot ware, jute mills, textile mills, printing and dying factory, transformer industry, automobile , biscuit and bread factory, pharmaceutical , cosmetic , soap factory, rice mill, flour mill, ice factory, ball pen , polythene , saw mill, brick field, cold storage, weling, plant nursery, etc. Besides, there are many spare parts workshops at Nawabpur, Bangshal, Dholai Khal Par and Sutrapur areas of Dhaka. Cottage industries weaving, jamdani sari,	
Main Exports		Rice, mustard seed, vegetables, peanut, banana, coconut, jackfruit, readymade garments, medicine, cosmetics, electronics, electrical goods etc.	

Source-BBS District report-,Dhaka Zilla/2012
Note: There are two city corporations in Dhaka district and four city corporations in Dhaka Division (2016), https://en.wikipedia.org/wiki/List_of_City_Corporations_of_Bangladesh

11.4. Vehicle Ownership

11.4.1. Fleet Mix and Growth

Table 11.5 shows the number of registered vehicles in Bangladesh as reported by from Bangladesh Road Transport Authority (BRTA) for the last eight years. In line with the growth in road-based transport there has been significant increase in the number of mechanized vehicles in recent years. Between 2000 and 2015 the number of mechanized vehicles increased by about 9.2%. In the last 15 years (2001-2015), the CAGR of vehicles has been

- minibus/bus (4.2%),
- microbus (12.0%),
- truck (4.7%),
- jeep (1.8%),
- car (5.9%),
- autorickshaw (5.9%),
- motorcycle (12%).

At present, there are 2.64 million motor vehicles in Bangladesh and the CAGR of total number of motor vehicles in Bangladesh for the five years 2012 to – 2016 is 9.4%. The biggest increase has been in motorcycles. Bangladesh has one of the lowest vehicle ownership levels in the world. In 2015 motorcycle ownership was 8.65 per 1,000 people and car ownership was 1.79 per 1000 people. Two - wheelers dominate the fleet with almost 58%. More detail can be found in Appendix C.

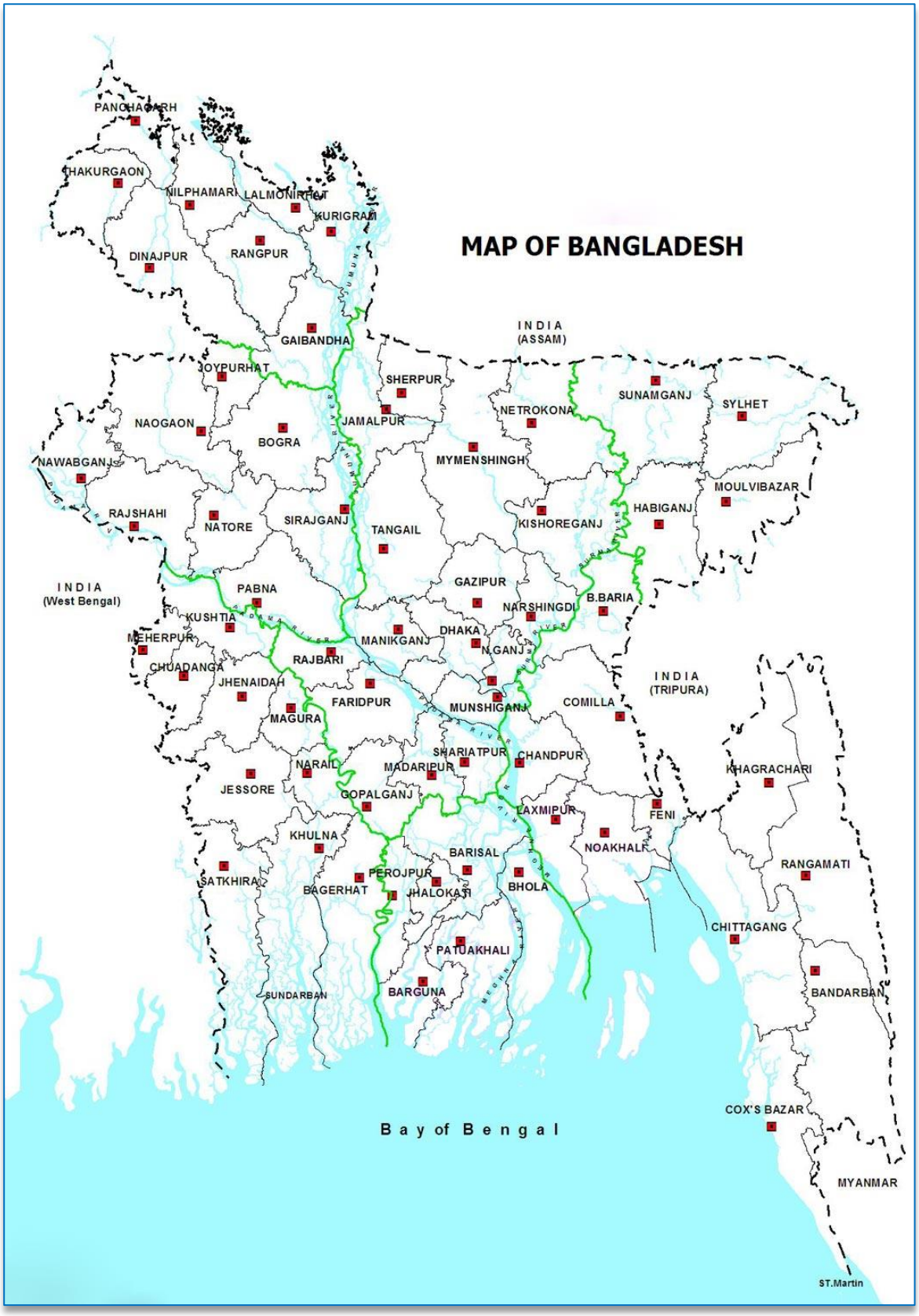


Figure 11.5: Bangladesh Divisions

Table 11.5: Registered Vehicles in Bangladesh

Year	Large Bus	Truck	Jeep (SUV)	Car	Taxi	Auto Rickshaw	Motor - cycle	Delivery Van	Human Hauler	Micro bus	Minibus	Pick Up	Others	Total	Average Annual Growth Rate (%)
2009	26,016	73,336	30,162	196,870	44,361	108,436	650,147	15,564	5,846	59,404	24,749	23,273	49,222	1,307,386	
2010	27,778	82,871	32,286	219,830	44,380	126,763	759,257	17,063	6,520	66,379	25,644	32,240	57,233	1,498,244	14.6
2011	29,539	90,198	34,420	232,780	44,455	147,186	873,873	18,067	7,672	70,430	25,920	42,700	66,390	1,683,630	12.4
2012	30,978	94,533	35,989	242,004	44,627	170,731	975,461	18,841	8,387	73,474	26,169	50,325	72,816	1,844,335	9.5
2013	32,085	99,662	37,303	252,476	44,678	186,428	1,061,269	19,735	8,772	76,011	26,317	56,878	79,830	1,981,444	7.4
2014	33,573	107,798	39,173	267,175	45,052	206,325	1,151,954	20,911	8,997	80,324	26,573	66,432	87,796	2,142,083	8.1
2015	35,964	114,128	42,774	288,237	45,140	226,325	1,392,312	22,630	10,139	85,548	26,896	76,689	96,516	2,463,298	15.0
2016	38,087	117,498	45,537	299,887	45,148	232,303	1,525,283	23,792	11,772	88,932	27,177	82,075	102,858	2,640,349	7.19
Traffic in 2016(Million)	0.04	0.12	0.05	0.30	0.05	0.23	1.53	0.02	0.01	0.09	0.03	0.08	0.10	2.64	
CAGR (5 y's)	**5.2%**	**5.4%**	**5.8%**	**5.2%**	**0.3%**	**9.6%**	**11.8%**	**5.7%**	**8.9%**	**4.8%**	**1.0%**	**14.0%**	**9.2%**	**9.4%**	
Percentage (2016)	1.4%	4.5%	1.7%	11.4%	1.7%	8.8%	57.8%	0.9%	0.4%	3.4%	1.0%	3.1%	3.9%	100.0%	

Data source-BRTA, 25/7/2016, www.brta.gov.bd

Notes: 1. Other: Ambulance, Auto Tempo, Cargo Van, Covered Van, Special Purpose, Tanker, Tractor and other type vehicle of BRTA

2. Pick Up: (Double/Single Cabin)

3. CAGR: Compound Growth Rate

The trend data is presented in Figure 11.6.

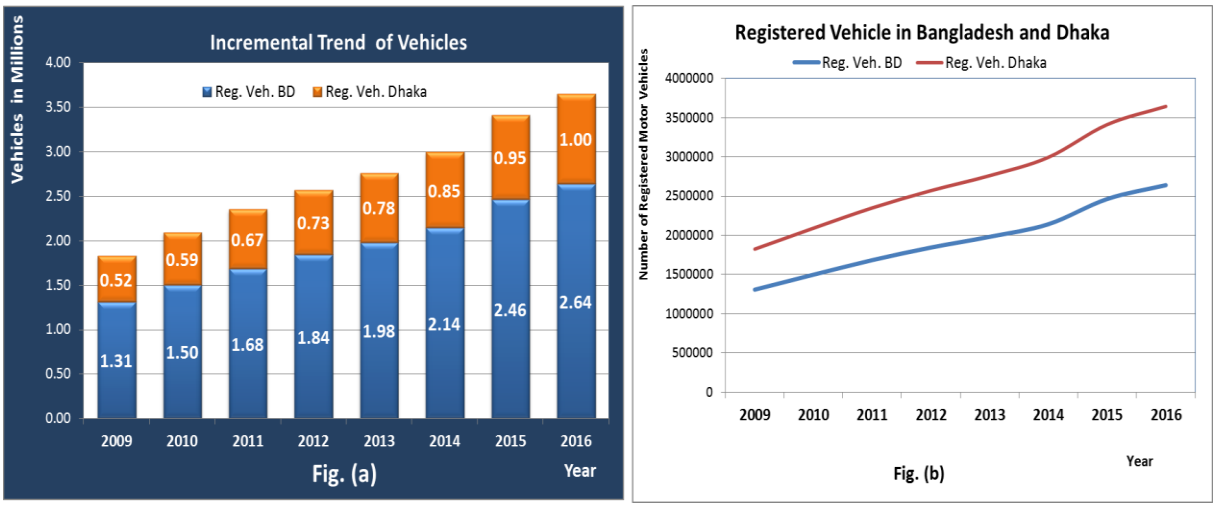


Figure 11.6: Trends in Vehicle Registration – 2009 to 2016

11.4.2. Regression Analysis

The vehicle registration data presented above lends itself to regression analysis to give a means of predicting future numbers of vehicles. There is good correlation between the number of vehicles and GDP. Regression analysis has shown the following relationship:

$$\boldsymbol{y_i(\mathrm{MVG}) = 11.361 + 0.56\,x_i(\mathrm{GDP}) + \mu_i}$$

Where,

y_i (Motorized Vehicle (MVG)) =dependent variable and estimate value of y for a fixed value of x;

x_i (GDP) = independent variable;

The coefficient of correlation r is ± 0.56. There is a positive association between GDP and Motorized Vehicle (MVG). If GDP increases by 1% then the motorized vehicle (MVG) increases by about 0.56%.

The results of such analysis are illustrated in Figure 11.7

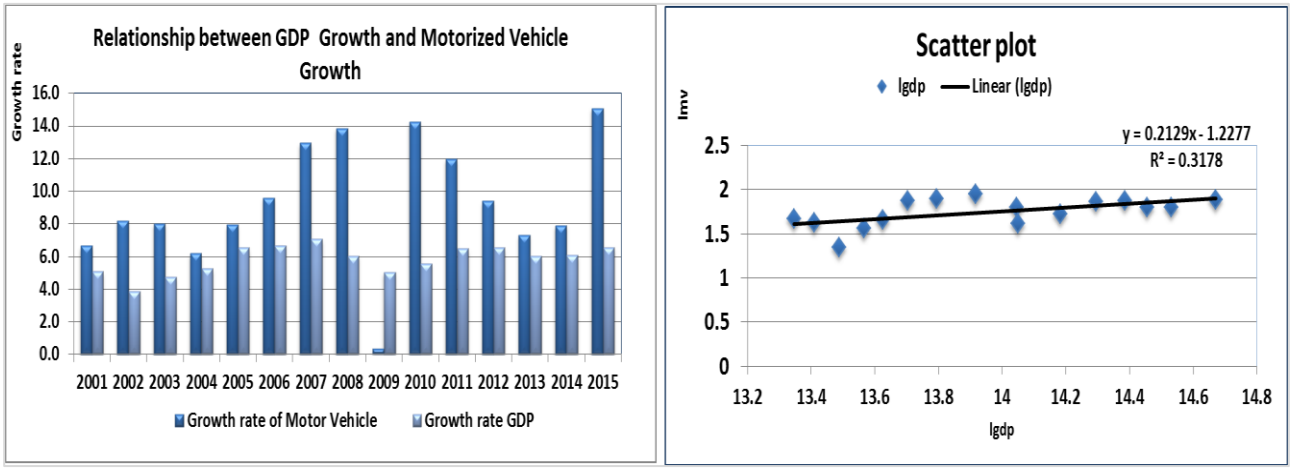


Figure 11.7: GDP versus Motorized Vehicle Growth

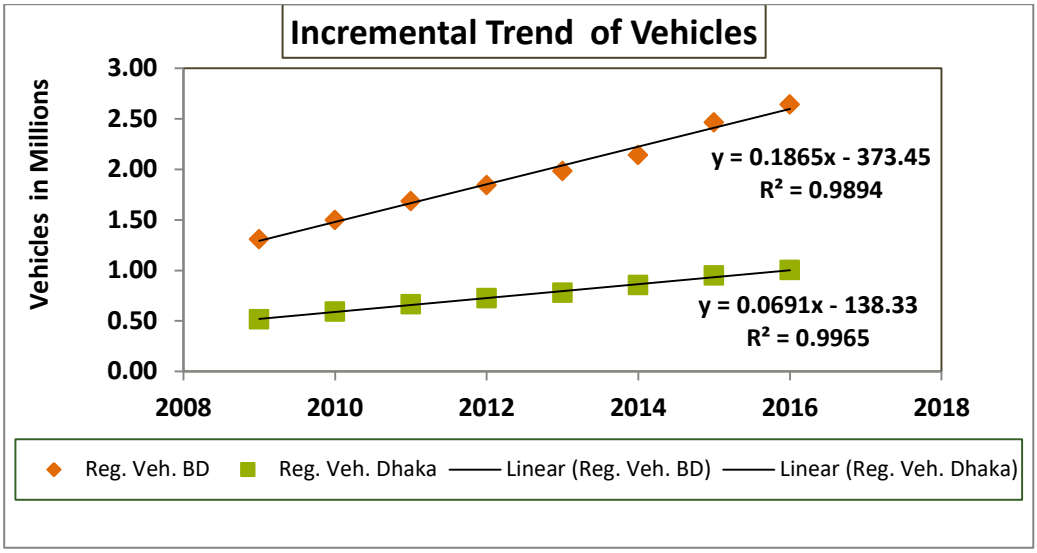


Figure 11.8: Incremental Trend of Vehicles for Dhaka and Rest of Bangladesh

11.5. Macro-Economic Indicators

11.5.1. Gross Domestic Product (GDP)

Bangladesh's GDP has been estimated at US$195.1 billion. According to Bangladesh Bank, the growth in GDP has been over 6% per annum for the last five years, being:

- 6.5% (2011-12)
- 6.0% (2012-13)
- 6.1% (2013-14)
- 6.6% (2014-15).
- 7.1% (2015-2016)

The growth in GDP averaged 5.66% from 1994 until 2015, reaching an all-time high of 7.05% in 2015-2016 and a record low of 4.1% in 1994. The CAGR in GDP for the last ten years is 6.2%. Further information is provided in Table 11.6 and Figures 11.9 and 11.10

Table 11.6: Economic Growth 2000 to 2015

Year	*GDP growth (annual %)*	*GDP per capita growth (annual %)*	*GDP per capita, PPP growth (annual %)*	*GNI growth (annual %)*	*GNI per capita growth (annual %)*
2000	5.3	3.3	3.3	5.5	3.4
2001	5.1	3.1	3.1	4.8	2.9
2002	3.8	2.0	2.0	4.8	2.9
2003	4.7	2.9	2.9	4.8	3.0
2004	5.2	3.6	3.6	5.6	3.9
2005	6.5	5.0	5.0	6.6	5.1
2006	6.7	5.3	5.3	7.9	6.5
2007	7.1	5.8	5.8	7.9	6.6
2008	6.0	4.8	4.8	7.1	5.9
2009	5.0	3.9	3.9	5.3	4.1
2010	5.6	4.4	4.4	5.8	4.6
2011	6.5	5.2	5.2	6.2	5.0

Year	GDP growth (annual %)	GDP per capita growth (annual %)	GDP per capita, PPP growth (annual %)	GNI growth (annual %)	GNI per capita growth (annual %)
2012	6.5	5.3	5.3	7.0	5.7
2013	6.0	4.7	4.7	5.6	4.3
2014	6.1	4.8	4.8	4.8	3.5
2015	6.6	5.3	5.3	6.4	5.1

Data Source: World Development Indicators, PPP= Purchasing power parity.
Last Updated Date: 22 July 2016, http://data.worldbank.org/country/bangladesh

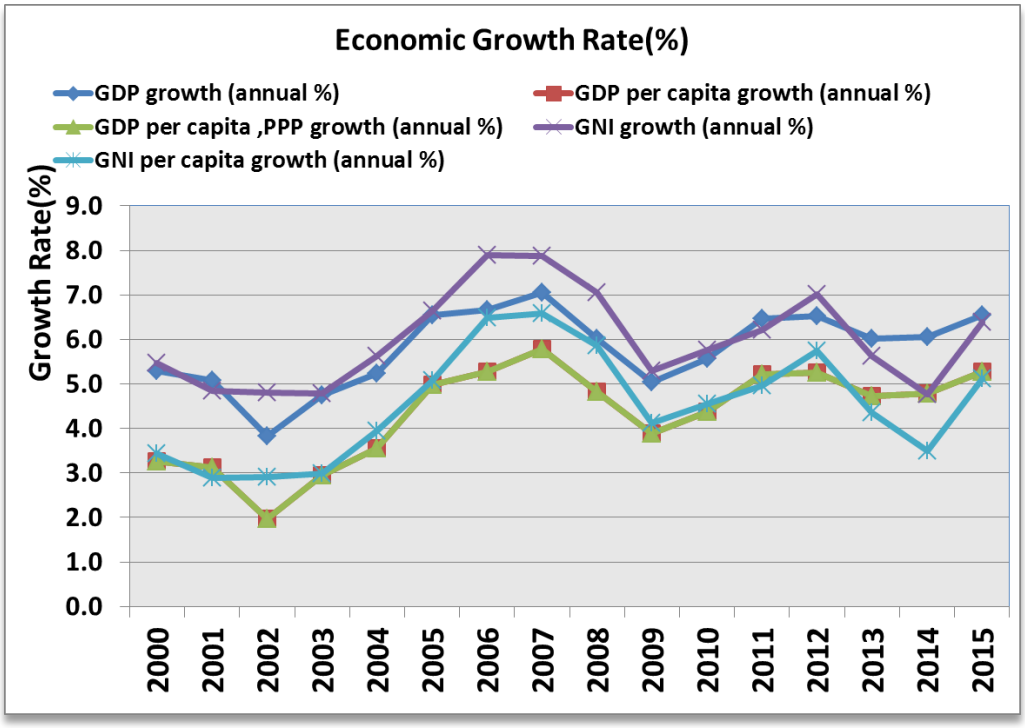
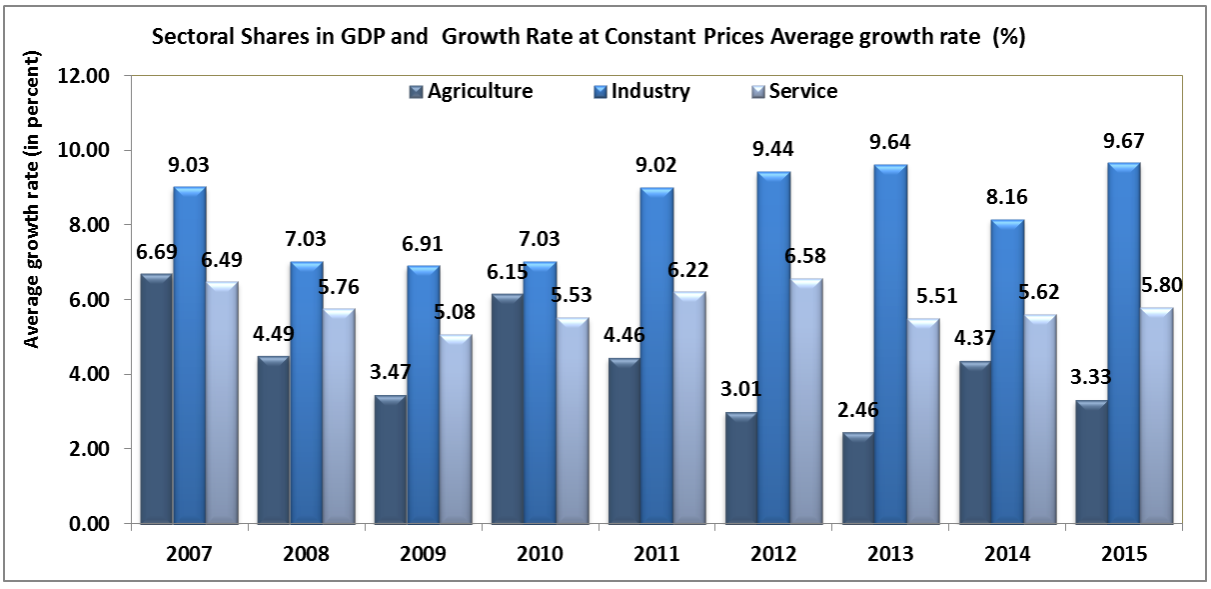


Figure 11.9: Economic Growth Rate



Source: http://data.worldbank.org/country/bangladesh,Last Updated Date: 7/22/2016,

Figure 11.10: Average Sectoral GDP Growth at Constant Prices

Recent GDP growth rates and projections are compared in Table 11.7.

Table 11.7: GDP Growth Projections

Overview	2015	Q4 / 16	Q1 / 17	Q2 / 17	Q3 / 17	2020
GDP Growth Rate (%)	6.55	7.05	6.8	6.7	6.8	6.8
Inflation Rate (%)	5.5	5.7	5.6	6.3	5.1	4.8

Source: http://www.tradingeconomics.com/bangladesh/gdp-growth, date:19 Nov 2016
Economic Forecasts | 2016-2020 Outlook, BDT= Bangladesh Taka,

11.5.2. Economic Growth – ADB Forecast

The ADB has forecast a 6.9% percent growth rate for Bangladesh in 2017 and has forecast an annual inflation rate of 5.9% in 2016 and a slightly higher figure of 6.1% in 2017.

11.5.3. Inflation

Bangladesh has been observing a moderate level of price increase as is shown by movements in the consumer price index (CPI) given in Table 11.8 and shown graphically in Figure 11.11. According to the CPI, the inflation rate in FY 2014-15 was 6.41% at the national level compared with 7.35% in FY 2013-14.

The 5-year CAGR to 2014-15 was 8.0%, 8.4% and 7.4% for general, food and non-food indices respectively. During FY 2014-15, non-food inflation was lower than food inflation.

Table 11.8: Consumer Price Index and Inflation

Year	General	GR	Food	GR	Non-food	GR
2006-07	109.39	7.2	111.63	7.8	106.51	6.4
2007-08	122.84	12.3	130.3	16.7	113.27	6.3
2008-09	132.17	7.6	140.61	7.9	127.36	12.4
2009-10	141.18	6.8	149.4	6.3	130.66	2.6
2010-11	156.59	10.9	170.48	14.1	138.77	6.2
2011-12	170.19	8.7	183.65	7.7	152.94	10.2
2012-13	181.73	6.8	193.24	5.2	166.97	9.2
2013-14	195.08	7.3	209.79	8.6	176.23	5.5
2014-15	207.58	6.4	223.8	6.7	186.79	6
5-year CAGR	8.00%		8.40%		7.40%	

Source Bangladesh Economic Review 2014-15, Page- ,CHAPTER 3, page-24,
Base year 2005 -06 index -= 100

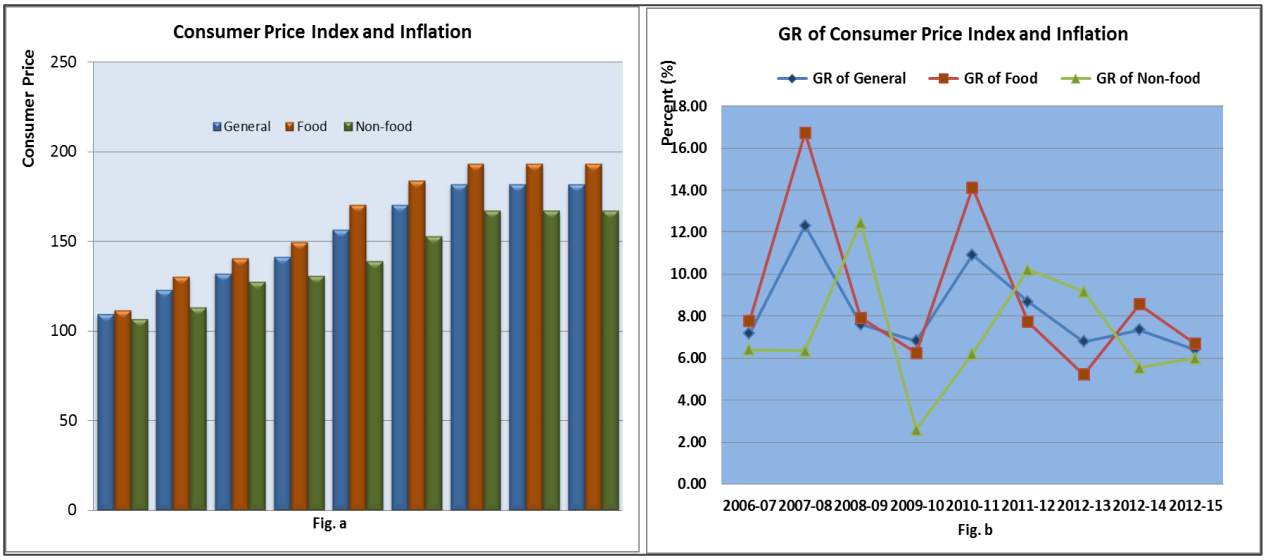


Figure 11.11: Consumer Price Index and Inflation

11.5.4. Per Capita Income

Per capita income (PPP at constant 2011 international $) of the country has grew by 5.3% pa in 2015. In 2014-15, Bangladesh per capita income reached USD1314 compared with USD928 in 2010. Over the last five years the CAGR of per capita income has been 9.3%.

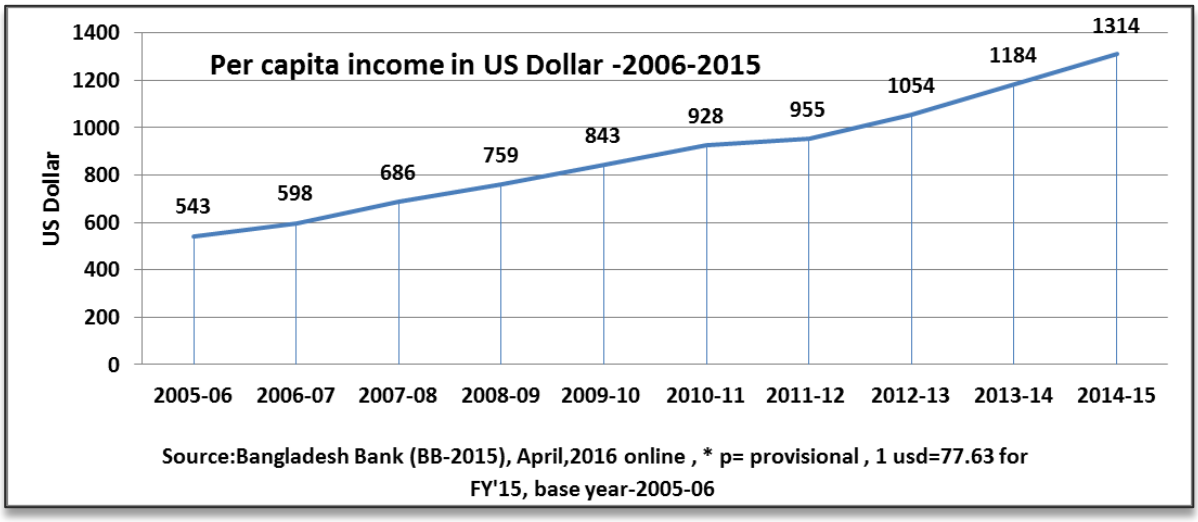


Figure 11.12: Per Capita Income in US Dollar -2006-2015

11.5.5. Industry

Garment exports which are the backbone of Bangladesh's industrial sector, accounted for more than 80% of total exports and surpassed $25 billion in 2015. The sector continues to grow, despite a series of factory accidents that have killed more than 1,000 workers, and crippling strikes, including a nationwide transportation blockade during the first several months of 2015.

Industrial activity is growing. According to BBS estimates, the contribution of the broad industry sector to real GDP stood at 29.55% in FY 2013-14 and increased to 30.42 % in FY 2014-15. Five-year CAGRs for various sectors are given in Table 11.9 and show annual growth rates of between 7.6% and 10.4%. The levels of traditional industrial products of the country such as jute, paper, cloths and sugar have been decreasing whilst commodities such as cement, readymade garments, tea, soap, detergent, leather products are increasing.

Table 11.9: Size and Growth Rate of Manufacturing Sector (At constant prices of 2005-06) BDT crore

Industry	2008-09	2009-10	2010-11	2011-12	2012-13	2013-14	2014-15	CAGR
Small & Cottage	18,525	20,040	21,176	22,569	24,558	26,180	28,907	7.6%
Growth Rate (%)	7.3	16.1	14.3	6.6	8.8	6.6	10.4	
Medium-Large	74,934	79,631	88,475	97,998	108,436	118,364	130,676	10.4%
Growth Rate (%)	6.5	13.2	18.1	10.8	10.7	9.2	10.4	
Total	93,459	99,671	109,651	120,567	132,994	144,544	159,583	9.9%
Growth Rate (%)	6.7	13.8	17.3	10.0	10.3	8.7	10.4	

Source: BBS, Bangladesh Economic Review 2014-2015, Page- ,93

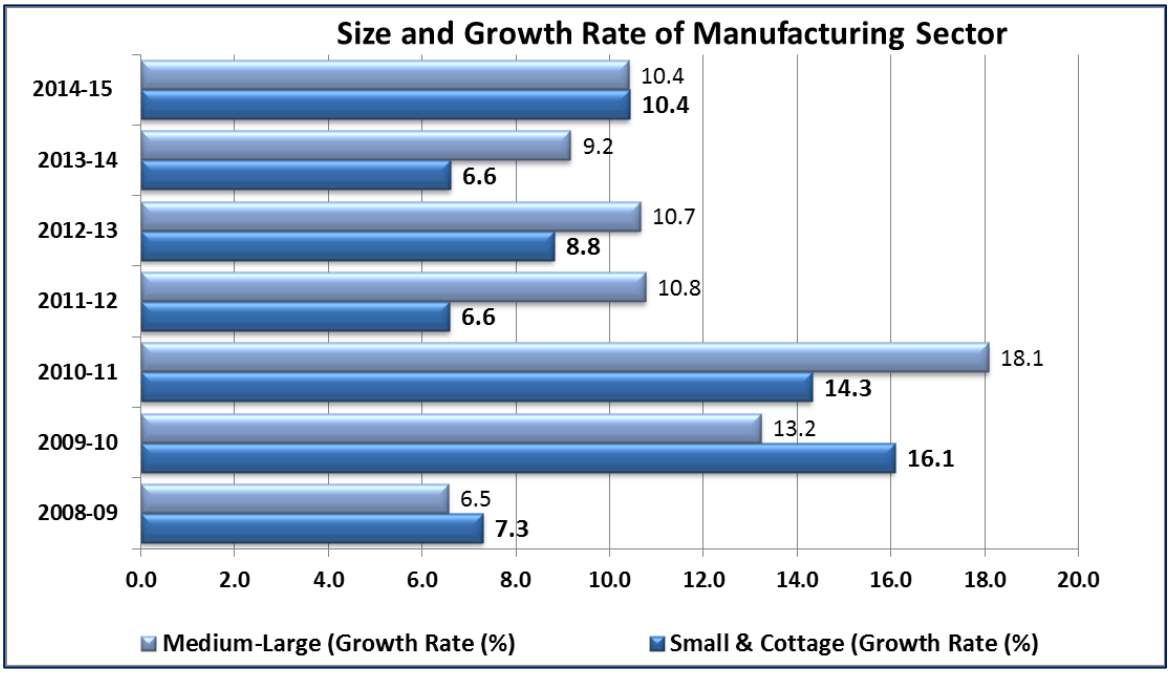


Figure 11.13: Size and Growth Rate of Manufacturing Sector

Table 11.10: Production of Major Industrial Commodities in Bangladesh

Period	Cotton Yarn	Cotton Cloth	Paper	Cigarettes	Oil Products	Food Products	Sugar	Fertilizers	Glass Sheets	Matches
	'000 bales	'000 metres	tonnes	Lac sticks	tonnes	tonnes	tonnes	Tonnes	'000 sq metres	'000 Gross box
2004-05	573	32,585	24,316	238,600	53,187	97,053	108,739	2,102,306	1,751	12,808
2005-06	671	38,050	25,704	245,970	63,305	108,239	129,413	1,926,645	2,037	13,428
2006-07	870	43,730	22,896	245,580	67,007	120,485	162,199	1,982,292	2,325	13,316
2007-08	951	46,079	24,079	241,800	70,331	125,436	163,844	1,581,364	2,085	12,964
2008-09	981	50,566	24,240	236,410	73,077	134,069	79,922	1,342,024	2,111	13,416
2009-10	1,006	52,975	18,676	236,790	76,918	156,528	62,203	1,138,644	2,021	13,330
2010-11	1,030	56,181	20,241	234,510	76,970	154,384	100,963	1,011,941	1,898	14,143
2011-12	955	56,546	20,740	315,050	113,765	162,407	63,309	1,036,947	1,442	18,148
2012-13	970	56,949	17,774	262,620	313,265	194,048	107,133	1,074,791	2,364	20,989
2013-14	974	57,386	13,098	283,130	352,115	209,106	128,268	976,691	2,009	20,813
5 years CAGR=	-0.1%	2.6%	-11.6%	3.7%	37.0%	9.3%	9.9%	-6.2%	-1.0%	9.2%

Source: Bangladesh Bank Time Series data. Table-VII, April 2016

Note: i) Oil Products = Soya bean + Vegetable Oil (Dalda) ii) Fertilizer = Urea + Ammonium Sulphate + TSP + SSP + DAP

iii) Food Products = Atta, Maida and Suji.

12. ECONOMIC EVALUATION

12.1. Study Approach and Methodology

The objective of the economic evaluation is to assess and compare the life cycle costs and benefits of the identified alternatives (Base Case and Investment Case) associated with the Dhaka – Ashulia Elevated Expressway with Project that include the widening of existing sections on N302 from two lanes to four lanes.

The comparison is based on the present and projected traffic volume on the existing road network and the new expressway and upgraded project roads, also considering the diverted traffic. Furthermore the evaluation is based on the physical road condition survey, vehicle characteristics and road user unit costs, the identified maintenance strategies for the identified alternatives (schedules and responsive maintenance measures), and the optimized timing proposed for the different road sub-sections according to their deterioration over the period of the evaluation.

The following two alternatives and generated annual cash flows are analysed and compared over a period of 30 years:

- Base Case Alternative: Road user costs along the existing road network being the alternative to the Investment Alternative,
- Investment Alternative: Road user costs on the Dhaka – Ashulia Elevated Expressway and the road sections on N302 being widened from two lanes to four lanes.

Separate overpasses at Nabinagor and Chandra will be constructed record under this project. As the junctions at these two locations are presently heavily congested by traffic, considerable time benefits for road users are expected from the flyover investments. The two flyover investments and subsequent benefits are not directly included in the economic evaluation. The generated benefits are considered as an overall improvement and be part of the Dhaka road infrastructure improvement programme. Therefore the effects are evaluated separately.

12.1.1. Data Collection and Assumptions

The data used for the economic evaluation are given below and have been obtained from various sources including from the bridge and road authorities. More data has been collected from similar studies recently carried out in the Dhaka region. The following inputs are considered for the economic evaluation.

- technical specification for investment and maintenance alternatives
- cost estimates for investments
- cost estimates for maintenance strategies
- vehicle operating costs
- time values for passenger and freight traffic
- vehicle characteristics
- traffic surveys and GDP growth forecasts
- traffic diversion scenarios
- travel speed observations and travel speed design
- accident records
- others including economic development perspectives

12.1.2. Methodology

The economic evaluation has been performed by using the HDM-4 model - version 2.08. The model analyses the total transport costs of the Dhaka – Ashulia Elevated Expressway Project for compared alternatives:

- "Without Project" or the reference Base Case where traffic continue to use the existing road network between the International Airport along road R301 and N302 to Baipayl and towards Chandra Junction, and
- "With Project" or the Investment Alternative where the road user costs on the Dhaka – Ashulia Elevated Expressway and bridgework and widening of road sections on road N302 from two lanes to four lanes.

As the HDM-4 model has some limitations with regard to projecting time value increases, the HDM output data are handled in an Excel model to allow for incorporation of such effects. The costs and benefits taken into consideration by the model are for both vehicle and non-vehicular traffic and comprise:

- economic costs of DAEEP and the widening of road R302 and bridgework between Ashulia Junction and Baipayl and further towards Chandra Junction
- average residual value of 30 % for the Expressway and other project investments at the end of the evaluation period are used for the economic evaluation
- maintenance strategies and costs
- vehicle Operating Costs (VOC) and savings
- travel time costs/savings to passengers and freight
- safety measures and accident savings

For the purpose of the economic evaluation, all costs and benefits are expressed in real resource values to the economy. Taxes, duties and most other transfer payments are deducted from market prices and costs and subsidies added back in. USD is used as the currency for the calculations.

Other exogenous costs and benefits, which are normally less quantifiable, are not analysed by the model but have been considered separately where relevant as part of other benefits.

These include:

- Induced economic development in the project areas and region, such as mainly industrial activities that were previously constrained by traffic congestion.
- The overall improvement of the road corridors to and from Dhaka.
- Direct employment effect from the project.
- Social benefits arising from the increased mobility of the population surrounding the project area including improved accessibility to health, education and other services.

The results of the economic evaluation are expressed in terms of economic internal rate of return (EIRR), net present value (NPV) discounted at 12% and net present value over cost ratio (NPV/C).

12.2. Project Justification

The Dhaka - Ashulia Elevated Expressway (DAEE) will be a 24.0 kilometre long signal-free expressway with a design speed of 80 km/hr, a four-lane carriageway and having four pairs of entry /exit ramps in addition to the entry/exit ramps at the northern terminal and the southern connection to the Dhaka Elevated Expressway. Its route alignment is from Hazrat Shahjalal International Airport near Haji Camp Abdullahpur - Kamarpara - Ashulia - Zirabo - Norshinghopur - Jamgora - Baipayl - EPZ.

The DAEE Project is an extension of the now under construction Dhaka Elevated Expressway Project (DEEP), which starts from Hazrat Shahjalal International Airport and following the railway alignment southwards, terminating at Dhaka-Chittagong highway near Kutubkhali (Shanirakra). The agreed alignment of DAEEP is shown in Figure 12.1.

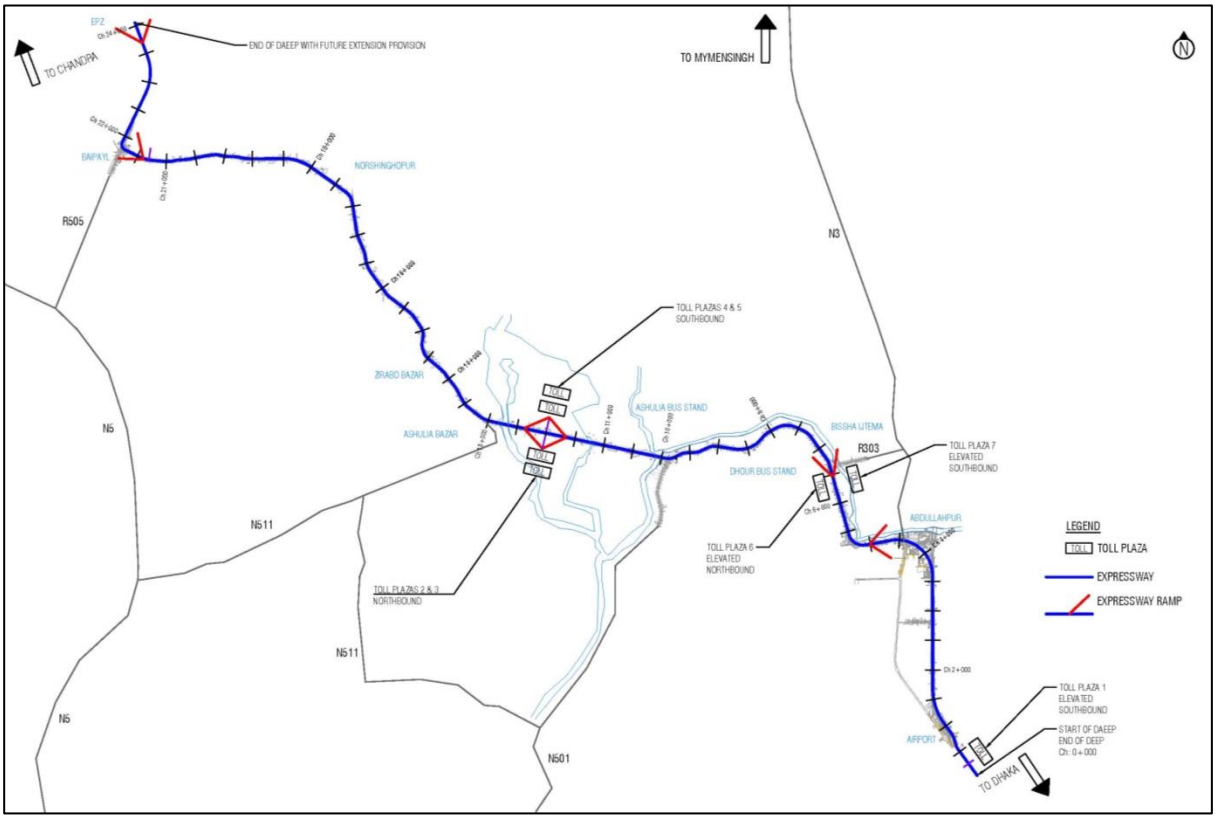


Figure 12.1: Alignment of Dhaka – Ashulia Elevated Expressway Project (DAEEP)

12.2.1. Project influence area

The Dhaka-Ashulia Elevated Expressway Project alignment follows an existing road link, which forms a part of the most important road link connecting the North-East part of the country to Dhaka and beyond. At present users from around 20 north-western districts use the existing Abdullahpur – Ashulia - Baipayl - Chandra link to enter Dhaka whereas users from a further five or six south-western districts use the Abdullahpur - Ashulia-Baipayl - Nabinagor link.

Most of the road users from the Northern districts enter Dhaka using the Abdullahpur gateway. Consequently, more than 40 million people from 30 districts are connected to Dhaka through this corridor. As such, the proposed infrastructure development project has a significant bearing from both improved connectivity and socio-economic point of view for a large number of people.

The implementation of the DAEEP will allow road users from these regions to expect lower transport costs and reduced travel times. Figure 12.2 shows the project-influenced areas and illustrates that the Dhaka - Ashulia corridor provides important transport connectivity for the traffic from national highways N2, N3, N4 and N5.

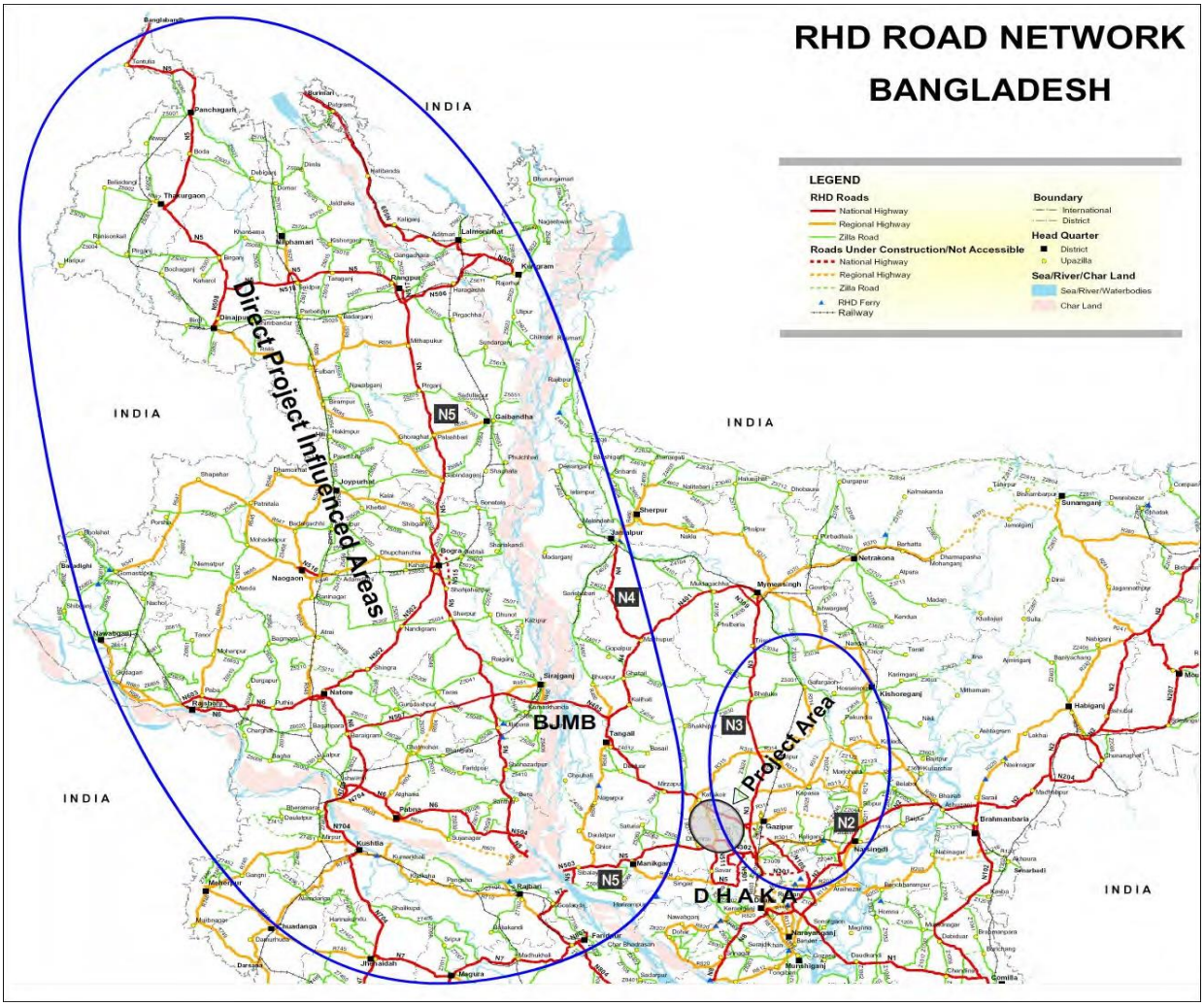


Figure 12.2: Project Influence Area

12.2.2. Road corridor perspectives

The Dhaka Elevated Expressway Project (DAEEP) corridor is also a part of the Asian Highway Route AH2 in Bangladesh as seen from Figure 12.3. The transport corridor is important for establishing an improved transport link on the Trans-Asia highway, thereby facilitating trade from Nepal, Bhutan and north-eastern India to and through Bangladesh. Furthermore it is anticipated that the DAEE Project will provide improved access to Bangabandhu Jamuna Multipurpose Bridge (which currently does not have good access from south of Tangail), and is expected to further accelerate the associated economic growth in the region.

Along the corridor, the land use pattern is largely dominated by industry including the largest export processing zone (EPZ) of Bangladesh, which demands improved transport facilities. Since the Chittagong port is a major origin or destination of a large share of the freight traffic generated from the Dhaka EPZ and its adjoining areas, the Baipayl -Ashulia - Abdullahpur road is presently acting as a pseudo economic corridor.

Implementation of the DAEEP and the DEEP would essentially improve the share of primary road in Dhaka, and the two projects will form an arterial free-flow corridor. Major road works are presently taking place in Dhaka and are interrupting the normal traffic and creating congestion many places. In this regard, the DAEEP and the DEEP are expected to be a great reliever in providing diversion to the affected road users. Proper integration of projects will also facilitate in developing the proposed multi-level-multi-modal interchange facilities at Airport Railway Station.

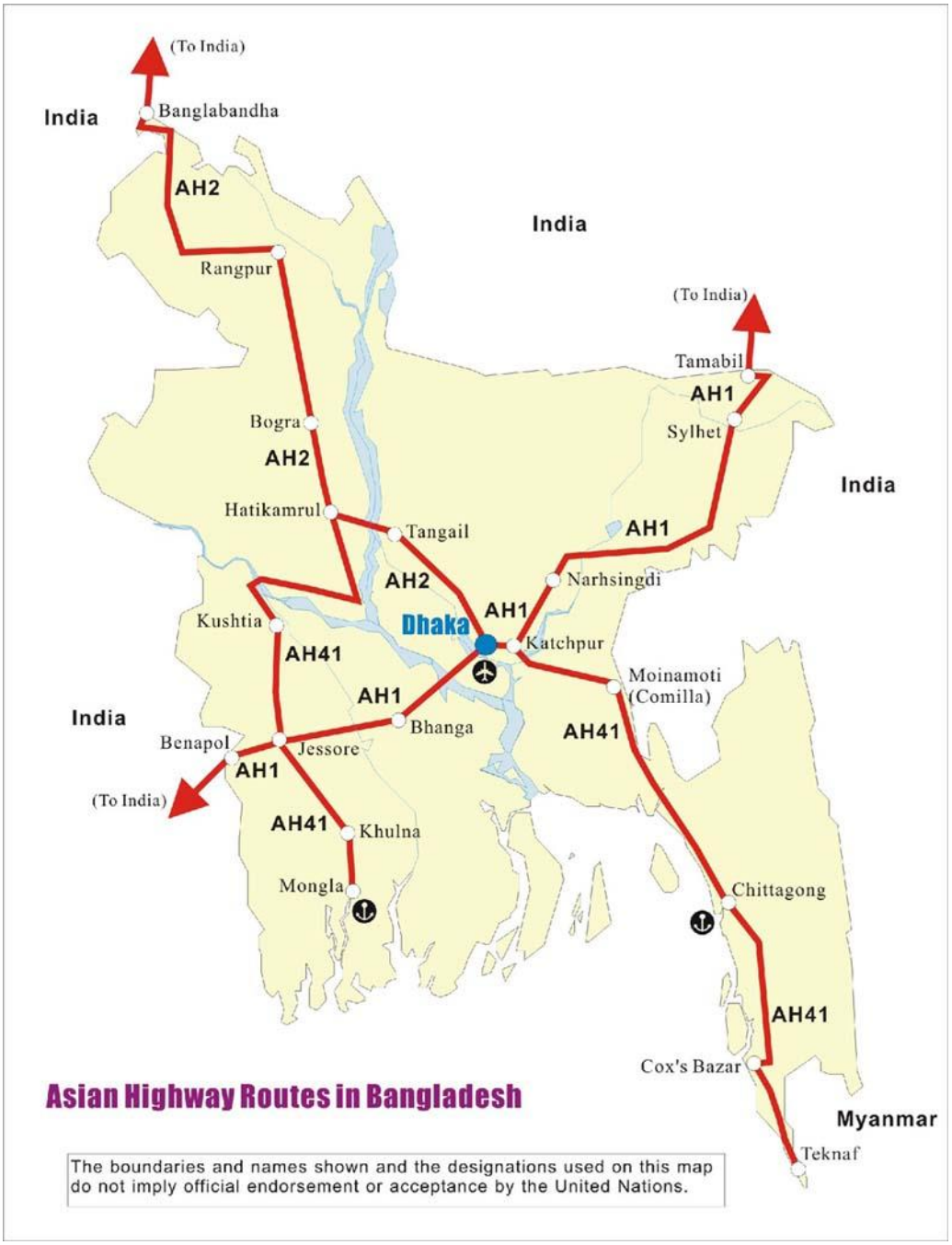


Figure 12.3: Asian Highway Routes in Bangladesh

12.2.3. Road congestion

Road congestion in Dhaka is very serious. Dhaka is the world's densest and fastest-growing city by some measures, and it is the twentieth largest by population and Dhaka's infrastructure does presently not match the scale of its population and suffers from the absence of a sufficient road network, feeder streets leading to arterials leading to highways.

The hotspots include Ashulia and Baipayl T-Junctions as well as road N302 which is part of the DAEEP alignment. Furthermore, both the Chandra and Nabinagor junctions are heavily congested and consequently the flyover projects are proposed for these locations. Figure 12.4 illustrates some of the main congestion areas and hotspots for accidents along the DAEEP.

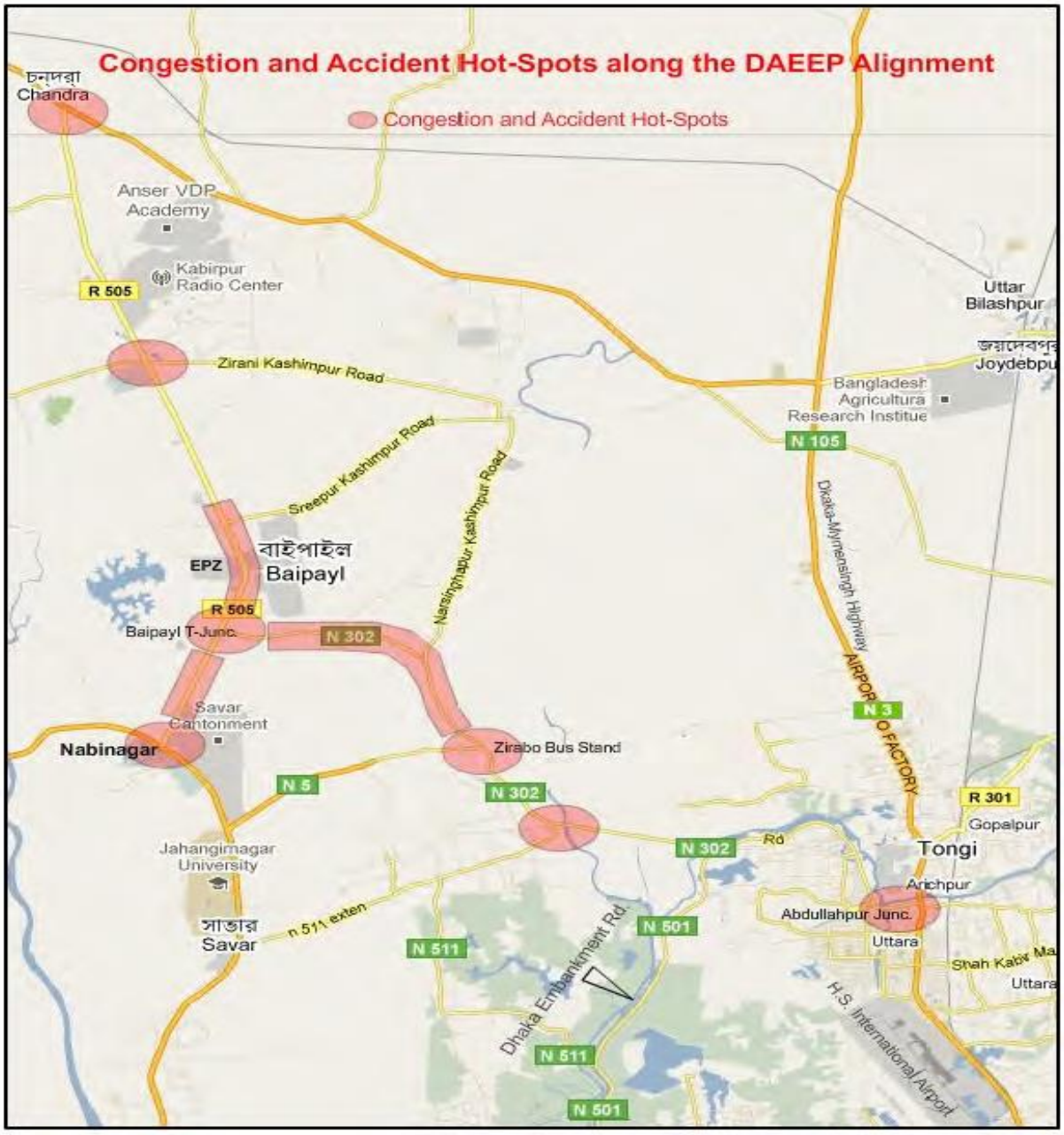


Figure 12.4: Congestion and Accident Hotspots along DAEEP

12.2.4. Economic development perspectives

National and regional economic development is expected to be an essential outcome of improving the road network and creating better local and transit traffic in Dhaka.

The primary anticipated benefits of the DAEEP and associated road and highway projects are:

- savings in vehicle operation costs including fuel cost and possible environmental benefits through reduced pollution due to reduced congestion.
- savings in travel time and associated productivity increase.
- the travel time-savings would accrue not only to the users of the proposed DAEEP, but also to the users of other nearby roads where congestion would be reduced since some traffic will be diverted to the DAEE.
- reduction in accidents and costs.

- other benefits including corridor for transit traffic and industrial development.

The freight traffic from the northern and south-western parts of the country will in particular gain from the DAEEP as the Dhaka Export Processing Zone (DEPZ) is located near to Baipayl Junction and is presently a major cause of the traffic congestion at that junction. Furthermore, a large number of industrial establishments along the existing Ashulia – Baipayl - Chandra link will benefit from the traffic improvement, particularly because trucks and semi-trailers are mainly responsible for the present congestion along the existing route because of their lower travel speed and lower manoeuvrability.

In addition to the increased benefit to the business and industrial areas, other businesses in the northern region that are dependent on the Chittagong port will equally be positively affected.

The opportunities for benefits of allowed daytime travel through Dhaka using the DAEEP and DEEP depend on the existing supply chain management and the traffic conditions at other major highways. For example, if there remains major traffic bottlenecks at other locations on the highway, businesses may want to move goods only during the night to avoid those bottlenecks. In such cases, the benefits of the DAEEP and DEEP might be reduced. Therefore, the combination of the implementation of the DAEEP and the DEEP will be a considerable precondition for the expected time benefits.

The area near Baipayl junction has over the years developed into an unorganized industrial zone that tends to support a significant number of non-EPZ industries. The region may likely enhance from the concentration of industries and further opportunities exist for industrial parks such as a High-Tech park in Kaliakoir. This will require proper regional land use planning supported by the DAEEP – DEEP, to achieve synergies for further economic growth in the region.

12.3. Definition of Project Alternatives

The economic evaluation of the DAEEP is based on comparing the project alternatives for:

- Base Case Alternative: Road user costs along the existing road network being the alternative to the Investment Alternative,
- Investment Alternative: Road user costs on the Dhaka – Ashulia Elevated Expressway and the road sections on N302 being widened from two to four lanes.

The Base Case Alternative is defined as the existing roadway from the Hazrat Shahjalal International Airport near Haji Camp Abdullahpur – Ashulia – Baipayl, and has a total length of 24.0 km. The Base Case Alternative is divided into four road sub-sections due to differing road conditions and traffic volume, as well as for providing more details on generated costs and benefits as part of the economic evaluation. The existing road sub-sections are presently the alternative for the road users to the proposed project alternative (DAEEP) that will follow the existing road alignment.

12.3.1. Condition of existing road network alternative

The Base Case Alternative and the physical condition details of the existing road sub-sections are summarised in Table 12.1.

Table 12.1: Summary of Road Condition Survey Results of Existing Sub-sections

		Section No.	Section 1	Section 2	Section 3	Section 4
		Start at km:	0.00	4.20	9.56	22.12
		End at km:	4.20	9.56	22.12	24.12
		Start-End Location	Airport - Ashulia J'n on R301	Ashulia J'n on N302 to N501 J'n	J'n N501 on N302 – J'n N302/N505	J'n N302 / N505 - Chandra
Geometry	Length	km	4.20	5.36	12.56	2.00
	Width	m	29.0	7.2	7.2	18.0
	Shoulder width (one shoulder)	m	1.5	1.5	1.5	1.5
	Rise + fall	m/km	1	1	1	1
	No. of rises + falls	no./km	1	1	1	1
	Superelevation	%	2.5	2.5	2.5	2.5
	Avg. horizontal curvature	degrees/km	2	2	2	2
	Average actual speed	km/h	17	17	17	17
	Altitude	m	5	5	5	5
Other	Drain type		V-Earth	V-Earth	V-Earth	V-Earth
	Drainage condition		Fair	Fair	Fair	Fair
	Effective no of lanes	no	6	2	2	4
Pavement	Surface class	Type	Asphalt	Asphalt	Asphalt	Asphalt
	Pavement type	Type	Asphalt mix on granular base	Asphalt mix on granular base	Asphalt mix on granular base	Asphalt mix on granular base
	Material type	Type	Asphalt Concrete	Asphalt Concrete	Asphalt Concrete	Asphalt Concrete
	Most recent surface thickness	mm	50	50	50	50
	Old surface thickness	mm	50	50	50	50
	Base course thickness (average)	mm	100	100	100	100
	Last reconstr'n/new constr'n	Year	1995	2001	2001	2013
	Last rehabilitation (overlay)	Year	2006	2006	2006	N/A
	Structural Number	SN	2.45	2.45	2.45	2.45
	Subgrade CBR	%	8.00	8.00	8.00	8.00
Condition	Roughness, IRI	m/km	5.50	5.50	5.50	5.50
	All structural cracks	%	3	3	3	3
	Wide structural cracks	%	1	1	1	1
	Thermal cracks	%	2	2	2	1
	Ravelled area	%	3	3	3	3
	Potholes	no/km	1	1	1	1
	Edge break area	m^2/km	5	5	5	5
	Mean rut depth	mm	5	5	5	5
	Rut depth std. Dev	mm	0	0	0	0
	Texture depth	mm	0.5	0.5	0.5	0.5
	Skid resistance (SCRIM 50 km/h)	mm	0.4	0.4	0.4	0.4
Traffic	Recorded AADT 2016	Motorised	36.287	11.857	19.036	30.032
	Recorded AADT 2016	Vehicular	29.798	10.282	16.628	27.002
	Est. AADT 2022 (1st yr of DAEEP)	Motorised	41.254	8.224	18.125	32.337
	Est. AADT 2022 (1st yr of DAEEP)	Vehicular	32.198	6.028	14.687	28.177

Source: Consultant's survey results

12.3.1. Design specifications of DAEE and widening of existing sub-sections

The main design specifications used for economic analysis of the project are presented in Table 12.2 for the widening of sub-sections 2 and 3 of the existing road and for the entire Dhaka – Ashulia Elevated Expressway.

Table 12.2: Summary of Design Specifications for the DAEE and Widening of Existing Road Sub-sections on N302

		Section No.	Section 2	Section 3	DAEE
		Start at km:	4.20	9.56	0.00
		End at km:	9.56	22.12	24.00
		Start-End Location	Abdullahpur Junction on N302 to R501 junction	Junction R501 on N302 - Junction N302/R505	Int. Airport - R505 before Chandra
Design specifications	Start year of work	Year	2017	2017	2017
	Future speed limit	km/h	60	60	80
	New pavement type	Type	Asphalt mix on granular base	Asphalt mix on granular base	Asphalt mix on granular base
	Future width of carriageway	m	20	20	20
	Future width of shoulders	m	1.5	1.5	0
	Future number of lanes	no	4	4	4
	Future vertical rise plus fall	m/km	1	1	1
	Future no. of rises + falls	no/km	1	1	1
	Future horizontal curvature	degrees/km	2	2	2
	Future superelevation	%	2	2	2
	Expected future IRI (best guess)	m/km	2	2	2
	Future Structural Number, SN	SN	5	5	6
	Surface thickness	mm	150	150	150
Costs	Construction/upgrading costs	(USD million)	140.43		1,151.14
	Financial cost per km	(USD million)	3.63		42.97
	Economic cost per km (85%)	(USD million)	3.08		36.52
Traffic	Projected AADT 2022	Motorised	8.224	18.125	10.133
	Projected AADT 2022	Vehicular	6.028	14.687	9.985

12.3.2. Project Implementation Period

The project consists of two combined investments that will be implemented simultaneously:

- Widening of the existing road sections 2 and 3 from two lanes to four lanes over a period of three years from 2017 to 2019
- Construction of the Dhaka – Ashulia Elevated Expressway over a period of four years from 2017 to 2020.

12.4. HDM modelling

Besides the technical specifications and other assumptions, the economic evaluation of the Dhaka – Ashulia Elevated Expressway Project is based on the existing traffic flow pattern and the anticipated future traffic development on respectively:

- Existing road network when assuming that no road investments are made besides maintenance, and
- New DAEE and the upgraded and widened road sections on N302.

12.4.1. Present AADT on existing project road network

The AADT level on the existing road network along the DAEEP has been determined from present and recent traffic surveys. Traffic surveys were carried out in July 2016 at three locations with the purpose of determining the current AADT level along the existing projects network at Baipayl junction as well as at the locations of the two proposed flyovers at Nabinagor and Chandra. In March 2014, traffic counts were carried out for the Greater Dhaka Sustainable Urban Transport Project – Package 2: EPCM, Gazipur to Airport BRT Corridor at the Ashulia junction, and the traffic data has been updated to 2016 levels based on a conservative traffic growth rate of 5% since then.

The traffic counts at all locations were carried out on both a weekend day (Friday) and on a weekday in order to capture the difference in the traffic flows. Generally, the traffic levels on a weekend day were between 10 % and 40 % lower than on a regular weekday. Subsequently, the weighted average traffic volumes have been estimated for each counting location and for the respective road sub-sections defined for the economic evaluation. Table 12.3 summarises the AADT for the four sub-sections along the project road divided into vehicle categories and for non-motorised traffic.

Table 12.3: AADT at Sub-sections along the Project Road Alignment (2016)

	SECTION 1: (Six lanes -4.2 km) Airport - Abdullahpur Junction on R301	**SECTION 2:** (Two lanes 5.4 km) Abdullahpur Junc. on N302 to R501 junc.	**SECTION 3:** (Two- lanes, 12.5 km) Junction N501 on N302 – Baipayl Junction N302/R505	**SECTION 4:** (Four lanes, 2.0 km) Baipayl Junc. N302/R505 - Chandra
Car	8,120	3,103	1,890	4,032
Pickup & 4WD	1,329	245	1,753	2,670
Microbus	4,994	868	2,396	2,321
Medium bus	4,770	1,331	1,843	4,006
Large bus	4,186	1,484	2,059	3,589
Small Truck	2,777	919	2,279	3,545
Medium Truck	1,384	1,281	2,093	4,282
Heavy Truck	2,239	1,050	2,316	2,555
Motorcycle and rickshaw	6,489	1,575	2,408	3,030
Cyclists	2,751	1,718	4,270	4,925
Total	39,039	13,574	23,307	34,955
Total vehicular	29,799	10,281	16,629	27,000

Source: Consultant's traffic surveys 2014 and July 2016

The two sections (Sections 1 and 4) with four lane road indicate higher traffic volumes compared to Sections 2 and 3 having two lanes. Table 12.4 shows the distribution of traffic on the four sub-sections for motorised traffic only.

Table 12.4: Distribution of Motorised Traffic (AADT) along the road alignment (2016)

	SECTION 1: (Six lanes -4.2 km) Airport - Ashulia Junction on R301	**SECTION 2:** (Two lanes 5.4 km) Ashulia Junc. on N302 to N501 junc.	**SECTION 3:** (Two- lanes, 12.5 km) Junction N501 on N302 – Baipayl Junction N302/N505	**SECTION 4:** (Four lanes, 2.0 km) Baipayl Junc. N302/N505 - Chandra
Car	22.40%	26.20%	9.90%	13.40%
Pickup & 4WD	3.70%	2.10%	9.20%	8.90%
Microbus	13.80%	7.30%	12.60%	7.70%
Medium bus	13.10%	11.20%	9.70%	13.30%
Large bus	11.50%	12.50%	10.80%	12.00%
Small Truck	7.70%	7.80%	12.00%	11.80%
Medium Truck	3.80%	10.80%	11.00%	14.30%
Heavy Truck	6.20%	8.90%	12.20%	8.50%
Motorcycle and rickshaw	17.90%	13.30%	12.60%	10.10%
Total	100%	100%	100%	100%

Source: Consultant's traffic surveys 2014 and July 2016

12.4.2. Present AADT at Chandra and Nabinagor

Table 12.5: Weekday traffic at Chandra and Nabinagor (2016)

Vehicle Type	Chandra	Nabinagor
Car	4,331	4,527
Pickup & 4WD	4,247	2,960
Microbus	3,232	4,598
Medium bus	3,514	5,273
Large bus	4,834	4,500
Small Truck	4,646	4,218
Medium Truck	6,977	5,527
Heavy Truck	4,627	3,042
Motorcycle and rickshaw	3,856	1,185
Bicycle	178	65
Total	39,905	39,812
Total Motorised	37,693	38,824

Source: Consultant's traffic surveys July 2016

12.4.3. Traffic Growth

There is limited historical traffic survey data for the project road and consequently the determination of the actual historic traffic growth is difficult to justify. However, based on the available traffic data combined with the general evidence on the positive correlation between the development in GDP and traffic volume, the traffic growth rates for the present project are presented in Table 12.6 for three project evaluation periods for passenger and freight vehicles.

The estimated traffic growth rates are generally in line with recent feasibility studies for road and highway projects in Bangladesh. Furthermore, as already described in Section 11, along with the annual population and GDP growth, there has been a considerable historic growth in the vehicle fleet both in Bangladesh and in particular in Dhaka. This further indicates that the vehicle ownership will increase in the future and likely with higher growth rates than the anticipated GDP development. The traffic forecasts presented in the Pre-Feasibility Study of the DAEEP from 2012 have been reviewed and the traffic growth rates are found rather optimistic reflecting annual average traffic growth rates of more than 25% during the first ten years of the analysis. For the present study, the Consultant has taken into consideration more conservative traffic growth rates also reflecting what is generally used for similar projects including the Dhaka – Chittagong Expressway Project from 2016 and the SRTP Roads Design Package No. 10 – Hatikamrul - Rajshahi from 2014.

Table 12.6: Projected Traffic Growth Rates (Medium Traffic Growth)

Period	Passenger Vehicles incl. motorcycles	Freight Vehicles
2016 – 2021	6.0%	6.1%
2022 – 2028	6.0%	4.5%
2028 - forward	5.3%	4.0%

Source: Consultant's estimates

As part of the sensitivity analysis, the economic viability of the project is tested against Low (-20%) and High (+20%) traffic growth scenarios as presented in Section 13.3.2.

12.4.4. Traffic Modelling Results

Based on the recorded and analysed AADT and traffic growth rates for the different vehicles categories,

Figure 12.5 illustrates the projected traffic development on the existing project road sub-sections representing the Base Case Traffic Growth scenario without Investments.

The road capacity of respectively the four lane roads (Sections 1 and 4) and the two lane roads (Sections 2 and 3), will under normal circumstances be reach 160,000 vehicles per day and 60,000 vehicles per day respectively. For the Medium traffic growth scenario, Section 3 will experience capacity constraints after 25 years. Application of even higher traffic growth rates will mean that the capacity will be reached earlier for several of the road sections.

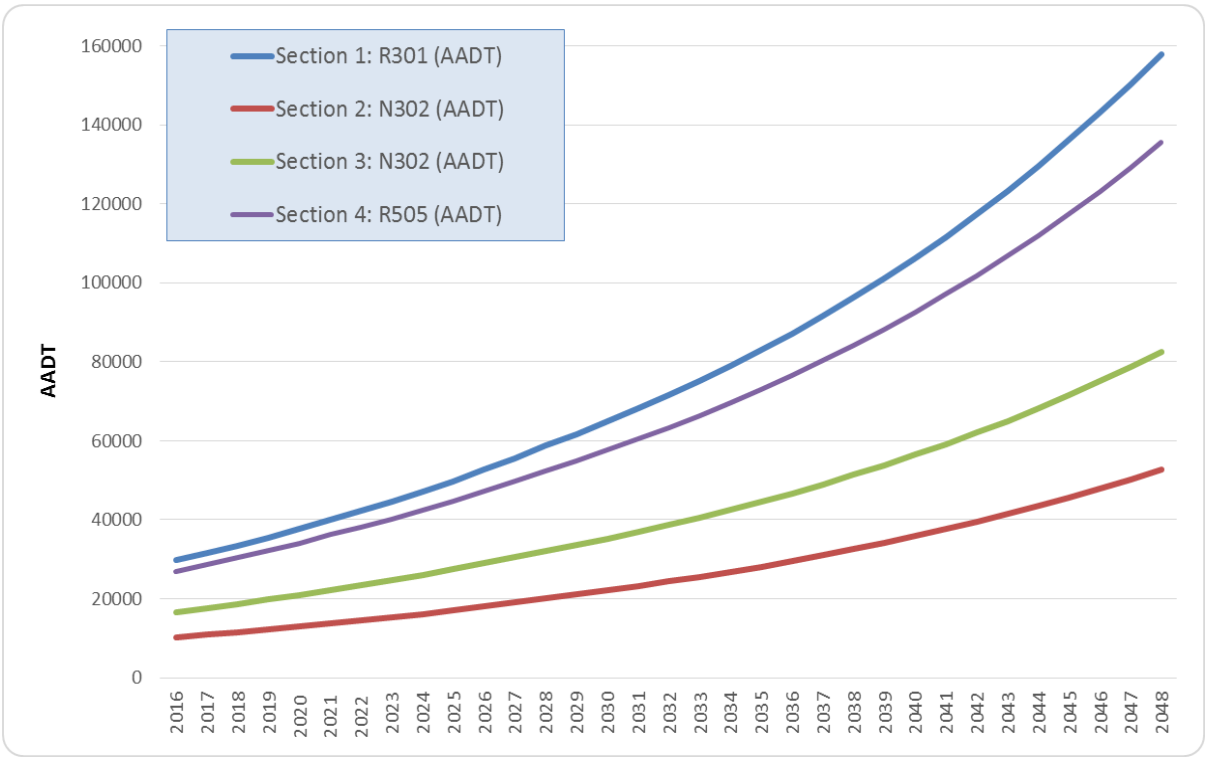


Figure 12.5: Traffic Projections (AADT) on Existing Project Road Sub-sections (Medium Traffic Growth)

The PCU estimates are based on the equivalence factors presented in Table 12.7 giving the PCU projections in Figure 12.6.

Table 12.7: Conversion Factors of Vehicle to PCU for Level Terrain

	Car	Pickup & 4WD	Micro Bus	Medium Bus	Large Bus	Small Truck	Medium Truck	Heavy Truck	Motor Cycle / Rickshaw
Conversion factor of vehicle to PCU for level terrain	1.0	1.0	3.0	3.0	3.0	3.0	3.0	3.0	0.75

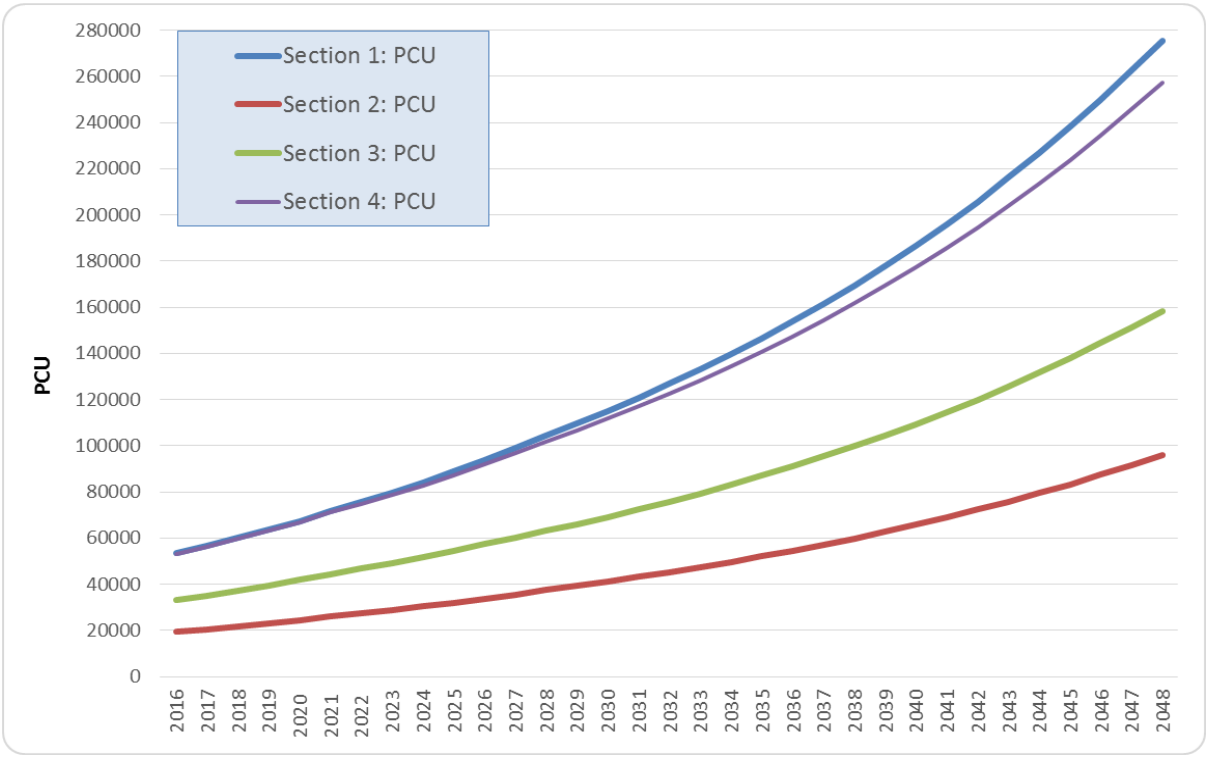


Figure 12.6: Projected Traffic Growth (PCU) on Existing Project Road Sub-sections (Base Case Traffic)

12.4.5. Value of Time and Toll Considerations

Several factors affect the travel demand and selection of routes. The Dhaka – Ashulia Elevated Expressway is expected to be operated as a toll road, and consequently the toll levels will influence the travel demand and diversion of traffic from the existing project road network to the DAEE.

The willingness to pay for using the tolled expressway and thereby the future traffic volume will determine and indicate the potential financial viability of the proposed DAEE Project. Of importance is to what extent future road traffic demand will be sufficient when operated as a toll road, the proposed toll levels, and its ability to generate sufficient revenue to attract investors to construct and operate the expressway. This is further analysed in Section 13

These willingness to pay considerations, will for the economic analysis, determine the amount of diverted traffic that will use the tolled expressway in the future as further described in Section 12.4.7.

12.4.6. Willingness to pay and time value

The willingness to pay toll refers to the trade-off that travellers make between time and money, and basically the travellers are deciding if they are willing to buy travel time savings and/or travel reliability. Traveller's value of time combined with the perspectives of travel time-savings will generally determine the travel pattern and whether travellers prefer to use the toll road or any alternative route. In the present project situation, the distance is the same for both the expressway and the existing road alternative and the reduced travel time is the most important factor.

Detailed travel modelling will further determine the travel decision pattern and is beyond the time values determined by travel time consumptions, travel purpose, passenger or freight, quality and condition of alternative routes, day of week, time of day, trip frequency, vehicle occupancy, trip length/distance, toll payment methods, time consumptions for payment and convenience.

The DAEE will be four-lanes throughout, and tolled with an open toll system that charges traffic according to where it enters the expressway rather than by distance. As the DAEEP and the DEE sections will be connected to form one full tolled expressway, it is anticipated that the operational assumptions will be coordinated between the two projects and potential toll operators.

The toll rate as preliminarily determined for the financial analysis is based on an average BDT9.4 per km or USD0.121 per km for a medium-sized truck, however, coordination with the outcome of toll decisions from the DEEP will eventually be considered. Other vehicle types will pay more or less than this, depending on their size and subsequent toll multipliers. The toll rate has been applied from the Dhaka – Chittagong Expressway Project as providing the best possibility to attract private sector financing for the project. Actual toll rates for this project are presently being negotiated between the client, financiers and potential operators. Being relatively low, it has a lesser impact on the expressway traffic levels that a higher toll would do. This is important as from the economic point of view, the lower the toll the better, so that as much traffic as possible makes use of the new investment. For a toll road project, a balance has to be struck between economic and financial objectives. Thus the economic analysis is based on the traffic level that is expected from the selected toll rate.

12.4.7. Anticipated Diverted Traffic along the DAEE

Assumptions taken for how much of the traffic from the existing project road network that is expected to be diverted to the Dhaka – Ashulia Elevated Expressway over the evaluation period are outlined in Table 12.8. To allow for the uncertainties of the eventual toll levels and the road users willingness to pay for using the tolled expressway, three traffic diversion scenarios have been examined with respectively 40%, 50% and 60% diverted vehicular traffic.

Motorcycles may, to a limited extent, use the expressway but rickshaws and CNGs will not be permitted. Furthermore it is assumed that non-motorized traffic will not use, nor will it be allowed to use the expressway.

Travel time-savings and diverted traffic are determined by travel speed and reliability of the tolled expressway, the toll levels and the value of time for different vehicle categories and passengers. The existing road following the DAEE alignment will be an upgraded alternative in particular along N302 between Ashulia and Baipayl Junctions, and the diversion of traffic to the DAEE will remove congestion in the early years. Eventually congestion will reoccur on N302 as a result of continued traffic growth.

Table 12.8: Estimated Diversion of Traffic to the DAEE

	Cars	Pickups & 4WD	Micro Bus	Medium Bus	Large Bus	Small Trucks	Medium Trucks	Heavy Trucks	Motor Cycles & Rickshaws
Low Diversion Scenario	40%	40%	40%	40%	40%	40%	40%	40%	2.5%
Base Case Diversion Scenario	50%	50%	50%	50%	50%	50%	50%	50%	5%
High Diversion Scenario	60%	60%	60%	60%	60%	60%	60%	60%	10%

Source: Consultant's estimates

The traffic presently using the road between Ashulia Junction and Baipayl Junction representing Sections 2 and 3 of the existing project road sub-sections is the basis for anticipated diverted traffic.

Figure 12.7 presents the AADT development over the period of evaluation when the Base Case Diversion Scenario is applied for the diverted traffic to the DAEE. Figure 12.8 presents the corresponding PCU projections.

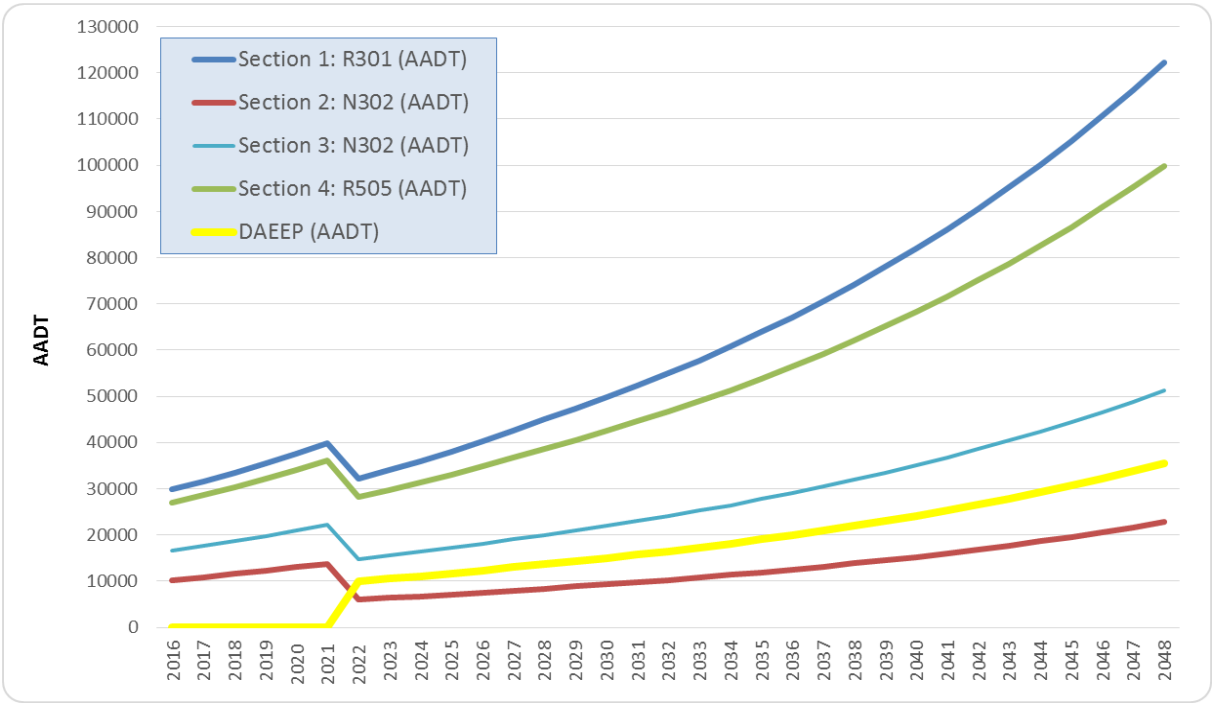


Figure 12.7: AADT Development along Existing Project Road Sections and Along the DAEE (Base case diversion scenario)

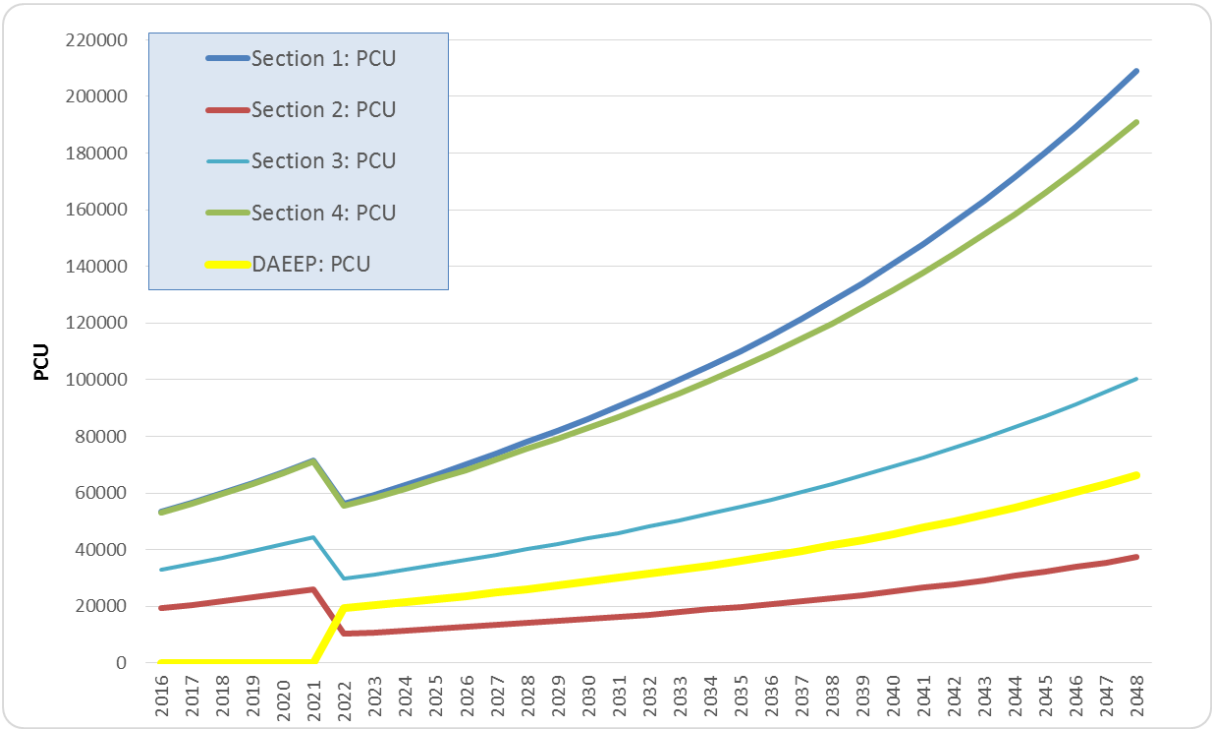


Figure 12.8: PCU Projections along Existing Project Road Sections and along the DAEE (Base case diversion scenario)

Besides the diverted traffic, it is further assumed that the new expressway as well as the widening of sub-sections 2 and 3 will generate additional traffic of 5 % when the project is open for traffic as the combined DEEP and DAEEP will likely make the corridor more attractive for both transit and local traffic.

12.4.8. Travel time studies

During July 2016, travel time surveys were carried out on the existing road on a weekday and a weekend day (Friday) in order to estimate the approximate travel time and average travel speed.

Along the 24.1 km existing road the travel speed varied slightly between road sub-sections and during the weekday (midday), the average travel speed was around 13 km/h corresponding to a total travel time of 111 minutes. During the weekend day (morning), the average travel speed was around 20 km/hour corresponding to 63 minutes.

The economic analysis has used the travel speed observations for estimating the average travel speed improvements from the widening of existing road sub-sections and the Dhaka – Ashulia Elevated Expressway where the design speeds are 60 km/hour and 80 km/hour respectively.

12.5. Vehicle Fleet Characteristics and Road User Costs

The vehicle fleet characteristics and road user costs that are used for the economic analysis are based on updated data obtained from RHD's Road User Costs Report 2004-05, consultation with RHD staff and recent road studies in Bangladesh including the Dhaka – Chittagong Expressway feasibility study project being carried out in 2016. Furthermore, the data sample is supported by on-site visual verification of the vehicle fleet on the project road combined with the Consultants' judgement. The vehicle fleet characteristics and road user cost are used as technical input to the HDM-4 modelling and subsequent economic evaluation of the project.

Vehicle fleet characteristics are presented in Table 12.9.

Table 12.10 presents the vehicle operating data (economic prices) that are used as input for the economic evaluation of the project.

Table 12.9: Vehicle Fleet Characteristics (motorised)

	Cars	Vans & Pickups	Micro Buses	Medium Buses	Large Buses	Small Trucks	Medium Trucks	Heavy Trucks	Motor-cycles & Rickshaws
Pass. Car Space Equiv.	1.0	1.0	1.4	1.4	1.4	1.3	1.4	1.6	0.5
Operating Weight	1.6	2.5	3.5	7.5	12.2	4.0	10.6	22.6	0.4
No. of wheels	4	4	4	4	6	4	6	10	3
No. of axles	2	2	2	2	2	2	2	3	2
Tyre type	Radial	Radial	Radial	Bias-Ply	Bias-Ply	Bias-Ply	Bias-Ply	Bias-Ply	Bias-Ply
Base no. of recaps	1.30	1.30	1.30	2.40	2.40	2.40	2.40	2.40	1.30
Retread costs (%)	15%	15%	15%	15%	15%	15%	15%	15%	15%
Annual km	25,000	34,250	43,750	54,400	54.400	42,000	54,000	55,000	10,000
Working hours	500	1,366	1,650	2,165	2,165	1,417	1,530	1,739	500
Average life (years)	10	9	9	10.2	10.2	9	11	12	11
Private use (%)	100	50	0	0	0	0	8	6	39
Passengers (no.)	3	2.65	10	35	48	2.5	2.5	2.5	2.5
Work pass. trips (%)	50	56.3	53	53	43.3	79.8	63.4	55	47.5
ESALF	0	0	0.05	0.1	2.74	0.29	4.17	4.48	0

Source: RHD Road User Cost 2004/5, Recent Economic Road Feasibility Studies in Dhaka

Table 12.10: Vehicle Operating Data - (Economic Unit Prices in USD) – 2016

	Cars	Vans & Pickups	Micro Buses	Medium Buses	Large Buses	Small Trucks	Medium Trucks	Heavy Trucks	Motor cycles & Rickshaws
New Vehicle Price	18,000	22,515	16,000	19,191	68,765	24,923	31,000	64,130	2,284
Replacement tire	40	97	83	83	274	96	151	232	19
Fuel (per litre)	1.1	1.1	1.0	1.0	1.0	1.0	1.0	1.0	1.1
Lubricant oil (per litre)	2.2	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.2
Maintenance labour costs/hr	4.0	3.7	3.4	3.4	7.2	7.1	7.2	7.2	3.7
Crew wages (per hour)	1.9	1.9	2.0	2.0	2.0	2.0	2.0	2.0	1.9
Annual Overheads	477	536	1,031	1,031	3,112	1,400	1,400	1,884	85
Annual interest (%)	6	6	6	6	6	6	6	6	6
Passenger working time/hr	3.05	3.05	1.25	0.80	0.80	1.75	1.92	2.10	0.57
Passenger Non-work time/hr	0.75	0.75	0.30	0.20	0.20	0.50	0.50	0.60	0.20
Cargo costs per hour	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.04	0.00

Source: RHD Road User Cost 2004/5, Recent Economic Road Feasibility Studies in Dhaka

The VOC inputs used for the economic analysis are expressed in economic cost, i.e. average market price net of taxes and subsidies, supplemented by detailed information in Bangladesh involving various sources of information e.g. petrol/fuel and lubricant dealers, vehicle prices from vehicle dealers in Dhaka, tyre prices from retail dealers. Further, the cost of maintenance labour, crew wages and passenger time value are representative of estimates from Dhaka.

The value of time of passengers and freight used for this project reflects the average income levels of the owners of the vehicles, which are substantially higher than the average. The time values are reflecting also the salary levels in the region of typical vehicle owners e.g. 4WD and cars, whereas the value of time for bus passengers is regard as considerably lower to reflect the average income level of the local population. The value of time for freight is reflecting the value of goods in transit.

It is customary for the value of passenger time to be broken down into work trips and non-work trips. Work trips are valued in terms of the opportunity cost of their output. Non-work trips include trips such as commuting to the workplace, shopping and leisure trips etc. These trips are commonly valued at a lower rate than work trips, and as a rule-of-thumb the value of these trips is set to 15 to 30% of the value of work time.

Based on the average long-term prices of crude oil and knowledge of transport and distribution costs, estimates are made of the economic price for fuel and diesel. The estimates are compared with the pump prices of petroleum products at retailers in Dhaka as of 2016.

The Consultant has considered information on the current level of salaries for maintenance and crew in Dhaka in order to assess the likely unit costs for those categories. Verification is found from recent studies carried out in Dhaka region. Generally, the cost of maintenance is higher for buses and trucks than for cars.

12.6. Cost of DAEE and Widening of Existing Road Sections on N302

The cost of construction of the Elevated Expressway and ramps are provided in Table 12.11 with measures for both financial and economic cost estimates. Table 12.12 presents the corresponding cost estimates for the road widening works on N302 including three bridges, and Table 12.13 gives the cost estimates for the Nabinagor flyover. Cost estimates are provided both in totals and in cost per km for economic and financial costs.

Table 12.11: *Summary of Cost Estimates for DAEE including Ramps*

Item No.		Description	Elevated Expressway (24.0 km)		Ramps (3.9 km)	
			BDT (million)	USD (million)	BDT (million)	USD (million)
Civil Works Cost	1	Div. No. 1 - General And Site Facilities	2,850.8	36.6		
	2	Div. No. 2- Earth Works	226.8	2.9	19.9	0.3
	3	Div. No. 3 - Pavement Works	621.9	8.0	78.9	1.0
	4	Div. No. 4 -Foundation Works for PCI Girder	12,196.0	156.4	318.4	4.1
	5	Div. No. 5 - Structural Works	38,167.2	489.3	1,128.0	14.5
	6	Div. No. 6 - Incidentals	1,246.6	16.0	108.6	1.4
	7	Div. No. 7 - Toll Plaza	1,285.5	16.5		
A	Subtotal		**56,594.8**	**725.7**	**1,653.8**	**21.3**
B	Provisional Sum for Physical Contingency - 3% of A		1,697.8	21.77	49.61	0.6
C	Sub Total (A+B)		58,292.4	747.34	1,703.39	21.8
D	Provisional Sum for Price Contingency - 6% of C		3,497.5	44.84	102.20	1.3

Item No.	Description	Elevated Expressway (24.0 km)		Ramps (3.9 km)	
		BDT (million)	USD (million)	BDT (million)	USD (million)
E	Engineers Estimate = (C+D)	61,789.9	792.18	1,805.60	23.2
F	Land Acquisition and Resettlement Costs	23,281.0	298.47	-	-
G	Design Cost	1,698	21.77	49.61	0.6
H	Supervision Cost	1,132	14.51	33.08	0.4
i	Project Estimate = (E+F+G+H))	87,900.7	1,126.93	1,888.29	24.2
Financial Cost Estimates per km		3,667.1	47.01	485.2	6.2
Economic Cost Estimates per km		3,117.0	39.96	412.4	5.3

Source: Consultant's estimates

Note: Conversion Rate USD 1 = BDT 78, Financial/economic conversion factor: 0.85

Table 12.12: Summary of Cost Est. for Widening & Bridge Work of Existing Road Sections on N302

Item No.		Description	Roadworks N302 at Grade (widening) (18.0 km)		2 Bridges N302 (2.72 km)	
			BDT (million)	USD (million)	BDT (million)	USD (million)
Civil Works Cost	1	Div. No. 1 - General And Site Facilities				
	2	Div. No. 2- Earth Works	354.4	4.5	109.0	1.4
	3	Div. No. 3 - Pavement Works	3,083.0	39.5	27.6	0.4
	4	Div. No. 4 -Foundation Works for PCI Girder			488.1	6.3
	5	Div. No. 5 - Structural Works			1,774.6	22.8
	6	Div. No. 6 - Incidentals	1,083.2	13.9	195.7	2.5
A	**Sub Total**		**4,520.6**	**57.9**	**2,595.1**	**33.4**
B	Provisional Sum for Physical Contingency - 3% of A		135.6	1.74	77.9	1.00
C	Sub Total (A+B)		4,656.2	59.70	2.673.0	34.4
D	Provisional Sum for Price Contingency - 6% of C		279.4	3.58	160.4	2.1
E	**Engineers Estimate = (C+D)**		**4,935.6**	**63.28**	**2,833.4**	**36.35**
F	Land Acquisitions and Resettlement Costs					
G	Design Cost		135.6	1.7	77.9	1.00.7
H	Supervision Cost		90.4	1.2	51.9	0.7
I	**Project Estimate = (E+F+ G+H)**		5161.6	66.2	2963.14	38.2
Financial Cost Estimates per km			**286.8**	**3.7**	**164.6**	**14.0**
Economic Cost Estimates per km			**243.8**	**3.1**	**139.6**	**11.9**

Table 12.13: Summary of Cost Estimates for Nabinagor Flyover

Item No.		Description	Nabinagar flyover (1.0 km)	
			BDT (million)	USD (million)
Civil Works Cost	1	Div. No. 1 - General And Site Facilities		
	2	Div. No. 2- Earth Works	22.7	0.3
	3	Div. No. 3 - Pavement Works	201.6	2.6
	4	Div. No. 4 -Foundation Works for PCI Girder	160.3	2.0
	5	Div. No. 5 - Structural Works	655.9	8.4
	6	Div. No. 6 - Incidentals	131.3	1.7
A	**Sub Total**		**1,171.8**	**15.0**
B	Provisional Sum for Physical Contingency - 3% of A		35.2	0.5
C	Sub Total (A+B)		**1,207.0**	**15.5**
D	Provisional Sum for Price Contingency - 6% of C		72.4	0.9
E	**Engineers Estimate = (C+D)**		**1,279.4**	**16.4**
F	Land Acquisition and Resettlement Costs			
G	Design Cost		35.2	0.5
H	Supervision Cost		23.4	0.3
I	**Project Estimate = (E+F+G+H)**		**1,338.0**	**17.2**
Financial Cost Estimates per km			**1,337.9**	**17.2**
Economic Cost Estimates per km			**1,137.2**	**14.6**

Source: Consultant's estimates

Notes: Conversion Rate USD 1 = BDT 78, Financial/economic conversion factor: 0.85

12.7. Maintenance Strategies

The construction of the Dhaka – Ashulia Elevated Expressway and the widening of the road sections on road N302 from two lanes to four lanes are part of the economic analysis, where the future road user costs are compared to the future road user costs of the existing road network as a result of motorised and non-motorised travellers. Accordingly, maintenance strategies for the two scenarios are provided for the analysis and estimated effects made in the HDM model.

The HDM model used estimated maintenance requirements and costs on the existing defined sub-sections, being the alternative to the widening of sections and the Elevated Expressway. The maintenance strategies are based on the deterioration of the road segments over time as estimated by the HDM-4 model as a result of the impacts by traffic and the quality of the road. The corresponding annual costs are estimated based on updated information on unit costs estimates.

The maintenance works strategies include overlay and surface treatment for the existing road sub-sections and the investment option. The strategies are set to be responsive maintenance works initiated according to Table 12.14. The maintenance strategies on the road segments are found adequate according to the HDM-4 generated roughness development on the segments as shown in Figure 12.9.

Table 12.14: Maintenance Strategies used for Base Case and Investment Alternative

Maintenance	Description	Costs	Base Case (existing road network)	Widening of existing road network	Elevated Expressway
Routine maintenance	Routine maintenance every year	USD1,800 per km	Scheduled every year	Scheduled every year after year 2020	Scheduled every year after year 2022
Pothole Patching	100% repair of potholes, 12 month time lapse to patching	USD45 per m^2	Responsive when pothole > 25 no. per km after year 2020	Responsive when pothole > 25 no. per km after year 2020	Responsive when pothole > 25 no. per km after year 2022
Resealing	15 mm overlay (strength coefficient 0.1) single bitumen surface dressing	USD12 per m^2	Responsive when total damaged area > 20% after year 2020	Responsive when total damaged area > 20% after year 2020	Responsive when total damaged area > 20% after year 2022
	Patching Edge repair Crack ceiling	USD45 per m^2 USD22 per m^2 USD26 per m^2			
Thin overlay	35 mm thin overlay including patching, edge repair & crack ceiling	USD20 per m^2 (patching USD45 per m^2, edge repair USD22 per m^2, crack sealing USD26 per m^2)	Responsive when IRI > 7.5 m/km	Responsive when IRI > 4 m/km	Responsive when IRI > 4 m/km

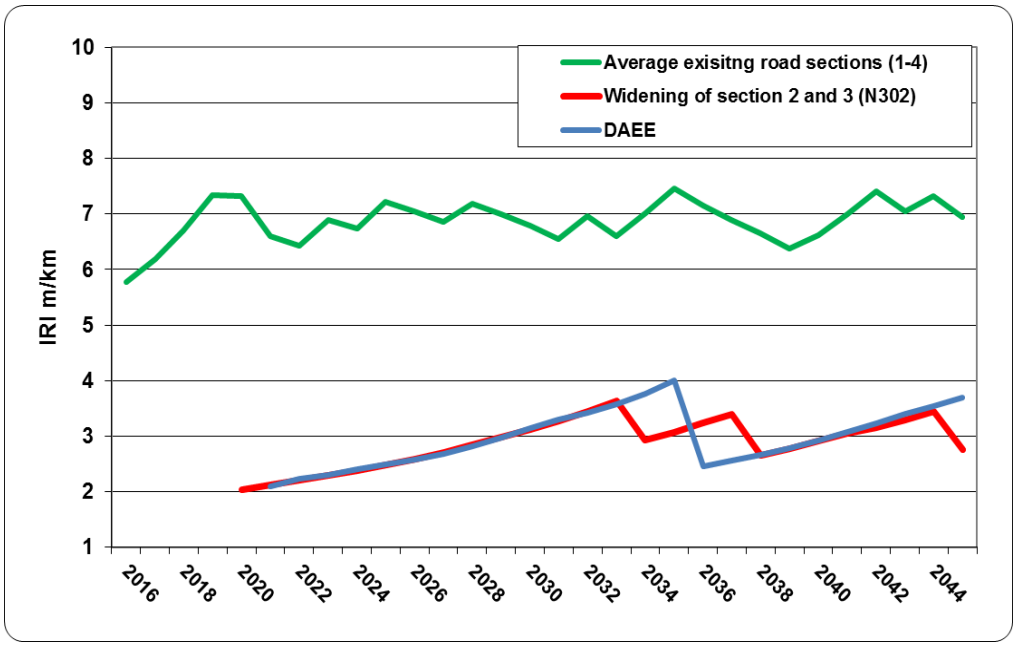
Source: RHD Road User Cost 2004/5, Recent Economic Road Feasibility Studies in Dhaka

Based on the present condition of the project road, the projected traffic development before and after widening and the DAEE project, the above-mentioned maintenance standards are applied over the economic evaluation period.

The physical condition of the roads is measured by the roughness development and is presented in Figure 12.9 showing responsive maintenance intervention applied on the existing road (base case) and the investment solution (DAEE and road widening of N302).

The initial roughness on the existing road has been measured to average around 5.5 m/km whereas the upgraded road sections and the elevated expressway are designed to have an initial IRI of 2 m/km.

The maintenance strategies for the existing sections (base case alternative) and the investment alternative are selected as responsive treatments, and their impact will ensure a sufficient quality of the road sections over the lifetime of the project analysis as compared to the initial physical stage.



Source: Consultant's HDM calculations

Figure 12.9: Roughness Development on Existing Road Sections, on Road Sections 2 and 3 after Widening of N302 and on Dhaka – Ashulia Elevated Expressway (DAEE)

12.8. Results of Economic Evaluation

12.8.1. Evaluation Approach

The economic evaluation is carried out based on output from the HDM-4 model (version 2.08). The model compares costs and benefits of the proposed DAEEP investments over a period of 30 years by comparing the "Investment Alternative", that consists of the construction of the DAEE and the widening of existing road sections from two lanes to four lanes, with the "Base Case Alternative", that includes regular road maintenance sufficient to keep the condition of the existing road sections to correspond to approximately the present standard.

The facility of including annual growth of time values in line with the anticipated GDP growth is not applied in the HDM model. This facility has been incorporated as part of the economic evaluation developed separately in and excel model together with the comparison of the economic cash-flow streams of costs and benefits of the two project alternatives.

A discount rate of 12% has been applied for the calculation of the net present value (NPV) and all costs are measured in economic prices and expressed in USD. The economic evaluation period is set to 30 years.

The economic evaluation has been carried out separately for each of the road four road sub-sections on the existing road network that form the alternative to the DAEE.

The main results of the economic evaluation are expressed in terms of economic internal rate of return (EIRR) and the net present value (NPV), and NPV/costs where a 12% discount rate is used and results are made for the Medium, Low and High traffic growth scenarios. As part of the sensitivity analysis, different discount factors are applied and compared.

12.8.2. Summary of Economic Indicators

Table 12.15 presents the main economic viability indicators for the Dhaka – Ashulia Expressway Project based on 50 % diversion of traffic.

Table 12.15: Summary of Economic Indicators for DAEEP (discount factor 12%)

Project	Traffic growth scenarios	NPV (USD million)	EIRR (%)	NPV / COST
DAEE + Widening of existing road section on N302 from 2 to 4 lanes	High Traffic (+20% growth)	106.0	13.1%	1.13
	Medium Traffic	**-53.8**	**11.4%**	**0.94**
	Low Traffic (-20% growth)	-226.1	9.4%	0.73

Source: Consultant's calculations

The results of the economic analysis are based on the Medium Traffic Diversion Scenario and indicate that the project is slightly below the economically viable criteria, showing an EIRR of 11.4% and a NPV of USD -53 million based on the assumptions taken. A higher traffic growth rate indicates a sufficient economic viability whereas a lower traffic growth shows insufficient economic viability.

The sensitivity analysis in Section 12.9 presents results based on changes in the most relevant model parameters including the amount of diverted traffic to the expressway. As illustrated by Figure 12.12 and Table 12.20 the sensitivity of DAEEP to changes in the portion of diverted traffic has been tested and shows the economic viability is only marginally influenced by such changes. The reason is that the diverted road users will alternatively use the existing road section along N302, which as part of the project will be upgraded and widened to also consist of four lanes like the expressway. As the physical road condition of the two road alternatives is similar, only marginal difference in road user benefits will be transferred between the alternatives.

12.8.3. Breakdown of Economic Costs and Benefits

The main benefits generated by the DAEE Project come from a combination of travel time-savings for both passenger and freight traffic and savings in vehicle operating costs. Reduced accident costs further contribute to the overall benefits.

Table 12.16 show the net present value (NPV) of the costs and benefits generated by the project. In addition are the distribution of benefits is illustrated graphically.

Benefits from travel time-savings represent the majority and correspond to 76.3% whereas benefits from reduced vehicle operating costs represent 22.4%, reduced accident costs 0.3% and combined VOC and time savings for non-motorised traffic 1.0%.

Table 12.16: Breakdown of Economic Costs and Benefits

Component / Growth Scenario	NPV (USD million)
Low Traffic Growth (-20%)	
Net Investment Costs	-826.3
Maintenance Costs	-3.40
VOC	112.6
Travel time costs	481.3
Accident Costs	2.0
NMT	7.6
NPV	-226.1

Component / Growth Scenario	NPV (USD million)
Medium Traffic Growth	
Net Investment Costs	-826.3
Maintenance Costs	-2.96
VOC	173.3
Travel time costs	592.6
Accident Costs	2.0
NMT	7.6
NPV	-53.8
High Traffic Growth (+20%)	
Net Investment Costs	-826.3
Maintenance Costs	-3.81
VOC	234.2
Travel time costs	692.2
Accident Costs	2.0
NMT	7.7
NPV	106.0

Source: Consultant's calculations

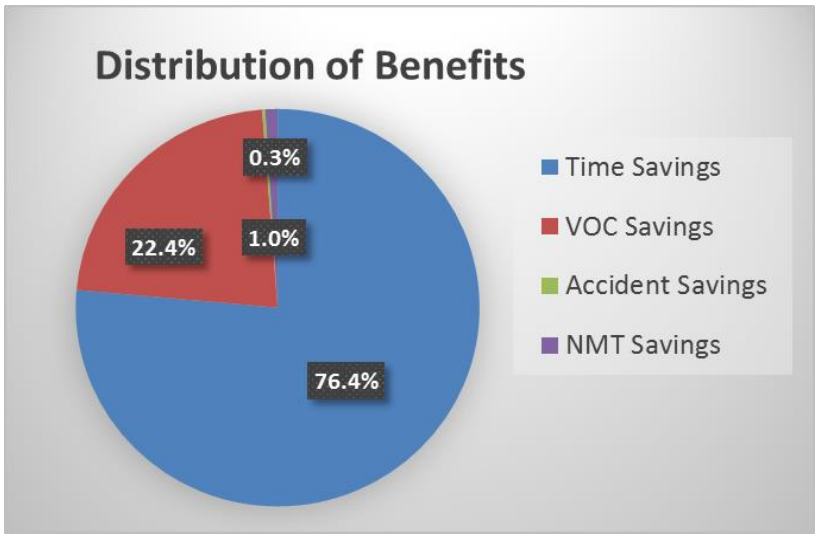


Figure 12.10: Distribution of Benefits

12.8.3.1. *Annual project cash flow*

Table 12.17 outlines the annual undiscounted project cash flows for the various components included in the economic analysis.

Table 12.17: Annual Undiscounted Project Cash Flows – (Medium Traffic Growth Scenario)

Year	Total Costs and Benefits (USD million)							
	Investment Costs	Residual value	Maintenance Costs	VOC	Travel time costs	Non-motorised traffic	Accident costs	Total costs
2016	-	-	-	-	-	-	-	-
2017	-284.4	-	-	-	-	-	-	-284.4
2018	-284.4	-	-	1.3	-	0.2	-	-282.9
2019	-284.4	-	2.05	2.9	-	0.5	-	-279.0
2020	-244.6	-	-1.66	21.6	35.9	1.0	0.2	-187.6
2021	-	-	-0.76	21.5	43.9	1.2	0.3	66.1
2022	-	-	-0.76	23.6	49.5	1.4	0.3	74.0
2023	-	-	2.00	26.8	55.7	1.6	0.3	86.4
2024	-	-	-0.04	24.8	62.5	1.1	0.3	88.7
2025	-	-	0.68	27.8	70.2	1.3	0.3	100.3
2026	-	-	-1.70	29.3	78.8	1.3	0.3	108.0
2027	-	-	1.42	32.3	88.6	1.4	0.4	124.1
2028	-	-	-1.66	36.1	99.7	1.5	0.4	136.0
2029	-	-	2.39	34.2	111.0	1.1	0.4	149.1
2030	-	-	-5.31	34.3	123.7	1.1	0.4	154.2
2031	-	-	-1.37	35.7	137.9	1.1	0.4	173.7
2032	-	-	2.16	40.2	153.7	1.2	0.4	197.7
2033	-	-	-6.57	40.6	171.2	1.0	0.5	206.7
2034	-	-	-0.48	48.2	191.2	1.5	0.5	240.9
2035	-	-	-8.74	54.1	213.3	1.6	0.5	260.8
2036	-	-	-1.35	54.4	238.5	1.2	0.5	293.2
2037	-	-	0.21	51.4	253.4	1.2	0.5	306.7
2038	-	-	0.73	45.5	267.4	1.2	0.5	315.3
2039	-	-	1.38	41.2	282.0	1.2	0.5	326.3
2040	-	-	-3.08	37.2	297.1	1.2	0.5	332.9
2041	-	-	-1.5	34.2	312.8	1.3	0.5	347.3
2042	-	-	-4.2	32.2	329.1	1.4	0.5	359.0
2043	-	-	0.7	24.5	345.8	1.3	0.5	372.8
2044	-	-	-2.5	20.9	363.1	1.4	0.5	383.3
2045	-	329.4	-2.5	10.9	381.0	1.2	0.5	720.5
NPV 2016	-838.6	12.3	-3.0	**173.3**	**592.6**	**7.6**	**2.0**	-53.8
							NPV	**-53.8**
							IRR	**11.42%**
							B:C	**0.94**

Source: Consultant's calculations

12.8.3.2. *Passenger and freight travel time benefits*

The benefits coming from time-savings are a direct result of the overall lane capacity and road condition improvements from the lane additions of the existing road sections on N302 from Ashulia

to Baipayl Junctions as well as from the new Dhaka – Ashulia Elevated Expressway. A considerable portion of the existing traffic will in year 2022 be diverted to the four-lane DAEE, and in year 2020, the existing sections on N302 are widened from two lanes to four lanes and will pose a considerable road capacity increase. In all, the improvement is allowing for higher average travel speed as a result of the improved lane capacity and subsequent reduced traffic congestion.

Additional benefits from time-savings comes from the two relatively short road sections on the DAEE alignment; respectively Section 1 (4.2 km – from the airport to the Ashulia Junction) on R302 and Section 4 (2 km between Baipayl Junction towards Chandra) on N505. The road capacity on both sections is better utilised by the existing traffic after the diversion to the DAEE and consequently the average speed is increased.

The travel time benefits will also be potentially large to the users of other nearby roads. The primary beneficiary will be traffic on the Dhaka - Mymensinghe road, which presently experiences delays at the Abdullahpur junction caused by heading north-west south-eastern traffic.

As the major through traffic to the northern and south-eastern regions will be grade-separated on the DAEEP, the traffic on the Dhaka – Mymensinghe road will not be interrupted to the same extent, and will eventually enjoy significant travel time savings. In addition, all local traffic using the existing road links and nearby regions will benefit as the through traffic will be using the future DAEEP or the alternative existing road alignment.

At present, the entrance of freight vehicles in Dhaka city is prohibited from 8:00 am to 8:00 pm in order to reduce congestion within the city. Since freight vehicles must enter Dhaka city to go to Chittagong (or any south-eastern destination), these vehicles can operate only at night. This adds significant idle time in the supply chain with negative consequences on industrial productivity and costs.

The proposed DAEEP, in combination with DEEP, will act as a grade-separated bypass to Dhaka city for the large volume of freight vehicles. Since these vehicles will not affect the at-grade traffic in Dhaka city, 'through' freight vehicles could with considerable benefits be allowed to travel without the time restrictions through DAEEP - DEEP.

12.8.3.3. Benefits from Reduction in Vehicle Operating Costs

Removal of the bottlenecks for the through traffic and reduction of congestion in nearby local roads will encourage smoother traffic flow with less acceleration, deceleration and idle times. This will reduce the fuel consumption, spare parts, depreciation and other operation costs by the vehicles to the benefit of the vehicle owners of all types using the DAEEP and possibly in nearby roads. As for the time-saving perspective, the increase of the road capacity and reduction in traffic on the existing road sections after diversion to the DAEE will result in reduced VOC due to the better road condition and smoother traffic flows. Assuming that adequate measures for road maintenance are carried out, as anticipated by the economic modelling setup, this will allow for reduced VOC as compared to the alternative no road network improvements.

12.8.3.4. Accidents

In addition to the reduction in vehicle operating costs and travel time costs as a result of the project, a key benefit of the DAEEP is the reduction in the anticipated number of accidents and consequently overall accident costs. Estimation of accident costs consist of two components – the cost of each type of accident (fatal, damage and injury) and the accident rate per vehicle-km. The HDM model uses the number of accidents per 100 million vehicle-km. It is expected that the number of accidents will be reduced on the Dhaka – Ashulia Elevated Expressway and on the upgraded road section on N302.

The cost of accidents is the value of injuries and fatalities. Each accident entails economic cost, as well as the social cost of pain, grief, and suffering of families of the victims. It also has an adverse

impact on the resources of the government. Using the human capital approach that focuses on the gross output of road accident victims, costs are classified into three main components, namely: victim related cost; property damage; and administration cost.

The costs of the various types of accidents were published by RHD in its 2004/05 annual report. An independent research of cost estimates for accidents is not part of the present study. Therefore, the cost estimates have for the present study been updated according to the inflationary development since then, and applied to the DAEE project. The resulting values are USD 42,000 per fatal accident, USD 5,250 per accident categorised as damage, and USD 2,625 for other reported accidents categorised as injuries. A summary is presented in Table 12.18.

Table 12.18: Average Accident Costs (2016)

	Fatal	Damage	Injury
Cost of accident	USD42,000	USD5,250	USD2,625

Source: RHD Road User Cost Report, 2004/5 adjusted to 2016 cost level.

There is only limited data for accidents along the project road; however recorded accidents and rates from the National Highway 1 have been used for guidance. Although accident data is rarely presented with reference to the vehicle-km on a particular road section, a figure of 41 accidents per 100 million vehicle-km was captured from a 2013 report that covered part of the Kanchpur - Daudkani road section. In 2016 the Dhaka – Chittagong Expressway PPP project similarly applied the accident cost structure, accident frequency and definitions.

Due to the uncertainties of directly adapting accident data from National Highway 1, the DAEE Project has assumed the equivalent number accidents per vehicle-km of which 3 are fatal, 18 are injuries and 20 are damage. When the DAEE Project is implemented, it is assumed that the accidents will be reduced by 50% which is in line with international experience. Traffic on the elevated expressway is not affected by pedestrian or non-motorised traffic, and only a limited amount of motorcycles and motorised rickshaws are assumed to use the expressway. Furthermore all interchanges will be grade separated. Table 12.19 presents the estimated number of accident on the existing project road network as well as for the DAEEP when implemented.

Table 12.19: Frequency of Accidents (number by 100 million-vehicle km)

	Fatal	Injury	Damage
Existing project road network	3	18	20
DAEEP	1	9	10

Source: Evidence from National Highway 1 and Consultant's estimate

12.8.3.5. Other Benefits

The main quantifiable benefits of the DAEEP arrive from time-savings and savings in vehicle operating costs as mentioned above. In addition, less quantifiable benefits can also be justified from the project and should mainly be addressed to business and industrial development perspective as the DAEEP and other parallel road improvement projects in and around Dhaka. These are expected to improve considerably the connectivity to and from the Port of Chittagong as well as the freight and passenger corridor traffic opportunities to the northern and western parts of the country.

The proposed DAEEP alignment follows an existing road link and forms a part of one of the most important road links connecting the northern and south-western part of the country to the capital Dhaka and beyond. Presently, road users from around 25 northern and south-eastern districts use the existing Abdullahpur – Ashulia – Baipayl - DEPZ link to enter Dhaka. As the major traffic

bottlenecks are seen at the Baipayl and the Abdullahpur junction considerable traffic delays are presently experienced by road users.

The DAEE Project is further expected to improve the traffic flow by separating the through traffic from the local traffic and thus reduce the travel time of the passengers entering and exiting Dhaka to the northern and southwestern districts. Considerable benefits to road users will further be enhanced because of the connectivity of DAEEP with the now under construction DEEP, especially for users travelling to and from the south-eastern parts of the country.

Chittagong port is a major origin or destination of a large proportion of freight traffic, and the Baipayl – Ashulia - Abdullahpur road is and will be used by a considerable share of the freight traffic. Another major destination (or origin) of the EPZ freight is the inland container terminal at Kamalapur which will further gain from road network improvements.

The freight traffic from the northern and south-western parts of the country will in particular gain from the DAEEP as the Dhaka Export Processing Zone (DEPZ) is located near to Baipayl Junction and is presently a major cause of the traffic congestion at that junction. Furthermore, the large number of industrial establishments along the existing Ashulia – Baipayl - Chandra link will benefit from the traffic improvement in particular as the trucks and semi-trailers are mainly responsible for the present congestion along the existing route because of their lower travel speed and lower manoeuvrability.

In addition to the benefits to the business and industrial areas, other businesses in the northern region that are dependent on the Chittagong port will equally be positively affected. Furthermore, the DAEEP will be able to provide travel time savings for freight traffic based on the assumption that transport are allowed during the daytime through the seamless integration between DAEEP and DEEP.

The benefits of daytime travel through Dhaka using the DAEEP and DEEP depend on the existing supply chain management and the traffic conditions at other major highways. For example, if there remains major traffic bottlenecks at other locations on the highway, businesses may want to move goods only during the night to avoid those bottlenecks. In such cases, the benefits of the DAEEP and DEEP might be reduced. Therefore, the combination of the implementation of the DAEEP and the DEEP will be a considerable precondition for the expected time benefits.

The area near Baipayl junction has over the years developed into an unorganized industrial zone that supports a significant number of non-EPZ industries. The region may likely benefit from the concentration of industries and further opportunities exists for industrial parks such as a High-Tech park in Kaliakoir. Although this will require proper regional land use planning however supported by the DAEEP – DEEP, potential synergies can be achieved for further economic growth in the region.

12.9. Sensitivity and Risk Analysis

The robustness of the project to plausible changes in the main input assumptions has been tested by means of a sensitivity analysis. This includes examining the effects on the project's main economic indicators of given changes in traffic growth rates, construction and maintenance costs, vehicle operating costs and travel time.

12.9.1. Changes in the Economic Discount Rate

It has been observed from other similar road and highway studies in Bangladesh that a discount rate of 12% have been applied, however such level is not specifically mentioned in the ToR of this project.

Therefore, if lower discount rates are used for the economic analysis of e.g. 10%, the project would according to the quantifiable benefits alone automatically indicate economic viability.

12.9.2. Changes in Investment Costs

The sensitivity of the EIRR to changes in investment costs of the DAEEP is showing that a minor decrease of around 5 % in investments cost based on the medium traffic growth will make the project economically viable based on quantifiable benefits alone.

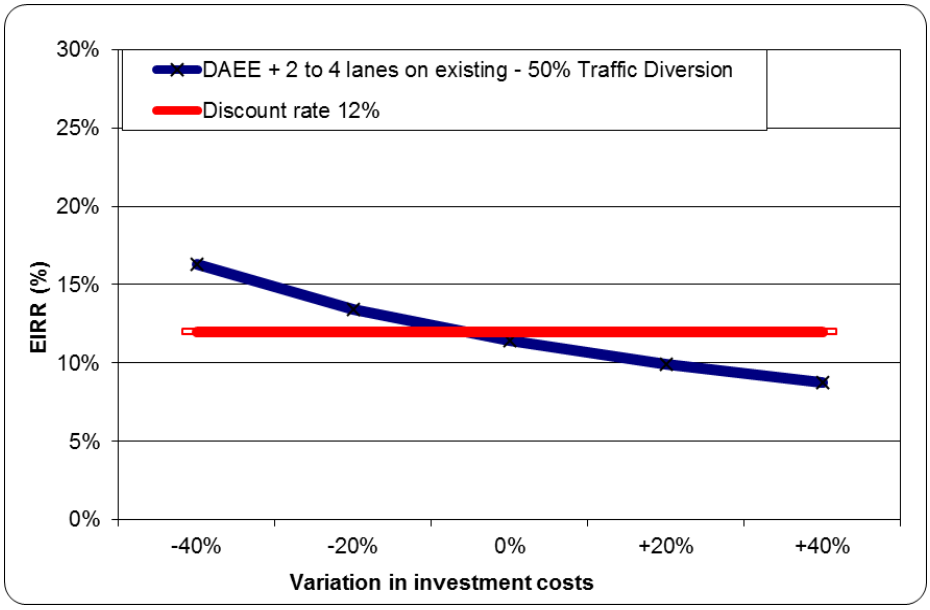


Figure 12.11: Sensitivity to EIRR by Changes in Investment Costs, (Medium Traffic Growth)

12.9.3. Changes in Diverted Traffic

The economic evaluation has tested how sensitive the DAEEP is to changes in the portion of diverted traffic and as seen from Figure 12.12, the economic viability is only marginally influenced by changes, the reason being that the diverted road users will alternatively use the existing road section along N302, which as part of the project will be upgraded and widened to also consist of four lanes like the expressway. As the road conditions of the two road alternatives are not differing too much, only marginal difference in road user benefits will be transferred between alternatives.

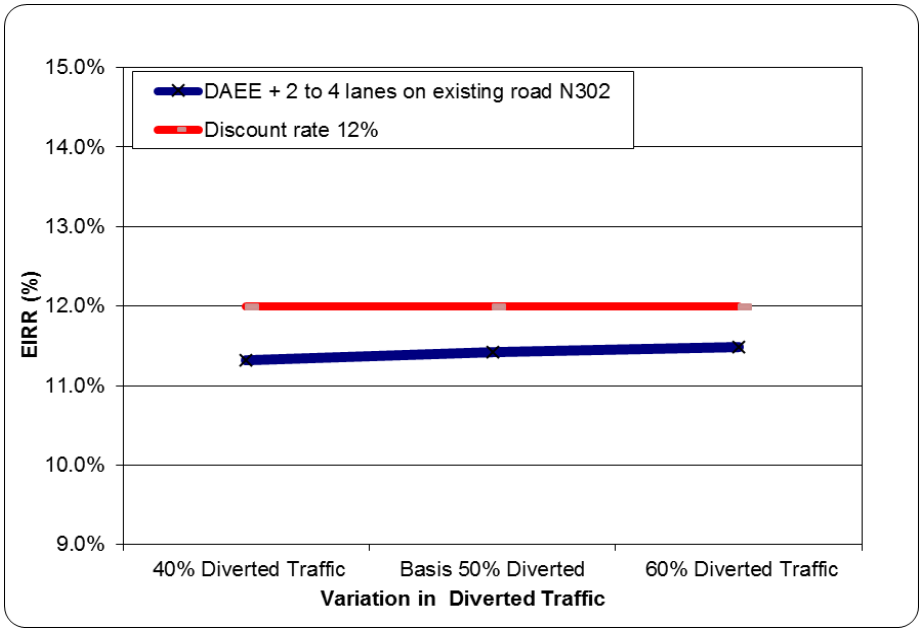


Figure 12.12: Sensitivity to EIRR by Changes in Traffic Diversion to DAEE, (Medium Traffic Growth)

12.9.1 Changes in Traffic Growth Rates

Three traffic growth scenarios have been considered; *viz* low, medium and high. The results of the three growth scenarios have already been presented above. Figure 12.13 indicates that the economic viability is maintained by applying about 4% higher traffic growth than assumed for the medium traffic growth scenario.

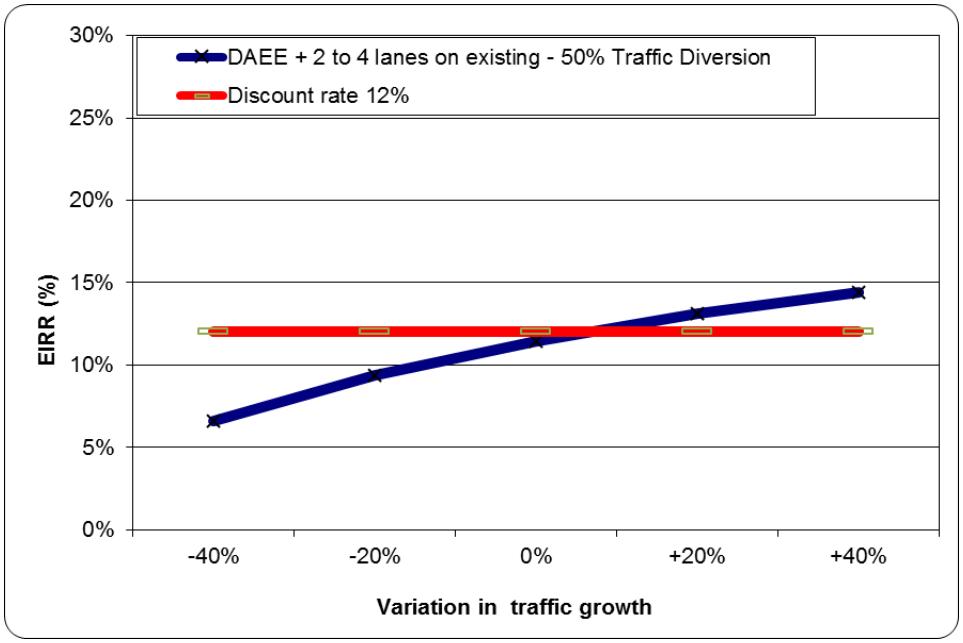


Figure 12.13: Sensitivity to EIRR by Changes in Traffic Growth, (Medium Traffic Growth)

12.9.4. Changes in Vehicle Operating Costs

The sensitivity of EIRR to changes in VOC is relatively low indicating that a decrease of around 5 % in VOCs still maintains the economic viability of the project.

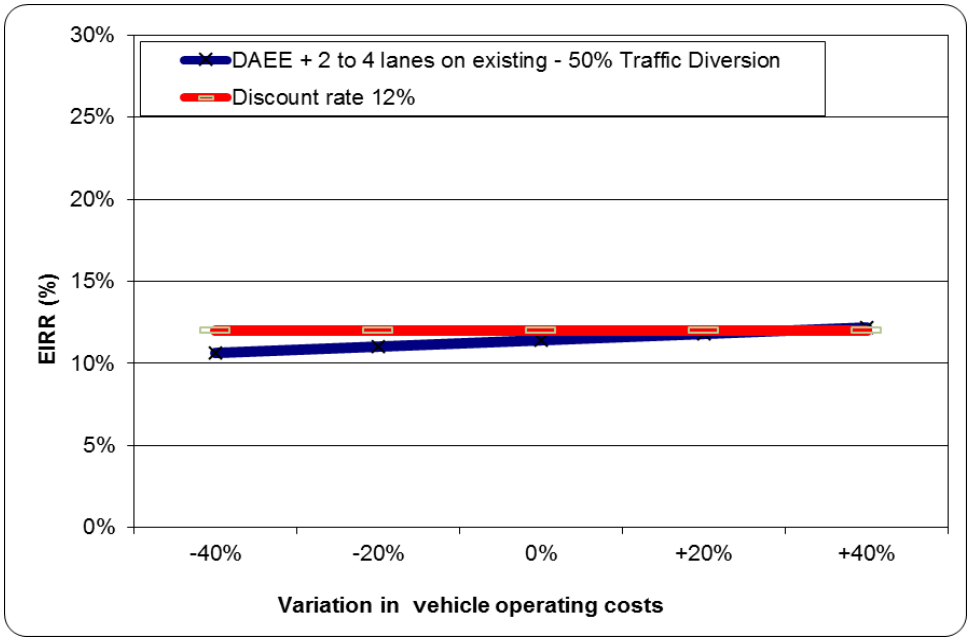


Figure 12.14: Sensitivity to EIRR by Changes in VOC (Medium Traffic Growth)

12.9.5. Changes in Time Values

The sensitivity of EIRR to changes in value of time indicates that a decline of more than 2-3% in the value of time will make the project economically unviable.

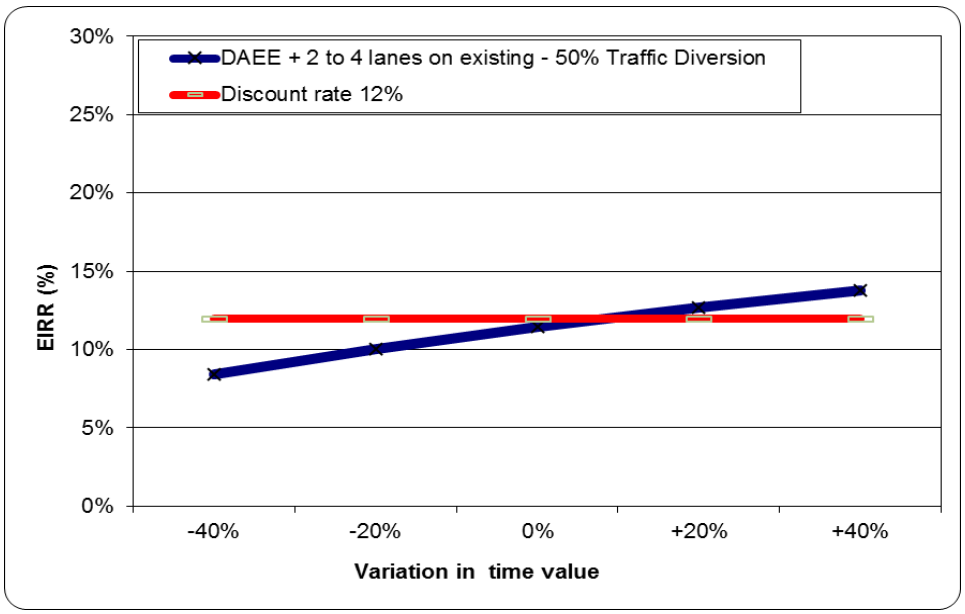


Figure 12.15: Sensitivity to EIRR by Changes in Value of Time (Medium Traffic Growth)

12.9.6. Summary

Table 12.20 summarises the results of the sensitivity analysis.

Table 12.20: Summary of Sensitivity Results

Parameter	NPV (USD million)	EIRR
Basis Case Results	-53.8	11.4%
Investment costs +20%	-219.0	9.9%
Investment costs -20%	111.5	13.4%
Diverted traffic 60%	-47.5	11.5%
Diverted traffic 40%	-62.2	11.3%
Vehicle operating costs +20%	-17.6	11.8%
Vehicle operating costs -20%	-90.0	11.0%
Value of travel time +20%	64.7	12.7%
Value of travel time -20%	-172.3	10.0%
Traffic growth +20%	106.0	13.1%
Traffic growth -20%	-226.1	9.4%

Source: Consultant's calculations

12.10. Conclusions and Recommendations

The results of the economic evaluation of the DAEEP based on the medium traffic diversion scenario indicate an economically viable project showing an EIRR of 12 % based on the assumptions taken.

Table 12.21 presents the main economic viability indicators for the Dhaka – Ashulia Expressway project for the various traffic growth scenarios.

Table 12.21: Summary of Economic Indicators for DAEEP (discount factor 12%)

Project	Traffic growth scenarios	NPV (USD million)	EIRR (%)	NPV / Cost
DAEE + Widening of existing road section on N302 from 2 to 4 lanes	High Traffic (+20% growth)	106.0	13.17%	1.13
	Medium Traffic	**-53.8**	**11.4%**	**0.94**
	Low Traffic (-20% growth)	-226.1	9.4%	0.73

Source: Consultant's calculations

The economic analysis of the Dhaka – Ashulia Elevated Expressway Project indicates an EIRR of 11.4% that is slightly below the economically viable criteria when comparing to the threshold of 12% discount rate.

It has been observed from other similar road and highway studies in Bangladesh that a discount rate of 12% have been applied, however such level is not specifically mentioned in the ToR of this project. Therefore, if lower discount rates are used for the economic analysis of e.g. 10%, the project would according to the quantifiable benefits automatically indicate economic viability.

The DAEEP is for reasons of improved traffic management and corridor improvements for road user and trade etc. a considerable influencing factor for the future industrial development opportunities in and around Dhaka that is even further expected to generate additional benefits to the project thereby justifying its implementation. Furthermore, the DAEEP and the on-going DEEP should be seen as integrated projects with mutual benefits that even further justifies the projects.

The economic project viability is only marginally influenced by changes in diverted traffic as road users will alternatively use the existing road section along N302, which as part of the project will be upgraded and widened to also consist of four lanes like the expressway. As the road condition of the two road alternatives is not differing too much, only marginal difference in road user benefits will be transferred between the alternatives.

13. FINANCIAL ANALYSIS

13.1. Approach and Methodology

The objective of the financial analysis is to assess the financial viability of the 24.0 km long Dhaka – Ashulia Elevated Expressway Project (DAEEP) including ramps. It is the intention that it will be converted into a tolled expressway and operated by a private operator.

The financial analysis has been carried of the DAEEP only, however the project is a continuation of the DEEP as the two projects are physically directly linked together and will eventually represent a tolled expressway with a total length of about 40 km.

The result of the traffic demand analysis derived from the traffic information from the existing road alignment has been the basis for projected traffic information along with the macroeconomic forecasts. The financial analysis has subsequently tested scenarios for the amount of traffic that is expected to be diverted to the tolled expressway based on considerations for the willingness for road users to pay toll. The competition between the existing road alignment and the DAEEP has in accordance to the results of the economic analysis also taken into consideration the physical condition of the existing road network and the DAEEP impacting travel speed and travel convenience of the road users.

The existing road along R302 will as part of the overall DAEE Project be upgraded and widened from two to four lanes providing a comparable good route alternative to the expressway.

Cost of toll operations and cost of expressway maintenance have been estimated for the DAEEP and the financial model calculations have provided financial indicators and sensitivity results.

The cash flow for the financial analysis of the DAEEP consists of the following elements:

Inflow:	Toll Revenues (varying toll levels between vehicle categories)
Inflow:	Residual Value (at the end of the project's life)
Outflow:	Investment Costs (CAPEX) • DAEE • Tolling Stations
Outflow:	Operating Costs (OPEX) • DAEE Maintenance • Operation of toll plazas

The results of the financial analysis are:

- the annual financial cash-flow streams from the estimated financial costs and revenues over an evaluation period of 32 years based on a real 5% financial discount factor that reflects and depends on the likely cost of finance identified for the project finance.
- financial viability indicators; Financial Internal Rate of Return (FIRR), Financial Net Present Value (FNPV) will be presented for the evaluated scenarios.
- sensitivity analysis; provided as part of the financial analysis by applying changes of the critical parameters such as diverted traffic, investment cost, toll levels and discount factor.
- scenarios for funding strategies. The funding structure and financial terms is yet to be determined, and subsequent sensitivity analysis has been carried out for alternative lower financial discount rates.

13.2. Financial modelling methodology and key assumptions

The financial modelling used for the financial analysis is developed in Excel spreadsheet that contains financial cash-flow estimates, main financial indicator results and results of the sensitivity analysis.

13.2.1. Main factors influencing the use of the expressway

Much of the debate over the feasibility of a new toll expressway revolves around its ability to attract traffic from existing toll-free roads. The DAEE alignment will run generally parallel to the existing road alignment that for some sub-sections (R302) will as part of the overall project be upgraded from dual to four-lane highway standard, and consequently represent a comparable route alternative and influencing the route choice of road users.

In Bangladesh people are less exposed to the PPP concept and toll road project (except from bridges) and therefore less attuned to paying tolls in order to access an expressway. Given the need for significant improvements to the transport infrastructure and limited resources, some form of funding model that attracts investors will be required and this will generally involve a toll being placed on the expressway to receive a return on this investment.

Tolls and other factors of influence are amongst other:

- A history of road tolls in Bangladesh and worldwide.
- DAEE following the existing road alignment representing a comparable route alternative.
- Present and projected traffic.
- Travel behaviour and willingness to pay.

13.2.1.1. Dhaka Elevated Expressway

Construction of the 19.7 km Dhaka Elevated Expressway which will run from Shahjalal International Airport to Kutubkhali via Mohakhali, Moghbazar, Kamalapur and Jatrabarhi to connect the Dhaka-Chittagong Highway commenced in 2015 and is due to be completed by 2020. Private Investment in this PPP project is by the Italian -Thai Development Public Company. This expressway will be an open system and tolls for entry at either end of the expressway have been set at BDT 125. Entry at other than the ends will attract a toll of BDT100. In an open system payment is performed on one spot regardless of the distance travelled; thus the toll on the Dhaka Elevated Expressway is BDT 6.35 per km for travelling the full length of the expressway and somewhat higher per km if entering at one of the ends and exiting before reaching the other end. Similarly there is some variation in the toll per km for entry at intermediate locations

13.2.1.2. Dhaka – Chittagong Expressway

A feasibility study for the Dhaka – Chittagong Expressway Project is presently underway. This will provide an alternative to the existing National Highway N1. A toll system and toll levels are presently being devised and discussed with the government's executing agency, the Roads and Highways Department. Initial indications are that the tolls per km are likely to be comparable to those of the Dhaka Elevated Expressway

13.2.1.3. Tolling Policy in Bangladesh

There are 62 items of toll infrastructures in Bangladesh. The vast majority of these are bridges over many of the waterways. Already along the National Highway 1 (NH1) the Meghna and Gumti Bridges are tolled.

A number of studies have identified the viability of toll infrastructure in Bangladesh. A study conducted in 1995 reviewed build-operate-transfer (BOT) arrangements in the Bangladesh road sector. It concluded that growth in the sector had not yet made BOT a viable option. Since then

traffic demand in Bangladesh has significantly changed, fuelled by a high growth in business activity with a correspondingly need for high standard road infrastructure. Since then a number of bridges and road sections have involved private concessionaire for infrastructure development and/or maintenance. This demand has seen a growth in PPP-style projects to meet the need and fill the funding gap from government. The Government of Bangladesh has recently established a PPP office to manage the high number of PPP proposals and options currently progressing and the RHD has developed its own PPP cell to provide further support.

In 2014, the Government released its draft tolling policy. It is worth noting that the toll rates proposed in that policy do not necessarily correlate with actual rates charged by private operators.

The following section highlights four major items of toll infrastructure in Bangladesh.

- Bangabandhu Bridge is the largest toll bridge in Bangladesh; operating since 1998.
- Bonpara toll road is the first toll road involving an operate and maintain (O&M) concessionaire to maintain the road collecting small amount of toll.
- Jatrabari - Gulistan flyover is the first and largest PPP infrastructure project in Bangladesh, built on build, operate, own and transfer (BOOT) basis.
- Meghna and the Meghna-Gumti bridges are toll bridges located along Highway N1.

Bangladesh has experienced minimal participation of the private sector in road infrastructure. The most frequent practice for tolled roads has been government building the infrastructure and then it assigns the O&M operators to maintain the roads by collecting tolls. The country's first toll road connecting Natore and Sirajganj on the Rajshahi-Dhaka Highway, also involved an O&M concessionaire to maintain the road collecting small amount of toll. The 55 km highway collects tolls of BDT50 to 150 for different types of vehicles. It has operated since 2003 and has managed to capture significant amount of traffic along this corridor. However, issues have arisen as substandard construction quality and poor maintenance work have resulted in large potholes, craters and ditches along the roadway.

The Roads and Highways Department conducted a survey with vehicle operators and asked what benefits they had experienced due to road improvement projects. Despite the issues over road pavement quality, this road project was identified as one of the three most beneficial projects in terms of travel time saving and vehicle operating cost reduction.

Although the road has separate lane for rickshaw and other slow moving vehicles, cars or buses are often found to use that lane diminishing its intended safety benefits. Correspondingly, a large number of accidents are reported every month.

The first and largest PPP infrastructure project in Bangladesh is the Jatrabari - Gulistan flyover, which was built on a build, operate, own and transfer (BOOT) basis. The flyover connects the NH1 Dhaka-Chittagong Highway, Dhaka-Mawa Highway, Dhaka-Demra Road and the Atish-Dipankar Road and the roads to Sayedabad, Motijheel, Gulistan, Bangabandhu Avenue and Polashi. The concession agreement allowed the construction firm to collect toll from the users for 24 years to recover their costs. The construction cost of the 9 km flyover was BDT23 billion and operations began in late 2013.

The concessionaire agreement for this project is being criticized as it allowed minimum traffic guarantee of 66% (43,283 different category vehicles per day) of the base case scenario (65,581 different category vehicles per day) with compensation in the form of concession extension in case of shortfall. The concessionaires are also allowed to increase the toll rates every three years. The current toll rates for different types of vehicles are outlined below:

Table 13.1: Toll Rates at Jatrabari – Gulistan Flyover (9 km)

Vehicle categories	Toll (BDT)	Toll/km (BDT)	Toll (USD)	Toll/km (USD
Cars	60	6.7	0.77	0.09
Jeeps	70	7.8	0.90	0.10
Pickups	130	14.4	1.67	0.19
Auto-Rickshaws	18	2.0	0.23	0.03
Motorcycles	10	1.1	0.13	0.01
Microbuses	85	9.4	1.09	0.12
Minibuses	173	19.2	2.22	0.25
Buses	260	28.9	3.33	0.37
Small trucks	173	19.2	2.22	0.25
Medium/Large trucks	260	28.9	3.33	0.37
Truck Trailers	375	41.7	4.81	0.53

Note: USD/BDT = 78

13.2.2. Key Assumptions

The key assumptions for the financial analysis are presented in the following.

13.2.2.1. Toll considerations

As already discussed in the economic evaluation, several factors affect the travel demand and selection of routes by road users. The Dhaka – Ashulia Elevated Expressway is expected to be operated as a toll road, and consequently the toll levels will influence the travel demand and diversion of traffic to the DAEE from the existing project road alignment, which will also represent a reasonable road alternative.

The willingness to pay for using the tolled expressway and thereby the future traffic volume will determine and indicate the potential financial viability of the proposed DAEE Project. Of importance is to what extent the likely future road traffic demand will be sufficient when operated as a toll road, the proposed toll levels, and its ability to generate sufficient revenue to attract investors to construct and operate the expressway.

13.2.2.2. Willingness to pay and time value

The willingness to pay toll refer to the trade-off that travellers make between time and money, and basically the travellers are deciding if they are willing to buy travel time savings and/or travel reliability. Traveller's value of time combined with the perspectives of travel time-savings will generally determine the travel pattern and whether travellers prefer to use the toll road or the alternative route. In the present project situation, the distance is the same for both the expressway and the existing road alternative, and subsequently the gained travel time as well as travel convenience are important determining factors. The average travel speed is designed to be higher on the expressway however will further be influenced by the diverted traffic volume.

The detailed travel modelling will further determine the travel decision pattern and is beyond the time values determined by travel time consumptions, travel purpose, passenger of freight, quality and condition of alternative routes, day of week, time of day, trip frequency, vehicle occupancy, trip length/distance, toll payment methods, time consumptions for payment and convenience.

The DAEE will be four-lanes throughout, and tolled with an open toll system that charges traffic only according to the location where they enter the expressway rather than by distance travelled to reach the exit point. This requires toll plazas only at the entry points to the expressway. In fact the toll plaza can be some distance downstream of the entry point as long as it is located prior to an exit. As

the DAEEP and the DEE sections will be connected to form the one expressway, the use of a similar tolling system will greatly simplify operations and remove a cause of user confusion.

Table 13.2 outlines the value of time for different vehicle categories as used in the economic evaluation measured in economic prices. Value of time in financial terms will be about 15% higher if considering the effect of VAT and even higher if other duties are considered.

Table 13.2: Value of Time for passengers for Different Vehicle Categories (economic values in USD)

	Cars	Vans & Pickups	Micro Buses	Medium Buses	Large Buses	Small Trucks	Medium Trucks	Heavy Trucks	Motor cycles & Rickshaws
Passenger value of time	3.05	3.05	1.25	0.80	0.80	1.75	1.92	2.10	0.57
Seat/ vehicle occupancy	3	2.65	10	35	48	2.5	2.5	2.5	2.5
Vehicle value of time per	9.15	8.08	12.5	28	38.4	4.37	4.8	5.25	1.43

The above presented time values are working time values and if considering non-working hours and the corresponding actual work related passenger trips, then the time values, in particular for passenger vehicles might be lower. The time values for trucks are largely work-related and generally, the transported commodities are in principle covering the cost of transportation.

Based on the design speed of the DAEE of 80 km/hour and taking into consideration that the actual travel speed may at times be lower, then on average road users will be able to travel through the full DAEE during 15-20 minutes, which for toll level consideration on average correspond to 25% of the hourly time values.

From an economic point of view, the lower the toll the better, as this will encourage as much traffic as possible make use of the new investment. For a toll road project, a balance has to be struck between economic and financial objectives. Thus, the economic analysis is based on the traffic level that is expected from the selected toll rate.

13.2.2.3. Proposed toll structure

The proposed toll levels for the different vehicle categories have considered the experience from the DEE Project and the Dhaka – Chittagong Expressway Project. The toll rate as preliminarily determined for the financial analysis is based on an average of 9.4 BDT per km or USD 0.121 per km for a medium-sized truck, however, coordination with the outcome of toll decisions on the DEEP will eventually need to be considered. Other vehicle types will pay more or less than this, depending on their size and subsequent toll multipliers. Actual toll rates for projects such as the Dhaka – Chittagong Project are presently being negotiated between the client, financiers and potential operators. Table 13.3 presents the proposed toll levels for the different vehicle categories.

Table 13.3: Proposed Toll Levels used for the Financial Analysis (BDT and USD)

Item	Car / taxi	Pickup / 4WD	Minibus	Medium bus	Large bus	Small truck	Medium truck	Heavy truck	Motor cycle / rickshaw
Toll multiplier between vehicles	1	1	3	3	3	1.5	1.5	2	0.5
Toll level per km (BDT)	6.27	6.27	18.80	18.80	18.80	9.40	9.40	12.53	3.13
Toll level per km (USD)	0.08	0.080	0.241	0.241	0.241	0.121	0.121	0.161	0.040

As mentioned, the toll levels stated in Table 13.3 are tentative and, depending on the outcome of the final toll level negotiations, the impact on travel demand and subsequent financial viability will vary accordingly. Therefore, the financial analysis has provided viability indicators for varying toll levels

and traffic diversion in order to show the break-even project viability for combinations of toll levels and traffic, and subsequently what will be required to make the DAEE Project financial viable and potentially attractive to private financiers and operators.

13.2.2.4. Anticipated Diverted Traffic along the DAEE

Assumptions taken for how much of the traffic from the existing project road network that is expected to be diverted to the Dhaka – Ashulia Elevated Expressway over the evaluation period are outlined in Table 13.4. To allow for the uncertainties of the eventual toll levels and the road users willingness to pay for using the tolled expressway, three traffic diversion scenarios have been examined; with 40%, 50% and 60% for all categories of the diverted vehicular traffic. Detailed information on anticipated route selection of the different vehicle category road users may end up with traffic diversion most likely favouring heavy traffic rather than passenger vehicles. Such a proportion will also likely have positive impacts on the generated revenues from toll collections.

Motorcycles and motorized rickshaws are only to a limited extent expected to use the expressway. Furthermore is it assumed that non-motorized traffic will not be allowed to use the expressway.

Travel time-savings and diverted traffic are determined by travel speed and reliability of the tolled expressway, the toll levels and the value of time for difference vehicle categories and passengers. The existing road following the DAEE alignment will be an upgraded alternative in particular along R302 between Ashulia and Baipayl Junctions, and the amount of diverted traffic to the DAEE will reduce congestion in the early years. The likelihood is that traffic growth will eventually again create congestion.

Table 13.4: Percentages for Diverted Traffic to the DAEE

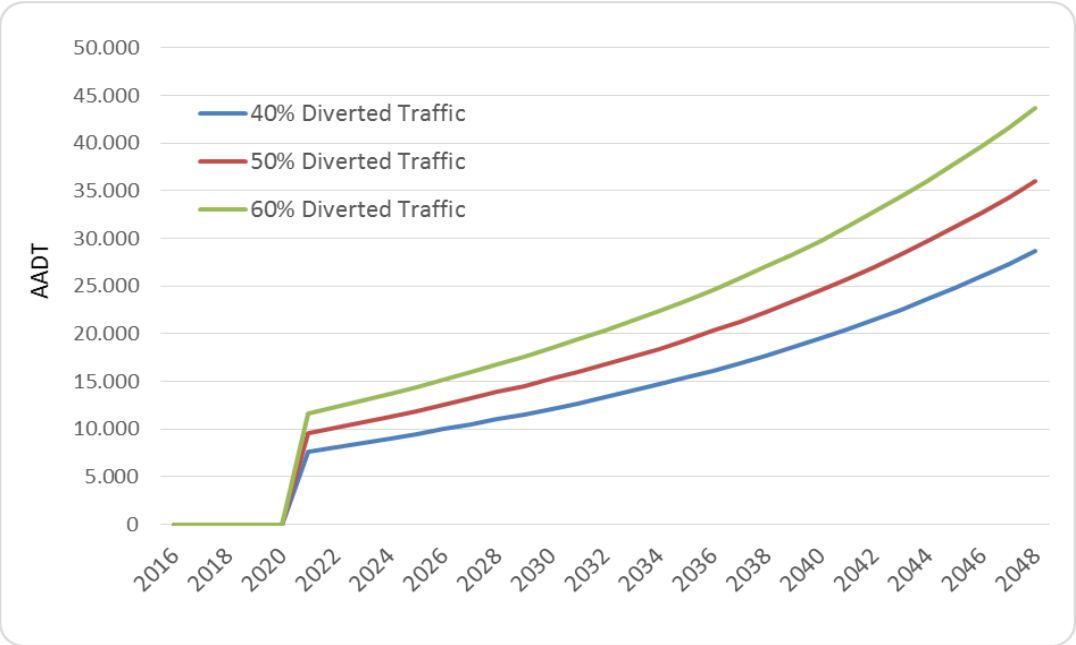
Scenario	Cars	Pickups & 4WD	Micro buses	Medium buses	Large buses	Small trucks	Medium trucks	Heavy trucks	Motorcycles & rickshaws
Low Diversion Scenario	40%	40%	40%	40%	40%	40%	40%	40%	2.5%
Base Case Diversion Scenario	50%	50%	50%	50%	50%	50%	50%	50%	5%
High Diversion Scenario	60%	60%	60%	60%	60%	60%	60%	60%	10%

Source: Consultant's estimates

Traffic presently using the road between Ashulia Junction and Baipayl Junction representing road sections 2 and 3 of the existing project road sub-sections is the basis for anticipated diverted traffic.

Figure 13.1 presents the estimated AADT over the analysis period for the three traffic diversion scenarios.

There is a delicate balance between the number of road users and the level of tolls and the subsequent generated revenues. There will likely be more road users if the toll is low while less users if the implemented toll levels are too high. As the travel speed is a function of the traffic volume and distribution, then the travel time will subsequently be influenced by the selected toll structure. At present, there is limited information and evidence in Dhaka and Bangladesh from toll roads on the exact relationship between toll levels and saved time for road users, and further on the willingness to pay for using the expressway. That will require more information from detailed user surveys.



Source: Consultant's estimate

Figure 13.1: Traffic Diversion to the DAEE (Three Scenarios)

13.2.2.5. Toll strategies

There are various possible toll strategies, which can be adopted for the financial analysis also depending on the number of toll plazas that will be implemented. Two toll plazas are proposed on the DAEE:

- One above the railway line for southbound traffic about to join the Dhaka Elevated Expressway near the airport, and
- One in about the middle of the DAEE where there is a straight section of road through the floodplain / swamp area. This will have four separate elements, which will allow for tolling of northbound and southbound expressway and non-expressway traffic.

All traffic entering the expressway will be tolled at the point of entry. The central toll plaza will allow for local traffic (such as from Mirpur Road) to enter the system and pay a lesser toll.

Figure 13.2 shows the proposed toll plaza locations. The full diamond interchange in the middle of the project will actually have the entry ramp ahead of the exit. The locations ensure that road users cannot travel along the expressway for free.

For the purposes of financial analysis and estimation of toll revenues, and based on the traffic assumptions taken for the analysis, the road users are assumed to travel along the full distance based on the initially proposed toll levels for the different vehicle categories. Other methods can be adopted based on either toll based on average distance from entry point where the toll is collected or half toll at intermediate points.

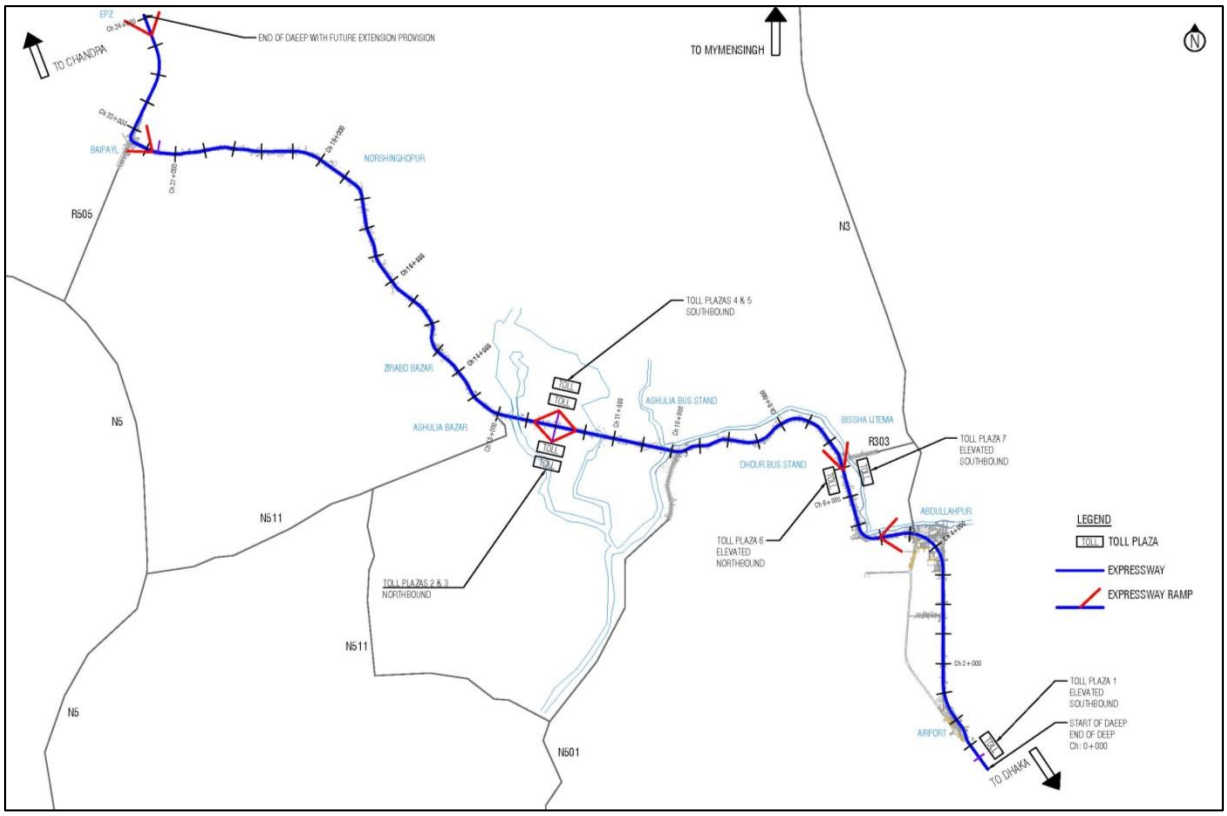


Figure 13.2: Proposed Locations of Toll Plazas and Interchanges

13.2.2.6. Cost estimate of DAEE

Table 13.5 presents the total cost estimate for the Dhaka – Ashulia Elevated Expressway. The cost structure show the total costs of the DAEE, the cost of toll plazas, costs of land and resettlement, and the costs less toll plazas and land and resettlement.

Table 13.5: Estimated Construction Cost of DAEE

Estimated Cost of Construction of DAEE	BDT (million)	USD (million)
Total construction costs of DAEE	89,789	1 151.1
Cost of Toll Plazas	1403	18.0
Costs of Land Acquisition and Resettlement	23,281	298.5
Total Costs less Toll Plaza & Acquisition & Resettlement	**65,105**	**834.7**

Source: Consultants calculations

The funding of the DAEE is yet to be determined and various combinations exist – e.g. with or without private financing of land and resettlement costs, and the financial viability for funding options is further considered below where the GoB finance the cost of land and resettlement.

13.2.2.7. Other financial assumptions

Table 13.6 presents other assumptions used for the financial analysis.

Table 13.6: Assumptions for the Financial Analysis

Item	Value
Total construction costs of DAEE (CAPEX)	USD 1,151.1 million
Cost of land acquisition and resettlement	USD 298.5 million
Cost of toll plazas	USD 16.5 million
Estimated distribution of CAPEX (2017-2020)	15%, 15%, 35%, 35%
Residual Value (end of project)	30 % of total construction costs
Distance	24.0 km
Construction period	2017 – 2020
First year of operations	2021
Financial discount rate / Weighted Average Cost of Capital (WACC). The financial discount is tentatively set to 5 %, however not determined yet for the project and depends on the eventual cost of capital of the private financiers and the terms of financing could therefore be more or less favourable.	5%
Annual toll price increase	6.5%
Period of analysis	32 years starting in 2016
Annual cost of toll operations (OPEX). The cost of operations is over the years expected to decline proportionally to the revenues due to economics of scale.	of revenue year 1 – 5: 2.5% of revenue year 6 – 9: 2.0% of revenue year 10 – 15: 1.5% of revenue year 16 – 20: 1.0% of revenue year 21 – forward: 1.0%
Cost of maintenance (OPEX). The cost of road maintenance is estimated based on an annual average cost, however the annual maintenance may differ and consist of periodic and responsive measures depending on traffic volume and distribution.	USD 60,000 per km per year

13.3. Results of Financial Analysis

As mentioned above the results of the financial analysis and the viability of the DAEE Projects when considering a toll solution depends on a number of critical variables including road users willingness to pay toll, the toll levels and consequently the amount of traffic than will use the expressway.

Table 13.7 presents the result of the financial analysis of the tolled DAEE based on the assumptions taken with regard to toll levels and diverted traffic. The capital expenditure (CAPEX) used for the analysis is without the cost of land and resettlement which will be financed by the GoB. The results indicate that the project is positive financial viability reaching a FIRR of 6.2 % before taxes which is above the financial discount factor of 5 % initially assumed for the analysis. FIRR is 3.8% after taxes.

To impact the financially viability of the project, some of the assumed parameters are, as part of the sensitivity analysis presented below, changed showing possible scenarios for financial viability of the DAEE Project.

Table 13.7: Result of Financial Analysis of Tolled DAEE (Base Case Scenario)

Medium Traffic Growth Rates and 50% Diverted Traffic to DAEE		
Net Present Value (2016)		**(USD million)**
Cost of DAEE construction		-560
Cost of construction of toll plazas		-13
Cost of maintenance		-14
Cost of toll operations		-10
Revenues from toll stations		755
Total		**158**
Revenues in % of total costs		126%
discount factor	Financial NPV	**158**
5%	Financial IRR	**6.15% (before taxes)**
5%	Financial IRR	**3.8% (after taxes)**

Source: Consultant's calculations

13.3.1. Cash-Flow Generation

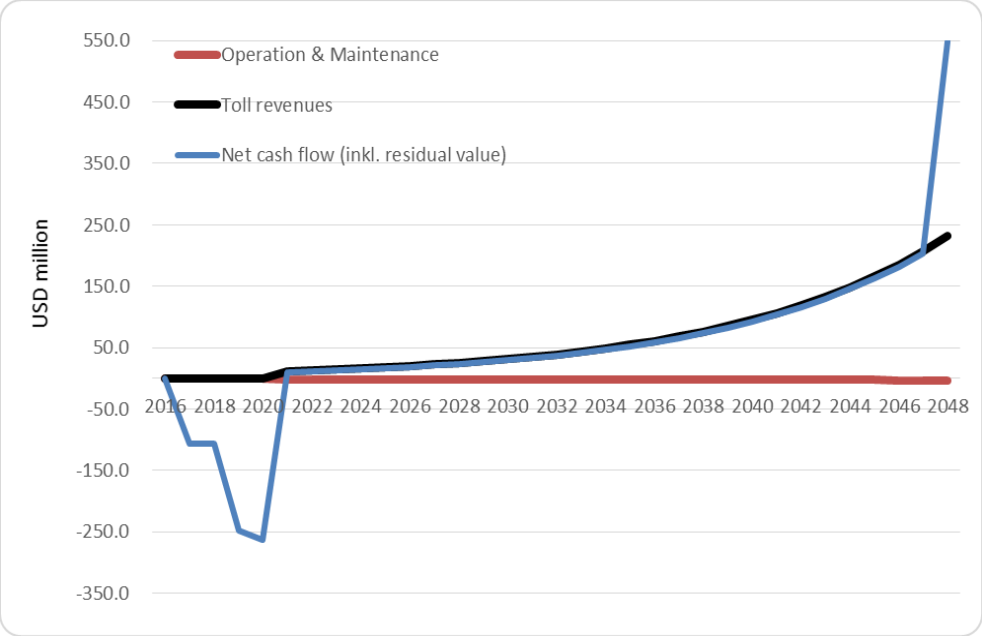
Table 13.8 and Figure 13.3 show the financial cash-flow stream of the various components from the Base Case Scenario.

Table 13.8: Annual Undiscounted Cash-Flow Streams (Base Case Scenario)

Year	Construction Cost (USD)	Cost of Toll Plazas (USD)	Maintenance Cost (USD)	Operation Cost (USD)	Revenue (USD)	Net cash flow (USD)
2016						
2017	-114,033,311	-	-	-	-	-114,033,311
2018	-114,033,311	-	-	-	-	-114,033,311
2019	-266,077,725	-	-	-	-	-266,077,725
2020	-266,077,725	-16,480,549	-	-	-	-282,558,274
2021	-	-	-1,200,000	-332,538	13,301,523	11,768,985
2022	-	-	-1,200,000	-373,756	14,950,254	13,376,498
2023	-	-	-1,200,000	-420,102	16,804,073	15,183,971
2024	-	-	-1,200,000	-472,214	18,888,575	17,216,360
2025	-	-	-1,200,000	-530,814	21,232,561	19,501,747
2026	-	-	-1,200,000	-596,711	23,868,438	22,071,727
2027	-	-	-1,200,000	-536,654	26,832,675	25,096,022
2028	-	-	-1,200,000	-599,659	29,982,951	28,183,292
2029	-	-	-1,200,000	-670,083	33,504,147	31,634,064
2030	-	-	-1,200,000	-748,801	37,440,053	35,491,252
2031	-	-	-1,200,000	-627,595	41,839,643	40,012,049
2032	-	-	-1,200,000	-701,365	46,757,691	44,856,326
2033	-	-	-1,200,000	-783,832	52,255,454	50,271,622
2034	-	-	-1,200,000	-876,022	58,401,447	56,325,425
2035	-	-	-1,200,000	-979,085	65,272,302	63,093,217
2036	-	-	-1,200,000	-1,094,306	72,953,732	70,659,426
2037	-	-	-1,200,000	-815,416	81,541,610	79,526,194
2038	-	-	-1,200,000	-911,432	91,143,177	89,031,746
2039	-	-	-1,200,000	-1,018,784	101,878,392	99,659,608

Year	Construction Cost (USD)	Cost of Toll Plazas (USD)	Maintenance Cost (USD)	Operation Cost (USD)	Revenue (USD)	Net cash flow (USD)
2040	-	-	-1,200,000	-1,138,814	113,881,442	111,542,628
2041	-	-	-1,200,000	-1,273,024	127,302,437	124,829,413
2042	-	-	-1,200,000	-1,423,093	142,309,300	139,686,207
2043	-	-	-1,200,000	-1,590,899	159,089,887	156,298,989
2044	-	-	-1,200,000	-1,778,544	177,854,360	174,875,817
2045	-	-	-1,200,000	-1,988,378	198,837,838	195,649,459
2046	-	-	-1,200,000	-2,223,034	222,303,367	218,880,333
2047	-	-	-1,200,000	-2,485,452	248,545,248	244,859,796
2048	345,342,107	-	-1,200,000	-2,778,928	277,892,756	619,255,936

Source: Consultant's calculations



Source: Consultant's calculations

Figure 13.3: Annual Undiscounted Cash-Flow Streams (Base Case Scenario)

13.3.2. Sensitivity Analysis

In continuation of the result of the financial analysis of the Base Case Scenario, a number of critical parameters influence the result of the financial viability assessment. Initially, the sensitivity analysis focuses on selected parameters and to what extent their variation may result in providing a financial viable project. The results of the sensitivity analysis assume that the cost of land and resettlement will be finance by the GoB. Consequently, at this stage the parameters of change are the toll level, diverted traffic volume and tax implications on the toll operator. In addition, in order to show the financial viability requirement depending on eventual cost of project funding, different financial discount rates have been applied.

Figure 13.4 and Figure 13.5 show the sensitivity on the financial return when respectively the toll levels are changed and when the amount of diverted traffic is changed. The financial return is presented for the project both before and after taxes.

13.3.3. Tax considerations

The financial analysis assumes that all taxes are included in the tariff levels proposed for the DAEE project as the financial returns must be seen from the operators' point of view, as the operator will have to recover all costs of toll operations and investments, which will also include the obligations of paying taxes.

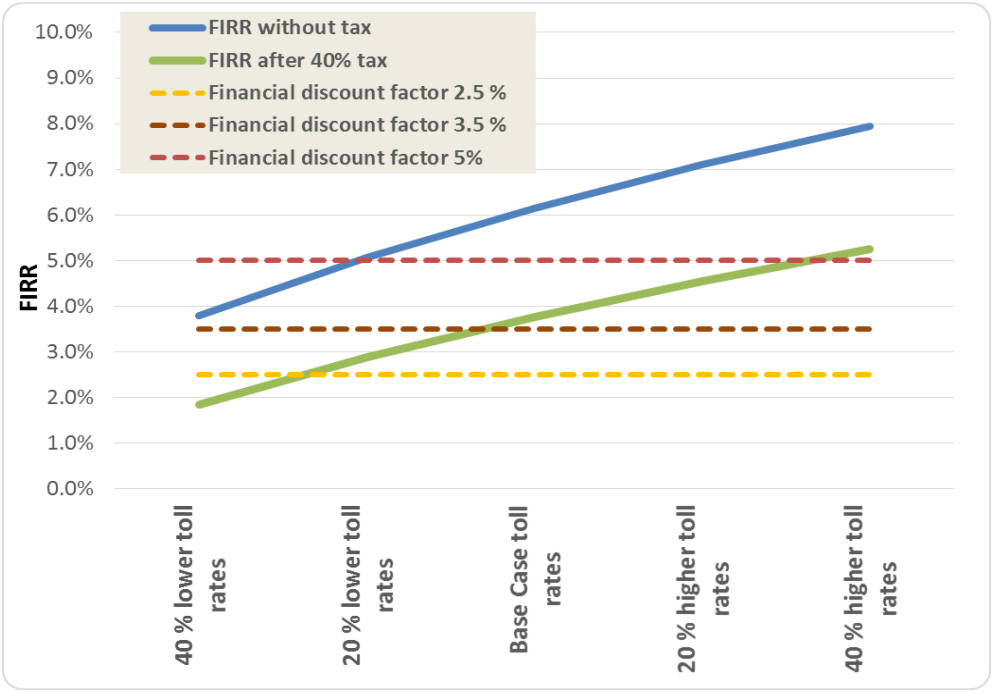
The Government of Bangladesh is presently charging VAT 15% and company tax of 25%. Consequently, the potential DAEE toll operator will be obliged to pay a total of 40% tax unless certain arrangements for tax advantages/exemption will be given to the operator for a specific future period. Such issues are still unknown and such terms and conditions will obviously be part of contract negotiation with the potential private toll operator in the future.

The tariff levels proposed in this feasibility study report are, as stated, also based on the likely levels to be applied for both the DEE and the Dhaka - Chittagong projects, as well as from the current tariff levels applied at the Jatrabari – Gulistan Flyover.

As the toll levels at the Dhaka - Chittagong and the DEE projects are not yet finally decided, and subsequently made available, the proposed tariff levels for the DAEE project should be considered as tentative, and may change in order to harmonize the level of toll levels across the mentioned projects in and around Dhaka. To consider those, this report has provided sensitivity analysis that shows in Figure 13.4 and show changed toll levels will impact the financial viability of the DAEE project as seen from the private operators point of view before any tax payments are determined – whether it will be 40% or lower.

Figure 13.4 indicates that the financial viability of the DAEE Project, before taxes, is further improved if the toll level is increased and still assuming that 50 % of the traffic is diverted to the DAEE. If a lower discount rate than 5% is applied, the financial viability becomes more attractive from the operators point of view.

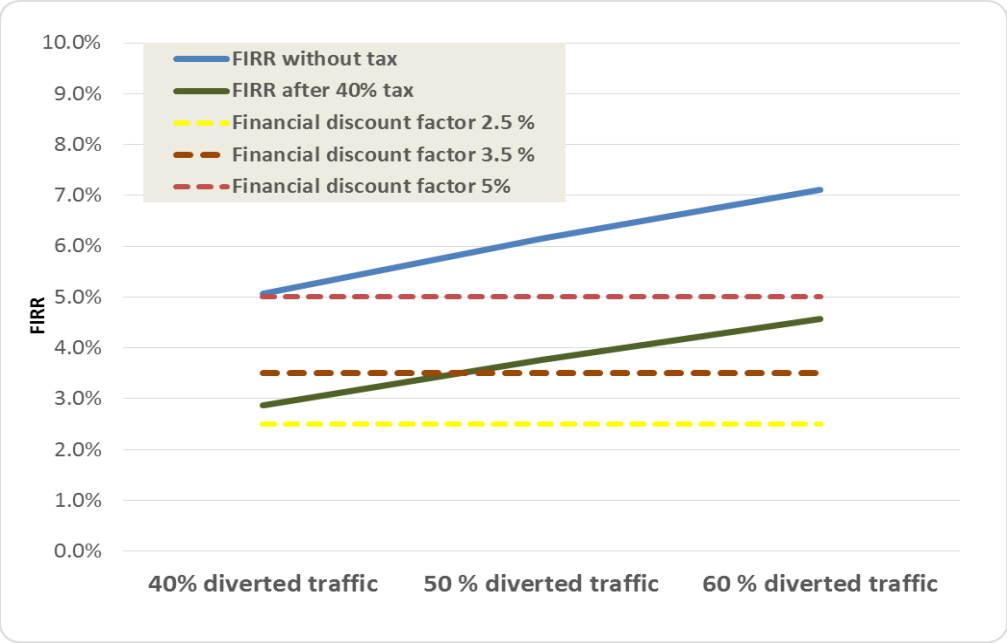
After taxes, to obtain sufficient financial viability, it will require either slightly higher toll rates or a lower cost of finance e.g. between 2.5% and 3.5% as indicated in the figure below.



Source: Consultant's calculations

Figure 13.4: Results of financial analysis based on changes in toll levels (50% diverted traffic)

Figure 13.5 shows that a larger amount of the estimated traffic is diverted to the DAEE, the financial viability is improved. After taxes, it will require a financial discount rate below 3.5% and/or if the diverted traffic is slightly above 50%, and still assuming that the Base Case toll levels are maintained.



Source: Consultants calculations

Figure 13.5: Results of financial analysis based on changes in diverted traffic (Base case toll levels)

The scenario for financial return after tax shows that the project becomes financially viable if the toll rates are about 20% higher than considered for the base case which is based on the experience from the likely toll levels to be applied by the DEE, the Chittagong – Dhaka and the Jatrabari – Gulistan Flyover projects.

Considering the toll levels from the base case as well as 40% taxes, then the financial viability seen from the operators' point of view would require annual financial compensation from e.g. BBA. amounting to as presented in Table 13.9. The anticipated compensation amount is based on a financial discount factor of 5%.

Should a lower financial discount rate eventually be applied reflecting a cheaper funding of the project, then the annual corresponding compensation amounts would accordingly be reduced.

Table 13.9 Compensation for Taxes

Year	Revenue per year (USD) considering VAT 15% and Company Tax 25% (Total 40% tax)	Anticipated annual amount of BBA compensation to toll operator for tax exposure to make revenues sufficient	
		USD	BDT
2016			
2017			
2018			
2019			
2020			
2021	7,980,914	5,320,609	415,007,508
2022	8,970,153	5,980,102	466,447,932
2023	10,082,444	6,721,629	524,287,073
2024	11,333,145	7,555,430	589,323,533
2025	12,739,536	8,493,024	662,455,896

Year	Revenue per year (USD) considering VAT 15% and Company Tax 25% (Total 40% tax)	Anticipated annual amount of BBA compensation to toll operator for tax exposure to make revenues sufficient	
		USD	BDT
2026	14,321,063	9,547,375	744,695,280
2027	16,099,605	10,733,070	837,179,473
2028	17,989,771	11,993,181	935,468,083
2029	20,102,488	13,401,659	1,045,329,379
2030	22,464,032	14,976,021	1,168,129,644
2031	25,103,786	16,735,857	1,305,396,873
2032	28,054,615	18,703,076	1,458,839,960
2033	31,353,273	20,902,182	1,630,370,170
2034	35,040,868	23,360,579	1,822,125,152
2035	39,163,381	26,108,921	2,036,495,821
2036	43,772,239	29,181,493	2,276,156,431
2037	48,924,966	32,616,644	2,544,098,234
2038	54,685,906	36,457,271	2,843,667,134
2039	61,127,035	40,751,357	3,178,605,835
2040	68,328,865	45,552,577	3,553,101,002
2041	76,381,462	50,920,975	3,971,836,039
2042	85,385,580	56,923,720	4,440,050,160
2043	95,453,932	63,635,955	4,963,604,488
2044	106,712,616	71,141,744	5,549,056,041
2045	119,302,703	79,535,135	6,203,740,533
2046	133,382,020	88,921,347	6,935,865,045
2047	149,127,149	99,418,099	7,754,611,748
2048	166,735,654	111,157,103	8,670,253,998

13.4. Conclusions of Financial Analysis

Based on the available information, the conclusion of the financial analysis is that the DAEE Project is found financial viable showing an FIRR of 6.2% before taxes by further assuming that land and resettlement costs will be financed by the Government of Bangladesh, and the capital expenditures associated to the DAEE will be the responsibility of the private financer/operator.

After taxes, the financial viability is reduced to an FIRR of 3.8%. A lower financial discount rate of e.g. 3.5% would make the project financially viable to the operator after taxes.

Depending on the eventual project cost of finance, the financial project viability may consequently require annual financial compensation from e.g. BBA to make it attractive from a toll operator's point of view.

The after taxes considerations for the project is based on the requirements that more than 50 % of the existing road users decide to use the expressway in the future based on their willingness to pay an average toll fee of USD 0.147 per km or BDT 11.5 per km.

Driving the full distance on the expressway would for all vehicle types on average correspond to USD 3.5 or BDT 275, and this being less for cars and more for trucks and buses.

Different composition of vehicle categories may end up with traffic diversion scenarios most likely favouring heavy traffic rather than passenger vehicles. Such a proportion will also likely have positive impacts on the generated revenues from toll collections.

APPENDIX A TERMS OF REFERENCE

Government of the People's Republic of Bangladesh Ministry of Road Transportation and Bridges Bangladesh Bridge Authority (BBA)

Request for Proposal

For

Engaging Consultancy Firm to Conducting Feasibility Study for Construction of Dhaka Ashulia Elevated Expresses way From Dhaka Hazrat Shahjalal International Airport to BaiPail Via Ashulia including 02 nos separate flyover at Nobinagor and Chandra.

Invitation for Proposals No.50.01.0000.150.00.001.2015 - Issued: July 23 , 2015

July 2015

Section 6

Government of the People's Republic of Bangladesh Ministry of Road Transportation and Bridges Bangladesh Bridge Authority (BBA)

Terms of Reference (ToR)

For

Feasibility Study for Construction of Dhaka Ashulia Elevated Expresses way From Dhaka Hazrat Shahjalal International Airport to BaiPail Via Ashulia including 02 nos separate flyover at Nobinagor and Chandra.

July, 2015

Terms of Reference

1. Background of the project

Bangladesh Bridge Authority (BBA) is an authority under Bridge Division of Ministry of Road Transport and Bridge with the role to develop and maintain bridges including elevated expressways in the country for promoting ease of access in transportation connectivity. As part of its mandate, BBA facilitates minimization of road congestions through constructing elevated expressways and has already awarded the Dhaka Elevated Expressway to a private developer on a PPP basis for addressing congestions within Dhaka city.

Dhaka is the administrative, commercial and cultural centre of the country. Dhaka has experienced extremely rapid and sustained population growth for a number of decades. With an area of approximately 1500 sq. km. and a population of over 15 million, the city's road networks are inadequate and cannot meet the requirements. The percentage of existing road in Dhaka city is around

8% while the international standard is 25%. This results in huge traffic congestion within the city. This is even more critical at the northern part of the city due to its linking to important commercial, industrial and business centers of Dhaka City.

For this purpose, BBA had conceived the project for development of an elevated expressway to minimize the existing traffic congestion in the northern part of Dhaka more specifically in and around Dhaka-Ashulia area. It was also envisaged that the expressway will be a part of Asian Highway route in Bangladesh and is vital for establishing an improved transport link on the Trans-Asian highways.

The Project (Construction of Dhaka-Ashulia Elevated Expressway) has been in-principle approved by the Cabinet Committee on Economic Affairs (CCEA) on 20 July 2011. Subsequently a pre-feasibility study was carried out by BUET in 2012 for technical assessment of the project. Since 2011 the PPP Office was trying for project development and transaction advisory services for the project with request from BBA. Meanwhile, on 22 January 2015, BBA signed a memorandum of understanding (MoU) with Chinese company China National Machinery IMP. & EXP. Corp. (CMC) to construct the elevated expressway under G to G basis.

2. Objectives of the assignment

The objective of the study is to prepare a preliminary design for (i) Construction of Dhaka-Ashulia Elevated Expressway Project (DAEEP) at Hazrat Shahjalal International Airport Abdullahpur- Ashulia-EPZ including 02 nos separate flyover at Nobinagar and Chandra (DAEEP). and (ii) Construction of East- West (Middle Outer Ring Road) Elevated Expressway Project at Hemayetpur (On Dhaka-Aricha Highway) - Nimtoli - Keraniganj - Ekuria - Zazira - Fatulla - Hajiganj - Bandar - Madanpur (on Dhaka-Chittagong Highway).

3. Brief Outline and scope of the work of the study

Primarily BBA has planned for development of a 34-km long elevated expressway in the alignment of Hazrat Shahjalal International Airport-Abdullahpur-Ashulia-EPZ-Chandra. A pre-feasibility study was carried out by BUET for primarily selection of the alignment to connect around 40 million people to Dhaka through all the national highways (N1-N5

& N8). The scope has been revised to develop a 24-km long elevated expressway which stops at EPZ with future option to extend to Chandra as shown in figure below:

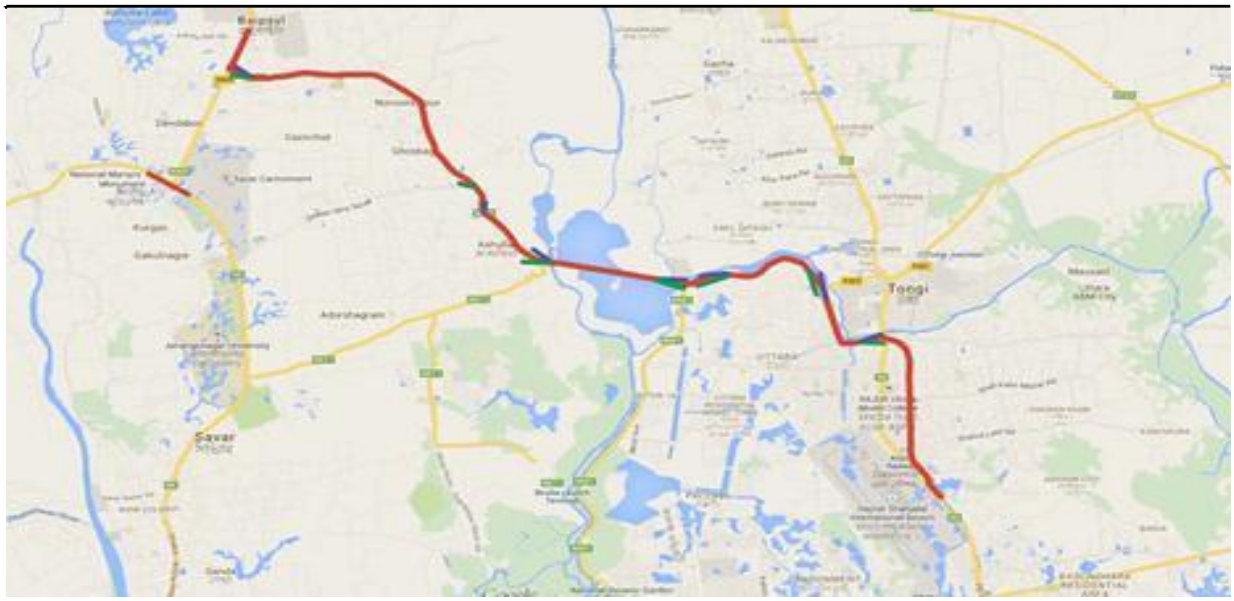


Figure 1: Proposed alignment of Dhaka - Ashulia Elevated Expressway

BBA also planned for construct of a Approximately 80- km long East -West (Middle/Outer Ring Road) elevated expressway in the alignment of at Hemayetpur (On Dhaka-Aricha Highway) - Nimtoli -Keraniganj - Ekuria - Zazira - Fatulla - Hajiganj - Bandar - Madanpur (on Dhaka-Chittagong Highway).

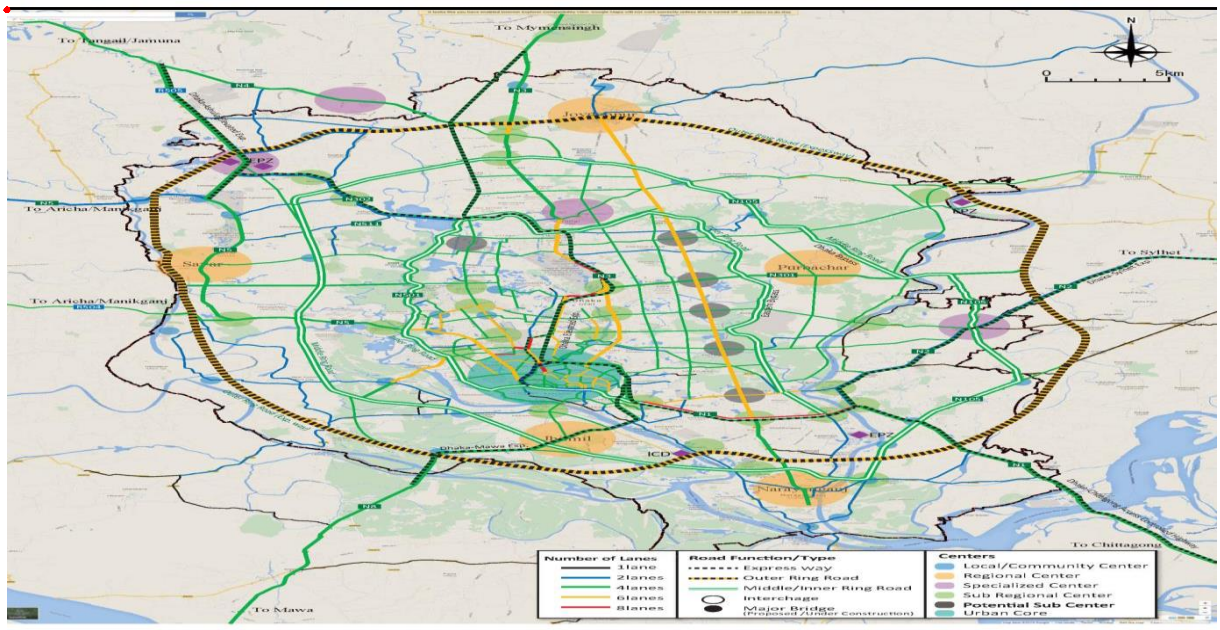


Figure 2: Proposed alignment of East-West (Outer Ring Road) Elevated Expressway)

These services are to provided by standard, experienced professionals utilizing sound planning and engineering knowledge and practices. The Consultants shall perform all necessary survey, investigation, planning, design and documentation. The proposed Elevated Expressway is to be designed for 4 lane structure

4. SCOPE OF THE SERVICES

The Consultant will carry out the detailed feasibility study for the Project taking in to account issues relating to the technical, financial, social, economic, environmental and other relevant factors. Review all existing data from pre-feasibility study (by BUET) and relevant studies (The Revision of STP) relating to the proposed elevated expressway.

4.1 Details traffic survey with O-D survey, traffic analysis and traffic forecast for a reasonable time horizon establishing traffic model.

The Consultants will be required to perform following traffic studies:

- Origin Destination Survey;
- Classified Traffic Volume Count Survey; Turning Movement Survey; Speed-Delay Survey;
- Other traffic surveys as may be required by the projects;

The data derived from the surveys above shall be analyzed to forecast demand for the proposed infrastructure. To achieve this objective the Consultants shall establish possible traffic growth rates in respect of all categories of vehicles, taking into account the past trends, annual population and real per capital growth rate, elasticity of transport demand in relation to income and estimated annual production increase. The other aspects including social-economic development plans and the land use patterns of the city and cross elasticity shall have to be taken into consideration.

4.2 Optimization of length, location and alignment of ramp and main corridor of the Elevated Expressway

The Consultant will:

- Carry a thorough investigation of the area selected as per pre-feasibility study for
  the crossing, aided by available maps coverage of the area;
- A preliminary Survey of the selected route in sufficient details for the preparations of cost and estimates of construction quantities;

4.3 Carry out detailed geotechnical investigations, geological mapping, seismic study and morphology survey;

The Consultant will be required to perform following traffic studies:

Review the available data and information and will assess the requirement to collect supplementary information;

- Undertake a detailed geotechnical investigation to identify the potential requirement of soil treatment etc;
- Identify the geotechnical features of the study area by preparing a geotechnical map;
- Briefly investigate the seismic characteristics of the area to assess the potential earthquake hazard to be infrastructure;
- Conduct other investigation that may be deemed necessary;
- Take the results of the above investigations and will ascertain the foundation requirement, stability aspects and construction methods;

In order to render the consultancy services, accordingly the following scope of services are set out: Service to be provided by the consultants are feasibility study and pre design for Construction of Dhaka Elevated Expressway Project (DEEP) at Hazrat Shahjalal

International Airport Abdullahpur-Ashulia- EPZ including 02 nos separate flyover at Nobinagar and Chandra and (ii) Construction of East- West (Outer Ring Road) Elevated Expressway Project at Hemayetpur (On Dhaka-Ashulia Highway) – Nimtoli – Keraniganj – Ekuria – Zazira – Fatulia – Hagiganj – Bandar – Madanpur)on Dhaka – Chittagong Highway).

4.4 Topographic Survey

A total-station based digital strip survey will be carried out along the whole corridor to get detailed geometric features of at-grade road as well as road adjacent land use development condition.

5. **Review of Relevant Projects and Integration:**

The STP and all relevant projects will be reviewed and their potential impacts on Dhaka-Ashulia Elevated Expressway Project (DAEEP) and East- West (Middle/Outer Ring Road) Elevated Expressway as well as impacts on them will be qualitatively examined. Comments will also be provided on integration of DAEEP & ORR with other proposed projects to attain maximum synergy or on alleviation strategy if DAEEP & ORR adversely affects other proposed projects.

Traffic Studies:

Traffic data will be collected from on-spot surveys at several key locations of the Dhaka Ashulia Elevated Expressway and East- West (Middle/Outer Ring Road) Elevated Expressway Project catchment area. Existing traffic information collected during the feasibility phase of DEE project by AECOM will be complemented by these new surveys. Special considerations will be given to understand the freight traffic movement along the corridor. At this point of prefeasibility study, no household survey, Origin-Destination surveyor willingness to pay surveys will be conducted.

Traffic Modeling:

The collected data will be fed into a simplified four-step transport demand model to quantify the potential traffic demand in the proposed expressway. Traffic demand modeling will also help quantify the potential in travel time saving for the users of Dhaka- Ashulia Elevated Expressway (DAEEP) and East- West (Outer. Ring Road) Elevated Expressway as well as the reduction in congestion in the nearby roads due to traffic diversion to DAEEP & ORR. Wider network impacts will not be considered during this feasibility study.

6. **Environmental Screening/Assessment:**

An environmental screening exercise will be carried out to understand the potential environmental impacts of the project. The screening will involve listing of potential impacts and the qualitative magnitude of the impacts. The purpose of the screening process is to identify:

- The project nature to ascertain the level of environmental assessment required at the project feasibility level and also
- Tentatively the impacts (positive or negative) that may need more detailed investigation and mitigation (or enhancement) to be conducted during environmental and social impact assessment (ESIA) during the feasibility and design phase Major concerns and issues related to environmental sustainability, if any, will be raised and discussed based on reconnaissance survey and available information.

Assessment of Soil Conditions:

Geotechnical assessment will be carried out to determine the soil profile of the proposed alignment. The assessment will primarily be based on, bore-logs, SPT, CPT data, collected from secondary sources. Primary data may also be produced if necessary.

7. **Preliminary Design:**

Guided by results of the reconnaissance survey, review of planned projects, traffic study and geotechnical investigation, a suitable preliminary geometric and structural design for the proposed expressway (elevated or at grade or a combination) will be provided.

8. **Preparation of LAP**

The assignment for the consultants will include but not limited to the following tasks:

- Preparation of land acquisition plan for the land area to be affected by the project,
- Collection of all relevant Mouza Maps, Collect all Parchas/Khatian and have to prepare a list of the affected land losers following the class of land consulting the latest published land records/holdings if any;
- Preparation of Plot schedule for LAP
- Process data and prepare digital maps of land to be acquired by the project
- Verification of record of rights of the affected persons.
- Reconcile data of the proposed project footprint as per the design adopted for multi-lane expressway Project
- Separate out all private lands under project right of way and prepare LAP for the land required under the project
- The activities include Field survey, data collection and consultation, desk review, planning, Establishment of databases, Preparation of LAPs and reports, Finalization of LAPs and reports with comments.
- Submit the land acquisition plan liaison with Deputy Commissioner's office in acceptable format.

The following outputs are to be delivered by the consultants,

- LAPs of the land to be taken by the project in the alignment for construction of Multi Lane expressway Project
- Database on land acquisition plan and maps of the project right of way

9. **Preparation of RAP**

The main scope and objective of the consultancy services for RAP preparation is divided in two parts,

- Review of relevant policies of Bangladesh Government and prepare a resettlement policy framework,
- Conducting socio economic surveys on the project effected persons/households and preparation of the resettlement action plan.

The assignment for the consultants will include but not limited to the following tasks:

10. **Initial Documentation Review**

- Review of relevant policy, legal and administrative frameworks of the government.
- Review social safeguard policies of ESMF that will form the framework for the RAP study.
- Review the project related documents i.e. feasibility study report to understand scope and operations of the tunnel project.

11. **Conduct Census Survey and Inventory of Assets**

For the preparation of resettlement action plan the consultant will conduct census survey of the final alignment covering all affected households, commercials and business enterprises, community properties etc. An inventory survey of the affected asset will also be taken for preparation of the database and resettlement action plan. The census and inventory will cover number of affected household with demographic and socio-economic information and quality of the affected properties, relocation options etc.

Objective of census and inventory survey:

The main objective of this assignment is to prepare a Resettlement Action Plan and implementation of the same and thereby mitigate the adverse social impact of the project which will facilitate the smooth implementation of the overall project activities. Another objective of this assignment is to conduct consultation with various stakeholders related to project sites.

The data would be collected to meet the following issues of the RAP:

- Prepare a database of households in the final alignment through the Census
- Prepare an Inventory of Affected Assets based on the 100 percent survey and formulate appropriate mitigation measures for the APs and their communities on the ROW in RAP
- Carry out an assessment of social risks and impacts, both direct and indirect those are likely to be affected by proposed Project activities.
- Address gender issues in resettlement planning
- Formulate detailed income restoration programs
- Identify viable Relocation Options for the APs
- Prepare an Entitlement Matrix for the RAP based on category of losses identified during census and detailed inventory survey.
- Conduct Community/Stakeholder Consultations in the final alignment area to gather inputs and feedback on the Project in general and dissemination of Social Safeguard issues in particular
- Create a detailed computerized database to use throughout the RAP preparation by using standard software that will enable easy analysis of the data
- Upon completing the comprehensive Census and inventory of assets within the ROW, formulate and finalize a Compensation Package for the APs

The specific objectives of the Census and inventory survey are to:

- Identify the Households, Commerce & Business Enterprises (CBEs) and Common Property Resources (CPRs) on the ROW and measure their socioeconomic status
- Identify the owners of homesteads and other built structures on the ROW and estimate their losses
- Identify, as feasible, households using the government land, i,e. tenants/lease holders/squatters, etc.
- Video filming of the structures on the ROW and document their use and physical characteristics
- Collection of rate of the affected land, structure and trees from the local eligible people i.e. potential seller, potential buyer, teacher, religious leader, community leader etc. and determine the market/replacement value of the affected properties
- Resettlement plan in accordance with the GOB policy

12. **Inventory of losses (IOL):**

The consultant will conduct survey with a structured questionnaires to make an inventory of affected assets within the project right of way/site. Information to be collected through the questionnaires would be used for preparation of RAP. All categories of affected properties such as land, structure, trees, crops and other physical assets will be surveyed during IOL.

13. **Organizing and conducting consultation meeting:**

The consultation meeting with the affected people and stakeholders would be held during conducting census & socio-economic survey. In coordination with the client the selected consulting farm is asked to plan, organize and implement community wise stakeholders meeting at the site. To complement the formal community meeting, focus group discussion (FGS) are to be organized and implemented at selected sites. All the proceedings and interactions of FGS sessions are recorded and session minutes are drafted to illustrate community people's needs and desires in expectation of resettlement.

14. **Video Filming of the Affected Properties:**

Video filming of the structure is to be done to prevent fraudulent claims in the future. The selected consulting firm will paste household number on the visible wall of the structure and household owners or any senior proxy will say the household head with father's husband's name and address during video filming

15. **Preparation of Resettlement Action Plan:**

Prepare RAP report which shall cover, but not limited to, social impact assessment, resettlement framework, consultation and participation plan and resettlement plan

In addition to the above consultants will further conduct the following activities

- Collection of basic data needed for preparation of RAP.
- Prepare alternatives to minimize the amount of impact of resettlement by selecting relocation sites, which are suitable and acceptable to the communities;
- Design and implement a program to involve beneficiaries in project conceptualization, planning and implementation and to facilitate public awareness of the project; and to enhance its ownership;
- Describe legal framework for RAP, relevant local laws, customs that apply to resettlement; describe entitlement policies for each category of impact and specify that resettlement implementation would be based on specific provisions of agreed RAP;
- Describe method of valuation used for affected structures, land, trees, and other assets; and prepare entitlement matrix; describe suggestions and complains mechanism (SCM) including grievance redress procedures for registering complaints and suggestions; describe mechanisms for screening of suggestions for feeding into project design and implementation, and management and resolution of complaints;
- Based on findings and recommendations, prepare a Social Impact Management Framework (SIMF) for the program as a tool for preparation and implementation of Resettlement Action Plan (RAP), and a Consultation and Participation Plan.

During preparatory stage of the RAP the Consulting Firm will deliver the following documents,

a. A resettlement policy framework (RPF) will be prepared by the consultant team taking into account of the government law of land acquisition. The consultant will review relevant available documents for preparation of the RPF.
b. Draft resettlement action plan for review and comments of the client. The RAP would contain socioeconomic and demographic information of the affected households, legal and policy framework for land acquisition, grievance mechanism, institutional arrangement for RAP implementation, necessary budgetary provision, monitoring and evaluation etc. List of affected household with address, category & quantity of loss, will be annexed with the RAP. One single RAP will need to be prepared for proposed project.
c. A final version of RAP would be submitted incorporating comments from the client
d. DVD of video filming would be submitted by the consultant.
e. All database of the survey output would be delivered to the PMU with user friendly menu driven software after completion of each assignment.

15.1 **Detailed environmental impact assessment and environment management and mitigation Plane Preparation of EMP including EIA**

The consultant shall submit a comprehensive Environmental Impact Assessment (EIA) Study report considering all activity of the proposed (i) Construction of Dhaka-Ashulia Elevated Expressway Project (DAEEP) at Hazrat Shahjalal International Airport Abdullahpur-Ashulia-EPZ- including 02 nos separate flyover at Nobinagar and Chandra and (ii) Construction of East- West (Outer Ring Road) Elevated Expressway The DAEEP project would be an extension of ongoing Dhaka Elevated Expressway Project (DEEP).

The EIA report should be prepared in accordance with following indicative outlines:

Executive Summary
Introduction
Background
Purpose of the Study
Need of the Project
Importance of the Project
Scope of EIA Study
EIA Team

Legislative regulation and policy consideration (covering the potential legal, administrative, planning and policy framework within which the EIA will be prepared).

Environmental Baseline Data

16. **Project Data Sheet**

Project Proponent
Project Location and Area Nature and Size of the Project Project Concept
Project Components
Components of the project concerning the types of activities proposed to be located in the area, other infrastructure, utilities and service requirements

16.1 **Project Activities**

A list of the main project activities to be undertaken during: site clearing and construction, operation of activities and associated developments

16.2 **Project Schedule**

- The phase and timing of infrastructure construction and other required facilities for Multi-Lane elevated expressway Project

16.3 **Resources and Utilities Demand**

Resources required to develop the project, such as soil and construction material and demand for utilities (water, electricity, sewerage, waste disposal and others), as well as infrastructure (road, drains, and others) to support the project

16.4 **Process Description**

Project Site, Project Layout, Land Requirement, Technology Selection and Process Description, Description of Major Systems, Analysis of Suitability for Different Alternatives, elevated Expressway Alignment Selection (including alternative option), elevated Expressway Design and Construction, Material Balance, Pollution Mitigation Measures (Units & Devices),

16.5 **Physical and Chemical Component**

16.5.1 **Map and Survey Information**

Location map Cadastral map showing land plots (project and adjacent area) Topographic map for identifying catchment boundaries, general land use and terrain survey map showing contour information Aerial photograph.

16.5.2 **Geology and Soil**

Geological map showing geological units, fault zone, and other natural features Soil map and soil profile analysis. This may only be established from soil survey and geotechnical investigation (important for analysis for soil stability, cut and fill) Soil properties and composition Bathymetry of the river stretch along the proposed site.

16.5.3 **Hydrology and Drainage**

Catchment boundaries of rivers/canals which drain the project Hydrological and Morphological characteristics of rivers in and around the project area Flood characteristics and historical records of flood events covering areas affected, height of flood and frequency Ground water potential and aspects of aquifer, such as recharge zones, ground water abstraction etc Drainage system and drainage characteristics around the project area.

16.5.4 **Water Quality and Use**

Water quality of the receiving water bodies likely to be affected by the project: Sources of pollutants from existing and known future activities within the catchment of the rivers.

16.5.5 **Air Quality and Noise**

Baseline data of the project site with respect to air quality and noise level Air pollutant and noise sources from existing and known sources.

16.6 **Ecological Components**

16.6.1 **Habitats**

- Aquatic habitat likely to be impacted by the project
- Terrestrial habitat likely to be impacted by the project

16.6.2 **Species and Population**

Identification of population of flora and fauna to assess their conservation status of being rare) endemic and endangered. Biodiversity of the project site.

16.7 **Social and Economic Factor**

16.7.1 **Population within and around the project area**

Organizational structure of communities and the degree of public awareness and response to the proposed project

16.7.2 **Human Settlement**

- Size and distribution of human settlement
- Community infrastructure, utilities and services available Housing and future requirements within the impacted area Historical/archaeological features of significance

16.7.3 **Economic Activities**

Economic activities of population in and around the project area. Activities should include those that are dependent on resources which may be impacted by project.

Income dependence on economic activities impacted directly or indirectly by the project. Employment and economic returns to the population by the project.

16.8 **Infrastructure and Utilities**

16.8.1 Availability of infrastructure to support the proposed project. Attention should focus on different transportation requirements due to project increase in traffic to and from the project area

16.8.2 Availability of utilities and services, especially water, gas and electricity supply, sewerage and waste disposal facilities to cater to the projected demand for such utilities and services

17. **Prediction of Impacts**

17.1 Identification of Impacts

17.2 Pre-Construction and Development Impacts

17.2.1 Impact on Landform

17.2.2 Impact on Natural Resources

17.2.3 Impact on Eco-systems

17.2.4 Impact on Ambient Air

17.2.5 Noise Impact

17.2.6 Impact on Water Bodies

17.2.7 Impact on Soil

17.2.8 Impact on Workers Health. Sanitation and Safety

17.2.9 Impact on Key Point Installations & Others

17.2.10 Solid Waste Disposal

17.2.11 Impact due to transportation of raw materials

17.3 **Construction Stage Impact**

17.3.1 Impact on Landform

17.3.2 Impact on Natural Resources

17.3.3 Impact on Eco-systems

17.3.4 Impact on Ambient Air

17.3.5 Noise Impact

17.3.6 Impact on Water Bodies

17.3.7 Impact on Soil

17.3.8 Impact on Workers Health. Sanitation and Safety

17.3.9 Impact on Key Point Installations & Others

17.3.10 Solid Waste Disposal

17.3.11 Social Impact

17.3.12 Impact due to transportation of raw materials

17.4 **Operation Stage Impact**

17.4.1 Impact on Natural Resource
17.4.2 Impact on Eco-systems
17.4.3 Impact on Ambient Air
17.4.4 Noise Impact
17.4.5 Impact on Water Bodies (both surface & ground)
17.4.6 Impact on Ecology (flora and Fauna)
17.4.7 Impact on Public Health and Safety
17.4.8 Impact on Traffic Movement
17.4.9 Social Impact
17.4.10 Impact on Tourism
17.4.11 Impact on Key Point Installations & Others

18. **Evaluation of Impacts**

The judgment of significance of impacts can be based on one or more of the following, depending on the environmental factor being evaluated. These are :

18.1 Impact identification and seeping matrix

18.2 Possible impacts in planning, construction and operation stage
18.3 Comparison with laws, regulation or accepted national or international standards
18.4 Reference to pre-set criteria such as conservation or protected status of a site, feature or species
18.5 Consistency with pre-set policy objectives
18.6 Consultation and acceptability with the relevant decision makers, local community or the general public

19. **Mitigation of Impacts**

Mitigation measures which may be considered including-

19.1 Mitigation measures for planning, construction and operation stage
19.2 Changing project layout, transport routes, disposal routes or locations, timing or engineering design
19.3 Introducing pollution controls, waste treatment, phased implementation and construction, engineering measures, monitoring. landscaping, social services or public education
19.4 Compensation to restore, relocate or provision of concession for damage

20. **Environmental Management Plan**

For each significant major impact, proposed mitigation measures will be set out for incorporation into project design or procedures, impacts, which are not capable of mitigation, will be identified as residual impacts Both technical and financial plans shall be incorporated for proposed mitigation measures. An outline of the Environmental Management Plan shall be developed for the project.

In Environmental Monitoring Plan, a detail technical and financial proposal shall be included for developing an in-house environmental monitoring system to be operated by the proponent's own resources (equipments and expertise).

20.1 **EMP during Preparation Phase**
20.1.1 Land Development
20.1.2 Transport of Material
20.1.3 Method and Equipment for Tunnel Construction

20.2 **EMP during Construction Phase**
20.2.1 Site Preparation
20.2.2 Infrastructure
20.2.3 Services
20.2.4 Construction
20.2.5 Equipment
20.2.6 Safety Measures
20.3 **EMP during Operation Phase**
20.3.1 Air Pollution Management
20.3.2 Transportation and handling of raw material
20.3.3 Operation stage
20.3.4 Water Management
20.3.5 Solid Waste Management
20.3.6 Safety and occupational health
20.4 Greenbelt Development
20.5 Rehabilitation and Resettlement Plan
20.6 Budgets for EMP
20.7 Contingency Plans

The project authority shall:

a) Provide a conceptual contingency plan that considers environmental effects associated with operational upset conditions such as serious malfunctions or accidents
b) Describe the flexibility built into the plant design and layout to accommodate future modifications required by any change in emission standards, limits and guidelines

21. **Risk Assessment**
21.1 Consequence Analysis
21.2 Emergency Response Plan
21.3 Risk Mitigation Measures
22. **Environmental Monitoring Plan**
22.1 **Monitoring Plan**
22.1.1 Ambient Air Monitoring
22.1.2 Meteorological Monitoring
22.1.3 Equipment and Ambient Noise
22.1.4 Surface Water and Waste Water Monitoring
22.1.5 Flora and Fauna Monitoring
22.1.6 Workers Health and Safety Monitoring
22.1.7 Monitoring of DMP
22.1.8 Monitoring and CSR activities
22.1.9 Action during Abnormal Operating Conditions
22.1.10 Budgets for Monitoring
22.1.11 Reporting
23. Project benefits with benefit cost analysis that covers among others, Environmental and Social Cost

24. Consultation with stakeholders/public consultation (ensure that consultation with interested parties and the general public will take place and their general views taken into account in planning and the execution of the project) beneficial Impacts (summarise the benefits of the project to the Bangladesh nation, people and local community and the enhancement potential)
25. Conclusion and Recommendation

25.1 **Assessment of resettlement of requirements and preparation of action plan**

The Consultant will:
Ensure the proposed solution has a minimum requirement of resettlement and/or displacement of people;

- Assess resettlement requirement in case it is inevitable; Prepare resettlement framework in consultation with the client;
- Prepare resettlement action plane

26. **Preliminary design of the Elevated Expressway, Ramp, bus station and other components with cost estimation.**

The Consultant will:

- Establish the design criteria in consultation with the client; The safety concept shall form part of the above criteria;
- Conduct a preliminary design to be able to scope out the project and estimate the cost to ascertain the viability;

27. **Preparation of land acquisition plan.**

Beside on the selected alignment and preliminary design, the consultant shall prepare a land acquisition plan to assist the Client in acquisition of land

28. **Detailed Economic and Financial evaluation determining EIRR, NPV, BCR, FIRR along with sensitivity analysis for different scenarios and toll rates**
    - Taking account of the estimated project cost and benefits, the consultant will:
    - Suggest an appropriate level of the Toll for the usage of the Elevated Expressway
    - Carry out economic and financial evaluation to identify the following:
    - Economic Internal Rate of Return (EIRR)
    - Net Present Value (NPV)
    - Benefit Cost Ratio (BCR)
    - Financial Internal Rate of Return (FIRR)
    - Carry out sensitivity analysis of the different parameters identified;
    - Based on the investigation advice whether the proposed project is feasible; If the project is feasible, suggest the most feasible development option;

29. **PRE-FEASIBILITY STUDY OF MIDDLE RING ROAD**

The Consultant will prepare a pre-feasibility study of about 40-km section of the proposed middle ring road from Hemayetpur (on Dhaka-Aricha Highway, N5) to Madanpur (on Dhaka-Chittagong Highway, N1). The tentative alignment of the proposed section (highlighted in red in figure below) of the ring road will go through Hemayetpur (on Dhaka - Aricha Highway) - Nimtoli - Keraniganj - Ekuria - Zazira - Fatulla - Hajiganj - Bandar - Madanpur (on Dhaka-Chittagong Highway). The middle ring road is proposed in the ongoing revision of Strategic Transport Plan (JICA supported, planned from

2016 to 2035 for Greater Dhaka area) to case the pressure on bypass traffic from entering Dhaka city. BBA is planning to build this section of the ring road with future option to continue construction of remaining sections of the middle ring road.

29.1 **Transfer of Knowledge**

The consultant shall arrange foreign training for 10 (ten) days for 5 (five) deserving Engineers of BBA which enable them to develop the design of Elevated Expressway. Arrange 2 (two) nos. of national level workshop/seminar on submission of Interim Report & Draft Final Report and Final Report. The venue will be arranged by consultant in consultation with BBA and 50-60 member of participants will be attend in the workshop/seminar.

30. **List of report, Schedule of deliveries, period of performance.**

Report shall be in English and presented and illustrated in a clear and concise professional manner and to be submitted of each report along with CD containing soft copy of the report in pdf format. All report need to be approved by the Bangladesh Bridge Authority. The consultant shall submit report for Dhaka-Ashulia & East-West (Middle/Outer Ring Road) elevated expressway projects separately.

	Inception report-within I(one) month of Commencement -05 + 05 copies;
	Interim Report within 4 (four) month after starting the work-OS + 05 copies;
	Draft Final Report within 5 (five) month after starting the work- 10 + 10 copies;
	Final Report within 06 (six) month of Commencement incorporating Client's/expert's comments on the draft report- 15 + 15 copies;
	The Consultant shall submit the monthly progress report within the 1 SI week of the following month after submission of inception report-05 copies;

The draft feasibility report will contain necessary charts, bore logs, soil report, maps drawing and other sketches, as required. Pertinent breakup of data and analysis of economic and technical aspects of the proposed elevated expressway will be included in the report. The report will present alternative studies for the elevated expressway in layout as well as in structural form. The merits and demerits of each such alternative will be focused in the report. The report will present recommendations for the best suited alignment, layout and structural from of the elevated expressway view of technical, economic and aesthetic aspects.

The draft feasibility report will contain preliminary design, site plan, sketches and cost estimates of the proposed elevated expressway. The preliminary data will be adequate to justify a through comparison of the alternative as well as to form the basis for detailed design and construction.

31. **Period of Performance**

The duration for the services will be 06 (six) months from the Commencement data.

32. **The Client will provide the following inputs and facilities:**

i. Administrative assistance in obtaining visas, custom clearance and other and administrative permissions required by the consultants in performance of their duties;

ii. All relevant report, maps, data and studies as are available with the Client; and

iii. Any other assistance not readily available that the consultants may reasonable request, including liaison with the Government and agencies concerned.

33. **Mode of Payment:**

	15% (fifteen) percent of the Contract Price after submission of Inception report.
	30% (thirty) Percent of the Contract Price after submission of Interim report.
	35% (thirty five) Percent of the Contract Price after submission of Draft Final Rep
	Final payment (rest of the amount, minimum 20%) of the Contract Price shall be after submission of Final Report.

APPENDIX B 24 HR TRAFFIC COUNTS

1. Nabinagor – Tuesday 19 July 2016
2. Nabinagor – Friday 22 July 2016
3. Baipayl – Wednesday 20 July 2016
4. Baipayl – Friday 22 July 2016
5. Chandra – Monday 18 July 2016
6. Chandra – Friday 22 July 2016

Traffic Survey for Feasibility Study for the Construction of Dhaka Ashulia Elavated Expressway

Daily Summary Sheet
Turning Movement Mannual Count

Name of Intersection: **Baipayl** Turning Movement No:-1 From: Abdullahpur To: E P Z Date: 20.07.2016 Day: Wednesday

Weather: Sunny/Fair/Cloudy/Rainy Duration: 24 hrs.

Time	1	2	3	4	5	6	7	8	9	10		11	12	13	
	Large Bus/ Double Decker/ Articulated Bus	Medium Bus	Small Bus/ Micro Bus	Utility /Jeep/ Laguna /Tempo /Maxi/ Human Hauler	Car/Taxi /Station Wagan	Auto Rickshaw, CNG/ Michuk	Motor Cycle	Heavy Truck/ Trailer/ Container /Truck 3 axle	Medium Truck/ Truck Lorry/ Truck 2 axle	Small Truck/ Pickup /Small Van	Total Motorized	Bicycle	Rickshaw (Cycle)/ Rickshaw Van	Animal Cart /Push Cart	Total Non Motorized
08-00 to 09-00	27	25	15	6	24	13	8	35	21	22	196	0	43	0	43
09-00 to 10-00	19	27	24	16	29	16	39	9	16	16	211	0	91	0	91
10-00 to 11-00	31	23	9	7	33	9	31	11	19	19	192	0	77	0	77
11-00 to 12-00	46	24	30	6	67	13	21	33	32	50	322	0	89	0	89
12-00 to 13-00	35	21	35	11	86	5	19	56	13	61	342	0	64	0	64
13-00 to 14-00	39	22	20	4	58	3	34	53	29	43	305	0	52	0	52
14-00 to 15-00	58	8	52	10	35	0	38	38	10	17	266	4	87	1	92
15-00 to 16-00	49	15	35	9	30	3	15	56	8	26	246	2	34	0	36
16-00 to 17-00	29	17	23	10	30	4	11	51	20	28	223	0	22	0	22
17-00 to 18-00	27	28	21	8	22	9	21	59	25	34	254	1	46	0	47
18-00 to 19-00	31	15	22	7	23	12	31	47	28	28	244	0	49	0	49
19-00 to 20-00	16	4	10	4	7	6	18	20	10	14	109	0	27	0	27
20-00 to 21-00	35	8	19	4	11	3	14	49	8	23	174	0	21	0	21
21-00 to 22-00	48	0	22	4	5	2	20	73	8	23	205	0	18	0	18
22-00 to 23-00	13	2	24	1	3	4	7	48	6	28	136	0	8	0	8
23-00 to 24-00	39	2	9	4	6	3	6	83	5	14	171	0	5	0	5
00-00 to 01-00	12	1	13	1	4	6	7	85	5	39	173	0	8	0	8
01-00 to 02-00	40	1	15	1	2	6	1	92	6	36	200	0	2	0	2
02-00 to 03-00	57	1	15	1	1	7	10	68	5	26	191	0	11	0	11
03-00 to 04-00	45	1	1	1	2	3	3	80	5	35	176	0	1	0	1
04-00 to 05-00	61	1	25	4	6	7	6	87	11	30	238	0	7	0	7
05-00 to 06-00	48	3	46	4	8	8	8	62	11	8	206	0	10	0	10
06-00 to 07-00	45	0	56	7	13	15	11	65	6	12	230	0	21	0	21
07-00 to 08-00	40	32	25	17	40	13	22	75	11	19	294	5	37	0	42
Total	**890**	**281**	**566**	**147**	**545**	**170**	**401**	**1335**	**318**	**651**	**5304**	**12**	**830**	**1**	**843**

Traffic Survey for Feasibility Study for the Construction of Dhaka Ashulia Elavated Expressway

Daily Summary Sheet

Turning Movement Mannual Count

Name of Intersection: **Baipayl** Turning Movement No:-2 From: Abdullahpur To: Nabinagar Date: 20.7.2016 Day: Wednesday

Weather: Sunny/Fair/Cloudy/Rainy Duration: 24 hrs.

Time	1	2	3	4	5	6	7	8	9	10		11	12	13	
	Large Bus/ Double Decker/ Articulated Bus	Medium Bus	Small Bus/ Micro Bus	Utility /Jeep/ Laguna /Tempo /Maxi/ Human	Car/Taxi /Station Wagan	Auto Rickshaw, CNG/ Michuk	Motor Cycle	Heavy Truck/ Trailer/ Container /Truck 3 axle	Medium Truck/ Truck Lorry/ Truck 2 axle	Small Truck/ Pickup /Small Van	Total Motorized	Bicycle	Rickshaw (Cycle)/ Rickshaw Van	Animal Cart /Push Cart	Total Non Motorized
08-00 to 09-00	24	14	25	46	6	15	9	9	4	22	174	0	41	0	41
09-00 to 10-00	15	20	37	8	17	17	6	5	3	8	136	0	43	0	43
10-00 to 11-00	5	9	29	7	11	6	14	0	5	12	98	0	32	0	32
11-00 to 12-00	7	15	21	13	20	6	19	2	9	13	125	0	45	0	45
12-00 to 13-00	6	11	31	9	23	21	20	2	10	5	138	0	37	0	37
13-00 to 14-00	11	6	29	12	11	10	29	14	4	5	131	0	57	0	57
14-00 to 15-00	5	9	30	7	6	9	17	7	7	9	106	0	24	0	24
15-00 to 16-00	1	9	25	9	19	20	17	6	11	15	132	0	24	0	24
16-00 to 17-00	3	0	38	10	13	14	25	3	16	11	133	0	35	0	35
17-00 to 18-00	0	14	37	17	10	10	12	2	11	4	117	0	23	0	23
18-00 to 19-00	3	12	29	13	8	17	18	0	9	15	124	1	18	0	19
19-00 to 20-00	2	15	19	11	12	19	15	0	7	7	107	4	14	0	18
20-00 to 21-00	8	13	24	16	9	25	13	7	10	11	136	8	23	0	31
21-00 to 22-00	38	22	40	16	15	15	10	9	17	11	193	1	18	0	19
22-00 to 23-00	11	21	22	10	5	27	12	13	15	7	143	0	26	0	26
23-00 to 24-00	11	17	7	3	1	12	10	15	14	10	100	0	20	0	20
00-00 to 01-00	16	8	10	1	2	14	8	21	11	9	100	0	28	0	28
01-00 to 02-00	12	6	6	1	3	13	1	21	38	23	124	0	19	0	19
02-00 to 03-00	10	6	4	2	3	5	0	21	41	26	118	0	8	0	8
03-00 to 04-00	11	5	6	2	5	4	1	21	27	22	104	0	4	0	4
04-00 to 05-00	13	7	16	11	10	7	0	13	26	19	122	0	25	0	25
05-00 to 06-00	10	12	24	5	0	14	4	10	22	18	119	0	26	0	26
06-00 to 07-00	13	12	31	13	5	14	4	5	8	13	118	0	25	0	25
07-00 to 08-00	11	2	26	1	7	26	14	3	2	4	96	0	23	0	23
Total	**246**	**265**	**566**	**243**	**221**	**340**	**278**	**209**	**327**	**299**	**2994**	**14**	**638**	**0**	**652**

Traffic Survey for Feasibility Study for the Construction of Dhaka Ashulia Elavated Expressway

Daily Summary Sheet

Turning Movement Mannual Count

Name of Intersection: **Baipayl** Turning Movement No:-3 From: E P Z To: Nabinagar Date 20.7.2016 Day: Wednesday

Weather: Sunny/Fair/Cloudy/Rainy Duration: 24 hrs.

Time	1	2	3	4	5	6	7	8	9	10		11	12	13	
	Large Bus/ Double Decker/ Articulated Bus	Medium Bus	Small Bus/ Micro Bus	Utility /Jeep/ Laguna /Tempo /Maxi/ Human	Car/Taxi /Station Wagan	Auto Rickshaw, CNG/ Michuk	Motor Cycle	Heavy Truck/ Trailer/ Container /Truck 3 axle	Medium Truck/ Truck Lorry/ Truck 2 axle	Small Truck/ Pickup /Small Van	Total Motorized	Bicycle	Rickshaw (Cycle)/ Rickshaw Van	Animal Cart /Push Cart	Total Non Motorized
08-00 to 09-00	64	55	10	40	41	0	9	8	24	15	266	16	36	0	52
09-00 to 10-00	20	45	18	37	57	2	11	7	39	27	263	5	39	0	44
10-00 to 11-00	19	32	22	32	62	1	13	13	48	20	262	0	34	0	34
11-00 to 12-00	15	66	16	51	53	1	23	2	104	28	359	2	45	0	47
12-00 to 13-00	8	59	26	46	60	0	25	1	65	24	314	2	41	0	43
13-00 to 14-00	8	32	21	47	57	1	16	0	69	29	280	0	50	0	50
14-00 to 15-00	30	61	20	69	64	3	39	2	54	21	363	2	59	1	62
15-00 to 16-00	72	59	37	92	75	0	39	4	57	46	481	1	54	2	57
16-00 to 17-00	43	43	46	91	100	0	26	1	38	29	417	5	58	0	63
17-00 to 18-00	73	49	83	112	143	0	31	5	64	47	607	10	53	0	63
18-00 to 19-00	77	90	78	83	121	0	54	3	79	55	640	22	55	0	77
19-00 to 20-00	56	73	74	80	154	6	35	2	76	51	607	25	52	0	77
20-00 to 21-00	36	76	14	30	73	4	43	17	109	62	464	40	61	0	101
21-00 to 22-00	8	51	8	39	63	4	38	1	116	47	375	12	57	0	69
22-00 to 23-00	11	63	32	16	29	1	12	5	123	39	331	16	23	0	39
23-00 to 24-00	21	22	11	20	25	1	9	19	111	41	280	2	18	0	20
00-00 to 01-00	14	13	4	9	15	0	3	12	85	39	194	1	7	0	8
01-00 to 02-00	16	12	0	4	9	1	3	2	74	43	164	0	11	0	11
02-00 to 03-00	18	10	0	8	12	0	3	8	93	50	202	0	6	0	6
03-00 to 04-00	17	1	1	11	11	0	3	0	80	26	150	2	10	0	12
04-00 to 05-00	24	1	5	8	4	9	3	1	54	28	137	1	22	0	23
05-00 to 06-00	50	26	17	7	7	20	8	0	20	13	168	1	67	0	68
06-00 to 07-00	38	123	23	24	26	18	15	2	19	22	310	7	98	0	105
07-00 to 08-00	29	149	13	38	31	12	25	11	25	20	353	4	58	0	62
Total	**767**	**1211**	**579**	**994**	**1292**	**84**	**486**	**126**	**1626**	**822**	**7987**	**176**	**1014**	**3**	**1193**

Traffic Survey for Feasibility Study for the Construction of Dhaka Ashulia Elavated Expressway

Turning Movement Mannual Count

Name of Intersection: **Baipayl** Turning Movement No:-4 From: E P Z To: Abdullahpur Date 20.7.2016 Day: Wednesday

Weather: Sunny/Fair/Cloudy/Rainy Duration: 24 hrs.

Time	1	2	3	4	5	6	7	8	9	10	Total Motorized	11	12	13	Total Non Motorized
	Large Bus/ Double Decker/ Articulated Bus	Medium Bus	Small Bus/ Micro Bus	Utility /Jeep/ Laguna /Tempo /Maxi/ Human	Car/Taxi /Station Wagan	Auto Rickshaw, CNG/ Michuk	Motor Cycle	Heavy Truck/ Trailer/ Container /Truck 3 axle	Medium Truck/ Truck Lorry/ Truck 2 axle	Small Truck/ Pickup /Small Van		Bicycle	Rickshaw (Cycle)/ Rickshaw Van	Animal Cart /Push Cart	
08-00 to 09-00	48	24	14	17	17	0	13	9	26	29	197	15	55	0	70
09-00 to 10-00	28	25	15	10	25	0	15	14	23	20	175	11	80	0	91
10-00 to 11-00	20	27	9	18	24	2	24	7	33	27	191	7	117	0	124
11-00 to 12-00	29	29	14	22	30	0	40	15	38	39	256	10	125	0	135
12-00 to 13-00	31	26	23	21	31	0	36	10	31	54	263	11	97	0	108
13-00 to 14-00	30	34	28	29	39	2	40	12	31	41	286	21	95	0	116
14-00 to 15-00	27	19	10	19	51	0	45	17	26	40	254	17	72	0	89
15-00 to 16-00	68	27	25	36	82	3	36	12	35	65	389	9	77	0	86
16-00 to 17-00	47	27	20	31	56	1	39	12	50	49	332	12	84	0	96
17-00 to 18-00	31	29	23	28	55	2	40	13	36	39	296	29	81	0	110
18-00 to 19-00	30	31	26	30	51	1	46	24	47	48	334	55	68	0	123
19-00 to 20-00	32	23	19	17	39	1	39	28	62	51	311	51	59	0	110
20-00 to 21-00	37	23	30	17	38	0	27	28	103	45	348	73	73	0	146
21-00 to 22-00	15	22	10	15	27	3	25	21	144	62	344	23	50	0	73
22-00 to 23-00	22	15	14	16	6	1	19	12	132	72	309	13	55	0	68
23-00 to 24-00	19	4	11	5	17	5	18	17	89	28	213	3	40	0	43
00-00 to 01-00	14	2	4	5	8	0	4	10	71	56	174	2	29	0	31
01-00 to 02-00	8	2	6	4	2	0	0	33	65	35	155	1	24	0	25
02-00 to 03-00	20	2	7	2	2	0	0	21	45	24	123	1	18	0	19
03-00 to 04-00	22	1	5	5	4	0	0	16	48	24	125	2	109	0	111
04-00 to 05-00	32	6	3	3	11	3	2	15	21	22	118	3	31	0	34
05-00 to 06-00	102	14	10	20	15	3	3	16	14	19	216	4	52	0	56
06-00 to 07-00	38	25	10	25	7	5	3	11	20	15	159	12	44	0	56
07-00 to 08-00	44	60	17	26	26	3	17	15	20	25	253	0	42	0	42
Total	**794**	**497**	**353**	**421**	**663**	**35**	**531**	**388**	**1210**	**929**	**5821**	**385**	**1577**	**0**	**1962**

Traffic Survey for Feasibility Study for the Construction of Dhaka Ashulia Elavated Expressway

Daily Summary Sheet

Turning Movement Mannual Count

Name of Intersection: **Baipayl** Turning Movement No:-5 From: Nabinagar To: Abdullahpur Dated 20.7.2016 Day: Wednesday

Weather: Sunny/Fair/Cloudy/Rainy Duration: 24 hrs.

Time	1	2	3	4	5	6	7	8	9	10		11	12	13	
	Large Bus/ Double Decker/ Articulated Bus	Medium Bus	Small Bus/ Micro Bus	Utility /Jeep/ Laguna /Tempo /Maxi/ Human	Car/Taxi /Station Wagan	Auto Rickshaw, CNG/ Michuk	Motor Cycle	Heavy Truck/ Trailer/ Container /Truck 3 axle	Medium Truck/ Truck Lorry/ Truck 2 axle	Small Truck/ Pickup /Small Van	Total Motorized	Bicycle	Rickshaw (Cycle)/ Rickshaw Van	Animal Cart /Push Cart	Total Non Motorized
08-00 to 09-00	1	9	23	6	10	1	19	8	16	13	106	0	60	9	69
09-00 to 10-00	0	2	33	17	6	1	15	6	11	19	110	2	96	1	99
10-00 to 11-00	0	1	21	11	1	0	25	7	5	16	87	5	97	0	102
11-00 to 12-00	0	0	28	15	4	0	15	10	14	15	101	0	38	1	39
12-00 to 13-00	0	9	35	26	7	0	22	11	13	14	137	1	37	1	39
13-00 to 14-00	5	10	34	2	9	12	24	12	17	21	146	0	29	1	30
14-00 to 15-00	4	4	21	7	10	10	17	10	8	16	107	0	17	0	17
15-00 to 16-00	6	6	29	20	12	3	19	16	16	22	149	0	20	1	21
16-00 to 17-00	6	3	53	32	19	3	27	37	8	24	212	0	49	0	49
17-00 to 18-00	5	5	31	51	26	2	34	25	9	8	196	2	56	1	59
18-00 to 19-00	5	5	42	36	28	4	27	33	13	16	209	4	23	0	27
19-00 to 20-00	5	3	32	40	21	4	12	22	5	20	164	5	37	0	42
20-00 to 21-00	5	1	42	48	36	4	28	20	0	12	196	2	38	0	40
21-00 to 22-00	3	1	45	48	20	2	12	25	4	11	171	0	30	0	30
22-00 to 23-00	6	1	48	28	11	1	11	32	2	9	149	0	26	1	27
23-00 to 24-00	0	0	20	56	26	2	6	35	2	8	155	0	16	0	16
00-00 to 01-00	3	0	20	29	23	2	4	36	7	11	135	0	19	0	19
01-00 to 02-00	5	1	12	23	5	1	7	49	5	6	114	0	14	0	14
02-00 to 03-00	0	1	12	20	4	2	3	41	9	11	103	0	10	0	10
03-00 to 04-00	3	1	17	31	2	1	6	29	6	14	110	0	8	0	8
04-00 to 05-00	0	2	13	52	2	5	3	30	5	16	128	0	9	0	9
05-00 to 06-00	1	1	10	45	5	2	1	31	4	13	113	0	17	0	17
06-00 to 07-00	0	4	11	33	16	11	8	23	2	4	112	4	42	0	46
07-00 to 08-00	3	11	27	17	9	7	17	22	4	5	122	2	98	0	100
Total	**66**	**81**	**659**	**693**	**312**	**80**	**362**	**570**	**185**	**324**	**3332**	**27**	**886**	**16**	**929**

Traffic Survey for Feasibility Study for the Construction of Dhaka Ashulia Elavated Expressway

Daily Summary Sheet

Turning Movement Mannual Count

Name of Intersection: **Baipayl** Turning Movement No:-6 From: Nabinagar To: E P Z Dated 20.7.2016 Day: Wednesday

Weather: Sunny/Fair/Cloudy/Rainy Duration: 24 hrs.

Time	1	2	3	4	5	6	7	8	9	10	Total Motorized	11	12	13	Total Non Motorized
	Large Bus/ Double Decker/ Articulated Bus	Medium Bus	Small Bus/ Micro Bus	Utility /Jeep/ Laguna /Tempo /Maxi/ Human	Car/Taxi /Station Wagan	Auto Rickshaw, CNG/ Michuk	Motor Cycle	Heavy Truck/ Trailer/ Container /Truck 3 axle	Medium Truck/ Truck Lorry/ Truck 2 axle	Small Truck/ Pickup /Small Van		Bicycle	Rickshaw (Cycle)/ Rickshaw Van	Animal Cart /Push Cart	
08-00 to 09-00	80	121	40	28	41	0	35	67	9	29	450	23	40	0	63
09-00 to 10-00	53	76	13	31	45	0	37	23	64	57	399	5	47	0	52
10-00 to 11-00	38	62	11	29	38	0	45	47	15	43	328	1	58	0	59
11-00 to 12-00	39	118	29	32	50	0	46	33	30	57	434	10	61	0	71
12-00 to 13-00	36	90	22	34	41	0	48	16	58	51	396	2	62	1	65
13-00 to 14-00	36	78	25	22	68	5	34	23	34	32	357	0	59	0	59
14-00 to 15-00	39	85	20	19	56	10	75	0	59	38	401	2	88	0	90
15-00 to 16-00	31	113	19	22	44	0	84	16	68	39	436	5	87	1	93
16-00 to 17-00	82	122	30	23	37	0	76	52	58	57	537	3	67	0	70
17-00 to 18-00	69	111	30	26	42	0	56	33	46	69	482	15	73	2	90
18-00 to 19-00	68	107	25	29	53	0	66	32	41	62	483	27	80	1	108
19-00 to 20-00	39	108	16	39	53	0	62	8	34	61	420	49	56	0	105
20-00 to 21-00	53	64	13	23	63	35	57	2	33	52	395	5	34	0	39
21-00 to 22-00	24	87	3	33	38	2	8	0	42	50	287	0	56	0	56
22-00 to 23-00	48	27	31	29	15	3	55	86	56	37	387	1	47	0	48
23-00 to 24-00	30	20	29	16	35	2	45	49	55	31	312	0	31	0	31
00-00 to 01-00	32	32	16	2	8	1	28	45	45	51	260	0	33	0	33
01-00 to 02-00	35	36	17	0	0	10	11	53	56	29	247	0	22	0	22
02-00 to 03-00	30	17	16	3	5	0	6	42	45	23	187	0	8	0	8
03-00 to 04-00	87	16	5	3	16	0	9	43	51	32	262	0	3	0	3
04-00 to 05-00	14	18	7	7	19	0	16	48	47	29	205	0	3	0	3
05-00 to 06-00	51	20	26	17	12	0	26	40	42	29	263	0	8	0	8
06-00 to 07-00	20	79	10	33	11	57	39	23	50	22	344	12	46	0	58
07-00 to 08-00	10	102	23	31	32	53	54	12	56	29	402	52	54	0	106
Total	**1044**	**1709**	**476**	**531**	**822**	**178**	**1018**	**793**	**1094**	**1009**	**8674**	**212**	**1123**	**5**	**1340**

Traffic Survey for Feasibility Study for the Construction of Dhaka Ashulia Elavated Expressway

Daily Summary Sheet

U Turn Movement Mannual Count

Name of Intersection: **Baipayl** Turning Movement No:-1 From: Abdullahpur To: Abdullahpur Date: 20.07.2016 Day: Wednesday

Weather: Sunny/Fair/Cloudy/Rainy Duration: 24 hrs.

Time	1	2	3	4	5	6	7	8	9	10		11	12	13	
	Large Bus/ Double Decker/ Articulated Bus	Medium Bus	Small Bus/ Micro Bus	Utility /Jeep/ Laguna /Tempo /Maxi/ Human Hauler	Car/Taxi /Station Wagan	Auto Rickshaw, CNG/ Michuk	Motor Cycle	Heavy Truck/ Trailer/ Container /Truck 3 axle	Medium Truck/ Truck Lorry/ Truck 2 axle	Small Truck/ Pickup /Small Van	Total Motorized	Bicycle	Rickshaw (Cycle)/ Rickshaw Van	Animal Cart /Push Cart	Total Non Motorized
08-00 to 09-00	0	3	19	34	13	41	12	0	3	16	141	8	67	0	75
09-00 to 10-00	0	1	95	21	10	34	14	0	0	13	188	20	78	0	98
10-00 to 11-00	0	2	8	20	9	27	11	0	0	15	92	14	57	0	71
11-00 to 12-00	0	0	6	16	7	18	8	0	0	6	61	6	57	0	63
12-00 to 13-00	0	0	12	20	7	21	7	0	0	5	72	2	52	0	54
13-00 to 14-00	0	0	11	39	5	22	10	0	0	2	89	3	80	0	83
14-00 to 15-00	0	0	5	26	3	17	3	0	0	4	58	4	75	0	79
15-00 to 16-00	0	0	3	21	1	10	3	0	0	3	41	1	69	0	70
16-00 to 17-00	0	0	0	31	3	20	3	0	0	5	62	2	79	0	81
17-00 to 18-00	0	0	4	38	3	27	7	0	0	2	81	3	76	0	79
18-00 to 19-00	0	0	0	30	3	15	3	0	0	3	54	3	59	0	62
19-00 to 20-00	0	0	4	34	1	16	3	0	0	5	63	1	73	0	74
20-00 to 21-00	0	0	8	34	5	12	0	0	0	3	62	0	68	0	68
21-00 to 22-00	0	0	6	38	9	6	0	0	0	3	62	0	47	0	47
22-00 to 23-00	0	1	7	17	2	3	0	0	5	5	40	0	31	0	31
23-00 to 24-00	0	0	2	12	2	4	0	0	2	7	29	0	21	0	21
00-00 to 01-00	0	0	0	4	1	3	0	0	0	5	13	0	10	0	10
01-00 to 02-00	0	0	0	4	1	3	0	0	5	2	15	0	9	0	9
02-00 to 03-00	0	0	0	4	1	1	0	0	7	1	14	0	7	0	7
03-00 to 04-00	0	0	1	1	0	3	0	0	5	4	14	0	5	0	5
04-00 to 05-00	0	0	0	2	0	4	0	0	0	2	8	0	8	0	8
05-00 to 06-00	0	0	0	14	0	2	0	0	0	3	19	0	13	0	13
06-00 to 07-00	0	0	0	77	0	5	0	0	0	2	84	0	96	0	96
07-00 to 08-00	0	0	0	139	0	5	0	0	0	0	144	0	158	0	158
Total	**0**	**7**	**191**	**676**	**86**	**319**	**84**	**0**	**27**	**116**	**1506**	**67**	**1295**	**0**	**1362**
PCU Value	3	3	3	1	1	0.75	0.75	3	3	3					
	0	21	573	676	86	239.25	63	0	81	348	2,087				

Traffic Survey for Feasibility Study for the Construction of Dhaka Ashulia Elavated Expressway

Daily Summary Sheet

U Turn Movement Mannual Count

Name of Intersection: **Baipayl** Turning Movement No:-5 From: Nabinagar To: Nabinagar Dated 20.07.2016 Day: Wednesday

Weather: Sunny/Fair/Cloudy/Rainy Duration: 24 hrs.

Time	1	2	3	4	5	6	7	8	9	10		11	12	13	
	Large Bus/ Double Decker/ Articulated Bus	Medium Bus	Small Bus/ Micro Bus	Utility /Jeep/ Laguna /Tempo /Maxi/ Human	Car/Taxi /Station Wagan	Auto Rickshaw, CNG/ Michuk	Motor Cycle	Heavy Truck/ Trailer/ Container /Truck 3 axle	Medium Truck/ Truck Lorry/ Truck 2 axle	Small Truck/ Pickup /Small Van	Total Motorized	Bicycle	Rickshaw (Cycle)/ Rickshaw Van	Animal Cart /Push Cart	Total Non Motorized
08-00 to 09-00	0	1	0	2	2	0	3	0	0	5	13	0	10	0	10
09-00 to 10-00	0	3	0	8	4	0	2	0	9	5	31	1	17	0	18
10-00 to 11-00	0	0	0	11	6	0	8	0	13	14	52	0	19	0	19
11-00 to 12-00	0	0	4	8	3	0	4	0	3	5	27	2	13	0	15
12-00 to 13-00	0	0	1	2	1	0	1	0	2	5	12	6	6	2	14
13-00 to 14-00	0	0	5	3	8	0	2	0	8	4	30	2	10	1	13
14-00 to 15-00	0	0	4	8	11	0	6	0	0	5	34	8	20	0	28
15-00 to 16-00	0	0	3	8	8	0	7	0	0	6	32	4	17	0	21
16-00 to 17-00	0	0	6	5	5	0	5	0	0	4	25	0	9	0	9
17-00 to 18-00	0	2	5	1	1	0	6	0	0	0	15	4	7	2	13
18-00 to 19-00	0	0	0	4	2	0	4	0	0	7	17	1	9	0	10
19-00 to 20-00	0	0	0	11	0	0	9	0	0	14	34	8	2	0	10
20-00 to 21-00	0	0	5	0	3	0	1	0	0	3	12	6	6	0	12
21-00 to 22-00	0	0	4	0	3	0	4	0	0	3	14	1	4	0	5
22-00 to 23-00	0	0	3	0	0	0	2	0	0	0	5	1	2	0	3
23-00 to 24-00	0	0	3	0	0	0	2	0	0	0	5	11	2	0	13
00-00 to 01-00	0	0	3	0	0	0	3	0	0	0	6	2	1	0	3
01-00 to 02-00	0	0	3	0	0	0	0	0	3	0	6	0	2	0	2
02-00 to 03-00	2	0	0	0	0	0	3	0	0	0	5	0	3	0	3
03-00 to 04-00	0	0	1	0	0	2	0	0	0	0	3	0	1	0	1
04-00 to 05-00	0	0	0	0	1	0	1	0	0	0	2	1	0	0	1
05-00 to 06-00	0	0	1	0	2	0	2	0	0	3	8	0	3	0	3
06-00 to 07-00	0	2	3	0	0	2	1	0	1	1	10	0	1	0	1
07-00 to 08-00	0	2	2	0	0	0	1	0	0	1	6	3	3	0	6
Total	**2**	**10**	**56**	**71**	**60**	**4**	**77**	**0**	**39**	**85**	**404**	**61**	**167**	**5**	**233**
PCU Value	3	3	3	1	1	0.75	0.75	3	3	3					
	6	30	168	71	60	3	57.75	0	117	255	768				

Traffic Survey for Feasibility Study for the Construction of Dhaka Ashulia Elavated Expressway

Daily Summary Sheet
Turning Movement Mannual Count

Name of Intersection: **Baipayl** Turning Movement No:-1 From: Abdullahpur To: E P Z Date: 22.7.2016 Day: Friday

Weather: Sunny/Fair/Cloudy/Rainy Duration: 24 hrs.

Time	1	2	3	4	5	6	7	8	9	10		11	12	13	
	Large Bus/ Double Decker/ Articulated Bus	Medium Bus	Small Bus/ Micro Bus	Utility /Jeep/ Laguna /Tempo /Maxi/ Human Hauler	Car/Taxi /Station Wagan	Auto Rickshaw, CNG/ Michuk	Motor Cycle	Heavy Truck/ Trailer/ Container /Truck 3 axle	Medium Truck/ Truck Lorry/ Truck 2 axle	Small Truck/ Pickup /Small Van	Total Motorized	Bicycle	Rickshaw (Cycle)/ Rickshaw Van	Animal Cart /Push Cart	Total Non Motorized
08-00 to 09-00	52	78	67	79	60	60	35	15	42	55	543	27	49	0	76
09-00 to 10-00	31	74	55	35	47	39	33	16	15	47	392	21	38	0	59
10-00 to 11-00	21	19	14	45	40	37	31	19	19	14	259	25	35	0	60
11-00 to 12-00	30	34	24	41	47	39	40	18	23	14	310	27	30	1	58
12-00 to 13-00	14	31	12	60	67	45	44	15	11	20	319	34	43	0	77
13-00 to 14-00	56	60	24	54	50	39	30	24	32	32	401	21	41	1	63
14-00 to 15-00	40	34	28	51	42	54	46	17	14	23	349	14	50	0	64
15-00 to 16-00	38	15	4	42	31	36	35	29	17	11	258	28	44	0	72
16-00 to 17-00	19	28	11	47	29	35	12	16	17	25	239	25	40	0	65
17-00 to 18-00	47	64	25	49	54	41	40	64	26	64	474	23	38	0	61
18-00 to 19-00	25	34	21	63	50	36	37	28	31	30	355	25	41	0	66
19-00 to 20-00	33	27	17	47	39	32	31	26	31	39	322	19	29	0	48
20-00 to 21-00	22	31	6	15	22	25	17	29	28	37	232	1	17	0	18
21-00 to 22-00	30	30	16	32	33	27	12	52	26	20	278	8	9	0	17
22-00 to 23-00	30	35	20	22	33	25	27	48	46	49	335	8	13	0	21
23-00 to 24-00	51	27	19	29	20	24	20	49	46	21	306	4	12	0	16
00-00 to 01-00	34	13	15	18	15	21	17	54	42	21	250	4	20	0	24
01-00 to 02-00	18	5	12	18	17	11	10	49	26	24	190	1	16	0	17
02-00 to 03-00	26	11	13	11	17	10	8	49	35	43	223	3	6	0	9
03-00 to 04-00	34	3	15	13	12	4	5	46	48	26	206	0	6	0	6
04-00 to 05-00	23	1	15	12	14	3	9	40	44	43	204	0	1	0	1
05-00 to 06-00	19	20	22	12	20	15	7	43	27	24	209	6	7	0	13
06-00 to 07-00	22	30	25	27	32	24	22	29	29	24	264	15	35	0	50
07-00 to 08-00	19	31	31	48	37	26	25	30	23	24	294	23	34	0	57
Total	**734**	**735**	**511**	**870**	**828**	**708**	**593**	**805**	**698**	**730**	**7212**	**362**	**654**	**2**	**1018**

Traffic Survey for Feasibility Study for the Construction of Dhaka Ashulia Elavated Expressway

Daily Summary Sheet

Turning Movement Mannual Count

Name of Intersection: **Baipayl** Turning Movement No:-2 From: Abdullahpur To: Nabinagar Date: 22.7.2016 Day: Friday

Weather: Sunny/Fair/Cloudy/Rainy Duration: 24 hrs.

Time	1 Large Bus/ Double Decker/ Articulated Bus	2 Medium Bus	3 Small Bus/ Micro Bus	4 Utility /Jeep/ Laguna /Tempo /Maxi/ Human	5 Car/Taxi /Station Wagan	6 Auto Rickshaw, CNG/ Michuk	7 Motor Cycle	8 Heavy Truck/ Trailer/ Container /Truck 3 axle	9 Medium Truck/ Truck Lorry/ Truck 2 axle	10 Small Truck/ Pickup /Small Van	Total Motorized	11 Bicycle	12 Rickshaw (Cycle)/ Rickshaw Van	13 Animal Cart /Push Cart	Total Non Motorized
08-00 to 09-00	37	56	43	32	13	13	8	40	41	45	328	13	15	0	28
09-00 to 10-00	21	39	32	33	10	14	10	20	19	44	242	10	27	0	37
10-00 to 11-00	9	23	26	21	4	6	1	5	15	20	130	4	86	0	90
11-00 to 12-00	5	34	33	34	0	8	0	11	11	19	155	15	150	0	165
12-00 to 13-00	9	38	44	19	0	6	12	9	8	19	164	9	135	0	144
13-00 to 14-00	10	45	52	37	4	10	10	7	13	18	206	0	150	0	150
14-00 to 15-00	10	43	47	14	2	3	12	10	8	17	166	7	145	0	152
15-00 to 16-00	27	51	29	34	17	19	17	19	23	23	259	27	19	1	47
16-00 to 17-00	16	47	45	15	4	2	8	13	17	20	187	1	160	0	161
17-00 to 18-00	15	38	52	23	3	3	6	8	20	18	186	2	146	0	148
18-00 to 19-00	11	39	51	14	2	3	7	13	12	24	176	0	112	1	113
19-00 to 20-00	15	42	50	11	1	1	6	9	11	31	177	0	78	0	78
20-00 to 21-00	22	46	49	22	23	8	10	12	20	25	237	4	27	0	31
21-00 to 22-00	32	42	46	9	5	7	6	21	14	29	211	2	20	0	22
22-00 to 23-00	28	39	46	13	6	6	6	20	18	26	208	3	32	0	35
23-00 to 24-00	25	35	35	22	17	8	4	20	26	34	226	3	21	0	24
00-00 to 01-00	18	3	18	10	5	6	5	36	34	34	169	7	8	0	15
01-00 to 02-00	21	1	31	13	11	5	5	33	42	34	196	0	8	0	8
02-00 to 03-00	27	6	27	7	4	5	4	35	40	36	191	0	7	0	7
03-00 to 04-00	28	3	30	6	3	3	3	30	37	35	178	0	8	0	8
04-00 to 05-00	26	2	31	7	4	11	3	26	32	35	177	0	12	0	12
05-00 to 06-00	20	11	34	7	6	8	4	23	28	20	161	1	16	0	17
06-00 to 07-00	4	32	47	10	6	10	10	5	6	15	145	13	26	0	39
07-00 to 08-00	7	48	44	12	8	12	7	7	7	10	162	14	51	0	65
Total	**443**	**763**	**942**	**425**	**158**	**177**	**164**	**432**	**502**	**631**	**4637**	**135**	**1459**	**2**	**1596**

Traffic Survey for Feasibility Study for the Construction of Dhaka Ashulia Elavated Expressway

Daily Summary Sheet

Turning Movement Mannual Count

Name of Intersection: **Baipayl** Turning Movement No:-3 From: E P Z To: Nabinagar Date 22.7.2016 Day: Friday

Weather: Sunny/Fair/Cloudy/Rainy Duration: 24 hrs.

Time	1	2	3	4	5	6	7	8	9	10	Total Motorized	11	12	13	Total Non Motorized
	Large Bus/ Double Decker/ Articulated Bus	Medium Bus	Small Bus/ Micro Bus	Utility /Jeep/ Laguna /Tempo /Maxi/ Human	Car/Taxi /Station Wagan	Auto Rickshaw, CNG/ Michuk	Motor Cycle	Heavy Truck/ Trailer/ Container /Truck 3 axle	Medium Truck/ Truck Lorry/ Truck 2 axle	Small Truck/ Pickup /Small Van		Bicycle	Rickshaw (Cycle)/ Rickshaw Van	Animal Cart /Push Cart	
08-00 to 09-00	20	64	12	5	27	4	8	8	30	25	203	5	19	1	25
09-00 to 10-00	37	83	10	25	44	4	13	10	55	32	313	5	29	0	34
10-00 to 11-00	37	77	12	13	60	5	18	13	76	40	351	2	26	0	28
11-00 to 12-00	28	78	23	13	99	1	23	6	58	37	366	0	23	0	23
12-00 to 13-00	30	71	29	12	71	6	29	5	43	28	324	2	31	0	33
13-00 to 14-00	46	59	21	14	64	9	30	8	52	46	349	3	24	0	27
14-00 to 15-00	32	100	13	6	41	8	22	9	48	31	310	2	31	0	33
15-00 to 16-00	60	96	18	9	86	4	18	12	70	38	411	3	19	0	22
16-00 to 17-00	60	95	17	11	44	6	20	19	48	38	358	1	19	0	20
17-00 to 18-00	115	85	31	12	86	5	15	12	26	32	419	2	14	0	16
18-00 to 19-00	69	146	34	17	97	9	22	12	56	60	522	2	17	0	19
19-00 to 20-00	46	91	22	15	41	2	5	20	40	33	315	0	4	0	4
20-00 to 21-00	21	52	14	9	25	8	16	19	51	26	241	0	10	0	10
21-00 to 22-00	33	74	18	20	48	5	5	29	47	34	313	3	6	0	9
22-00 to 23-00	22	110	12	19	32	4	6	18	57	35	315	0	8	0	8
23-00 to 24-00	23	53	13	21	21	9	5	2	57	38	242	2	9	0	11
00-00 to 01-00	20	20	6	17	23	3	6	23	53	27	198	1	3	0	4
01-00 to 02-00	19	9	3	6	20	2	8	20	52	23	162	0	0	0	0
02-00 to 03-00	14	4	1	5	10	0	4	21	48	27	134	0	4	0	4
03-00 to 04-00	19	18	3	8	13	1	6	15	31	18	132	0	1	0	1
04-00 to 05-00	29	15	9	12	20	3	1	25	45	28	187	1	9	0	10
05-00 to 06-00	24	15	9	8	7	6	1	15	13	12	110	2	5	0	7
06-00 to 07-00	34	43	17	18	46	10	10	14	22	20	234	7	22	0	29
07-00 to 08-00	86	208	35	37	83	30	7	8	30	31	555	16	17	1	34
Total	**924**	**1666**	**382**	**332**	**1108**	**144**	**298**	**343**	**1108**	**759**	**7064**	**59**	**350**	**2**	**411**

Traffic Survey for Feasibility Study for the Construction of Dhaka Ashulia Elavated Expressway

Turning Movement Mannual Count

Name of Intersection: **Baipayl** Turning Movement No:-4 From: E P Z To: Abdullahpur Date 22.7.2016 Day: Friday

Weather: Sunny/Fair/Cloudy/Rainy Duration: 24 hrs.

Time	1	2	3	4	5	6	7	8	9	10	Total Motorized	11	12	13	Total Non Motorized
	Large Bus/ Double Decker/ Articulated Bus	Medium Bus	Small Bus/ Micro Bus	Utility /Jeep/ Laguna /Tempo /Maxi/ Human	Car/Taxi /Station Wagan	Auto Rickshaw, CNG/ Michuk	Motor Cycle	Heavy Truck/ Trailer/ Container /Truck 3 axle	Medium Truck/ Truck Lorry/ Truck 2 axle	Small Truck/ Pickup /Small Van		Bicycle	Rickshaw (Cycle)/ Rickshaw Van	Animal Cart /Push Cart	
08-00 to 09-00	33	26	51	29	36	30	17	26	35	22	305	3	17	0	20
09-00 to 10-00	27	39	56	25	37	14	12	27	27	19	283	6	38	0	44
10-00 to 11-00	54	53	60	26	55	6	13	55	24	27	373	8	52	0	60
11-00 to 12-00	37	46	54	26	42	14	28	34	19	17	317	7	41	0	48
12-00 to 13-00	22	62	17	40	50	10	15	15	18	17	266	15	43	0	58
13-00 to 14-00	34	62	5	25	55	6	15	11	26	23	262	7	25	0	32
14-00 to 15-00	26	59	7	17	37	1	6	10	14	21	198	7	22	0	29
15-00 to 16-00	23	55	28	21	22	5	7	8	13	19	201	4	20	0	24
16-00 to 17-00	48	50	24	28	21	9	18	22	25	24	269	8	20	0	28
17-00 to 18-00	91	70	22	41	67	25	29	53	40	56	494	12	57	0	69
18-00 to 19-00	64	59	17	34	52	16	34	41	42	38	397	10	37	0	47
19-00 to 20-00	58	49	20	28	47	18	22	28	31	29	330	2	17	0	19
20-00 to 21-00	26	21	13	14	26	7	7	23	14	7	158	3	6	0	9
21-00 to 22-00	21	30	11	18	19	8	6	30	16	12	171	1	3	0	4
22-00 to 23-00	22	15	11	16	21	11	10	35	12	8	161	2	9	0	11
23-00 to 24-00	52	19	16	14	13	16	5	15	12	12	174	2	4	0	6
00-00 to 01-00	45	22	6	13	20	4	2	56	45	25	238	0	1	0	1
01-00 to 02-00	38	14	3	12	16	3	6	60	43	22	217	0	1	0	1
02-00 to 03-00	23	10	1	12	10	7	7	56	31	21	178	1	0	0	1
03-00 to 04-00	27	1	3	7	10	6	6	27	21	12	120	0	0	0	0
04-00 to 05-00	23	0	4	10	11	5	3	18	14	8	96	0	1	0	1
05-00 to 06-00	30	20	10	18	30	9	12	18	22	16	185	1	15	0	16
06-00 to 07-00	26	46	13	16	27	16	18	14	4	8	188	7	42	0	49
07-00 to 08-00	82	77	25	33	34	23	30	17	12	18	351	1	60	0	61
Total	**932**	**905**	**477**	**523**	**758**	**269**	**328**	**699**	**560**	**481**	**5932**	**107**	**531**	**0**	**638**

Traffic Survey for Feasibility Study for the Construction of Dhaka Ashulia Elavated Expressway

Daily Summary Sheet

Turning Movement Mannual Count

Name of Intersection: **Baipayl** Turning Movement No:-5 From: Nabinagar To: Abdullahpur Dated 22.7.2016 Day: Friday

Weather: Sunny/Fair/Cloudy/Rainy Duration: 24 hrs.

Time	1	2	3	4	5	6	7	8	9	10		11	12	13	
	Large Bus/ Double Decker/ Articulated Bus	Medium Bus	Small Bus/ Micro Bus	Utility /Jeep/ Laguna /Tempo /Maxi/ Human	Car/Taxi /Station Wagan	Auto Rickshaw, CNG/ Michuk	Motor Cycle	Heavy Truck/ Trailer/ Container /Truck 3 axle	Medium Truck/ Truck Lorry/ Truck 2 axle	Small Truck/ Pickup /Small Van	Total Motorized	Bicycle	Rickshaw (Cycle)/ Rickshaw Van	Animal Cart /Push Cart	Total Non Motorized
08-00 to 09-00	0	2	32	11	13	2	18	3	1	18	100	17	49	0	66
09-00 to 10-00	0	2	39	9	11	4	27	1	5	38	136	10	81	0	91
10-00 to 11-00	0	4	32	9	18	7	16	3	1	23	113	15	67	0	82
11-00 to 12-00	0	1	40	11	9	6	21	2	7	18	115	8	44	1	53
12-00 to 13-00	0	3	32	10	5	6	13	0	8	28	105	5	24	0	29
13-00 to 14-00	0	6	47	13	16	6	18	2	13	16	137	14	47	1	62
14-00 to 15-00	0	26	54	11	24	2	22	21	25	38	223	12	32	0	44
15-00 to 16-00	1	23	54	25	28	12	11	8	26	42	230	10	32	2	44
16-00 to 17-00	0	9	52	16	26	5	19	5	12	24	168	8	37	0	45
17-00 to 18-00	0	11	42	12	30	3	16	7	9	14	144	8	11	0	19
18-00 to 19-00	0	8	38	8	27	6	33	8	5	12	145	7	42	0	49
19-00 to 20-00	0	6	29	5	15	5	9	4	4	13	90	4	19	0	23
20-00 to 21-00	0	6	20	2	8	3	8	3	16	23	89	2	15	0	17
21-00 to 22-00	0	3	17	8	13	4	7	4	38	30	124	4	18	0	22
22-00 to 23-00	0	1	27	3	5	2	3	9	43	36	129	1	9	1	11
23-00 to 24-00	0	5	23	2	4	1	1	32	31	36	135	2	9	0	11
00-00 to 01-00	0	0	4	3	3	0	0	14	21	17	62	0	10	0	10
01-00 to 02-00	0	0	2	2	5	3	1	11	30	15	69	1	8	0	9
02-00 to 03-00	0	0	2	4	7	1	2	20	23	14	73	0	9	0	9
03-00 to 04-00	0	0	5	3	2	2	1	12	22	19	66	1	9	0	10
04-00 to 05-00	0	0	6	2	3	2	2	13	24	12	64	1	8	0	9
05-00 to 06-00	0	9	15	6	3	5	2	8	12	19	79	2	10	0	12
06-00 to 07-00	3	14	40	3	9	9	6	1	4	4	93	4	21	0	25
07-00 to 08-00	0	19	66	5	11	4	18	3	6	4	136	75	74	0	149
Total	**4**	**158**	**718**	**183**	**295**	**100**	**274**	**194**	**386**	**513**	**2825**	**211**	**685**	**5**	**901**

Traffic Survey for Feasibility Study for the Construction of Dhaka Ashulia Elavated Expressway

Daily Summary Sheet

Turning Movement Mannual Count

Name of Intersection: **Baipayl** Turning Movement No:-6 From: Nabinagar To: E P Z Dated 22.7.2016 Day: Friday

Weather: Sunny/Fair/Cloudy/Rainy Duration: 24 hrs.

Time	1	2	3	4	5	6	7	8	9	10	Total Motorized	11	12	13	Total Non Motorized
	Large Bus/ Double Decker/ Articulated Bus	Medium Bus	Small Bus/ Micro Bus	Utility /Jeep/ Laguna /Tempo /Maxi/ Human	Car/Taxi /Station Wagan	Auto Rickshaw, CNG/ Michuk	Motor Cycle	Heavy Truck/ Trailer/ Container /Truck 3 axle	Medium Truck/ Truck Lorry/ Truck 2 axle	Small Truck/ Pickup /Small Van		Bicycle	Rickshaw (Cycle)/ Rickshaw Van	Animal Cart /Push Cart	
08-00 to 09-00	69	49	5	35	38	14	52	32	54	39	387	8	81	0	89
09-00 to 10-00	130	83	34	34	49	9	35	59	66	53	552	10	61	1	72
10-00 to 11-00	91	89	23	14	46	3	55	39	97	47	504	1	121	0	122
11-00 to 12-00	64	95	13	22	34	0	46	23	89	33	419	5	105	0	110
12-00 to 13-00	28	80	1	14	19	0	44	12	88	50	336	0	84	0	84
13-00 to 14-00	40	66	9	20	37	2	53	13	51	28	319	3	135	0	138
14-00 to 15-00	37	44	11	17	35	3	36	17	41	21	262	0	107	0	107
15-00 to 16-00	36	68	0	15	32	0	76	26	50	29	332	2	117	0	119
16-00 to 17-00	57	91	0	18	29	4	54	22	38	38	351	3	101	0	104
17-00 to 18-00	65	107	0	24	74	7	50	23	40	60	450	0	98	0	98
18-00 to 19-00	43	108	0	9	38	30	83	7	41	63	422	2	134	0	136
19-00 to 20-00	36	76	0	6	27	18	75	4	45	58	345	2	106	0	108
20-00 to 21-00	61	84	12	17	47	11	61	10	45	64	412	10	80	0	90
21-00 to 22-00	48	70	15	34	52	9	55	17	47	69	416	3	77	0	80
22-00 to 23-00	48	68	17	13	29	6	48	16	49	32	326	0	70	0	70
23-00 to 24-00	40	46	17	6	19	0	49	11	44	30	262	0	64	0	64
00-00 to 01-00	30	33	5	10	13	2	6	25	45	23	192	0	10	0	10
01-00 to 02-00	44	20	3	9	11	2	4	16	52	21	182	0	10	1	11
02-00 to 03-00	24	16	24	6	4	0	2	14	69	16	175	0	7	0	7
03-00 to 04-00	33	12	33	12	12	0	3	16	65	14	200	2	10	0	12
04-00 to 05-00	34	13	3	14	5	0	1	13	68	12	163	0	5	0	5
05-00 to 06-00	55	18	19	13	5	0	0	16	72	18	216	0	6	0	6
06-00 to 07-00	57	63	8	21	53	0	0	30	65	30	327	15	29	0	44
07-00 to 08-00	56	71	5	37	49	0	0	31	63	25	337	91	49	0	140
Total	**1226**	**1470**	**257**	**420**	**757**	**120**	**888**	**492**	**1384**	**873**	**7887**	**157**	**1667**	**2**	**1826**

Traffic Survey for Feasibility Study for the Construction of Dhaka Ashulia Elavated Expressway

Daily Summary Sheet

U Turn Movement Mannual Count

Name of Intersection: **Baipayl** Turning Movement No:-1 From: Abdullahpur To: Abdullahpur Dated 22.7.2016 Day: Friday

Weather: Sunny/Fair/Cloudy/Rainy Duration: 24 hrs.

Time	1	2	3	4	5	6	7	8	9	10	Total Motorized	11	12	13	Total Non Motorized
	Large Bus/ Double Decker/ Articulated Bus	Medium Bus	Small Bus/ Micro Bus	Utility /Jeep/ Laguna /Tempo /Maxi/ Human Hauler	Car/Taxi /Station Wagan	Auto Rickshaw, CNG/ Michuk	Motor Cycle	Heavy Truck/ Trailer/ Container /Truck 3 axle	Medium Truck/ Truck Lorry/ Truck 2 axle	Small Truck/ Pickup /Small Van		Bicycle	Rickshaw (Cycle)/ Rickshaw Van	Animal Cart /Push Cart	
08-00 to 09-00	0	2	2	11	6	0	0	0	3	1	25	0	35	1	36
09-00 to 10-00	0	11	9	6	6	1	6	0	1	4	44	0	16	0	16
10-00 to 11-00	0	7	1	4	1	0	0	0	2	1	16	1	19	0	20
11-00 to 12-00	0	7	1	0	0	2	1	0	0	5	16	3	19	0	22
12-00 to 13-00	0	5	0	0	9	0	1	0	0	3	18	3	23	0	26
13-00 to 14-00	0	3	0	0	6	0	1	0	0	4	14	0	12	0	12
14-00 to 15-00	0	2	1	0	0	0	0	0	6	2	11	0	11	0	11
15-00 to 16-00	0	3	2	0	3	2	0	0	0	1	11	1	14	0	15
16-00 to 17-00	0	1	0	0	2	0	0	0	2	4	9	0	6	0	6
17-00 to 18-00	1	1	0	11	3	0	1	0	0	6	23	0	7	0	7
18-00 to 19-00	0	1	3	4	0	0	1	0	1	3	13	0	6	0	6
19-00 to 20-00	0	2	3	4	2	0	0	0	0	2	13	0	8	0	8
20-00 to 21-00	0	0	0	0	2	0	1	0	0	4	7	0	19	0	19
21-00 to 22-00	0	1	0	6	3	0	1	0	0	3	14	0	10	0	10
22-00 to 23-00	1	1	2	5	3	1	0	0	2	4	19	1	17	0	18
23-00 to 24-00	0	0	0	3	6	0	0	1	8	3	21	0	9	0	9
00-00 to 01-00	0	0	0	1	5	0	1	2	5	7	21	0	12	0	12
01-00 to 02-00	0	0	0	13	0	0	0	1	7	10	31	0	4	0	4
02-00 to 03-00	0	0	0	4	0	0	0	0	2	7	13	0	3	0	3
03-00 to 04-00	0	0	0	0	0	0	0	0	2	3	5	0	2	0	2
04-00 to 05-00	0	0	0	0	0	0	0	0	1	1	2	0	0	0	0
05-00 to 06-00	0	0	0	0	0	0	0	0	3	0	3	0	0	0	0
06-00 to 07-00	0	0	0	2	0	0	0	0	2	0	4	0	0	0	0
07-00 to 08-00	0	0	0	11	0	0	1	0	3	5	20	0	21	0	21
Total	**2**	**47**	**24**	**85**	**57**	**6**	**15**	**4**	**50**	**83**	**373**	**9**	**273**	**1**	**283**

Traffic Survey for Feasibility Study for the Construction of Dhaka Ashulia Elavated Expressway

Daily Summary Sheet

U Turn Movement Mannual Count

Name of Intersection: **Baipayl** Turning Movement No:-5 From: Nabinagar To: Nabinagar Dated 22.7.2016 Day: Friday

Weather: Sunny/Fair/Cloudy/Rainy Duration: 24 hrs.

Time	1	2	3	4	5	6	7	8	9	10	Total Motorized	11	12	13	Total Non Motorized
	Large Bus/ Double Decker/ Articulated Bus	Medium Bus	Small Bus/ Micro Bus	Utility /Jeep/ Laguna /Tempo /Maxi/ Human	Car/Taxi /Station Wagan	Auto Rickshaw, CNG/ Michuk	Motor Cycle	Heavy Truck/ Trailer/ Container /Truck 3 axle	Medium Truck/ Truck Lorry/ Truck 2 axle	Small Truck/ Pickup /Small Van		Bicycle	Rickshaw (Cycle)/ Rickshaw Van	Animal Cart /Push Cart	
08-00 to 09-00	0	0	7	0	16	2	0	0	0	0	25	0	10	0	10
09-00 to 10-00	0	0	0	11	15	0	5	0	0	0	31	0	19	0	19
10-00 to 11-00	0	0	7	0	16	2	1	0	0	0	26	0	21	0	21
11-00 to 12-00	0	0	4	0	8	1	0	0	0	0	13	0	11	0	11
12-00 to 13-00	0	0	1	0	3	1	3	0	0	0	8	0	8	0	8
13-00 to 14-00	0	0	4	0	8	0	2	0	0	0	14	0	10	0	10
14-00 to 15-00	0	0	4	0	7	0	12	0	0	0	23	0	12	0	12
15-00 to 16-00	0	0	4	0	5	0	15	0	0	0	24	0	6	0	6
16-00 to 17-00	0	0	6	0	7	0	8	0	0	0	21	1	11	0	12
17-00 to 18-00	0	0	6	0	8	0	9	0	0	0	23	0	15	0	15
18-00 to 19-00	0	0	4	0	12	0	9	0	1	2	28	3	17	0	20
19-00 to 20-00	0	0	9	0	8	0	11	0	0	9	37	2	15	0	17
20-00 to 21-00	0	6	2	0	10	0	9	0	0	3	30	0	17	0	17
21-00 to 22-00	0	0	7	0	1	0	8	0	9	0	25	0	13	0	13
22-00 to 23-00	0	0	0	0	6	0	3	0	8	6	23	0	1	0	1
23-00 to 24-00	0	0	6	0	8	0	0	5	7	2	28	0	0	0	0
00-00 to 01-00	0	0	3	0	8	0	1	5	5	3	25	0	0	0	0
01-00 to 02-00	0	0	1	0	8	0	0	0	2	0	11	0	0	0	0
02-00 to 03-00	0	0	2	0	4	0	0	0	2	0	8	0	0	0	0
03-00 to 04-00	0	0	4	0	6	0	0	0	1	1	12	1	0	0	1
04-00 to 05-00	0	0	6	0	6	0	7	0	0	2	21	9	0	0	9
05-00 to 06-00	0	0	5	0	12	0	14	0	0	0	31	6	0	0	6
06-00 to 07-00	0	0	4	0	11	0	11	0	0	0	26	5	0	0	5
07-00 to 08-00	0	0	2	0	8	0	8	0	0	0	18	6	0	0	6
Total	**0**	**6**	**98**	**11**	**201**	**6**	**136**	**10**	**35**	**28**	**531**	**33**	**186**	**0**	**219**

Traffic Survey for Feasibility Study for the Construction of Dhaka Ashulia Elavated Expressway

Daily Summary Sheet
Turning Movement Mannual Count

Name of Intersection: **Nabinagar** Turning Movement No:-1 From: Savar To: Baipayl Date : 19.7.2016 Day: Tuesday

Weather: Sunny/Fair/Cloudy/Rainy Duration: 24 hrs.

Time	1	2	3	4	5	6	7	8	9	10		11	12	13	
	Large Bus/ Double Decker/ Articulated Bus	Medium Bus	Small Bus/ Micro Bus	Utility /Jeep/ Laguna /Tempo /Maxi/ Human Hauler	Car/Taxi /Station Wagan	Auto Rickshaw, CNG/ Michuk	Motor Cycle	Heavy Truck/ Trailer/ Container /Truck 3 axle	Medium Truck/ Truck Lorry/ Truck 2 axle	Small Truck/ Pickup /Small Van	Total Motorized	Bicycle	Rickshaw (Cycle)/ Rickshaw Van	Animal Cart /Push Cart	Total Non Motorized
08-00 to 09-00	25	44	73	78	81	37	39	18	58	50	503	0	36	0	36
09-00 to 10-00	72	39	58	94	174	2	25	37	62	60	623	0	32	0	32
10-00 to 11-00	70	47	55	43	52	37	39	64	64	60	531	0	42	0	42
11-00 to 12-00	58	51	52	73	116	34	43	29	61	66	583	0	35	0	35
12-00 to 13-00	68	40	56	69	81	11	25	46	49	40	485	0	22	0	22
13-00 to 14-00	56	40	48	61	54	13	29	34	47	54	436	0	21	0	21
14-00 to 15-00	32	37	38	32	44	10	22	18	57	37	327	1	15	0	16
15-00 to 16-00	21	42	38	34	30	6	19	8	55	65	318	0	26	0	26
16-00 to 17-00	38	45	34	29	18	12	18	10	53	58	315	0	19	0	19
17-00 to 18-00	47	9	52	42	29	1	13	18	58	58	327	0	19	0	19
18-00 to 19-00	47	40	50	29	29	5	29	11	55	50	345	0	15	0	15
19-00 to 20-00	67	44	43	79	71	21	32	28	57	54	496	0	26	0	26
20-00 to 21-00	49	37	32	28	35	5	15	31	53	52	337	0	9	0	9
21-00 to 22-00	62	48	34	32	38	0	22	40	31	32	339	0	10	0	10
22-00 to 23-00	72	48	33	28	24	3	7	46	56	48	365	0	2	0	2
23-00 to 24-00	61	38	19	25	20	5	4	48	38	55	313	0	5	0	5
00-00 to 01-00	66	28	10	16	19	6	2	53	41	41	282	0	2	0	2
01-00 to 02-00	66	21	18	13	13	5	2	43	24	30	235	0	2	0	2
02-00 to 03-00	57	19	17	15	14	3	2	34	25	29	215	0	3	0	3
03-00 to 04-00	40	25	10	10	8	4	1	50	38	25	211	0	1	0	1
04-00 to 05-00	10	33	7	11	11	3	2	37	49	38	201	0	1	0	1
05-00 to 06-00	11	23	15	16	16	0	1	30	34	31	177	0	1	0	1
06-00 to 07-00	30	22	22	30	16	6	1	17	17	31	192	0	2	0	2
07-00 to 08-00	51	32	90	19	18	8	3	19	49	38	327	0	2	0	2
Total	**1176**	**852**	**904**	**906**	**1011**	**237**	**395**	**769**	**1131**	**1102**	**8483**	**1**	**348**	**0**	**349**

Traffic Survey for Feasibility Study for the Construction of Dhaka Ashulia Elavated Expressway

Daily Summary Sheet
Turning Movement Mannual Count

Name of Intersection: **Nabinagar** Turning Movement No:-2 From: Savar To: Nayarhat Date : 19.7.2016 Day: Tuesday

Weather: Sunny/Fair/Cloudy/Rainy Duration: 24 hrs.

Time	1	2	3	4	5	6	7	8	9	10	Total Motorized	11	12	13	Total Non Motorized
	Large Bus/ Double Decker/ Articulated Bus	Medium Bus	Small Bus/ Micro Bus	Utility /Jeep/ Laguna /Tempo /Maxi/ Human	Car/Taxi /Station Wagan	Auto Rickshaw, CNG/ Michuk	Motor Cycle	Heavy Truck/ Trailer/ Container /Truck 3 axle	Medium Truck/ Truck Lorry/ Truck 2 axle	Small Truck/ Pickup /Small Van		Bicycle	Rickshaw (Cycle)/ Rickshaw Van	Animal Cart /Push Cart	
08-00 to 09-00	52	49	14	9	22	1	5	4	15	24	195	1	7	0	8
09-00 to 10-00	68	48	19	11	54	0	4	3	22	7	236	1	32	0	33
10-00 to 11-00	38	68	14	8	39	0	13	6	20	27	233	0	29	0	29
11-00 to 12-00	58	65	11	13	39	1	13	4	18	21	243	1	19	0	20
12-00 to 13-00	38	58	10	10	35	6	6	5	28	18	214	2	15	0	17
13-00 to 14-00	28	61	21	13	35	0	8	4	15	26	211	4	30	0	34
14-00 to 15-00	30	46	20	9	27	0	10	4	20	19	185	1	36	0	37
15-00 to 16-00	37	68	33	18	32	8	11	6	19	23	255	1	36	0	37
16-00 to 17-00	52	79	11	11	25	7	22	4	14	34	259	2	44	0	46
17-00 to 18-00	53	75	14	17	35	0	23	6	23	34	280	1	40	0	41
18-00 to 19-00	48	85	8	12	31	0	8	6	20	36	254	5	28	0	33
19-00 to 20-00	25	51	5	8	25	0	9	4	33	20	180	2	80	0	82
20-00 to 21-00	65	55	10	8	23	0	3	4	55	31	254	1	11	0	12
21-00 to 22-00	84	61	17	5	20	0	4	5	60	35	291	1	26	0	27
22-00 to 23-00	74	55	11	1	5	0	7	4	59	13	229	0	2	0	2
23-00 to 24-00	74	7	9	0	3	0	6	4	27	8	138	0	0	0	0
00-00 to 01-00	44	1	2	1	3	0	1	4	70	12	138	0	0	0	0
01-00 to 02-00	5	0	3	1	5	0	1	4	66	5	90	0	0	0	0
02-00 to 03-00	0	0	6	3	3	0	0	5	71	7	95	0	0	0	0
03-00 to 04-00	0	0	4	1	3	0	0	5	85	6	104	0	0	0	0
04-00 to 05-00	0	1	1	3	12	0	0	4	71	4	96	1	0	0	1
05-00 to 06-00	15	34	20	10	16	0	0	1	63	30	189	1	1	0	2
06-00 to 07-00	13	48	6	5	14	0	4	4	49	29	172	1	11	0	12
07-00 to 08-00	17	67	6	10	24	0	3	4	59	43	233	2	13	0	15
Total	**918**	**1082**	**275**	**187**	**530**	**23**	**161**	**104**	**982**	**512**	**4774**	**28**	**460**	**0**	**488**

Traffic Survey for Feasibility Study for the Construction of Dhaka Ashulia Elavated Expressway

Daily Summary Sheet

Turning Movement Mannual Count

Name of Intersection: **Nabinagar** Turning Movement No:-3 From: Baipayl To: Nayarhat Date : 19.7.2016 Day: Tuesday

Weather: Sunny/Fair/Cloudy/Rainy Duration: 24 hrs.

Time	1	2	3	4	5	6	7	8	9	10	Total Motorized	11	12	13	Total Non Motorized
	Large Bus/ Double Decker/ Articulated Bus	Medium Bus	Small Bus/ Micro Bus	Utility /Jeep/ Laguna /Tempo /Maxi/ Human	Car/Taxi /Station Wagan	Auto Rickshaw, CNG/ Michuk	Motor Cycle	Heavy Truck/ Trailer/ Container /Truck 3 axle	Medium Truck/ Truck Lorry/ Truck 2 axle	Small Truck/ Pickup /Small Van		Bicycle	Rickshaw (Cycle)/ Rickshaw Van	Animal Cart /Push Cart	
08-00 to 09-00	2	42	52	40	34	0	20	11	55	21	277	2	42	0	44
09-00 to 10-00	1	25	44	24	40	0	16	9	3	15	177	0	27	0	27
10-00 to 11-00	0	26	36	7	11	0	14	11	14	29	148	2	36	0	38
11-00 to 12-00	3	16	35	18	15	0	8	8	25	19	147	0	44	0	44
12-00 to 13-00	0	20	60	22	30	0	15	9	34	13	203	2	30	0	32
13-00 to 14-00	0	31	48	34	52	1	15	24	40	13	258	0	23	0	23
14-00 to 15-00	2	24	55	13	24	0	13	16	33	7	187	0	22	0	22
15-00 to 16-00	1	28	45	18	33	0	21	20	22	18	206	0	14	0	14
16-00 to 17-00	2	33	50	22	36	0	25	23	38	13	242	0	39	0	39
17-00 to 18-00	3	48	49	30	25	0	25	16	23	17	236	0	29	0	29
18-00 to 19-00	7	65	35	27	28	0	25	17	24	16	244	0	28	0	28
19-00 to 20-00	0	42	16	30	36	0	26	3	21	9	183	2	22	0	24
20-00 to 21-00	19	40	43	39	33	0	10	66	30	12	292	0	0	0	0
21-00 to 22-00	23	32	46	25	32	0	2	46	32	21	259	0	0	0	0
22-00 to 23-00	19	16	35	29	36	2	3	32	7	3	182	0	0	0	0
23-00 to 24-00	13	14	5	28	19	0	4	31	22	8	144	0	0	0	0
00-00 to 01-00	12	5	3	16	11	0	0	35	21	3	106	0	0	0	0
01-00 to 02-00	31	4	2	9	9	0	0	53	8	3	119	0	0	0	0
02-00 to 03-00	43	4	53	1	5	1	2	63	13	2	187	0	0	0	0
03-00 to 04-00	40	4	40	1	5	3	0	64	4	2	163	0	0	0	0
04-00 to 05-00	43	2	42	4	3	0	0	51	5	2	152	0	1	0	1
05-00 to 06-00	47	10	44	21	3	3	0	49	13	6	196	0	0	0	0
06-00 to 07-00	52	4	44	3	14	0	0	51	17	14	199	1	0	0	1
07-00 to 08-00	45	37	45	17	15	0	13	34	35	26	267	0	15	0	15
Total	**408**	**572**	**927**	**478**	**549**	**10**	**257**	**742**	**539**	**292**	**4774**	**9**	**372**	**0**	**381**

Traffic Survey for Feasibility Study for the Construction of Dhaka Ashulia Elavated Expressway

Turning Movement Mannual Count

Name of Intersection: **Nabinagar** Turning Movement No:-4 From: Baipayl To: Savar Date : 19.7.2016 Day: Tuesday

Weather: Sunny/Fair/Cloudy/Rainy Duration: 24 hrs.

Time	1	2	3	4	5	6	7	8	9	10		11	12	13	
	Large Bus/ Double Decker/ Articulated Bus	Medium Bus	Small Bus/ Micro Bus	Utility /Jeep/ Laguna /Tempo /Maxi/ Human	Car/Taxi /Station Wagan	Auto Rickshaw, CNG/ Michuk	Motor Cycle	Heavy Truck/ Trailer/ Container /Truck 3 axle	Medium Truck/ Truck Lorry/ Truck 2 axle	Small Truck/ Pickup /Small Van	Total Motorized	Bicycle	Rickshaw (Cycle)/ Rickshaw Van	Animal Cart /Push Cart	Total Non Motorized
08-00 to 09-00	5	99	12	5	38	0	2	2	22	43	228	2	17	0	19
09-00 to 10-00	19	54	37	9	26	0	4	17	34	40	240	2	17	0	19
10-00 to 11-00	16	79	21	9	24	0	24	20	41	59	293	1	28	0	29
11-00 to 12-00	18	66	16	10	34	0	16	22	39	52	273	1	31	0	32
12-00 to 13-00	24	43	29	14	49	0	29	16	30	33	267	3	38	0	41
13-00 to 14-00	43	38	39	11	57	0	12	16	35	21	272	1	21	0	22
14-00 to 15-00	39	50	28	7	47	0	14	12	27	13	237	4	20	0	24
15-00 to 16-00	56	48	53	18	66	1	19	11	31	35	338	2	9	1	12
16-00 to 17-00	35	47	67	25	83	0	14	10	18	16	315	4	25	0	29
17-00 to 18-00	35	63	52	13	36	0	21	17	29	15	281	0	17	0	17
18-00 to 19-00	19	50	62	6	23	0	11	11	27	12	221	0	25	0	25
19-00 to 20-00	4	32	16	4	22	0	2	3	7	4	94	1	5	0	6
20-00 to 21-00	19	15	43	4	76	1	17	10	24	3	212	3	12	0	15
21-00 to 22-00	37	18	52	3	23	0	6	22	23	3	187	0	5	0	5
22-00 to 23-00	3	4	10	2	10	0	6	13	21	2	71	0	4	3	7
23-00 to 24-00	3	0	5	2	19	0	6	15	44	0	94	0	0	6	6
00-00 to 01-00	7	2	1	6	25	0	5	16	41	0	103	0	0	1	1
01-00 to 02-00	8	0	1	4	8	0	7	17	24	0	69	0	0	0	0
02-00 to 03-00	8	0	1	3	11	0	5	20	17	0	65	0	0	0	0
03-00 to 04-00	8	0	3	4	6	0	3	16	11	0	51	0	0	0	0
04-00 to 05-00	10	0	3	5	15	0	1	27	11	0	72	0	0	3	3
05-00 to 06-00	13	6	17	10	14	0	1	38	13	2	114	2	1	3	6
06-00 to 07-00	16	29	41	3	8	0	3	17	13	10	140	3	13	2	18
07-00 to 08-00	12	60	36	2	13	0	8	23	9	12	175	8	13	0	21
Total	**457**	**803**	**645**	**179**	**733**	**2**	**236**	**391**	**591**	**375**	**4412**	**37**	**301**	**19**	**357**

Traffic Survey for Feasibility Study for the Construction of Dhaka Ashulia Elavated Expressway

Daily Summary Sheet

Turning Movement Mannual Count

Name of Intersection: **Nabinagar** Turning Movement No:-5 From: Nayarhat To: Savar Date : 19.7.2016 Day: Tuesday

Weather: Sunny/Fair/Cloudy/Rainy Duration: 24 hrs.

Time	1	2	3	4	5	6	7	8	9	10	Total Motorized	11	12	13	Total Non Motorized
	Large Bus/ Double Decker/ Articulated Bus	Medium Bus	Small Bus/ Micro Bus	Utility /Jeep/ Laguna /Tempo /Maxi/ Human	Car/Taxi /Station Wagan	Auto Rickshaw, CNG/ Michuk	Motor Cycle	Heavy Truck/ Trailer/ Container /Truck 3 axle	Medium Truck/ Truck Lorry/ Truck 2 axle	Small Truck/ Pickup /Small Van		Bicycle	Rickshaw (Cycle)/ Rickshaw Van	Animal Cart /Push Cart	
08-00 to 09-00	34	45	26	35	60	0	17	9	48	30	304	3	0	0	3
09-00 to 10-00	24	42	12	19	41	0	17	0	34	25	214	2	28	0	30
10-00 to 11-00	16	55	8	29	61	0	18	2	60	30	279	5	38	0	43
11-00 to 12-00	26	52	16	27	62	0	22	2	51	28	286	5	37	0	42
12-00 to 13-00	18	48	11	26	62	0	26	1	63	25	280	6	36	0	42
13-00 to 14-00	48	55	8	34	67	0	26	1	52	16	307	7	41	0	48
14-00 to 15-00	46	61	17	27	56	0	35	5	63	33	343	2	30	0	32
15-00 to 16-00	47	61	25	32	69	1	27	0	61	31	354	3	29	0	32
16-00 to 17-00	50	52	27	40	69	0	34	3	53	55	383	2	52	0	54
17-00 to 18-00	70	37	39	45	94	0	30	2	54	56	427	3	27	0	30
18-00 to 19-00	61	35	23	55	97	1	22	1	58	71	424	4	21	0	25
19-00 to 20-00	82	44	41	38	75	1	29	4	57	47	418	2	20	0	22
20-00 to 21-00	72	60	28	85	91	3	11	10	65	32	457	0	4	0	4
21-00 to 22-00	66	75	34	46	52	4	9	9	60	55	410	5	5	0	10
22-00 to 23-00	71	55	41	13	21	7	9	8	70	50	345	0	12	0	12
23-00 to 24-00	42	45	24	8	24	2	3	9	60	40	257	0	7	0	7
00-00 to 01-00	54	30	20	5	12	5	6	29	40	35	236	0	9	0	9
01-00 to 02-00	19	2	10	3	7	8	6	38	16	14	123	0	8	0	8
02-00 to 03-00	6	5	2	13	7	5	5	42	27	26	138	0	7	0	7
03-00 to 04-00	16	6	13	18	16	6	7	15	40	40	177	0	4	0	4
04-00 to 05-00	41	39	13	12	8	8	8	23	43	42	237	0	5	0	5
05-00 to 06-00	16	44	15	11	8	4	8	26	15	20	167	0	10	0	10
06-00 to 07-00	13	43	13	7	10	2	9	16	11	32	156	0	19	0	19
07-00 to 08-00	72	65	28	7	15	2	8	18	18	35	268	1	8	0	9
Total	**1010**	**1056**	**494**	**635**	**1084**	**59**	**392**	**273**	**1119**	**868**	**6990**	**50**	**457**	**0**	**507**

Traffic Survey for Feasibility Study for the Construction of Dhaka Ashulia Elavated Expressway

Daily Summary Sheet

Turning Movement Mannual Count

Name of Intersection: **Nabinagar** Turning Movement No:-6 From: Nayarhat To: Baipayl Date : 19.7.2016 Day: Tuesday

Weather: Sunny/Fair/Cloudy/Rainy Duration: 24 hrs.

Time	1	2	3	4	5	6	7	8	9	10	Total Motorized	11	12	13	Total Non Motorized
	Large Bus/ Double Decker/ Articulated Bus	Medium Bus	Small Bus/ Micro Bus	Utility /Jeep/ Laguna /Tempo /Maxi/ Human	Car/Taxi /Station Wagan	Auto Rickshaw, CNG/ Michuk	Motor Cycle	Heavy Truck/ Trailer/ Container /Truck 3 axle	Medium Truck/ Truck Lorry/ Truck 2 axle	Small Truck/ Pickup /Small Van		Bicycle	Rickshaw (Cycle)/ Rickshaw Van	Animal Cart /Push Cart	
08-00 to 09-00	1	10	7	22	30	13	24	0	21	10	138	3	56	0	59
09-00 to 10-00	0	15	14	22	19	1	14	1	24	11	121	5	51	0	56
10-00 to 11-00	1	12	43	6	23	2	24	6	61	4	182	1	63	0	64
11-00 to 12-00	0	17	25	15	33	2	28	4	43	15	182	3	68	1	72
12-00 to 13-00	1	0	12	18	26	2	21	7	35	13	135	3	56	0	59
13-00 to 14-00	2	33	17	14	24	1	42	3	15	11	162	3	64	0	67
14-00 to 15-00	6	16	36	27	14	1	26	4	22	6	158	5	40	0	45
15-00 to 16-00	8	32	29	11	21	1	21	6	37	19	185	6	52	0	58
16-00 to 17-00	5	35	14	22	25	2	44	0	18	11	176	3	68	0	71
17-00 to 18-00	4	30	17	22	23	3	29	0	21	5	154	6	73	0	79
18-00 to 19-00	1	17	8	22	17	3	50	2	19	9	148	9	78	0	87
19-00 to 20-00	13	17	12	15	30	2	20	0	21	7	137	4	32	0	36
20-00 to 21-00	13	18	12	20	19	5	11	27	8	12	145	2	26	0	28
21-00 to 22-00	11	17	9	7	18	13	8	31	13	7	134	0	15	0	15
22-00 to 23-00	5	13	9	14	5	2	7	26	32	26	139	2	5	0	7
23-00 to 24-00	14	14	9	11	9	2	5	18	38	29	149	1	10	0	11
00-00 to 01-00	11	6	9	10	11	2	2	11	36	28	126	0	7	0	7
01-00 to 02-00	9	3	12	27	9	2	4	15	23	18	122	2	5	0	7
02-00 to 03-00	11	3	9	17	11	0	1	12	21	17	102	0	2	0	2
03-00 to 04-00	14	1	9	40	10	1	2	12	17	12	118	0	1	0	1
04-00 to 05-00	10	2	10	35	15	1	1	16	11	5	106	2	1	0	3
05-00 to 06-00	18	1	13	26	20	7	1	24	6	6	122	2	6	0	8
06-00 to 07-00	22	5	22	50	30	8	1	26	6	16	186	2	13	0	15
07-00 to 08-00	23	4	21	34	22	6	1	24	13	10	158	1	6	0	7
Total	**203**	**321**	**378**	**507**	**464**	**82**	**387**	**275**	**561**	**307**	**3485**	**65**	**798**	**1**	**864**

Traffic Survey for Feasibility Study for the Construction of Dhaka Ashulia Elavated Expressway

Daily Summary Sheet
Turning Movement Mannual Count

Name of Intersection: **Nabinagar** Turning Movement No:-1 From: Savar To: Baipayl Date : 22.7.2016 Day: Friday

Weather: Sunny/Fair/Cloudy/Rainy Duration: 24 hrs.

Time	1	2	3	4	5	6	7	8	9	10		11	12	13	
	Large Bus/ Double Decker/ Articulated Bus	Medium Bus	Small Bus/ Micro Bus	Utility /Jeep/ Laguna /Tempo /Maxi/ Human Hauler	Car/Taxi /Station Wagan	Auto Rickshaw, CNG/ Michuk	Motor Cycle	Heavy Truck/ Trailer/ Container /Truck 3 axle	Medium Truck/ Truck Lorry/ Truck 2 axle	Small Truck/ Pickup /Small Van	Total Motorized	Bicycle	Rickshaw (Cycle)/ Rickshaw Van	Animal Cart /Push Cart	Total Non Motorized
08-00 to 09-00	57	70	40	33	61	0	18	0	27	32	338	2	27	0	29
09-00 to 10-00	89	100	40	46	59	1	20	0	40	47	442	0	42	0	42
10-00 to 11-00	79	92	27	47	83	0	28	2	54	44	456	0	37	0	37
11-00 to 12-00	68	102	33	30	69	0	35	0	32	44	413	3	40	0	43
12-00 to 13-00	49	104	30	42	58	0	23	0	35	37	378	0	33	0	33
13-00 to 14-00	59	106	36	33	68	0	43	0	38	44	427	4	24	0	28
14-00 to 15-00	48	89	41	35	69	0	16	2	23	39	362	3	24	0	27
15-00 to 16-00	57	84	19	36	43	0	28	2	21	26	316	2	36	0	38
16-00 to 17-00	56	101	32	42	53	0	33	2	24	29	372	1	19	0	20
17-00 to 18-00	49	111	25	33	48	0	36	3	62	39	406	11	23	0	34
18-00 to 19-00	45	90	18	39	45	0	31	8	64	35	375	4	36	0	40
19-00 to 20-00	35	79	32	20	28	0	7	3	40	28	272	1	11	0	12
20-00 to 21-00	38	80	33	18	32	1	16	2	30	33	283	3	26	0	29
21-00 to 22-00	91	60	27	33	72	0	27	1	31	33	375	1	9	0	10
22-00 to 23-00	57	43	15	18	28	0	7	1	34	22	225	2	5	0	7
23-00 to 24-00	74	24	13	14	29	0	5	1	56	13	229	0	3	0	3
00-00 to 01-00	74	9	10	11	14	0	2	7	121	32	280	0	4	0	4
01-00 to 02-00	12	4	8	4	9	0	0	3	92	20	152	0	0	0	0
02-00 to 03-00	14	2	4	4	8	0	0	3	60	19	114	0	2	0	2
03-00 to 04-00	9	26	6	17	6	0	0	3	79	29	175	0	6	0	6
04-00 to 05-00	9	8	2	14	8	0	6	2	55	34	138	0	13	0	13
05-00 to 06-00	13	78	18	19	6	9	7	2	63	24	239	0	21	0	21
06-00 to 07-00	21	114	39	21	21	0	12	0	30	15	273	2	22	0	24
07-00 to 08-00	40	142	79	25	42	0	34	0	29	16	407	7	30	0	37
Total	**1143**	**1718**	**627**	**634**	**959**	**11**	**434**	**47**	**1140**	**734**	**7447**	**46**	**493**	**0**	**539**

Traffic Survey for Feasibility Study for the Construction of Dhaka Ashulia Elavated Expressway

Daily Summary Sheet
Turning Movement Mannual Count

Name of Intersection: **Nabinagar** Turning Movement No:-2 From: Savar To: Nayarhat Date : 22.7.2016 Day: Friday

Weather: Sunny/Fair/Cloudy/Rainy Duration: 24 hrs.

Time	1	2	3	4	5	6	7	8	9	10	Total Motorized	11	12	13	Total Non Motorized
	Large Bus/ Double Decker/ Articulated Bus	Medium Bus	Small Bus/ Micro Bus	Utility /Jeep/ Laguna /Tempo /Maxi/ Human	Car/Taxi /Station Wagan	Auto Rickshaw, CNG/ Michuk	Motor Cycle	Heavy Truck/ Trailer/ Container /Truck 3 axle	Medium Truck/ Truck Lorry/ Truck 2 axle	Small Truck/ Pickup /Small Van		Bicycle	Rickshaw (Cycle)/ Rickshaw Van	Animal Cart /Push Cart	
08-00 to 09-00	35	68	27	11	28	2	10	2	29	28	240	2	22	0	24
09-00 to 10-00	41	84	24	11	65	0	15	0	59	45	344	1	72	0	73
10-00 to 11-00	51	67	27	11	73	0	13	0	72	61	375	2	73	0	75
11-00 to 12-00	47	93	33	11	49	1	13	1	64	36	348	6	82	0	88
12-00 to 13-00	49	82	33	6	34	3	13	0	67	50	337	3	56	0	59
13-00 to 14-00	52	89	37	7	44	1	14	3	74	56	377	6	47	0	53
14-00 to 15-00	26	60	21	7	55	2	24	0	41	30	266	8	46	0	54
15-00 to 16-00	43	65	32	11	55	3	28	0	71	39	347	9	103	0	112
16-00 to 17-00	43	31	39	17	81	4	35	1	50	14	315	5	85	0	90
17-00 to 18-00	22	92	39	7	77	1	40	2	54	32	366	4	70	0	74
18-00 to 19-00	15	84	39	7	51	0	26	4	50	22	298	3	59	0	62
19-00 to 20-00	5	29	33	6	49	0	29	0	23	18	192	1	41	0	42
20-00 to 21-00	50	46	24	4	12	1	5	3	80	37	262	0	15	0	15
21-00 to 22-00	32	30	37	4	18	0	2	4	62	10	199	0	24	0	24
22-00 to 23-00	39	18	26	3	17	0	4	4	53	7	171	0	3	0	3
23-00 to 24-00	32	16	23	1	2	0	1	6	50	7	138	0	5	0	5
00-00 to 01-00	31	9	15	0	0	1	1	10	62	13	142	0	4	0	4
01-00 to 02-00	11	7	12	1	3	0	1	10	62	17	124	0	3	0	3
02-00 to 03-00	13	8	15	1	2	0	0	17	67	11	134	0	3	0	3
03-00 to 04-00	10	1	13	2	3	0	1	13	58	29	130	0	2	0	2
04-00 to 05-00	6	4	7	2	9	0	1	16	69	32	146	0	3	0	3
05-00 to 06-00	12	7	5	2	3	4	1	14	72	36	156	0	3	0	3
06-00 to 07-00	15	29	29	4	22	0	9	3	40	20	171	0	18	0	18
07-00 to 08-00	11	76	28	5	26	2	7	0	55	25	235	0	25	0	25
Total	**691**	**1095**	**618**	**141**	**778**	**25**	**293**	**113**	**1384**	**675**	**5813**	**50**	**864**	**0**	**914**

Traffic Survey for Feasibility Study for the Construction of Dhaka Ashulia Elavated Expressway

Daily Summary Sheet

Turning Movement Mannual Count

Name of Intersection: **Nabinagar** Turning Movement No:-3 From: Baipayl To: Nayarhat Date : 22.7.2016 Day: Friday

Weather: Sunny/Fair/Cloudy/Rainy Duration: 24 hrs.

Time	1	2	3	4	5	6	7	8	9	10	Total Motorized	11	12	13	Total Non Motorized
	Large Bus/ Double Decker/ Articulated Bus	Medium Bus	Small Bus/ Micro Bus	Utility /Jeep/ Laguna /Tempo /Maxi/ Human	Car/Taxi /Station Wagan	Auto Rickshaw, CNG/ Michuk	Motor Cycle	Heavy Truck/ Trailer/ Container /Truck 3 axle	Medium Truck/ Truck Lorry/ Truck 2 axle	Small Truck/ Pickup /Small Van		Bicycle	Rickshaw (Cycle)/ Rickshaw Van	Animal Cart /Push Cart	
08-00 to 09-00	15	34	31	5	27	0	9	6	35	18	180	4	39	0	43
09-00 to 10-00	27	70	14	27	33	2	10	4	18	31	236	8	52	0	60
10-00 to 11-00	17	52	13	17	35	0	10	6	31	36	217	10	43	0	53
11-00 to 12-00	11	62	20	10	54	0	8	3	26	26	220	2	45	0	47
12-00 to 13-00	17	55	15	17	56	0	12	2	23	36	233	3	38	0	41
13-00 to 14-00	27	63	11	11	32	3	9	2	16	9	183	7	27	0	34
14-00 to 15-00	18	55	23	6	48	0	10	2	19	13	194	8	35	0	43
15-00 to 16-00	29	62	10	9	48	0	13	2	25	18	216	6	42	1	49
16-00 to 17-00	45	61	11	10	61	0	13	3	28	28	260	3	49	0	52
17-00 to 18-00	44	72	20	30	66	0	12	2	25	48	319	5	45	0	50
18-00 to 19-00	51	75	60	28	69	0	14	4	42	72	415	4	44	0	48
19-00 to 20-00	25	79	18	25	59	0	9	8	6	43	272	2	28	0	30
20-00 to 21-00	23	51	18	9	53	0	12	10	29	25	230	5	20	0	25
21-00 to 22-00	18	29	12	13	40	1	12	3	35	15	178	1	19	0	20
22-00 to 23-00	15	28	7	6	22	1	5	3	45	21	153	3	12	0	15
23-00 to 24-00	17	23	22	7	29	1	1	6	69	33	208	1	6	0	7
00-00 to 01-00	10	11	8	4	14	1	0	4	38	22	112	1	6	0	7
01-00 to 02-00	17	0	10	1	16	2	0	4	60	24	134	0	2	0	2
02-00 to 03-00	15	4	2	1	4	2	0	5	44	19	96	0	0	0	0
03-00 to 04-00	9	3	1	1	4	3	0	2	25	28	76	0	2	0	2
04-00 to 05-00	13	1	8	9	4	4	0	9	53	15	116	1	3	0	4
05-00 to 06-00	19	18	11	11	18	2	1	5	23	14	122	4	12	0	16
06-00 to 07-00	19	56	37	6	33	4	7	2	21	10	195	3	12	0	15
07-00 to 08-00	18	71	25	7	18	2	6	3	24	16	190	0	18	0	18
Total	**519**	**1035**	**407**	**270**	**843**	**28**	**173**	**100**	**760**	**620**	**4755**	**81**	**599**	**1**	**681**

Traffic Survey for Feasibility Study for the Construction of Dhaka Ashulia Elavated Expressway

Turning Movement Mannual Count

Name of Intersection: **Nabinagar** Turning Movement No:-4 From: Baipayl To: Savar Date : 22.7.2016 Day: Friday

Weather: Sunny/Fair/Cloudy/Rainy Duration: 24 hrs.

Time	1 Large Bus/ Double Decker/ Articulated Bus	2 Medium Bus	3 Small Bus/ Micro Bus	4 Utility /Jeep/ Laguna /Tempo /Maxi/ Human	5 Car/Taxi /Station Wagan	6 Auto Rickshaw, CNG/ Michuk	7 Motor Cycle	8 Heavy Truck/ Trailer/ Container /Truck 3 axle	9 Medium Truck/ Truck Lorry/ Truck 2 axle	10 Small Truck/ Pickup /Small Van	Total Motorized	11 Bicycle	12 Rickshaw (Cycle)/ Rickshaw Van	13 Animal Cart /Push Cart	Total Non Motorized
08-00 to 09-00	0	37	23	17	38	0	3	1	35	14	168	1	15	0	16
09-00 to 10-00	17	22	44	27	11	1	4	7	39	10	182	0	17	0	17
10-00 to 11-00	10	40	46	24	19	0	9	11	49	17	225	0	10	0	10
11-00 to 12-00	0	43	38	22	42	0	10	1	48	20	224	0	15	0	15
12-00 to 13-00	0	34	30	26	37	0	6	3	40	16	192	0	16	0	16
13-00 to 14-00	1	38	46	24	34	1	2	0	46	8	200	0	16	0	16
14-00 to 15-00	1	46	43	43	29	0	1	2	45	11	221	0	12	0	12
15-00 to 16-00	2	48	37	37	14	1	4	3	44	14	204	0	25	0	25
16-00 to 17-00	2	38	51	37	31	0	6	6	35	3	209	0	21	0	21
17-00 to 18-00	11	63	64	43	27	0	8	2	44	19	281	0	15	0	15
18-00 to 19-00	8	48	56	30	23	1	8	4	29	12	219	0	9	0	9
19-00 to 20-00	27	38	59	21	9	0	12	4	21	5	196	0	10	0	10
20-00 to 21-00	7	36	35	28	20	0	3	1	22	22	174	0	7	0	7
21-00 to 22-00	6	41	36	25	24	3	3	2	27	11	178	0	13	0	13
22-00 to 23-00	6	18	34	22	4	0	1	5	30	13	133	0	14	0	14
23-00 to 24-00	18	15	50	13	5	1	1	11	24	7	145	0	6	0	6
00-00 to 01-00	4	14	19	9	7	0	0	5	20	8	86	0	3	0	3
01-00 to 02-00	11	0	13	7	6	0	1	7	49	11	105	0	3	0	3
02-00 to 03-00	0	0	10	7	4	0	1	5	24	9	60	0	1	0	1
03-00 to 04-00	5	0	21	8	8	1	0	10	33	11	97	0	2	0	2
04-00 to 05-00	3	4	3	6	3	4	3	5	20	4	55	0	11	0	11
05-00 to 06-00	1	20	14	5	4	0	1	1	19	8	73	0	0	0	0
06-00 to 07-00	4	32	59	4	7	3	13	8	22	6	158	1	17	0	18
07-00 to 08-00	3	52	42	31	7	0	5	5	41	0	186	2	2	0	4
Total	**147**	**727**	**873**	**516**	**413**	**16**	**105**	**109**	**806**	**259**	**3971**	**4**	**260**	**0**	**264**

Traffic Survey for Feasibility Study for the Construction of Dhaka Ashulia Elavated Expressway

Daily Summary Sheet

Turning Movement Mannual Count

Name of Intersection: **Nabinagar** Turning Movement No:-5 From: Nayarhat To: Savar Date : 22.7.2016 Day: Friday

Weather: Sunny/Fair/Cloudy/Rainy Duration: 24 hrs.

Time	1	2	3	4	5	6	7	8	9	10	Total Motorized	11	12	13	Total Non Motorized
	Large Bus/ Double Decker/ Articulated Bus	Medium Bus	Small Bus/ Micro Bus	Utility /Jeep/ Laguna /Tempo /Maxi/ Human	Car/Taxi /Station Wagan	Auto Rickshaw, CNG/ Michuk	Motor Cycle	Heavy Truck/ Trailer/ Container /Truck 3 axle	Medium Truck/ Truck Lorry/ Truck 2 axle	Small Truck/ Pickup /Small Van		Bicycle	Rickshaw (Cycle)/ Rickshaw Van	Animal Cart /Push Cart	
08-00 to 09-00	47	49	15	23	19	0	11	13	41	41	259	0	24	0	24
09-00 to 10-00	46	31	28	24	28	1	11	3	27	19	218	6	26	0	32
10-00 to 11-00	31	36	16	21	50	0	17	0	44	20	235	5	35	0	40
11-00 to 12-00	44	46	17	28	43	0	24	6	45	31	284	4	31	0	35
12-00 to 13-00	38	43	18	29	30	0	9	6	32	21	226	1	22	0	23
13-00 to 14-00	54	86	20	36	61	0	27	9	43	21	357	3	30	0	33
14-00 to 15-00	50	40	19	26	38	1	20	4	30	16	244	2	21	0	23
15-00 to 16-00	51	53	15	30	58	0	23	11	26	20	287	0	38	0	38
16-00 to 17-00	49	40	16	37	113	0	34	4	29	18	340	0	46	0	46
17-00 to 18-00	39	69	17	34	113	0	37	9	47	24	389	6	40	0	46
18-00 to 19-00	59	58	21	43	129	0	40	9	53	35	447	0	31	0	31
19-00 to 20-00	61	64	28	41	66	1	16	6	50	27	360	0	13	0	13
20-00 to 21-00	43	51	29	14	34	0	7	15	41	20	254	0	18	0	18
21-00 to 22-00	56	38	18	15	21	0	16	6	49	18	237	0	9	0	9
22-00 to 23-00	48	23	6	8	27	1	2	9	59	13	196	0	5	0	5
23-00 to 24-00	39	11	6	11	33	6	0	9	38	5	158	0	5	0	5
00-00 to 01-00	22	2	1	5	16	0	3	4	30	6	89	0	12	0	12
01-00 to 02-00	22	0	3	3	19	0	0	5	21	6	79	0	6	0	6
02-00 to 03-00	19	2	0	4	22	2	0	1	22	3	75	0	4	0	4
03-00 to 04-00	29	7	3	5	12	0	0	0	23	7	86	0	4	0	4
04-00 to 05-00	35	25	8	10	14	0	0	1	33	4	130	0	10	0	10
05-00 to 06-00	51	65	14	10	12	3	5	5	14	12	191	1	10	0	11
06-00 to 07-00	89	117	20	11	24	0	9	2	12	9	293	1	8	0	9
07-00 to 08-00	77	109	21	22	35	0	29	5	20	16	334	1	10	0	11
Total	**1099**	**1065**	**359**	**490**	**1017**	**15**	**340**	**142**	**829**	**412**	**5768**	**30**	**458**	**0**	**488**

Traffic Survey for Feasibility Study for the Construction of Dhaka Ashulia Elavated Expressway

Daily Summary Sheet

Turning Movement Mannual Count

Name of Intersection: **Nabinagar** Turning Movement No:-6 From: Nayarhat To: Baipayl Date : 22.7.2016 Day: Friday

Weather: Sunny/Fair/Cloudy/Rainy Duration: 24 hrs.

Time	1	2	3	4	5	6	7	8	9	10	Total Motorized	11	12	13	Total Non Motorized
	Large Bus/ Double Decker/ Articulated Bus	Medium Bus	Small Bus/ Micro Bus	Utility /Jeep/ Laguna /Tempo /Maxi/ Human	Car/Taxi /Station Wagan	Auto Rickshaw, CNG/ Michuk	Motor Cycle	Heavy Truck/ Trailer/ Container /Truck 3 axle	Medium Truck/ Truck Lorry/ Truck 2 axle	Small Truck/ Pickup /Small Van		Bicycle	Rickshaw (Cycle)/ Rickshaw Van	Animal Cart /Push Cart	
08-00 to 09-00	3	24	26	17	10	12	21	4	38	13	168	3	55	0	58
09-00 to 10-00	0	27	37	25	20	0	21	6	66	15	217	3	63	0	66
10-00 to 11-00	0	16	31	15	18	0	8	5	52	16	161	2	61	0	63
11-00 to 12-00	1	23	32	20	16	0	20	7	104	12	235	2	92	0	94
12-00 to 13-00	0	25	28	12	12	1	13	4	58	41	194	4	51	0	55
13-00 to 14-00	0	22	37	19	26	1	12	6	36	11	170	5	32	1	38
14-00 to 15-00	1	34	35	19	17	1	17	3	66	17	210	4	79	0	83
15-00 to 16-00	3	32	38	26	20	2	27	5	32	26	211	3	53	0	56
16-00 to 17-00	1	36	37	27	22	6	16	3	62	19	229	1	77	0	78
17-00 to 18-00	1	49	29	22	25	0	56	13	33	25	253	9	87	0	96
18-00 to 19-00	0	37	26	22	35	0	36	5	57	30	248	2	53	0	55
19-00 to 20-00	1	28	24	19	13	4	10	5	27	15	146	5	51	0	56
20-00 to 21-00	1	19	19	12	18	3	15	9	49	20	165	2	71	0	73
21-00 to 22-00	0	17	13	11	23	1	19	3	70	25	182	1	48	0	49
22-00 to 23-00	0	10	15	8	11	0	1	1	16	13	75	0	15	0	15
23-00 to 24-00	0	8	9	7	4	1	6	5	16	13	69	0	22	0	22
00-00 to 01-00	0	1	6	6	7	0	7	5	31	17	80	0	16	0	16
01-00 to 02-00	0	1	3	7	4	0	1	4	9	11	40	0	9	0	9
02-00 to 03-00	0	0	2	5	4	0	2	4	13	9	39	0	4	0	4
03-00 to 04-00	0	6	4	4	11	0	0	4	20	11	60	0	11	0	11
04-00 to 05-00	0	4	3	2	4	2	1	3	5	6	30	0	11	0	11
05-00 to 06-00	0	10	12	4	2	9	4	1	0	9	51	0	18	0	18
06-00 to 07-00	1	93	29	4	2	5	17	1	13	17	182	7	50	0	57
07-00 to 08-00	1	86	24	28	19	15	25	4	39	28	269	24	92	0	116
Total	**14**	**608**	**519**	**341**	**343**	**63**	**355**	**110**	**912**	**419**	**3684**	**77**	**1121**	**1**	**1199**

Traffic Survey for Feasibility Study for the Construction of Dhaka Ashulia Elavated Expressway

Daily Summary Sheet
Turning Movement Mannual Count

Name of Intersection: **Chandra** Turning Movement No:-1 From: Bailpayl To: Kashimpur Date : 18.07.2016 Day: Monday

Weather: Sunny/Fair/Cloudy/Rainy Duration: 24 hrs.

Time	1	2	3	4	5	6	7	8	9	10		11	12	13	
	Large Bus/ Double Decker/ Articulated Bus	Medium Bus	Small Bus/ Micro Bus	Utility /Jeep/ Laguna /Tempo /Maxi/ Human Hauler	Car/Taxi /Station Wagan	Auto Rickshaw, CNG/ Michuk	Motor Cycle	Heavy Truck/ Trailer/ Container /Truck 3 axle	Medium Truck/ Truck Lorry/ Truck 2 axle	Small Truck/ Pickup /Small Van	Total Motorized	Bicycle	Rickshaw (Cycle)/ Rickshaw Van	Animal Cart /Push Cart	Total Non Motorized
08-00 to 09-00	6	16	58	20	55	3	24	19	24	30	255	7	8	2	17
09-00 to 10-00	16	28	15	42	60	5	34	54	47	56	357	1	8	0	9
10-00 to 11-00	12	22	26	44	65	3	10	78	33	39	332	3	8	0	11
11-00 to 12-00	2	36	21	50	75	0	43	83	40	51	401	3	17	0	20
12-00 to 13-00	3	29	13	30	62	0	34	55	51	51	328	1	1	0	2
13-00 to 14-00	8	31	17	28	56	0	21	46	42	51	300	2	0	2	4
14-00 to 15-00	1	38	4	46	66	0	17	34	38	38	282	0	12	0	12
15-00 to 16-00	0	29	19	45	75	0	32	48	60	58	366	1	0	0	1
16-00 to 17-00	1	17	11	42	85	8	32	11	48	45	300	0	21	0	21
17-00 to 18-00	1	15	28	36	65	0	25	154	48	44	416	0	22	0	22
18-00 to 19-00	4	11	30	32	35	4	34	57	33	27	267	0	16	0	16
19-00 to 20-00	4	14	14	30	55	4	31	87	56	48	343	0	31	0	31
20-00 to 21-00	3	11	18	15	38	3	37	60	53	40	278	0	13	0	13
21-00 to 22-00	8	7	17	18	15	3	11	45	32	41	197	0	15	0	15
22-00 to 23-00	3	4	3	21	8	3	11	35	30	29	147	0	8	0	8
23-00 to 24-00	3	6	6	23	6	6	20	35	45	37	187	0	21	0	21
00-00 to 01-00	10	5	0	13	27	0	0	26	50	23	154	0	0	0	0
01-00 to 02-00	10	6	2	3	2	0	0	18	33	26	100	0	0	0	0
02-00 to 03-00	4	3	4	0	2	5	7	14	31	20	90	0	9	0	9
03-00 to 04-00	2	4	6	0	0	3	13	4	53	47	132	0	21	0	21
04-00 to 05-00	0	4	5	0	5	4	35	2	37	26	118	0	46	0	46
05-00 to 06-00	0	6	12	0	28	1	41	1	34	31	154	0	41	0	41
06-00 to 07-00	0	14	14	24	32	4	22	0	48	31	189	0	32	0	32
07-00 to 08-00	0	21	20	30	35	4	15	0	47	45	217	0	13	0	13
Total	**101**	**377**	**363**	**592**	**952**	**63**	**549**	**966**	**1013**	**934**	**5910**	**18**	**363**	**4**	**385**

Traffic Survey for Feasibility Study for the Construction of Dhaka Ashulia Elavated Expressway

Daily Summary Sheet

Turning Movement Mannual Count

Name of Intersection: **Chandra** Turning Movement No:-2 From: Baipayl To:Kaliakair Date : 18.07.2016 Day: Monday

Weather: Sunny/Fair/Cloudy/Rainy Duration: 24 hrs.

Time	1	2	3	4	5	6	7	8	9	10	Total Motorized	11	12	13	Total Non Motorized
	Large Bus/ Double Decker/ Articulated Bus	Medium Bus	Small Bus/ Micro Bus	Utility /Jeep/ Laguna /Tempo /Maxi/ Human	Car/Taxi /Station Wagan	Auto Rickshaw, CNG/ Michuk	Motor Cycle	Heavy Truck/ Trailer/ Container /Truck 3 axle	Medium Truck/ Truck Lorry/ Truck 2 axle	Small Truck/ Pickup /Small Van		Bicycle	Rickshaw (Cycle)/ Rickshaw Van	Animal Cart /Push Cart	
08-00 to 09-00	59	93	30	42	11	1	15	18	59	36	364	1	29	0	30
09-00 to 10-00	55	68	15	24	13	1	26	11	33	21	267	2	16	3	21
10-00 to 11-00	97	51	15	43	15	0	8	9	17	12	267	0	13	0	13
11-00 to 12-00	79	72	20	45	22	0	10	11	27	22	308	0	14	0	14
12-00 to 13-00	115	61	14	43	29	0	16	14	33	33	358	0	10	0	10
13-00 to 14-00	142	53	43	31	29	0	8	52	32	31	421	3	14	0	17
14-00 to 15-00	107	70	15	54	36	0	6	22	53	54	417	0	10	0	10
15-00 to 16-00	93	46	17	45	32	0	6	21	31	24	315	1	8	0	9
16-00 to 17-00	84	46	14	39	22	1	7	21	27	38	299	2	9	0	11
17-00 to 18-00	106	31	8	40	19	2	7	10	18	11	252	0	8	0	8
18-00 to 19-00	83	46	12	59	29	0	9	48	34	18	338	1	7	0	8
19-00 to 20-00	90	22	11	61	17	0	3	68	28	10	310	0	7	3	10
20-00 to 21-00	82	42	4	9	4	0	4	63	35	13	256	0	3	0	3
21-00 to 22-00	22	58	4	5	3	0	2	30	45	73	242	0	3	0	3
22-00 to 23-00	19	48	2	3	2	0	4	34	44	230	386	0	2	0	2
23-00 to 24-00	19	7	1	1	2	0	2	33	36	25	126	0	2	0	2
00-00 to 01-00	7	3	1	3	2	0	0	34	14	19	83	0	2	0	2
01-00 to 02-00	7	0	1	2	1	0	1	16	14	5	47	0	0	0	0
02-00 to 03-00	7	3	0	0	3	0	0	16	15	13	57	0	0	0	0
03-00 to 04-00	11	7	1	2	1	3	0	31	24	30	110	0	0	0	0
04-00 to 05-00	12	32	1	31	10	3	2	26	20	16	153	0	2	0	2
05-00 to 06-00	27	26	2	17	12	2	2	34	25	15	162	0	3	0	3
06-00 to 07-00	35	23	6	18	38	3	1	36	26	25	211	1	1	0	2
07-00 to 08-00	71	43	7	19	40	2	2	40	53	52	329	3	1	0	4
Total	**1429**	**951**	**244**	**636**	**392**	**18**	**141**	**698**	**743**	**826**	**6078**	**14**	**164**	**6**	**184**

Traffic Survey for Feasibility Study for the Construction of Dhaka Ashulia Elavated Expressway

Daily Summary Sheet

Turning Movement Mannual Count

Name of Intersection: **Chandra** Turning Movement No:-3 From: Kashimpur To: Kaliakair Date : 18.07.2016 Day: Monday

Weather: Sunny/Fair/Cloudy/Rainy Duration: 24 hrs.

Time	1	2	3	4	5	6	7	8	9	10		11	12	13	
	Large Bus/ Double Decker/ Articulated Bus	Medium Bus	Small Bus/ Micro Bus	Utility /Jeep/ Laguna /Tempo /Maxi/ Human	Car/Taxi /Station Wagan	Auto Rickshaw, CNG/ Michuk	Motor Cycle	Heavy Truck/ Trailer/ Container /Truck 3 axle	Medium Truck/ Truck Lorry/ Truck 2 axle	Small Truck/ Pickup /Small Van	Total Motorized	Bicycle	Rickshaw (Cycle)/ Rickshaw Van	Animal Cart /Push Cart	Total Non Motorized
08-00 to 09-00	27	33	12	55	26	50	25	20	50	41	339	5	57	2	64
09-00 to 10-00	28	32	19	30	21	12	33	13	30	41	259	0	28	0	28
10-00 to 11-00	20	26	12	56	24	9	27	26	57	39	296	0	32	0	32
11-00 to 12-00	19	35	20	29	20	6	14	26	50	34	253	0	24	0	24
12-00 to 13-00	11	23	9	35	20	13	19	24	90	23	267	0	24	0	24
13-00 to 14-00	16	26	10	32	24	10	22	18	60	24	242	0	22	0	22
14-00 to 15-00	19	26	8	33	24	7	17	22	51	31	238	0	20	0	20
15-00 to 16-00	30	15	7	28	17	9	28	42	26	22	224	0	15	0	15
16-00 to 17-00	7	26	11	33	25	8	15	29	69	18	241	0	17	0	17
17-00 to 18-00	7	12	10	47	36	4	11	23	61	16	227	0	11	0	11
18-00 to 19-00	5	6	7	19	18	5	13	30	52	12	167	0	11	0	11
19-00 to 20-00	11	12	12	19	15	3	9	40	111	43	275	0	5	0	5
20-00 to 21-00	12	22	16	24	13	3	5	33	119	86	333	0	2	0	2
21-00 to 22-00	18	15	13	15	15	4	4	38	84	48	254	0	5	0	5
22-00 to 23-00	9	5	8	8	11	1	4	33	96	52	227	0	0	0	0
23-00 to 24-00	7	10	6	9	12	3	5	29	92	42	215	0	2	0	2
00-00 to 01-00	11	4	10	8	9	2	2	32	76	29	183	0	1	0	1
01-00 to 02-00	7	2	1	8	8	3	3	23	69	38	162	0	3	0	3
02-00 to 03-00	2	3	0	9	8	2	4	11	48	32	119	0	2	0	2
03-00 to 04-00	12	12	11	13	9	6	3	23	46	14	149	0	5	0	5
04-00 to 05-00	9	7	9	13	12	3	1	19	36	6	115	0	2	0	2
05-00 to 06-00	19	15	17	10	4	5	3	27	57	16	173	0	14	0	14
06-00 to 07-00	34	17	29	7	31	11	9	33	34	19	224	0	23	0	23
07-00 to 08-00	38	17	29	14	46	6	8	21	37	18	234	2	22	0	24
Total	**378**	**401**	**286**	**554**	**448**	**185**	**284**	**635**	**1501**	**744**	**5416**	**7**	**347**	**2**	**356**

Traffic Survey for Feasibility Study for the Construction of Dhaka Ashulia Elavated Expressway

Turning Movement Mannual Count

Name of Intersection: **Chandra** Turning Movement No:-4 From: Kashimpur To: Bailpayl Date : Date : 18.07.2016 Day: Monday

Weather: Sunny/Fair/Cloudy/Rainy Duration: 24 hrs.

Time	1	2	3	4	5	6	7	8	9	10	Total Motorized	11	12	13	Total Non Motorized
	Large Bus/ Double Decker/ Articulated Bus	Medium Bus	Small Bus/ Micro Bus	Utility /Jeep/ Laguna /Tempo /Maxi/ Human	Car/Taxi /Station Wagan	Auto Rickshaw, CNG/ Michuk	Motor Cycle	Heavy Truck/ Trailer/ Container /Truck 3 axle	Medium Truck/ Truck Lorry/ Truck 2 axle	Small Truck/ Pickup /Small Van		Bicycle	Rickshaw (Cycle)/ Rickshaw Van	Animal Cart /Push Cart	
08-00 to 09-00	13	23	10	13	28	1	19	9	15	37	168	8	19	0	27
09-00 to 10-00	16	22	11	16	35	0	12	20	18	22	172	1	13	2	16
10-00 to 11-00	24	32	16	10	20	0	8	21	30	32	193	0	11	1	12
11-00 to 12-00	17	28	7	10	22	0	12	26	27	28	177	0	4	1	5
12-00 to 13-00	22	22	11	6	19	0	4	24	28	22	158	1	10	1	12
13-00 to 14-00	29	34	14	11	35	0	8	32	24	34	221	0	10	1	11
14-00 to 15-00	8	36	15	6	32	10	9	10	27	36	189	0	8	1	9
15-00 to 16-00	7	33	3	7	29	1	11	6	24	33	154	0	9	0	9
16-00 to 17-00	3	38	27	6	37	1	14	6	39	38	209	0	9	0	9
17-00 to 18-00	4	39	10	6	23	2	10	5	45	21	165	4	8	2	14
18-00 to 19-00	0	28	11	2	20	1	9	3	43	23	140	0	14	0	14
19-00 to 20-00	0	29	8	3	11	0	10	7	49	17	134	1	9	0	10
20-00 to 21-00	3	25	2	2	8	0	3	9	64	33	149	0	5	0	5
21-00 to 22-00	4	20	1	1	7	0	3	8	74	19	137	0	0	0	0
22-00 to 23-00	4	20	3	3	6	0	1	12	74	16	139	0	0	0	0
23-00 to 24-00	0	0	9	3	5	1	2	4	29	13	66	0	0	0	0
00-00 to 01-00	4	0	7	1	3	0	1	8	16	27	67	0	0	0	0
01-00 to 02-00	0	15	3	2	8	0	2	5	31	21	87	0	0	0	0
02-00 to 03-00	2	16	2	2	13	0	3	11	24	19	92	1	1	0	2
03-00 to 04-00	0	21	13	8	7	2	4	12	24	14	105	0	7	0	7
04-00 to 05-00	1	35	25	4	8	1	1	9	27	15	126	0	5	0	5
05-00 to 06-00	0	21	26	8	9	0	0	12	10	8	94	1	2	0	3
06-00 to 07-00	0	20	23	12	18	3	5	11	10	15	117	0	15	0	15
07-00 to 08-00	0	33	26	15	23	4	7	13	17	17	155	0	26	0	26
Total	**161**	**590**	**283**	**157**	**426**	**27**	**158**	**283**	**769**	**560**	**3414**	**17**	**185**	**9**	**211**

Traffic Survey for Feasibility Study for the Construction of Dhaka Ashulia Elavated Expressway

Daily Summary Sheet

Turning Movement Mannual Count

Name of Intersection: **Chandra** Turning Movement No:-5 From: Kaliakair To: Bailpayl Date : 18.07.2016 Day: Monday

Weather: Sunny/Fair/Cloudy/Rainy Duration: 24 hrs.

Time	1	2	3	4	5	6	7	8	9	10	Total Motorized	11	12	13	Total Non Motorized
	Large Bus/ Double Decker/ Articulated Bus	Medium Bus	Small Bus/ Micro Bus	Utility /Jeep/ Laguna /Tempo /Maxi/ Human	Car/Taxi /Station Wagan	Auto Rickshaw, CNG/ Michuk	Motor Cycle	Heavy Truck/ Trailer/ Container /Truck 3 axle	Medium Truck/ Truck Lorry/ Truck 2 axle	Small Truck/ Pickup /Small Van		Bicycle	Rickshaw (Cycle)/ Rickshaw Van	Animal Cart /Push Cart	
08-00 to 09-00	52	27	30	27	78	0	15	13	42	32	316	1	12	1	14
09-00 to 10-00	47	24	20	30	39	0	14	9	35	21	239	0	13	0	13
10-00 to 11-00	43	21	28	17	38	1	19	7	33	16	223	2	10	0	12
11-00 to 12-00	71	20	14	24	33	0	11	6	22	23	224	2	9	0	11
12-00 to 13-00	104	21	18	18	47	0	11	6	36	23	284	0	6	0	6
13-00 to 14-00	115	22	22	31	73	0	15	3	38	39	358	0	10	0	10
14-00 to 15-00	96	33	24	28	94	0	17	12	35	42	381	0	9	0	9
15-00 to 16-00	110	39	18	30	65	2	13	15	49	24	365	0	8	0	8
16-00 to 17-00	77	32	25	31	70	1	12	5	59	31	343	1	6	0	7
17-00 to 18-00	59	39	23	29	69	0	9	10	117	28	383	0	13	1	14
18-00 to 19-00	33	23	30	19	26	0	7	78	32	29	277	4	3	0	7
19-00 to 20-00	62	14	43	35	23	0	6	91	20	30	324	5	4	0	9
20-00 to 21-00	34	22	23	34	25	0	5	61	26	27	257	10	4	0	14
21-00 to 22-00	20	22	3	27	16	0	4	28	36	30	186	4	1	0	5
22-00 to 23-00	3	20	7	12	9	0	4	21	22	22	120	4	1	0	5
23-00 to 24-00	4	17	9	12	3	0	1	22	25	12	105	2	1	0	3
00-00 to 01-00	3	14	3	6	6	0	1	37	15	11	96	0	0	1	1
01-00 to 02-00	15	5	1	7	5	0	2	33	11	5	84	0	1	0	1
02-00 to 03-00	9	19	11	7	5	0	0	11	29	12	103	0	0	0	0
03-00 to 04-00	16	5	19	15	7	0	4	16	10	6	98	4	2	0	6
04-00 to 05-00	22	27	14	14	7	0	10	17	22	14	147	0	3	0	3
05-00 to 06-00	29	55	13	10	8	0	12	20	33	48	228	1	5	0	6
06-00 to 07-00	27	36	15	12	6	0	10	18	24	30	178	0	6	0	6
07-00 to 08-00	61	35	31	13	12	0	10	30	33	26	251	3	7	0	10
Total	**1112**	**592**	**444**	**488**	**764**	**4**	**212**	**569**	**804**	**581**	**5570**	**43**	**134**	**3**	**180**

Traffic Survey for Feasibility Study for the Construction of Dhaka Ashulia Elavated Expressway

Daily Summary Sheet

Turning Movement Mannual Count

Name of Intersection: **Chandra** Turning Movement No:-6 From: Kaliakair To: Kashimpur Date : 18.07.2016 Day: Monday

Weather: Sunny/Fair/Cloudy/Rainy Duration: 24 hrs.

Time	1	2	3	4	5	6	7	8	9	10		11	12	13	
	Large Bus/ Double Decker/ Articulated Bus	Medium Bus	Small Bus/ Micro Bus	Utility /Jeep/ Laguna /Tempo /Maxi/ Human	Car/Taxi /Station Wagan	Auto Rickshaw, CNG/ Michuk	Motor Cycle	Heavy Truck/ Trailer/ Container /Truck 3 axle	Medium Truck/ Truck Lorry/ Truck 2 axle	Small Truck/ Pickup /Small Van	Total Motorized	Bicycle	Rickshaw (Cycle)/ Rickshaw Van	Animal Cart /Push Cart	Total Non Motorized
08-00 to 09-00	8	20	5	55	38	5	23	36	79	33	302	3	29	0	32
09-00 to 10-00	15	10	8	52	24	1	51	29	48	25	263	2	37	0	39
10-00 to 11-00	6	8	5	52	15	3	36	29	68	20	242	11	28	0	39
11-00 to 12-00	10	11	9	44	21	1	34	18	55	17	220	9	24	0	33
12-00 to 13-00	6	13	7	39	23	0	28	11	38	27	192	2	39	0	41
13-00 to 14-00	8	11	3	49	21	6	33	19	43	33	226	3	31	0	34
14-00 to 15-00	11	16	6	70	23	6	35	22	50	23	262	2	39	0	41
15-00 to 16-00	7	20	4	46	27	2	48	17	68	34	273	5	31	0	36
16-00 to 17-00	9	19	7	41	29	4	28	17	86	31	271	8	32	0	40
17-00 to 18-00	7	8	7	41	19	8	19	18	123	13	263	17	31	0	48
18-00 to 19-00	83	20	42	27	17	117	79	131	89	32	637	6	77	0	83
19-00 to 20-00	75	16	28	13	10	47	31	124	102	49	495	3	30	0	33
20-00 to 21-00	94	12	27	13	5	45	19	142	111	53	521	0	14	0	14
21-00 to 22-00	67	2	9	10	1	31	5	87	85	41	338	0	3	0	3
22-00 to 23-00	80	3	8	9	1	8	4	82	23	13	231	0	4	0	4
23-00 to 24-00	33	3	4	5	0	6	3	40	27	30	151	0	5	0	5
00-00 to 01-00	34	1	5	4	1	0	0	45	22	14	126	0	0	0	0
01-00 to 02-00	10	7	2	4	0	0	0	18	41	26	108	0	0	0	0
02-00 to 03-00	6	5	7	6	6	9	4	41	54	29	167	0	5	0	5
03-00 to 04-00	8	12	14	7	7	18	15	98	21	21	221	5	10	0	15
04-00 to 05-00	16	16	13	9	8	36	9	53	26	18	204	0	31	0	31
05-00 to 06-00	5	20	16	5	5	20	11	67	31	28	208	0	48	0	48
06-00 to 07-00	18	10	20	11	11	13	17	13	20	21	154	0	41	0	41
07-00 to 08-00	18	8	16	11	13	9	28	19	10	20	152	3	50	0	53
Total	**634**	**271**	**272**	**623**	**325**	**395**	**560**	**1176**	**1320**	**651**	**6227**	**79**	**639**	**0**	**718**

Traffic Survey for Feasibility Study for the Construction of Dhaka Ashulia Elavated Expressway

Daily Summary Sheet

U Turn Movement Mannual Count

Name of Intersection: Chandra Turning Movement No:-1 From: Bailpayl To: Bailpayl Date: 18.07.2016 Day: Monday

Weather: Sunny/Fair/Cloudy/Rainy Duration: 24 hrs.

Time	1	2	3	4	5	6	7	8	9	10		11	12	13	
	Large Bus/ Double Decker/ Articulated Bus	Medium Bus	Small Bus/ Micro Bus	Utility /Jeep/ Laguna /Tempo /Maxi/ Human Hauler	Car/Taxi /Station Wagan	Auto Rickshaw, CNG/ Michuk	Motor Cycle	Heavy Truck/ Trailer/ Container /Truck 3 axle	Medium Truck/ Truck Lorry/ Truck 2 axle	Small Truck/ Pickup /Small Van	Total Motorized	Bicycle	Rickshaw (Cycle)/ Rickshaw Van	Animal Cart /Push Cart	Total Non Motorized
08-00 to 09-00	0	0	5	8	2	6	2	0	2	5	30	0	53	0	53
09-00 to 10-00	0	0	13	0	16	0	19	0	0	2	50	8	75	0	83
10-00 to 11-00	0	0	8	0	12	3	18	0	1	2	44	5	73	0	78
11-00 to 12-00	0	0	6	9	17	3	14	0	0	19	68	8	79	0	87
12-00 to 13-00	0	1	5	2	20	1	9	0	1	2	41	2	63	0	65
13-00 to 14-00	0	0	1	3	12	0	9	0	0	3	28	5	41	0	46
14-00 to 15-00	0	0	4	3	4	4	8	0	1	7	31	4	41	0	45
15-00 to 16-00	0	0	1	3	2	1	7	0	0	1	15	0	38	0	38
16-00 to 17-00	0	1	6	1	10	0	10	0	0	2	30	1	52	0	53
17-00 to 18-00	0	0	2	1	4	0	5	0	0	2	14	3	50	0	53
18-00 to 19-00	0	0	4	0	3	0	6	0	0	4	17	1	50	0	51
19-00 to 20-00	0	2	3	2	7	0	4	0	0	11	29	0	48	0	48
20-00 to 21-00	0	5	11	3	5	0	3	0	2	6	35	2	33	0	35
21-00 to 22-00	0	4	4	4	2	0	4	0	0	4	22	0	33	0	33
22-00 to 23-00	0	3	3	0	3	0	3	0	0	5	17	0	29	0	29
23-00 to 24-00	0	2	1	2	2	0	2	0	1	3	13	0	19	0	19
00-00 to 01-00	0	1	1	2	1	0	1	0	0	0	6	0	14	0	14
01-00 to 02-00	0	1	1	0	0	0	0	0	1	1	4	0	1	0	1
02-00 to 03-00	0	0	0	2	0	0	0	0	1	1	4	0	0	0	0
03-00 to 04-00	0	1	1	0	1	0	0	0	0	2	5	0	8	0	8
04-00 to 05-00	0	0	1	2	1	0	0	0	1	1	6	0	27	0	27
05-00 to 06-00	0	0	1	0	1	1	0	1	0	1	5	0	26	0	26
06-00 to 07-00	0	0	1	0	2	0	10	0	0	2	15	0	43	0	43
07-00 to 08-00	0	0	2	0	2	0	3	0	0	2	9	0	44	0	44
Total	**0**	**21**	**85**	**47**	**129**	**19**	**137**	**1**	**11**	**88**	**538**	**39**	**940**	**0**	**979**
PCU Value	3.00	3.00	3.00	1.00	1.00	0.75	0.75	3.00	3.00	3.00					
Total PCU	-	63	255	47	129	14	103	3	33	264	911				

Traffic Survey for Feasibility Study for the Construction of Dhaka Ashulia Elavated Expressway

Daily Summary Sheet

U Turn Movement Mannual Count

Name of Intersection: Chandra Turning Movement No:-4 From: Kashimpur To: Kashimpur Date: 18.07.2016 Day: Monday

Weather: Sunny/Fair/Cloudy/Rainy Duration: 24 hrs.

Time	1	2	3	4	5	6	7	8	9	10		11	12	13	
	Large Bus/ Double Decker/ Articulated Bus	Medium Bus	Small Bus/ Micro Bus	Utility /Jeep/ Laguna /Tempo /Maxi/ Human	Car/Taxi /Station Wagan	Auto Rickshaw, CNG/ Michuk	Motor Cycle	Heavy Truck/ Trailer/ Container /Truck 3 axle	Medium Truck/ Truck Lorry/ Truck 2 axle	Small Truck/ Pickup /Small Van	Total Motorized	Bicycle	Rickshaw (Cycle)/ Rickshaw Van	Animal Cart /Push Cart	Total Non Motorized
08-00 to 09-00	0	0	0	1	1	0	0	0	0	0	2	0	1	0	1
09-00 to 10-00	0	0	0	7	2	0	0	0	0	1	10	0	3	0	3
10-00 to 11-00	0	1	0	2	1	0	1	0	0	0	5	0	3	0	3
11-00 to 12-00	0	0	0	0	4	0	1	0	0	0	5	0	1	0	1
12-00 to 13-00	0	0	0	1	0	0	1	0	0	0	2	0	3	0	3
13-00 to 14-00	0	0	0	2	1	0	0	0	0	0	3	0	2	0	2
14-00 to 15-00	0	0	0	11	0	1	1	0	0	0	13	0	2	0	2
15-00 to 16-00	0	1	0	8	1	0	0	0	0	0	10	0	1	0	1
16-00 to 17-00	0	1	1	7	0	1	0	0	0	0	10	0	4	0	4
17-00 to 18-00	0	0	0	4	0	0	1	0	0	0	5	1	6	0	7
18-00 to 19-00	0	0	0	0	0	0	1	0	0	0	1	0	1	1	2
19-00 to 20-00	0	0	0	4	0	1	0	0	0	1	6	0	2	0	2
20-00 to 21-00	0	0	1	4	0	0	0	0	0	0	5	1	0	1	2
21-00 to 22-00	0	0	0	1	2	0	0	0	0	0	3	1	1	0	2
22-00 to 23-00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
23-00 to 24-00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
00-00 to 01-00	0	0	0	1	0	0	0	0	0	0	1	0	0	0	0
01-00 to 02-00	0	0	0	0	0	0	0	0	0	1	1	0	1	0	1
02-00 to 03-00	0	0	0	3	0	0	0	0	0	0	3	1	0	0	1
03-00 to 04-00	0	0	0	2	0	0	0	0	0	1	3	0	1	0	1
04-00 to 05-00	0	0	1	5	0	1	0	0	0	1	8	1	2	0	3
05-00 to 06-00	0	0	0	3	1	0	0	0	0	0	4	0	1	0	1
06-00 to 07-00	0	0	0	7	2	0	1	1	1	1	13	1	2	0	3
07-00 to 08-00	0	0	0	3	1	0	0	0	0	1	5	1	0	0	1
Total	**0**	**3**	**3**	**76**	**16**	**4**	**7**	**1**	**1**	**7**	**118**	**7**	**37**	**2**	**46**
PCU Value	3.00	3.00	3.00	1.00	1.00	0.75	0.75	3.00	3.00	3.00					
Total PCU	-	9	9	76	16	3	5	3	3	21	145				

Traffic Survey for Feasibility Study for the Construction of Dhaka Ashulia Elavated Expressway

Daily Summary Sheet
Turning Movement Mannual Count

Name of Intersection: **Chandra** Turning Movement No:-1 From: Baipayl To: Kashimpur Date 22.07.2016 Day: Friday

Weather: Sunny/Fair/Cloudy/Rainy Duration: 24 hrs.

Time	1	2	3	4	5	6	7	8	9	10	Total Motorized	11	12	13	Total Non Motorized
	Large Bus/ Double Decker/ Articulated Bus	Medium Bus	Small Bus/ Micro Bus	Utility /Jeep/ Laguna /Tempo /Maxi/ Human Hauler	Car/Taxi /Station Wagan	Auto Rickshaw, CNG/ Michuk	Motor Cycle	Heavy Truck/ Trailer/ Container /Truck 3 axle	Medium Truck/ Truck Lorry/ Truck 2 axle	Small Truck/ Pickup /Small Van		Bicycle	Rickshaw (Cycle)/ Rickshaw Van	Animal Cart /Push Cart	
08-00 to 09-00	0	23	11	28	26	7	37	6	7	7	152	12	25	0	37
09-00 to 10-00	0	34	16	27	30	0	32	18	21	22	200	0	0	0	0
10-00 to 11-00	0	41	20	26	24	0	18	21	30	27	207	0	8	0	8
11-00 to 12-00	0	44	12	23	25	0	21	23	32	17	197	5	12	0	17
12-00 to 13-00	0	38	21	15	14	0	9	19	35	15	166	5	9	0	14
13-00 to 14-00	0	32	23	20	12	0	20	17	25	20	169	7	19	0	26
14-00 to 15-00	0	34	27	21	29	0	22	12	23	27	195	0	26	0	26
15-00 to 16-00	0	34	19	26	29	0	18	14	24	29	193	0	23	0	23
16-00 to 17-00	0	30	17	13	20	2	24	14	17	15	152	1	13	0	14
17-00 to 18-00	1	40	16	12	24	0	17	19	26	21	176	0	21	0	21
18-00 to 19-00	0	40	15	18	31	0	16	12	20	22	174	15	26	0	41
19-00 to 20-00	0	37	18	38	60	0	15	12	18	22	220	0	13	0	13
20-00 to 21-00	0	23	14	8	25	0	33	14	18	13	148	0	0	0	0
21-00 to 22-00	0	20	10	14	29	0	28	21	26	16	164	0	0	0	0
22-00 to 23-00	0	22	7	14	13	0	18	7	26	10	117	0	0	0	0
23-00 to 24-00	0	14	4	3	12	0	6	15	24	19	97	0	0	0	0
00-00 to 01-00	0	21	3	9	11	0	5	18	27	12	106	0	0	0	0
01-00 to 02-00	0	8	2	1	4	0	0	15	18	3	51	0	0	0	0
02-00 to 03-00	0	3	0	0	6	0	4	18	12	0	43	0	0	0	0
03-00 to 04-00	0	1	0	0	7	0	5	16	23	3	55	0	0	0	0
04-00 to 05-00	0	2	0	7	6	0	7	13	22	2	59	0	0	0	0
05-00 to 06-00	0	2	0	4	7	0	20	19	22	4	78	0	0	0	0
06-00 to 07-00	0	10	6	21	32	18	18	22	19	12	158	0	15	0	15
07-00 to 08-00	0	29	11	20	15	2	23	12	22	11	145	0	30	0	30
Total	**1**	**582**	**272**	**368**	**491**	**29**	**416**	**377**	**537**	**349**	**3422**	**45**	**240**	**0**	**285**

Traffic Survey for Feasibility Study for the Construction of Dhaka Ashulia Elavated Expressway

Daily Summary Sheet

Turning Movement Mannual Count

Name of Intersection: **Chandra** Turning Movement No:-2 From: Baipayl To:Kaliakair Date 22.07.2016 Day: Friday

Weather: Sunny/Fair/Cloudy/Rainy Duration: 24 hrs.

Time	1	2	3	4	5	6	7	8	9	10	Total Motorized	11	12	13	Total Non Motorized
	Large Bus/ Double Decker/ Articulated Bus	Medium Bus	Small Bus/ Micro Bus	Utility /Jeep/ Laguna /Tempo /Maxi/ Human	Car/Taxi /Station Wagan	Auto Rickshaw, CNG/ Michuk	Motor Cycle	Heavy Truck/ Trailer/ Container /Truck 3 axle	Medium Truck/ Truck Lorry/ Truck 2 axle	Small Truck/ Pickup /Small Van		Bicycle	Rickshaw (Cycle)/ Rickshaw Van	Animal Cart /Push Cart	
08-00 to 09-00	42	39	18	31	55	16	35	16	12	20	284	3	7	0	10
09-00 to 10-00	130	64	29	12	56	0	11	55	63	80	500	0	5	0	5
10-00 to 11-00	60	47	14	37	56	0	14	53	41	50	372	0	15	0	15
11-00 to 12-00	99	36	26	17	34	7	25	30	28	28	330	0	5	0	5
12-00 to 13-00	107	52	22	13	51	0	22	28	15	11	321	1	2	0	3
13-00 to 14-00	78	41	21	20	50	10	27	17	22	17	303	0	1	0	1
14-00 to 15-00	44	25	9	7	49	1	22	4	21	22	204	0	0	0	0
15-00 to 16-00	72	38	26	9	35	6	28	20	23	24	281	0	0	0	0
16-00 to 17-00	77	19	15	4	38	0	20	25	18	16	232	1	2	0	3
17-00 to 18-00	80	41	16	4	30	1	23	36	31	24	286	0	2	0	2
18-00 to 19-00	82	36	29	1	19	1	10	41	21	28	268	1	0	0	1
19-00 to 20-00	99	25	31	1	31	1	13	43	35	23	302	0	0	0	0
20-00 to 21-00	107	56	15	0	22	2	2	68	39	25	336	0	3	0	3
21-00 to 22-00	92	55	21	0	9	0	2	65	33	6	283	0	0	0	0
22-00 to 23-00	102	60	11	0	4	0	4	61	24	16	282	0	0	0	0
23-00 to 24-00	66	9	11	1	3	0	1	50	17	6	164	0	0	0	0
00-00 to 01-00	67	2	17	0	3	0	2	41	16	11	159	0	0	0	0
01-00 to 02-00	41	0	8	0	1	0	2	39	24	14	129	0	0	0	0
02-00 to 03-00	38	0	7	0	5	0	0	35	27	24	136	0	0	0	0
03-00 to 04-00	31	0	0	1	3	0	1	29	33	23	121	0	0	0	0
04-00 to 05-00	21	0	0	0	4	0	0	30	24	20	99	0	1	0	1
05-00 to 06-00	20	9	0	0	3	1	0	27	35	27	122	0	0	0	0
06-00 to 07-00	22	8	8	9	11	3	4	15	7	10	97	0	1	0	1
07-00 to 08-00	22	16	5	26	38	0	5	11	15	14	152	1	4	0	5
Total	**1599**	**678**	**359**	**193**	**610**	**49**	**273**	**839**	**624**	**539**	**5763**	**7**	**48**	**0**	**55**

Traffic Survey for Feasibility Study for the Construction of Dhaka Ashulia Elavated Expressway

Daily Summary Sheet

Turning Movement Mannual Count

Name of Intersection: **Chandra** Turning Movement No:-3 From: Kashimpur To: Kaliakair Date 22.07.2016 Day: Friday

Weather: Sunny/Fair/Cloudy/Rainy Duration: 24 hrs.

Time	1	2	3	4	5	6	7	8	9	10		11	12	13	
	Large Bus/ Double Decker/ Articulated Bus	Medium Bus	Small Bus/ Micro Bus	Utility /Jeep/ Laguna /Tempo /Maxi/ Human	Car/Taxi /Station Wagan	Auto Rickshaw, CNG/ Michuk	Motor Cycle	Heavy Truck/ Trailer/ Container /Truck 3 axle	Medium Truck/ Truck Lorry/ Truck 2 axle	Small Truck/ Pickup /Small Van	Total Motorized	Bicycle	Rickshaw (Cycle)/ Rickshaw Van	Animal Cart /Push Cart	Total Non Motorized
08-00 to 09-00	6	19	12	19	12	5	6	20	24	17	140	2	5	0	7
09-00 to 10-00	23	30	23	21	23	19	27	37	37	26	266	1	23	0	24
10-00 to 11-00	34	23	22	17	20	18	23	40	38	21	256	0	16	0	16
11-00 to 12-00	26	25	19	23	19	16	21	39	54	31	273	0	13	0	13
12-00 to 13-00	20	13	8	21	22	25	18	42	30	19	218	0	16	0	16
13-00 to 14-00	15	17	24	22	20	17	17	41	55	27	255	0	12	0	12
14-00 to 15-00	13	17	18	18	12	18	22	37	57	44	256	0	14	0	14
15-00 to 16-00	9	18	18	18	17	12	22	39	57	37	247	0	20	0	20
16-00 to 17-00	6	26	14	20	20	17	27	31	39	22	222	0	27	0	27
17-00 to 18-00	12	26	6	31	12	11	16	36	67	15	232	0	16	0	16
18-00 to 19-00	6	34	2	32	13	14	24	19	82	9	235	0	22	0	22
19-00 to 20-00	15	19	5	23	24	16	20	25	65	16	228	0	15	0	15
20-00 to 21-00	14	21	15	22	12	27	16	33	55	12	227	0	16	0	16
21-00 to 22-00	10	31	11	16	17	15	16	27	67	23	233	0	10	0	10
22-00 to 23-00	14	28	9	18	9	20	14	35	65	24	236	0	17	0	17
23-00 to 24-00	4	23	9	14	11	19	16	37	60	22	215	0	12	0	12
00-00 to 01-00	3	29	7	19	13	25	16	35	56	11	214	0	12	0	12
01-00 to 02-00	6	16	0	0	7	5	5	34	68	17	158	0	11	0	11
02-00 to 03-00	3	0	0	0	6	0	0	32	55	13	109	0	20	0	20
03-00 to 04-00	6	0	0	0	8	0	2	41	58	10	125	0	11	0	11
04-00 to 05-00	6	0	0	0	5	0	0	48	47	7	113	0	12	0	12
05-00 to 06-00	1	2	5	5	2	0	3	31	34	11	94	1	12	0	13
06-00 to 07-00	1	22	3	25	6	12	19	14	39	7	148	12	11	0	23
07-00 to 08-00	1	11	5	29	7	17	16	22	53	14	175	6	12	0	18
Total	**254**	**450**	**235**	**413**	**317**	**328**	**366**	**795**	**1262**	**455**	**4875**	**22**	**355**	**0**	**377**

Traffic Survey for Feasibility Study for the Construction of Dhaka Ashulia Elavated Expressway

Turning Movement Mannual Count

Name of Intersection: **Chandra** Turning Movement No:-4 From: Kashimpur To: Baipayl Date : 22.07.2016 Day: Friday

Weather: Sunny/Fair/Cloudy/Rainy Duration: 24 hrs.

Time	1	2	3	4	5	6	7	8	9	10	Total Motorized	11	12	13	Total Non Motorized
	Large Bus/ Double Decker/ Articulated Bus	Medium Bus	Small Bus/ Micro Bus	Utility /Jeep/ Laguna /Tempo /Maxi/ Human	Car/Taxi /Station Wagan	Auto Rickshaw, CNG/ Michuk	Motor Cycle	Heavy Truck/ Trailer/ Container /Truck 3 axle	Medium Truck/ Truck Lorry/ Truck 2 axle	Small Truck/ Pickup /Small Van		Bicycle	Rickshaw (Cycle)/ Rickshaw Van	Animal Cart /Push Cart	
08-00 to 09-00	1	3	13	16	5	10	8	7	0	8	71	1	11	0	12
09-00 to 10-00	2	15	15	32	11	12	10	13	3	9	122	4	10	0	14
10-00 to 11-00	1	5	16	21	13	11	13	9	3	14	106	7	19	0	26
11-00 to 12-00	0	15	16	12	16	13	8	17	2	17	116	1	13	0	14
12-00 to 13-00	0	4	19	13	10	9	4	15	0	15	89	2	15	0	17
13-00 to 14-00	0	7	16	8	11	11	5	15	8	15	96	3	13	0	16
14-00 to 15-00	0	14	15	14	10	14	3	8	5	15	98	3	10	0	13
15-00 to 16-00	0	17	15	25	15	13	10	13	3	13	124	8	21	0	29
16-00 to 17-00	0	7	15	16	19	11	10	7	3	20	108	2	11	0	13
17-00 to 18-00	0	6	18	23	22	15	11	10	0	20	125	11	16	0	27
18-00 to 19-00	0	7	12	22	29	19	15	9	3	15	131	2	21	0	23
19-00 to 20-00	0	5	7	23	23	13	7	4	0	10	92	5	25	0	30
20-00 to 21-00	0	14	11	17	17	15	9	5	4	9	101	2	14	0	16
21-00 to 22-00	0	13	16	16	23	17	6	9	9	13	122	2	13	0	15
22-00 to 23-00	0	9	8	22	13	12	8	16	6	18	112	0	3	0	3
23-00 to 24-00	0	5	9	16	17	10	3	11	12	8	91	0	12	0	12
00-00 to 01-00	0	4	10	18	18	19	5	12	12	5	103	1	14	0	15
01-00 to 02-00	0	5	3	15	13	10	1	10	7	4	68	0	17	0	17
02-00 to 03-00	0	3	4	0	17	11	2	4	8	3	52	0	14	0	14
03-00 to 04-00	0	2	3	2	15	12	2	8	7	4	55	0	15	0	15
04-00 to 05-00	0	2	2	0	0	12	1	13	6	4	40	3	8	0	11
05-00 to 06-00	0	2	2	18	11	16	4	9	3	4	69	11	15	0	26
06-00 to 07-00	0	7	6	16	9	12	7	4	1	4	66	8	17	0	25
07-00 to 08-00	0	9	16	19	19	19	13	6	2	8	111	5	20	0	25
Total	**4**	**180**	**267**	**384**	**356**	**316**	**165**	**234**	**107**	**255**	**2268**	**81**	**347**	**0**	**428**

Traffic Survey for Feasibility Study for the Construction of Dhaka Ashulia Elavated Expressway

Daily Summary Sheet

Turning Movement Mannual Count

Name of Intersection: **Chandra** Turning Movement No:-5 From: Kaliakair To: Baipayl Date : 22.07.2016 Day: Friday

Weather: Sunny/Fair/Cloudy/Rainy Duration: 24 hrs.

Time	1	2	3	4	5	6	7	8	9	10	Total Motorized	11	12	13	Total Non Motorized
	Large Bus/ Double Decker/ Articulated Bus	Medium Bus	Small Bus/ Micro Bus	Utility /Jeep/ Laguna /Tempo /Maxi/ Human	Car/Taxi /Station Wagan	Auto Rickshaw, CNG/ Michuk	Motor Cycle	Heavy Truck/ Trailer/ Container /Truck 3 axle	Medium Truck/ Truck Lorry/ Truck 2 axle	Small Truck/ Pickup /Small Van		Bicycle	Rickshaw (Cycle)/ Rickshaw Van	Animal Cart /Push Cart	
08-00 to 09-00	48	23	23	8	21	7	18	22	22	26	218	0	5	0	5
09-00 to 10-00	61	33	18	14	42	0	7	29	18	35	257	0	2	0	2
10-00 to 11-00	41	35	31	15	37	4	10	42	16	28	259	0	2	0	2
11-00 to 12-00	44	23	33	10	39	4	11	21	14	25	224	1	3	0	4
12-00 to 13-00	64	29	16	7	22	3	6	25	12	15	199	0	3	0	3
13-00 to 14-00	70	16	19	5	24	2	7	27	16	15	201	0	3	0	3
14-00 to 15-00	53	32	22	5	26	1	4	24	19	34	220	0	1	0	1
15-00 to 16-00	159	26	23	13	34	1	14	23	23	24	340	0	2	0	2
16-00 to 17-00	175	28	24	17	33	2	12	34	25	20	370	0	0	0	0
17-00 to 18-00	86	47	24	27	40	4	11	35	16	24	314	0	1	0	1
18-00 to 19-00	69	50	25	36	60	2	8	34	44	20	348	0	0	0	0
19-00 to 20-00	39	36	15	31	46	1	12	57	43	19	299	0	2	0	2
20-00 to 21-00	20	14	16	20	47	1	8	35	38	16	215	0	1	0	1
21-00 to 22-00	29	20	17	23	45	3	5	60	64	39	305	0	0	0	0
22-00 to 23-00	57	14	19	35	46	0	6	55	50	31	313	0	1	0	1
23-00 to 24-00	27	22	20	16	36	2	2	60	60	47	292	0	0	0	0
00-00 to 01-00	39	21	28	7	11	2	1	50	55	35	249	0	0	0	0
01-00 to 02-00	64	24	21	4	12	2	2	40	42	28	239	0	0	0	0
02-00 to 03-00	63	13	19	0	2	1	2	67	84	23	274	0	0	0	0
03-00 to 04-00	53	16	21	0	3	0	0	73	74	23	263	0	0	0	0
04-00 to 05-00	58	25	22	0	1	0	2	57	69	23	257	0	1	0	1
05-00 to 06-00	53	30	19	0	6	3	7	63	56	26	263	0	6	0	6
06-00 to 07-00	112	23	24	9	18	8	10	56	45	53	358	0	3	0	3
07-00 to 08-00	110	49	43	32	54	2	16	39	54	50	449	0	6	0	6
Total	**1594**	**649**	**542**	**334**	**705**	**55**	**181**	**1028**	**959**	**679**	**6726**	**1**	**42**	**0**	**43**

Traffic Survey for Feasibility Study for the Construction of Dhaka Ashulia Elavated Expressway

Daily Summary Sheet

Turning Movement Mannual Count

Name of Intersection: **Chandra** Turning Movement No:-6 From: Kaliakair To: Kashimpur Date : 22.07.2016 Day: Friday

Weather: Sunny/Fair/Cloudy/Rainy Duration: 24 hrs.

Time	1	2	3	4	5	6	7	8	9	10	Total Motorized	11	12	13	Total Non Motorized
	Large Bus/ Double Decker/ Articulated Bus	Medium Bus	Small Bus/ Micro Bus	Utility /Jeep/ Laguna /Tempo /Maxi/ Human	Car/Taxi /Station Wagan	Auto Rickshaw, CNG/ Michuk	Motor Cycle	Heavy Truck/ Trailer/ Container /Truck 3 axle	Medium Truck/ Truck Lorry/ Truck 2 axle	Small Truck/ Pickup /Small Van		Bicycle	Rickshaw (Cycle)/ Rickshaw Van	Animal Cart /Push Cart	
08-00 to 09-00	30	31	16	15	20	16	16	36	45	20	245	8	16	0	24
09-00 to 10-00	23	36	26	26	15	41	26	61	50	40	344	9	22	0	31
10-00 to 11-00	20	29	27	20	14	18	16	49	29	28	250	5	10	0	15
11-00 to 12-00	57	27	23	23	22	36	26	43	36	27	320	9	8	0	17
12-00 to 13-00	63	27	25	27	26	21	31	42	31	24	317	9	20	1	30
13-00 to 14-00	40	18	20	14	13	17	16	33	39	23	233	6	9	0	15
14-00 to 15-00	11	28	26	11	18	27	23	38	46	24	252	7	13	0	20
15-00 to 16-00	21	22	29	15	15	21	18	54	33	19	247	6	20	0	26
16-00 to 17-00	42	39	36	17	22	25	21	49	52	56	359	7	10	0	17
17-00 to 18-00	27	26	30	25	26	25	34	48	59	34	334	17	19	0	36
18-00 to 19-00	17	37	27	14	29	17	21	48	56	39	305	7	16	0	23
19-00 to 20-00	32	25	32	15	31	22	25	59	49	34	324	4	8	0	12
20-00 to 21-00	25	25	14	13	18	15	12	57	36	35	250	3	18	0	21
21-00 to 22-00	30	19	18	18	20	23	20	61	37	24	270	4	7	0	11
22-00 to 23-00	15	17	18	20	19	24	21	67	33	26	260	0	11	0	11
23-00 to 24-00	19	32	9	0	0	10	4	50	30	19	173	0	9	0	9
00-00 to 01-00	46	25	28	29	9	27	4	73	55	29	325	3	9	0	12
01-00 to 02-00	24	7	19	17	10	2	2	45	42	23	191	0	2	0	2
02-00 to 03-00	9	3	8	7	5	3	4	25	24	12	100	0	1	0	1
03-00 to 04-00	6	3	7	5	5	3	6	45	41	17	138	0	0	0	0
04-00 to 05-00	25	16	14	16	14	7	10	43	38	17	200	5	4	0	9
05-00 to 06-00	19	24	18	21	15	13	11	46	39	25	231	5	8	0	13
06-00 to 07-00	65	28	45	22	18	24	21	56	45	27	351	6	18	0	24
07-00 to 08-00	35	25	35	18	18	19	15	41	38	28	272	4	14	0	18
Total	**701**	**569**	**550**	**408**	**402**	**456**	**403**	**1169**	**983**	**650**	**6291**	**124**	**272**	**1**	**397**

Traffic Survey for Feasibility Study for the Construction of Dhaka Ashulia Elavated Expressway

Daily Summary Sheet

U Turn Movement Mannual Count

Name of Intersection: Chandra Turning Movement No:-1 From: Baipayl To: Baipayl Dated 2.07.2016 Day: Friday

Weather: Sunny/Fair/Cloudy/Rainy Duration: 24 hrs.

Time	1	2	3	4	5	6	7	8	9	10		11	12	13	
	Large Bus/ Double Decker/ Articulated Bus	Medium Bus	Small Bus/ Micro Bus	Utility /Jeep/ Laguna /Tempo /Maxi/ Human Hauler	Car/Taxi /Station Wagan	Auto Rickshaw, CNG/ Michuk	Motor Cycle	Heavy Truck/ Trailer/ Container /Truck 3 axle	Medium Truck/ Truck Lorry/ Truck 2 axle	Small Truck/ Pickup /Small Van	Total Motorized	Bicycle	Rickshaw (Cycle)/ Rickshaw Van	Animal Cart /Push Cart	Total Non Motorized
08-00 to 09-00	0	0	3	0	4	16	4	0	0	0	27	1	12	0	13
09-00 to 10-00	0	0	0	0	7	7	2	0	0	0	16	0	8	0	8
10-00 to 11-00	0	0	2	0	1	0	0	0	0	0	3	0	0	0	0
11-00 to 12-00	0	0	0	0	3	2	8	0	0	0	13	0	12	0	12
12-00 to 13-00	0	0	0	0	6	0	3	0	0	0	9	0	17	0	17
13-00 to 14-00	0	0	0	0	4	0	3	0	0	0	7	0	14	0	14
14-00 to 15-00	0	0	0	0	5	0	0	0	0	0	5	0	15	0	15
15-00 to 16-00	0	0	1	1	3	0	0	0	0	0	5	0	10	0	10
16-00 to 17-00	0	0	4	1	5	1	1	0	0	2	14	0	36	0	36
17-00 to 18-00	0	0	2	0	6	0	5	0	0	0	13	0	17	0	17
18-00 to 19-00	0	0	9	0	10	0	4	0	0	0	23	1	11	0	12
19-00 to 20-00	0	0	0	0	4	0	10	0	0	0	14	1	26	0	27
20-00 to 21-00	0	0	3	0	7	0	13	0	0	0	23	7	31	0	38
21-00 to 22-00	0	0	3	0	7	0	8	0	0	0	18	3	15	0	18
22-00 to 23-00	0	0	6	0	8	0	5	0	0	0	19	1	11	0	12
23-00 to 24-00	0	0	3	0	4	0	4	0	0	0	11	4	4	0	8
00-00 to 01-00	0	0	4	0	6	0	7	0	0	1	18	4	2	0	6
01-00 to 02-00	0	0	3	0	5	0	7	0	0	0	15	5	7	0	12
02-00 to 03-00	0	0	5	0	8	0	6	0	0	0	19	8	9	0	17
03-00 to 04-00	0	0	0	0	1	0	1	0	0	0	2	5	12	0	17
04-00 to 05-00	0	0	1	0	3	0	5	0	0	0	9	2	10	0	12
05-00 to 06-00	0	0	1	0	6	0	6	0	0	0	13	4	9	0	13
06-00 to 07-00	0	0	0	5	0	5	0	10	0	0	20	9	20	0	29
07-00 to 08-00	0	0	0	8	0	0	0	8	0	0	16	7	15	0	22
Total	**0**	**0**	**50**	**15**	**113**	**31**	**102**	**18**	**0**	**3**	**332**	**62**	**323**	**0**	**385**

Traffic Survey for Feasibility Study for the Construction of Dhaka Ashulia Elavated Expressway

Daily Summary Sheet

U Turn Movement Mannual Count

Name of Intersection: Chandra Turning Movement No:-4 From: Kashimpur To: Kashimpur Dated 2.07.2016 Day: Friday

Weather: Sunny/Fair/Cloudy/Rainy Duration: 24 hrs.

Time	1	2	3	4	5	6	7	8	9	10		11	12	13	
	Large Bus/ Double Decker/ Articulated Bus	Medium Bus	Small Bus/ Micro Bus	Utility /Jeep/ Laguna /Tempo /Maxi/ Human	Car/Taxi /Station Wagan	Auto Rickshaw, CNG/ Michuk	Motor Cycle	Heavy Truck/ Trailer/ Container /Truck 3 axle	Medium Truck/ Truck Lorry/ Truck 2 axle	Small Truck/ Pickup /Small Van	Total Motorized	Bicycle	Rickshaw (Cycle)/ Rickshaw Van	Animal Cart /Push Cart	Total Non Motorized
08-00 to 09-00	0	0	0	9	1	2	0	0	1	3	16	1	4	0	5
09-00 to 10-00	0	1	1	5	0	4	1	0	1	0	13	2	6	0	8
10-00 to 11-00	0	0	0	4	0	0	2	0	0	0	6	4	4	0	8
11-00 to 12-00	0	1	0	6	0	0	2	1	0	0	10	1	4	0	5
12-00 to 13-00	0	0	2	1	0	0	3	0	0	1	7	1	5	0	6
13-00 to 14-00	0	1	0	5	0	3	0	0	0	2	11	2	2	0	4
14-00 to 15-00	0	0	3	1	0	3	3	3	0	0	13	2	3	0	5
15-00 to 16-00	0	0	2	1	3	2	1	1	0	0	10	4	3	0	7
16-00 to 17-00	0	0	0	3	1	1	5	0	0	0	10	0	6	0	6
17-00 to 18-00	0	1	0	4	1	4	2	0	0	0	12	2	9	0	11
18-00 to 19-00	0	2	0	4	0	2	4	0	0	0	12	0	7	0	7
19-00 to 20-00	0	0	1	5	0	2	6	0	0	0	14	1	4	0	5
20-00 to 21-00	0	0	1	6	1	0	1	0	0	3	12	1	3	0	4
21-00 to 22-00	0	1	1	2	1	4	5	0	0	3	17	5	3	0	8
22-00 to 23-00	0	3	3	0	2	3	6	0	0	0	17	3	5	0	8
23-00 to 24-00	0	3	2	2	1	3	4	2	0	5	22	1	3	0	4
00-00 to 01-00	0	1	4	1	4	1	3	0	0	6	20	0	4	0	4
01-00 to 02-00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
02-00 to 03-00	0	3	2	1	1	4	2	0	0	3	16	1	0	0	1
03-00 to 04-00	1	1	2	1	2	5	1	0	2	3	18	2	0	0	2
04-00 to 05-00	2	0	3	4	0	1	2	0	0	4	16	1	0	0	1
05-00 to 06-00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
06-00 to 07-00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
07-00 to 08-00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	**3**	**18**	**27**	**65**	**18**	**44**	**53**	**7**	**4**	**33**	**272**	**34**	**75**	**0**	**109**

APPENDIX C MOTOR VEHICLE REGISTRATIONS

Number of Registered Vehicles in Dhaka (2009 to 2016)

Year	Large Bus	Truck	Jeep (SUV)	Car	Taxi	Auto Rickshaw	Motor - cycle	Delivery Van	Human Hauler	Micro bus	Mini-bus	Pick Up	Others	Total	* AAGR (%)
2009	15,552	22,299	18,260	143,389	36,011	7,612	179,383	10,788	2,475	40,503	9,341	14,258	17,041	516,912	
2010	16,783	26,922	19,520	163,004	36,011	7,664	210,081	11,990	2,718	46,202	9,490	20,481	22,211	593,077	14.7
2011	18,284	31,127	21,218	174,427	36,063	7,776	244,789	12,829	3,287	49,742	9,626	27,739	29,117	666,024	12.3
2012	19,502	33,951	22,459	182,614	36,106	7,887	277,599	13,406	3,432	52,385	9,729	32,888	33,639	725,597	8.9
2013	20,473	37,473	23,566	191,845	36,110	7,947	303,930	14,115	3,547	54,612	9,812	37,796	38,863	780,089	7.5
2014	21,837	43,240	25,148	204,817	36,412	8,003	336,824	15,016	3,656	58,454	9,947	45,091	44,695	853,140	9.4
2015	24,058	47,664	28,257	223,239	36,466	8,431	383,588	16,480	4,158	63,023	10,050	53,007	50,462	948,883	11.2
2016	25,968	49,806	30,679	233,536	36,467	8,465	408,720	17,499	4,756	66,020	10,141	57,029	55,083	1,004,169	5.8
CAGR (5 y's)	**7.3%**	**9.9%**	**7.7%**	**6.0%**	**0.2%**	**1.7%**	**10.8%**	**6.4%**	**7.7%**	**5.8%**	**1.0%**	**15.5%**	**13.6%**	**8.6%**	
Percentage (2016)	2.6%	5.0%	3.1%	23.3%	3.6%	0.8%	40.7%	1.7%	0.5%	6.6%	1.0%	5.7%	5.5%	100.0%	

Forecast Growth Rate (%) of Registered Vehicles in Dhaka

Year	Large Bus	Truck	Jeep (SUV)	Car	Taxi	Auto Rickshaw	Motor -cycle	Delivery Van	Human Hauler	Micro-bus	Mini-bus	Pick Up	Others	Total
2010	7.9	20.7	6.9	13.7	0.0	0.7	17.1	11.1	9.8	14.1	1.6	43.6	30.3	14.7
2011	8.9	15.6	8.7	7.0	0.1	1.5	16.5	7.0	20.9	7.7	1.4	35.4	31.1	12.3
2012	6.7	9.1	5.8	4.7	0.1	1.4	13.4	4.5	4.4	5.3	1.1	18.6	15.5	8.9
2013	5.0	10.4	4.9	5.1	0.0	0.8	9.5	5.3	3.4	4.3	0.9	14.9	15.5	7.5
2014	6.7	15.4	6.7	6.8	0.8	0.7	10.8	6.4	3.1	7.0	1.4	19.3	15.0	9.4
2015	10.2	10.2	12.4	9.0	0.1	5.3	13.9	9.7	13.7	7.8	1.0	17.6	12.9	11.2
2016	9.1	15.8	7.6	9.4	0.3	0.7	15.2	8.5	10.8	10.2	2.4	21.5	21.7	12.9
2017	5.1	7.4	5.1	5.0	0.2	1.4	7.5	4.9	5.6	5.0	1.1	9.7	9.0	6.4
2018	4.9	6.9	4.9	4.7	0.2	1.4	7.0	4.7	5.3	4.7	1.1	8.9	8.3	6.0
2019	4.7	6.5	4.6	4.5	0.2	1.4	6.5	4.4	5.0	4.5	1.1	8.1	7.6	5.7
2020	4.5	6.1	4.4	4.3	0.2	1.3	6.1	4.3	4.8	4.3	1.1	7.5	7.1	5.4
2021	4.3	5.7	4.2	4.2	0.2	1.3	5.8	4.1	4.6	4.2	1.1	7.0	6.6	5.1
2022	4.1	5.4	4.1	4.0	0.2	1.3	5.4	3.9	4.4	4.0	1.1	6.5	6.2	4.9
2023	3.9	5.1	3.9	3.8	0.2	1.3	5.2	3.8	4.2	3.8	1.0	6.1	5.9	4.6
2024	3.8	4.9	3.8	3.7	0.2	1.3	4.9	3.6	4.0	3.7	1.0	5.8	5.5	4.4
2025	3.6	4.7	3.6	3.6	0.2	1.3	4.7	3.5	3.9	3.6	1.0	5.5	5.2	4.2
2026	3.5	4.5	3.5	3.4	0.2	1.2	4.5	3.4	3.7	3.4	1.0	5.2	5.0	4.1
2027	3.4	4.3	3.4	3.3	0.2	1.2	4.3	3.3	3.6	3.3	1.0	4.9	4.7	3.9
2028	3.3	4.1	3.3	3.2	0.2	1.2	4.1	3.2	3.5	3.2	1.0	4.7	4.5	3.8
2029	3.2	3.9	3.2	3.1	0.2	1.2	3.9	3.1	3.3	3.1	1.0	4.5	4.3	3.6
2030	3.1	3.8	3.1	3.0	0.2	1.2	3.8	3.0	3.2	3.0	1.0	4.3	4.2	3.5
2031	3.0	3.6	3.0	2.9	0.2	1.2	3.7	2.9	3.1	2.9	1.0	4.1	4.0	3.4
2032	2.9	3.5	2.9	2.9	0.2	1.2	3.5	2.8	3.0	2.9	1.0	4.0	3.8	3.3
2033	2.8	3.4	2.8	2.8	0.2	1.1	3.4	2.7	2.9	2.8	0.9	3.8	3.7	3.2
2034	2.7	3.3	2.7	2.7	0.2	1.1	3.3	2.7	2.9	2.7	0.9	3.7	3.6	3.1
2035	2.7	3.2	2.7	2.6	0.2	1.1	3.2	2.6	2.8	2.6	0.9	3.5	3.4	3.0
2036	2.6	3.1	2.6	2.6	0.2	1.1	3.1	2.5	2.7	2.6	0.9	3.4	3.3	2.9
2037	2.5	3.0	2.5	2.5	0.2	1.1	3.0	2.5	2.6	2.5	0.9	3.3	3.2	2.8
2038	2.5	2.9	2.5	2.4	0.2	1.1	2.9	2.4	2.6	2.4	0.9	3.2	3.1	2.7
2039	2.4	2.8	2.4	2.4	0.2	1.1	2.8	2.4	2.5	2.4	0.9	3.1	3.0	2.7
2040	2.4	2.7	2.4	2.3	0.2	1.1	2.7	2.3	2.4	2.3	0.9	3.0	2.9	2.6
2041	2.3	2.7	2.3	2.3	0.2	1.0	2.7	2.2	2.4	2.3	0.9	2.9	2.8	2.5

Year	Large Bus	Truck	Jeep (SUV)	Car	Taxi	Auto Rickshaw	Motor -cycle	Delivery Van	Human Hauler	Micro-bus	Mini-bus	Pick Up	Others	Total
2042	2.3	2.6	2.2	2.2	0.2	1.0	2.6	2.2	2.3	2.2	0.9	2.8	2.8	2.5
2043	2.2	2.5	2.2	2.2	0.2	1.0	2.5	2.2	2.3	2.2	0.9	2.8	2.7	2.4
2044	2.2	2.5	2.1	2.1	0.2	1.0	2.5	2.1	2.2	2.1	0.9	2.7	2.6	2.4
2045	2.1	2.4	2.1	2.1	0.2	1.0	2.4	2.1	2.2	2.1	0.9	2.6	2.6	2.3
2046	2.1	2.4	2.1	2.0	0.2	1.0	2.4	2.0	2.1	2.0	0.8	2.5	2.5	2.2
2047	2.0	2.3	2.0	2.0	0.2	1.0	2.3	2.0	2.1	2.0	0.8	2.5	2.4	2.2
2048	2.0	2.3	2.0	2.0	0.2	1.0	2.3	1.9	2.0	2.0	0.8	2.4	2.4	2.1
2049	1.9	2.2	1.9	1.9	0.2	1.0	2.2	1.9	2.0	1.9	0.8	2.4	2.3	2.1
2050	1.9	2.2	1.9	1.9	0.2	1.0	2.2	1.9	2.0	1.9	0.8	2.4	2.3	2.1

Forecast Number of Registered Motor Vehicles in Dhaka

Year	Large Bus	Truck	Jeep (SUV)	Car	Taxi	Auto Rickshaw	Motor - cycle	Delivery Van	Human Hauler	Micro-bus	Mini-bus	Pick Up	Others	Total
2017	26,251	55,217	30,417	244,154	36,564	8,493	441,821	17,877	4,608	69,441	10,290	64,381	61,393	1,070,907
2018	27,602	59,327	31,974	256,318	36,643	8,611	474,865	18,749	4,864	72,903	10,405	70,649	66,928	1,139,840
2019	28,952	63,437	33,531	268,482	36,722	8,729	507,910	19,621	5,121	76,365	10,520	76,918	72,463	1,208,772
2020	30,303	67,547	35,088	280,646	36,801	8,847	540,954	20,493	5,378	79,827	10,636	83,187	77,997	1,277,704
2021	31,653	71,657	36,645	292,810	36,880	8,965	573,998	21,365	5,634	83,289	10,751	89,456	83,532	1,346,637
2022	33,004	75,767	38,202	304,974	36,959	9,084	607,043	22,237	5,891	86,751	10,866	95,724	89,067	1,415,569
2023	34,354	79,877	39,759	317,138	37,038	9,202	640,087	23,109	6,147	90,213	10,981	101,993	94,602	1,484,501
2024	35,705	83,987	41,316	329,302	37,117	9,320	673,131	23,981	6,404	93,675	11,097	108,262	100,137	1,553,433
2025	37,055	88,097	42,873	341,467	37,196	9,438	706,176	24,853	6,661	97,137	11,212	114,530	105,672	1,622,366
2026	38,406	92,207	44,430	353,631	37,275	9,556	739,220	25,725	6,917	100,599	11,327	120,799	111,207	1,691,298
2027	39,756	96,316	45,987	365,795	37,355	9,674	772,265	26,597	7,174	104,061	11,442	127,068	116,742	1,760,230
2028	41,107	100,426	47,544	377,959	37,434	9,792	805,309	27,469	7,430	107,522	11,558	133,337	122,277	1,829,163
2029	42,458	104,536	49,101	390,123	37,513	9,910	838,353	28,341	7,687	110,984	11,673	139,605	127,811	1,898,095
2030	43,808	108,646	50,658	402,287	37,592	10,028	871,398	29,212	7,944	114,446	11,788	145,874	133,346	1,967,027
2031	45,159	112,756	52,215	414,451	37,671	10,146	904,442	30,084	8,200	117,908	11,903	152,143	138,881	2,035,959
2032	46,509	116,866	53,772	426,615	37,750	10,264	937,486	30,956	8,457	121,370	12,019	158,411	144,416	2,104,892
2033	47,860	120,976	55,329	438,779	37,829	10,382	970,531	31,828	8,713	124,832	12,134	164,680	149,951	2,173,824
2034	49,210	125,086	56,886	450,943	37,908	10,500	1,003,575	32,700	8,970	128,294	12,249	170,949	155,486	2,242,756
2035	50,561	129,196	58,443	463,107	37,987	10,619	1,036,619	33,572	9,227	131,756	12,364	177,218	161,021	2,311,689
2036	51,911	133,305	60,000	475,271	38,066	10,737	1,069,664	34,444	9,483	135,218	12,480	183,486	166,556	2,380,621
2037	53,262	137,415	61,557	487,435	38,145	10,855	1,102,708	35,316	9,740	138,680	12,595	189,755	172,091	2,449,553

Year	Large Bus	Truck	Jeep (SUV)	Car	Taxi	Auto Rickshaw	Motor - cycle	Delivery Van	Human Hauler	Micro-bus	Mini-bus	Pick Up	Others	Total
2038	54,612	141,525	63,114	499,599	38,224	10,973	1,135,752	36,188	9,997	142,142	12,710	196,024	177,626	2,518,485
2039	55,963	145,635	64,671	511,764	38,303	11,091	1,168,797	37,060	10,253	145,604	12,825	202,292	183,160	2,587,418
2040	57,313	149,745	66,228	523,928	38,382	11,209	1,201,841	37,932	10,510	149,066	12,941	208,561	188,695	2,656,350
2041	58,664	153,855	67,785	536,092	38,462	11,327	1,234,886	38,804	10,766	152,528	13,056	214,830	194,230	2,725,282
2042	60,015	157,965	69,341	548,256	38,541	11,445	1,267,930	39,676	11,023	155,989	13,171	221,099	199,765	2,794,215
2043	61,365	162,075	70,898	560,420	38,620	11,563	1,300,974	40,548	11,280	159,451	13,286	227,367	205,300	2,863,147
2044	62,716	166,185	72,455	572,584	38,699	11,681	1,334,019	41,419	11,536	162,913	13,402	233,636	210,835	2,932,079
2045	64,066	170,294	74,012	584,748	38,778	11,799	1,367,063	42,291	11,793	166,375	13,517	239,905	216,370	3,001,011
2046	65,417	174,404	75,569	596,912	38,857	11,917	1,400,107	43,163	12,049	169,837	13,632	246,173	221,905	3,069,944
2047	66,767	178,514	77,126	609,076	38,936	12,035	1,433,152	44,035	12,306	173,299	13,747	252,442	227,440	3,138,876
2048	68,118	182,624	78,683	621,240	39,015	12,153	1,466,196	44,907	12,563	176,761	13,863	258,711	232,974	3,207,808
2049	69,468	186,734	80,240	633,404	39,094	12,272	1,499,240	45,779	12,819	180,223	13,978	264,980	238,509	3,276,741
2050	70,819	190,844	81,797	645,568	39,173	12,390	1,532,285	46,651	13,076	183,685	14,093	271,248	244,044	3,345,673

Number of Registered Vehicles in Bangladesh (2009 to 2016)

Year	Large Bus	Truck	Jeep (SUV)	Car	Taxi	Auto Rickshaw	Motor - cycle	Delivery Van	Human Hauler	Micro bus	Mini-bus	Pick Up	Others	Total	* AAGR (%)
2009	26,016	73,336	30,162	196,870	44,361	108,436	650,147	15,564	5,846	59,404	24,749	23,273	49,222	1,307,386	
2010	27,778	82,871	32,286	219,830	44,380	126,763	759,257	17,063	6,520	66,379	25,644	32,240	57,233	1,498,244	14.6
2011	29,539	90,198	34,420	232,780	44,455	147,186	873,873	18,067	7,672	70,430	25,920	42,700	66,390	1,683,630	12.4
2012	30,978	94,533	35,989	242,004	44,627	170,731	975,461	18,841	8,387	73,474	26,169	50,325	72,816	1,844,335	9.5
2013	32,085	99,662	37,303	252,476	44,678	186,428	1,061,269	19,735	8,772	76,011	26,317	56,878	79,830	1,981,444	7.4
2014	33,573	107,798	39,173	267,175	45,052	206,325	1,151,954	20,911	8,997	80,324	26,573	66,432	87,796	2,142,083	8.1
2015	35,964	114,128	42,774	288,237	45,140	226,325	1,392,312	22,630	10,139	85,548	26,896	76,689	96,516	2,463,298	15.0
2016	38,087	117,498	45,537	299,887	45,148	232,303	1,525,283	23,792	11,772	88,932	27,177	82,075	102,858	2,640,349	7.19
CAGR (5 y's)	5.2%	5.4%	5.8%	5.2%	0.3%	9.6%	11.8%	5.7%	8.9%	4.8%	1.0%	14.0%	9.2%	9.4%	
Percentage (2016)	1.4%	4.5%	1.7%	11.4%	1.7%	8.8%	57.8%	0.9%	0.4%	3.4%	1.0%	3.1%	3.9%	100.0%	

Forecast Growth Rate (%) of Registered Vehicles in Bangladesh

Year	Large Bus	Truck	Jeep (SUV)	Car	Taxi	Auto Rickshaw	Motor -cycle	Delivery Van	Human Hauler	Micro-bus	Mini-bus	Pick - Up	Others	Total
2010	6.8	13.0	7.0	11.7	0.0	16.9	16.8	9.6	11.5	11.7	3.6	38.5	16.3	14.6
2011	6.3	8.8	6.6	5.9	0.2	16.1	15.1	5.9	17.7	6.1	1.1	32.4	16.0	12.4
2012	4.9	4.8	4.6	4.0	0.4	16.0	11.6	4.3	9.3	4.3	1.0	17.9	9.7	9.5
2013	3.6	5.4	3.7	4.3	0.1	9.2	8.8	4.7	4.6	3.5	0.6	13.0	9.6	7.4
2014	4.6	8.2	5.0	5.8	0.8	10.7	8.5	6.0	2.6	5.7	1.0	16.8	10.0	8.1
2015	7.1	5.9	9.2	7.9	0.2	9.7	20.9	8.2	12.7	6.5	1.2	15.4	9.9	15.0
2016	5.9	3.0	6.5	4.0	0.0	2.6	9.6	5.1	16.1	4.0	1.0	7.0	6.6	7.2
2017	1.6	8.2	0.5	4.1	0.5	14.5	1.7	2.7	-2.9	4.6	1.5	13.5	8.4	4.1
2018	4.1	5.1	4.3	4.4	0.3	7.4	7.4	4.5	5.9	4.3	1.1	9.3	6.9	6.6
2019	3.9	4.9	4.1	4.3	0.3	6.9	6.9	4.3	5.6	4.1	1.1	8.5	6.5	6.2
2020	3.8	4.6	3.9	4.1	0.3	6.5	6.4	4.1	5.3	4.0	1.1	7.8	6.1	5.8
2021	3.5	4.2	3.6	3.8	0.3	5.7	5.7	3.8	4.8	3.7	1.1	6.8	5.4	5.2
2022	3.4	4.1	3.5	3.6	0.3	5.4	5.4	3.7	4.6	3.5	1.1	6.4	5.1	4.9
2023	3.3	3.9	3.4	3.5	0.3	5.1	5.1	3.5	4.4	3.4	1.1	6.0	4.9	4.7
2024	3.2	3.8	3.3	3.4	0.3	4.9	4.9	3.4	4.2	3.3	1.0	5.6	4.7	4.5
2025	3.1	3.6	3.2	3.3	0.3	4.7	4.6	3.3	4.0	3.2	1.0	5.3	4.5	4.3
2026	3.0	3.5	3.1	3.2	0.3	4.4	4.4	3.2	3.9	3.1	1.0	5.1	4.3	4.1
2027	2.9	3.4	3.0	3.1	0.3	4.3	4.2	3.1	3.7	3.0	1.0	4.8	4.1	4.0
2028	2.8	3.3	2.9	3.0	0.3	4.1	4.1	3.0	3.6	2.9	1.0	4.6	3.9	3.8
2029	2.7	3.2	2.8	2.9	0.3	3.9	3.9	2.9	3.5	2.8	1.0	4.4	3.8	3.7
2030	2.7	3.1	2.7	2.8	0.3	3.8	3.8	2.8	3.3	2.8	1.0	4.2	3.6	3.5
2031	2.6	3.0	2.7	2.7	0.3	3.6	3.6	2.7	3.2	2.7	1.0	4.0	3.5	3.4
2032	2.5	2.9	2.6	2.7	0.3	3.5	3.5	2.7	3.1	2.6	1.0	3.9	3.4	3.3
2033	2.5	2.8	2.5	2.6	0.3	3.4	3.4	2.6	3.0	2.5	1.0	3.7	3.3	3.2
2034	2.4	2.7	2.5	2.5	0.3	3.3	3.3	2.5	2.9	2.5	0.9	3.6	3.2	3.1
2035	2.3	2.7	2.4	2.5	0.3	3.2	3.2	2.5	2.9	2.4	0.9	3.5	3.1	3.0
2036	2.3	2.6	2.4	2.4	0.3	3.1	3.1	2.4	2.8	2.4	0.9	3.4	3.0	2.9

Year	Large Bus	Truck	Jeep (SUV)	Car	Taxi	Auto Rickshaw	Motor -cycle	Delivery Van	Human Hauler	Micro-bus	Mini-bus	Pick - Up	Others	Total
2037	2.2	2.5	2.3	2.4	0.3	3.0	3.0	2.4	2.7	2.3	0.9	3.3	2.9	2.8
2038	2.2	2.5	2.2	2.3	0.3	2.9	2.9	2.3	2.6	2.3	0.9	3.2	2.8	2.8
2039	2.1	2.4	2.2	2.2	0.3	2.8	2.8	2.3	2.6	2.2	0.9	3.1	2.7	2.7
2040	2.1	2.3	2.2	2.2	0.3	2.7	2.7	2.2	2.5	2.2	0.9	3.0	2.7	2.6
2041	2.1	2.3	2.1	2.2	0.3	2.7	2.7	2.2	2.4	2.1	0.9	2.9	2.6	2.5
2042	2.0	2.2	2.1	2.1	0.3	2.6	2.6	2.1	2.4	2.1	0.9	2.8	2.5	2.5
2043	2.0	2.2	2.0	2.1	0.3	2.5	2.5	2.1	2.3	2.0	0.9	2.7	2.5	2.4
2044	1.9	2.1	2.0	2.0	0.3	2.5	2.5	2.0	2.3	2.0	0.9	2.6	2.4	2.4
2045	1.9	2.1	1.9	2.0	0.3	2.4	2.4	2.0	2.2	1.9	0.9	2.6	2.4	2.3
2046	1.9	2.1	1.9	1.9	0.3	2.4	2.3	1.9	2.2	1.9	0.8	2.5	2.3	2.3
2047	1.8	2.0	1.9	1.9	0.3	2.3	2.3	1.9	2.1	1.9	0.8	2.5	2.3	2.2
2048	1.8	2.0	1.8	1.9	0.3	2.2	2.2	1.9	2.1	1.8	0.8	2.4	2.2	2.2
2049	1.8	1.9	1.8	1.8	0.3	2.2	2.2	1.8	2.0	1.8	0.8	2.3	2.2	2.1

Forecast Number of Registered Motor Vehicles in Bangladesh

Year	Large Bus	Truck	Jeep (SUV)	Car	Taxi	Auto Rickshaw	Motor - cycle	Delivery Van	Human Hauler	Micro-bus	Mini-bus	Pick Up	Others	Total
2017	38,701	127,092	45,746	312,140	45,368	266,034	1,551,911	24,431	11,428	93,064	27,591	93,150	111,480	2,748,136
2018	40,272	133,581	47,692	326,015	45,507	285,749	1,666,172	25,522	12,105	97,061	27,902	101,822	119,211	2,928,609
2019	41,843	140,070	49,639	339,889	45,646	305,465	1,780,432	26,614	12,781	101,057	28,212	110,494	126,941	3,109,081
2020	43,413	146,559	51,585	353,764	45,786	325,180	1,894,692	27,705	13,457	105,054	28,523	119,165	134,671	3,289,554
2021	44,984	153,048	53,531	367,638	45,925	344,895	2,008,952	28,797	14,133	109,050	28,833	127,837	142,402	3,470,026
2022	46,555	159,537	55,477	381,513	46,065	364,611	2,123,212	29,888	14,809	113,047	29,144	136,509	150,132	3,650,499
2023	48,125	166,026	57,423	395,387	46,204	384,326	2,237,472	30,980	15,486	117,043	29,455	145,181	157,862	3,830,971
2024	49,696	172,515	59,369	409,262	46,344	404,042	2,351,733	32,071	16,162	121,040	29,765	153,852	165,592	4,011,443
2025	51,267	179,004	61,316	423,136	46,483	423,757	2,465,993	33,163	16,838	125,036	30,076	162,524	173,323	4,191,916
2026	52,838	185,494	63,262	437,011	46,622	443,473	2,580,253	34,254	17,514	129,033	30,386	171,196	181,053	4,372,388
2027	54,408	191,983	65,208	450,885	46,762	463,188	2,694,513	35,346	18,190	133,029	30,697	179,868	188,783	4,552,861
2028	55,979	198,472	67,154	464,760	46,901	482,904	2,808,773	36,437	18,866	137,026	31,007	188,540	196,514	4,733,333
2029	57,550	204,961	69,100	478,635	47,041	502,619	2,923,033	37,529	19,543	141,023	31,318	197,211	204,244	4,913,806
2030	59,120	11,450	71,047	492,509	47,180	522,335	3,037,294	38,620	20,219	145,019	31,629	205,883	211,974	5,094,278
2031	60,691	217,939	72,993	506,384	47,320	542,050	3,151,554	39,712	20,895	149,016	31,939	214,555	219,704	5,274,750
2032	62,262	224,428	74,939	520,258	47,459	561,766	3,265,814	40,803	21,571	153,012	32,250	223,227	227,435	5,455,223
2033	63,833	230,917	76,885	534,133	47,598	581,481	3,380,074	41,895	22,247	157,009	32,560	231,899	235,165	5,635,695
2034	65,403	237,406	78,831	548,007	47,738	601,197	3,494,334	42,986	22,924	161,005	32,871	240,570	242,895	5,816,168

Year	Large Bus	Truck	Jeep (SUV)	Car	Taxi	Auto Rickshaw	Motor - cycle	Delivery Van	Human Hauler	Micro-bus	Mini-bus	Pick Up	Others	Total
2035	66,974	243,895	80,777	561,882	47,877	620,912	3,608,595	44,078	23,600	165,002	33,181	249,242	250,626	5,996,640
2036	68,545	250,384	82,724	575,756	48,017	640,627	3,722,855	45,169	24,276	168,998	33,492	257,914	258,356	6,177,113
2037	70,115	256,873	84,670	589,631	48,156	660,343	3,837,115	46,261	24,952	172,995	33,803	266,586	266,086	6,357,585
2038	71,686	263,362	86,616	603,505	48,296	680,058	3,951,375	47,352	25,628	176,991	34,113	275,257	273,816	6,538,057
2039	73,257	269,851	88,562	617,380	48,435	699,774	4,065,635	48,444	26,304	180,988	34,424	283,929	281,547	6,718,530
2040	74,828	276,341	90,508	631,254	48,574	719,489	4,179,895	49,535	26,981	184,984	34,734	292,601	289,277	6,899,002
2041	76,398	282,830	92,454	645,129	48,714	739,205	4,294,156	50,627	27,657	188,981	35,045	301,273	297,007	7,079,475
2042	77,969	289,319	94,401	659,004	48,853	758,920	4,408,416	51,718	28,333	192,977	35,355	309,945	304,738	7,259,947
2043	79,540	295,808	96,347	672,878	48,993	778,636	4,522,676	52,810	29,009	196,974	35,666	318,616	312,468	7,440,420
2044	81,110	302,297	98,293	686,753	49,132	798,351	4,636,936	53,901	29,685	200,971	35,977	327,288	320,198	7,620,892
2045	82,681	308,786	100,239	700,627	49,272	818,067	4,751,196	54,993	30,361	204,967	36,287	335,960	327,928	7,801,364
2046	84,252	315,275	102,185	714,502	49,411	837,782	4,865,457	56,084	31,038	208,964	36,598	344,632	335,659	7,981,837
2047	85,823	321,764	104,132	728,376	49,550	857,498	4,979,717	57,176	31,714	212,960	36,908	353,304	343,389	8,162,309
2048	87,393	328,253	106,078	742,251	49,690	877,213	5,093,977	58,267	32,390	216,957	37,219	361,975	351,119	8,342,782
2049	88,964	334,742	108,024	756,125	49,829	896,928	5,208,237	59,359	33,066	220,953	37,529	370,647	358,850	8,523,254
2050	90,535	341,231	109,970	770,000	49,969	916,644	5,322,497	60,450	33,742	224,950	37,840	379,319	366,580	8,703,727

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