

Mongolia  
Ministry of Roads and Transportation (MRT)  
Ulaanbaatar City Government (UBC)

**PREPARATORY SURVEY  
FOR  
THE CONSTRUCTION OF  
AJILCHIN FLYOVER PROJECT  
IN  
ULAANBAATAR CITY**

**FINAL REPORT**

**JUNE 2013**

JAPAN INTERNATIONAL COOPERATION AGENCY

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CTI ENGINEERING INTERNATIONAL CO., LTD.

CHODAI CO., LTD.

INFRASTRUCTURE DEVELOPMENT INSTITUTE – JAPAN

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AJILCHIN

EXCHANGE RATE

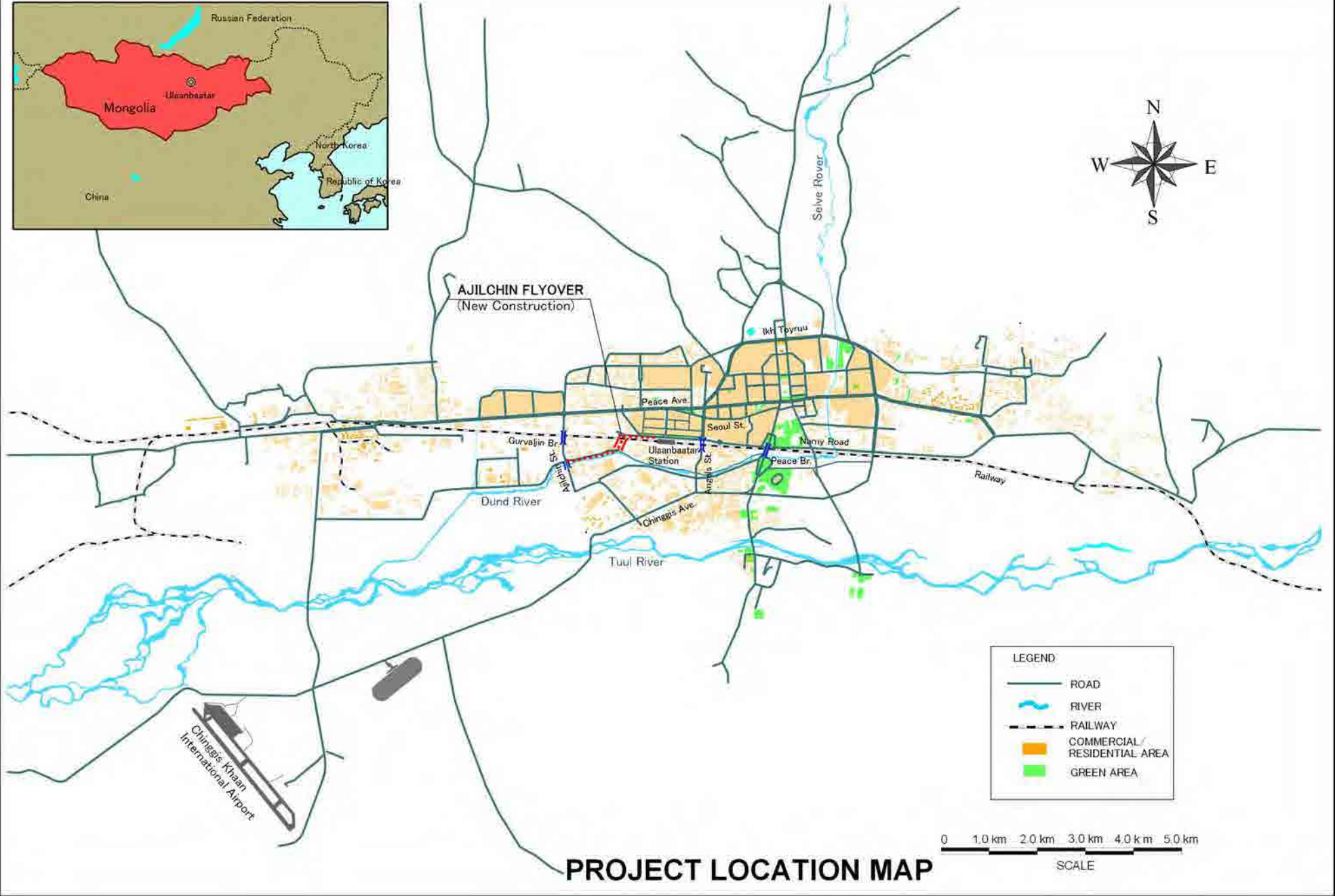
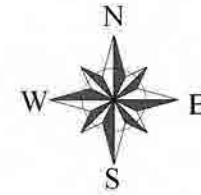
January, 2013

1MNT = 0.06 Japan Yen

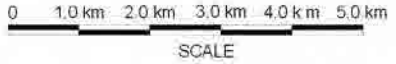
1USD = 1390.5 Mongolia Tugrik

1USD = 89.2 Japan Yen

\*JICA Exchange Rate



LEGEND	
	ROAD
	RIVER
	RAILWAY
	COMMERCIAL AREA
	RESIDENTIAL AREA
	GREEN AREA



**PROJECT LOCATION MAP**

PREPARATORY SURVEY FOR THE CONSTRUCTION OF AJILCHIN FLYOVER PROJECT IN ULAANBAATAR CITY, FINAL REPORT

Site Reconnaissance Photos (1)



Pic.1 Planned Site of Flyover (1)



Pic.2 Planned Site of Flyover (2)



Pic.3 From Planned Site of Flyover to Ulaanbaatar Station



Pic.4 Branch to the Third Thermal Power Plant



Pic.5 Intersection with Naryn Road (1)  
(To Peace Avenue)



Pic.6 Intersection with Naryn Road (2)  
(To Ulaanbaatar Station)

Site Reconnaissance Photos (2)



Pic.7 Affected Properties in the Railway Facilities



Pic.8 Dund Gol River



Pic.9 In the Railway facilities  
(Candidate Site for Material/Equipment Yard)



Pic.10 West Side of the Project (Near the Origin)



Pic.11 West Industrial Road (1)



Pic.12 West Industrial Road (2)

Site Reconnaissance Photos (3)



Pic.13 Landing Point near the West Side



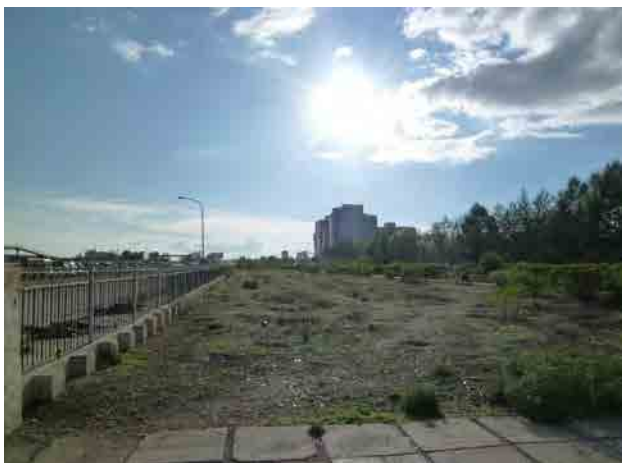
Pic.14 Landing Point near the East Side



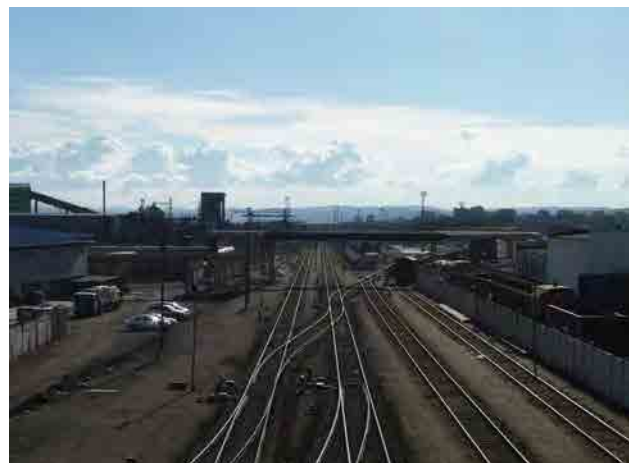
Pic.15 Planned Site of Flyover  
(Beside of the Railway Facilities)



Pic.16 The Place of Grade Separation on Narny Road



Pic.17 Green Zone Beside Narny Road



Pic.18 Inside the Railway Facilities



PERSPECTIVE-1





PERSPECTIVE-2  
(From East to West)



PERSPECTIVE-3  
(From OFF Ramp to Narry Road Grade Separation)

## <EXECUTIVE SUMMARY>

### 1. GENERAL

In Ulaanbaatar City, the capital city of Mongolia, where more than 40% of the national population is concentrated, traffic volume of vehicles has been rapidly increasing over the past few years in response to economic growth and the trend is expected to continue in the future.

The worsening traffic congestion raises concerns to its adverse negative impact on the socioeconomic development of Ulaanbaatar City. In addition, the limited number of railway crossing bridges hampers the north-south vehicular movement. The railway that runs at the heart of the city from east to west is the most important logistics carrier of the country. The existing three (3) railway crossing bridges experience serious traffic congestions that necessitate development of a new road crossing over the railway.

To address the above-mentioned issue, “the Study on City Master Plan and Urban Development Program of Ulaanbaatar City” (by JICA, 2007 to 2009; hereinafter referred to as “the JICA M/P”) was implemented. The JICA M/P recommended that a new road network and public transportation system be established until 2030. The JICA M/P was reviewed and modified by the Construction Urban Development and Planning Department in Ulaanbaatar City (hereinafter referred to as UB M/P) and was approved by the diet in January 2013.

The Construction of Ajilchin Flyover (hereinafter referred to as “the Project”) is one of the highest priority projects in the UB M/P, which will eliminate several missing-links caused by railway in the center of Ulaanbaatar City.

To facilitate the realization of the project, the Government of Mongolia discussed with JICA to conduct a preparatory survey for the Project and Minutes of Discussion was concluded between JICA and Government of Mongolia on 7<sup>th</sup> December 2011.

The objective of the preparatory survey is to collect relevant data and information, prepare project outline, cost estimate, implementation plan, environmental and social impact and so forth for appraisal of the Project under the scheme of Japanese yen loan.

### 2. CURRENT CONDITION OF SOCIO-ECONOMIC AND ROAD TRANSPORT

#### 2.1 SOCIO-ECONOMIC CONDITION

##### (1) Economic Condition of Mongolia

After the dissolution of socialist system in 1992, the economic growth of Mongolia has been characterized by low growth until 2000 while it's in the process of development of market economy. However the country achieved stable economic growth from 2001 through 2008 mainly propelled by the export of mineral resources that had favorable price in the global market.

In 2008, the economic growth declined at a negative growth of -1.3%, due to the sudden increase of domestic inflation rate by the steep rise of oil products price and grain price as well as the influence

of the global economic crisis partly result of Lehman Shock. Nevertheless, the economic growth in 2011 recovered to 17.3% under the financial support program of the International Monetary Fund (IMF), the World Bank (WB) and the Asian Development Bank (ADB). This was aided by the sound government policy of financial restraint, the economic recovery of China which is the largest export market for Mongolia and the re-ascension of mineral resource prices. In the near future, the economy of Mongolia is expected to have a stable growth in a similar manner before 2008 through the stable increase of the income from resource development such as coal and other minerals.

(2) Economic Growth in Ulaanbaatar City.

From 2007-2011, the growth rate of Gross Regional Domestic Production (hereinafter referred to as “RGDP”) in Ulaanbaatar City is 14.1% on average, which far exceeds 7.6% of the GDP in Mongolia. Although GRDP in Ulaanbaatar City in 2008 was just 6.9%, drastic annual growth rate of 21.9% in average has been recorded from 2009 through 2011.

As for the share of GRDP by industry in Ulaanbaatar City in 2011, the share of primary industry is limited to 0.4%, and secondary industry and tertiary industry show high shares at 30.7% and 68.8%, respectively. The share of industry generally continues to be stable from 2006 thus it is estimated that the tendency will continue by increment of trade scale due to development of mineral resources and certain enhancement of transport sectors.

## **2.2 POPULATION AND CAR OWNERSHIP**

(1) Population

The national population of Mongolia in the last decade increased from 2,475,000 persons in 2002 to 2,800,000 persons in 2011, i.e. approximately 1.13 times. Meanwhile, the population of Ulaanbaatar City increased from 847,000 persons to 1,201,000 persons, i.e. approximately 1.42 times, in the same period. The population growth rate of Ulaanbaatar City has reached up to 3.96% (annual range of 3.0%-5.5%), which clearly illustrate rapid increase of population inflow from the local region to the urbanized area.

(2) Car Ownership

The number of car ownership in Ulaanbaatar City increases 14.4% in annual average growth in the last decade of 2001-2010. The growth rate increased significantly in 2007-2010. The number of car ownership increased from 48,000 vehicles in 2001 to 162,000 vehicles in 2010, i.e. approximately 3.4 times in the past ten years indicating annual average growth rate of 25.3%.

## **2.3 CURRENT SITUATION OF THE ROAD NETWORK IN ULAANBAATAR CITY**

The road network density in Ulaanbaatar City (6 administrative district excluding satellite towns) is approximately 0.14 km/km<sup>2</sup>, which indicates extremely low grade of road improvement ratio compared with major cities in foreign countries. The traffic congestion on main roads in the Ulaanbaatar City is becoming chronic due to rapid increase in car ownership that exceeds 14% per year as described above. Specifically, the daily traffic volumes of 50,000 to 70,000 at “Peace Avenue” which is the only arterial road crossing the inner-city from east to west, and 62,200 at Peace Bridge located on the arterial road

connecting north and south in the center of Ulaanbaatar City both observed in May 2012 indicate that current traffic volume has already reached the critical limit of traffic capacity of the respective main roads in Ulaanbaatar City.

On the other hand, the railway running east-west in Ulaanbaatar City is not only an important infrastructure functioning as main logistics system in the country, but also one of the deterrent factors for road traffic by dividing Ulaanbaatar City into north and south regions. Currently, there are only 6 railway crossings in the central city; Peace Bridge, Narny Bridge, Gurvaljin Bridge, and other 3 at-grade crossings.

This situation induces traffic bottleneck at intersections and corresponding access roads near the railway crossings, and is accelerating traffic congestion in the center of Ulaanbaatar City limiting the average traveling speed below 20 km/hour.

As an urgent solution to the above-mentioned problems, another flyover is required to form a part of east-west trunk road network as well as to cross over the railway.

### 3. TRAFFIC DEMAND FORECAST

#### 3.1 FUTURE SOCIO-ECONOMIC FRAMEWORK IN ULAANBAATAR CITY

The future population of Ulaanbaatar City in 2030 is projected to be 1.739 million under JICA M/P. On the other hand, after the adjustment by the Urban Development Department of Ulaanbaatar Municipal Government, the future population of Ulaanbaatar City (6 districts) is projected to be 1.051 million in 2010 (average annual growth rate of 3.0%), 1.236 million persons in 2020 (ditto 1.6%) and 1.400 million persons in 2030 (ditto 1.3%). The traffic demand forecast during the preparatory survey was conducted on the basis of population frame adjusted by the Urban Development Department of Ulaanbaatar Municipal Government to accommodate the latest master plan. As for prospective GRDP in Ulaanbaatar City, the growth ratio provided in the JICA M/P was applied.

#### 3.2 FUTURE TRAFFIC DEMAND FORECAST

The future traffic demand in 2020 and 2030 “with Project” and “without Project” at major road sections are estimated respectively as follows.

Table 3.2 Future Traffic Demand (Daily Two-Way Traffic Volume) in 2020/2030 in the Future Road Network

Section Number	Daily Two-Way Traffic Volume (Vehicle)			
	2020		2030	
	With	Without	With	Without
①	26,600	-	57,000	-
②	21,000	22,700	24,200	29,700
③	31,600	24,600	52,300	31,800
④	54,600	67,000	51,300	98,800
⑤	50,300	62,300	76,000	115,700
⑥	35,600	35,600	99,300	99,300
⑦	55,200	52,900	103,900	100,800

⑧	22,100	21,900	45,300	47,400
⑨	6,900	8,500	13,100	15,500
⑩	22,600	28,600	46,200	50,200
⑪	26,700	21,200	49,200	44,600
⑫	44,300	46,600	70,300	72,400
⑬	11,800	23,000	25,300	24,800
⑭	33,400	31,600	64,100	62,900
⑮	30,000	34,400	53,300	63,400
⑯	29,900	37,100	55,300	67,900
⑰	25,500	28,000	40,000	40,200

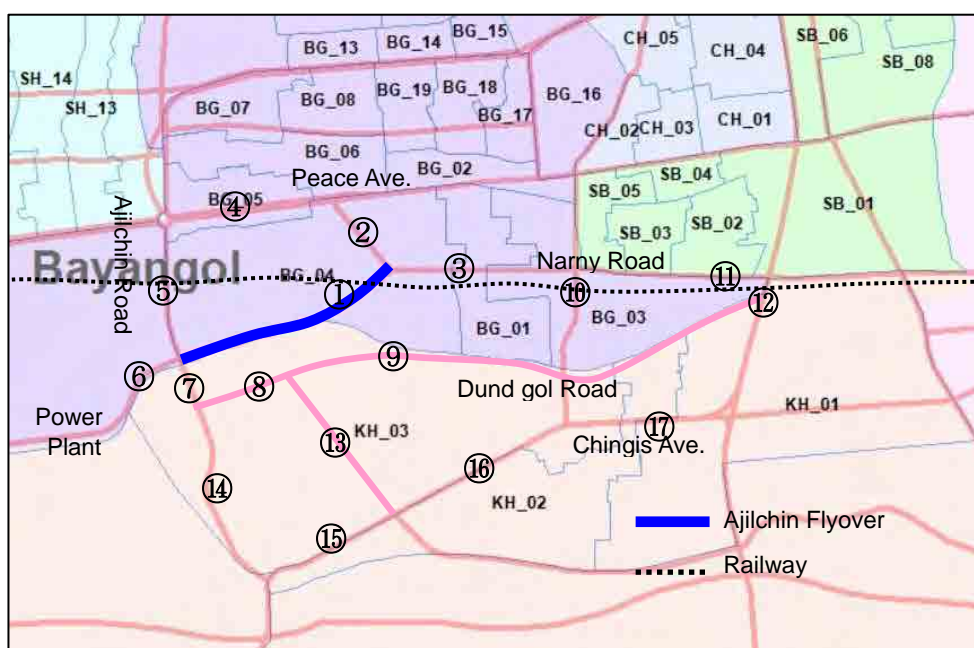


Figure 3.1 Location of Future Traffic Demand in Future Road Network

Based on the above forecast, the construction of Ajilchin Flyover will facilitate 26,600 and 57,000 vehicle traffics in 2020 and 2030, respectively, and will further have a significant effect on the alleviation of traffic congestion at ④Peace Avenue and three (3) existing railway bridge crossings; namely ⑤ Gurvaljin Bridge, ⑩ Naryn Bridge and ⑫ Peace Bridge.

## 4. NATURAL CONDITIONS

### 4.1 CLIMATE

Ulaanbaatar City has a continental climate, which is characterized by a cold climate from October to April with an average temperature of about 0°C or below (daily lowest temperature in January is -40°C) and a long spell of hot summer (daily highest temperature is 40°C) from May to September. Furthermore, daily temperature fluctuation reaches as large as 30°C to 40°C. Humidity exceeds 70% in winter season from November to February, and is less than 60% in March through October.

Based on meteorological data for the past 14 years (1998 to 2011), the annual average precipitation is 247.8 mm/year. As for monthly precipitation, they have comparatively large amounts of rain from May to September with the maximum monthly average precipitation occurring in July at 58.6 mm/month. The maximum monthly precipitation amount in the past 14 years is 137.7 mm/month in August 2000. Focusing on daily precipitation amounts, the maximum amount is 44.8 mm/day in July 2009.

### 4.2 GEOLOGICAL CONDITION

The geological formation of the Project site is classified as Diluvium and Alluvium of Quaternary Period in Cenozoic mainly consisting of loose sand, clayey gravel and sand with boulder (maximum diameter of 75mm).

As a result of boring investigation at 11 locations in the Project site, embankment consisting of a gravel layer with clay and sand exist with 1 - 2m thick. Especially, the top layer of embankment up to one meter deep from the surface is loose. Relatively dense sand and gravel bearing boulders underlies with 4 – 8m thick. Groundwater level is stably observed at around 3.2 – 4.5m below existing ground surface (approx. elevation of 1,275m). No permafrost soil was observed in the Project site.

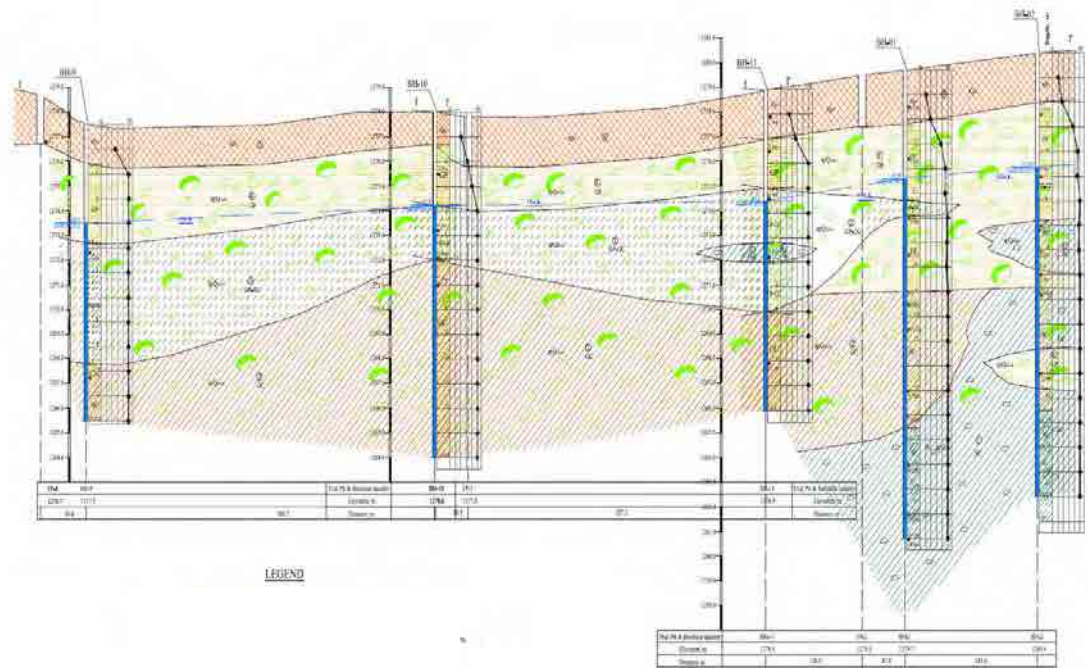


Figure 4.2 Geological Section of Project Site

## 5. ROUTE SELECTION FOR AJILCHIN FLYOVER

### 5.1 STUDY OF BRIDGING ROUTE

Alternative routes of Ajilchin Flyover are proposed as 1) East-West Route (from Narny Road to West Industry Road) and 2) North – South Route (from Narny Road to Dund gol Road). The results of the comparative study during the preparatory survey indicated that the East-West Route is the best possible option because of the aspects of traffic safety, project feasibility and environmental issues.

- 1) Higher traffic demand is expected on East West Rout. (E-W; 57,000vehicle/day, N-S; 41,000vehicle/day)
- 2) No resettlement and less compensation for land and facilities expected on East West Rout.
- 3) Higher traffic safety is expected on East Wes Route due to crossing condition of railway feeder line.

### 5.2 DEFINITION OF PROJECT AREA

(1) Starting/Ending Points of Project

Starting point: Intersection between Ajilchin Street and West Industrial Road

Ending point: Intersection of Narny Road in front of Ulaanbaatar Railway Station

(2) Flyover: From Narny Road to West Industrial Road.

(3) Access Road

North Side: Since widening of Narny Road from 2-lane to 4-lane is ongoing, the area of access road for Ajilchin Flyover shall be adjusted to the widening plan.

South Side: West side from the railway feeder line to Power Plant No.3 to the intersection with Ajilchin Street.

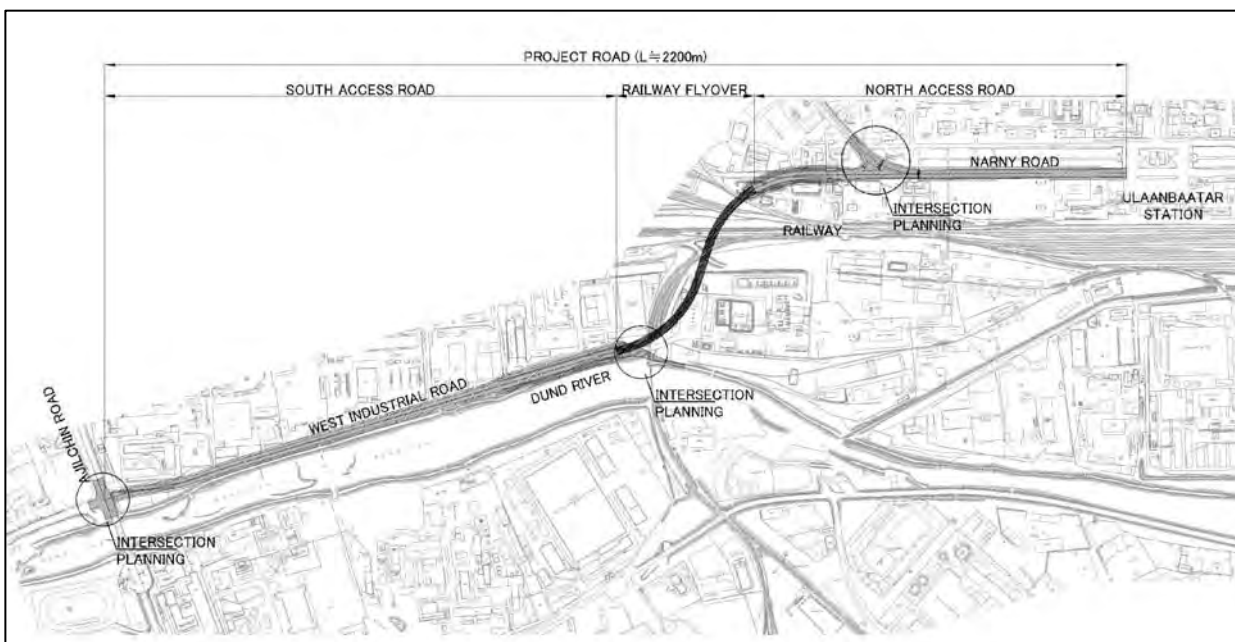


Figure 5.1 Project Area

## 6. UTILITY RELOCATION PLAN

As the result of utility survey and subsequent discussion with related utility administration offices, the following relocation works have been identified to be necessary for smooth implementation of the Project. Underground utilities will be relocated principally to outside of carriage way such as under the sidewalk for easy maintenance.

Table 6.1 Utility Relocation Plan

Type	Type (Title)of Utility	Specification	Relocation Plan	Implementation	Cost (MNT)
Heating Pipe	SOT-3	ø350mm x 2	Relocate to cross the new road ensuring regulated vertical clearance (H=5.0m)	After Land Acquisition	500 Million
Electricity	Underground cable at Intersection of Narny Road	10 kV x 2 L=250m	Relocate to sidewalk at south side of new road.	After Land Acquisition and Relocation of Railway Facility	801 Million
	Underground cable in the existing river dike along Dund River	10 kV x 2 L=500m	Relocation to new traffic strip.	Before Land Acquisition	
	Underground cable at intersection with West Industrial Road.	10 kV x 2 L=50m	Elevation shall be change in accordance with new road profile..	Before Land Acquisition	
	Cables along Water Pipe crossing Dund River.	10 kV x 4 L=50m	Elevation shall be change in accordance with new road profile.	Before Land Acquisition	
	Underground Cable at intersection with Ajilchin Road.	10V x 1 L=100m	Elevation shall be change in accordance with new road profile..	Before Land Acquisition	
	POL-J 42/1x120-240	35kV L=250m	Relocate to under the new side walk along Narny Road.	After Land Acquisition and Relocation of Railway Facility	
	Underground High Voltage Line	High ø50(x2) 5000V L=30m	Relocate to northern side where is in the side of private facility near P2.	Before Land Acquisition	
			Relocate with protection at the location of water pipe bridge to withstand new road widening.	Before Land Acquisition	
	Low Voltage Overhead Line and Poles	220V L=1200m Pole 16pcs	Relocate the overhead cable and poles along existing dike to road side of West Industrial Road.	Before Land Acquisition	
Water Supply and Sewage	Water Supply Steel Pipe	Ø500 L=20m	Relocate to cross the new road and dike with appropriate clearance.	After Land Acquisition	11.5 Million



	Sewage Pipe (Under Construction)	ø1200 L=380m	Relocate the extent interfered by bridge foundation to north side side-walk of new road.	After Land Acquisition and Relocation of Railway Facility	600 Million
	Sewage Pipe (No.24)	ø600 L=380m	Relocate to under the side walk on the north side subjecting to the section interfering in piers/foundations of bridge.	After Land Acquisition and Relocation of Railway Facility	150 Million
Communication	Main Cable	M1-7-14 SC1-7-13 SD10-2-3 SD10-2-4	Deepen to withstand the improvement of intersection at Ajilchin Street.	Before Land Acquisition	81 Million
		81(0) L=60m	Re-routing along West Industry Road	After Land Acquisition	2 Million
		55(B) L=220m	Re-routing along railway feeder line.	After Land Acquisition	6 Million
Railway Facility	High Voltage Underground Line	9.6kV 3x185: 20m 6.0kV 3x185: 20m 6.0kV 3x185: 5m No5 3x240: 5m No6 3x240: 5m Joint: 10 Locations	Re-routing in the Railway Premises to avoid piers.	Before Land Acquisition	145 Million
	Fiber Optics Cable for Communication	Ø130x2 L=200m	Relocate to northern side walk to avoid P9-P11.	After Land Acquisition	240 Million
	Communication Cable for Traffic Sign	Ø4x4	Re-routing in the Railway Premises to avoid piers.	Before Land Acquisition	100 Million
	Heating Pipe for Railway	Ø300x2 L=250m	Relocate to railway premises at south side of new road or to under the new side walk.	After Land Acquisition	805 Million
	Water Supply	Ø150 L=750m Protection Cover Valve ø 200 x 2 Valve ø 1000x1 Joint ø 200 x 12	Relocate to southern side of new road in railway premises. Pipe shall be under passing of Railway.	Before Land acquisition	152 Million
Total					3,594 Million

## 7. DESIGN OF FLYOVER AND ACCESS ROAD

### 7.1 ROAD PLAN

The geometric design criteria and conditions adopted for this Project are set as follows.

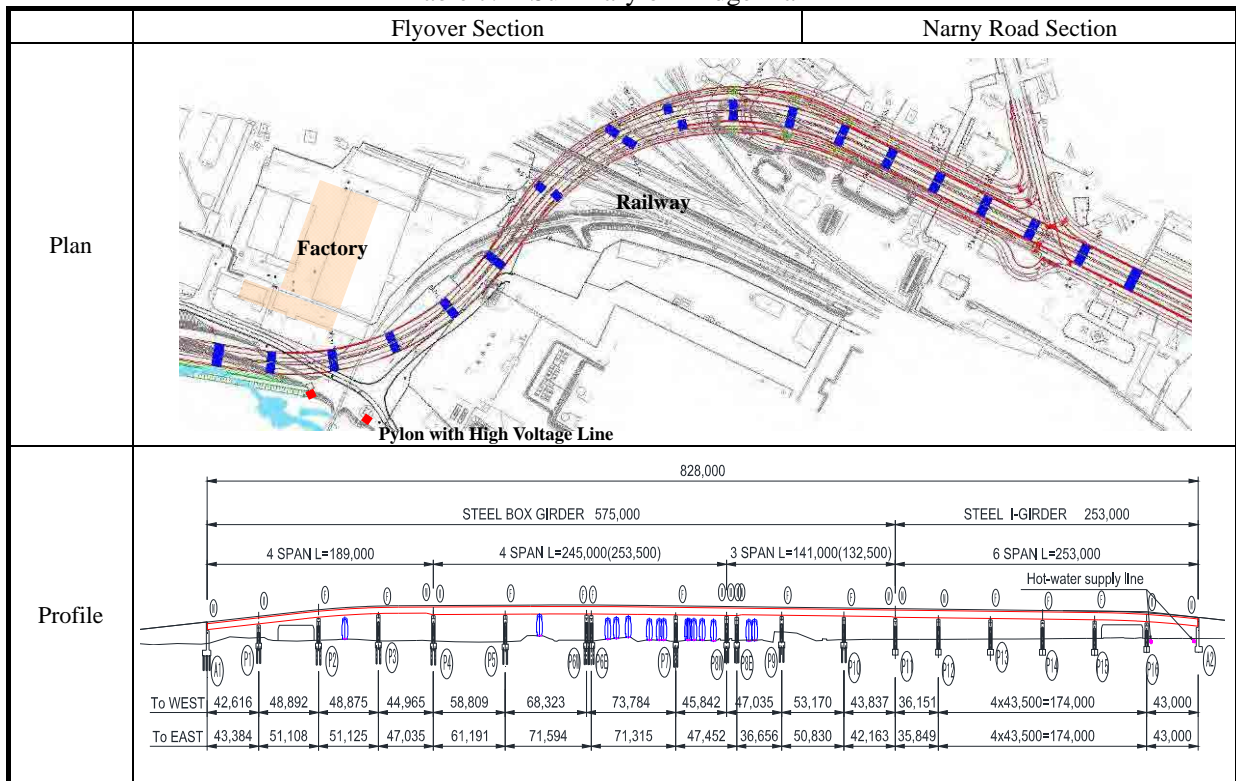
Table 7.1 Road Design Criteria

Item		Main Road	ON-OFF Ramp	Remarks
Design Speed V km/hour		60	40	
Lane Width m		3.5	3.25	
Median Zone (Marginal Strip) m		2.0 (0.25)	—	
Shoulder Width	General Part (m)	1.0	—	
	Bridge Part (m)	0.50	1.50 (External Side) 0.75 (Internal Side)	
Minimum Curve Radius R		200m	160m	
Maximum Super-elevation e%		4%	4%	
Minimum Radius without Super-elevation		2000 (Standard Grade 2%)	800	
Minimum Horizontal Curve Length		100 ( $\theta < 7:700/\theta$ )	70	
Easement Curve	Curve Length	35	35	
	Minimum Parameter	90	35	
	Minimum Radius without Clothoid Curve	500	140	
Maximum Longitudinal Grade		4.5%	4.5%	
Vertical Curve	Crest	1400	450 (Minimum Value)	
	Sag	1000	450 (Minimum Value)	

### 7.2 BRIDGE PLAN

Pier location and span arrangement are as follows.

Table 7.2 Summary of Bridge Plan



### 7.3 BASIC DESIGN CONDITIONS OF BRIDGES

The basic design conditions for bridges are set as a follows.

Table 7.3(1) Bridge Design Criteria-1

Planned Location		Naryn Road to West Industry Road, in Ulaanbaatar City
Bridge Length		828 m
Standard Road Width		8.0 m
Horizontal Alignment		A=100 ~ R=200 ~ A=100 ~ R=200 ~ A=100 ~ ∞
Design Live Load		B-Live Load in Specifications for Highway Bridges by Japan Road Association
Thermal Load		-40°C ≤ T ≤ 40°C
Design Horizontal Seismic Coefficient		Level 1 Earthquake Motion: kh = 0.10, Level 2 Earthquake Motion: kh = 0.50 (Own Natural Period: Approximately 0.4 seconds)
Superstructure	Type	Each Line Separated Structure (Main Line) Continuous Structure Twin Box Girder, Continuous Structure Steel I Girder (Ramp Section) Multi-span Continuous Box Girder
	Slab Type	Steel-Concrete Composite Deck Slab: Slab thickness is 210 mm to 250 mm.
	Bearing Type	Steel bearing
Sub-structure	Abutment and Pier	Reversed T Type Abutment, Overhang Type Cylindrical Pier, Rigid Frame Pier
	Foundation	Rotary Penetration Steel Pipe Pile: φ1000, Spread Foundation
	Bearing Stratum	GP-GC Layer

Materials to be applied for bridge design should conform to the following standards.

Table 7.3(2) Bridge Design Criteria-2

Material	Applied to	Specification
Concrete	Abutment, Pier, Wall Rail	σ <sub>ck</sub> =24 N/mm <sup>2</sup>
	Steel-Concrete Composite Deck Slab	σ <sub>ck</sub> =30 N/mm <sup>2</sup>
Reinforcing Bar		SD345 (JIS)
Steel for Structure	Superstructure	SM520, SM490Y, SM490, SM400, SS400 (JIS)
Steel Pipe for Structure	Rotary Penetration Steel Pipe Pile	SKK490 (JIS)

### 7.4 RESULTS OF DESIGN

Results of bridge and road design in this study are summarized as below.

Section	Item	The contents of the facility and renovation
<b>1. Bridge Section</b>		
	Superstructure	<b>【No.1 Bridge】</b> 4 span continuous multi box steel girder (L=189m, W=8.89m, Each lane separated structure) <b>【No.2 Bridge】</b> 4 span continuous multi box steel girder (L=245m, W=8.89~17.2m, Each lane separated structure) <b>【No.3 Bridge】</b> 3 span continuous multi box steel girder (L=141m, W=8.89m, Each lane separated structure) <b>【No.4 Bridge】</b> 6 span continuous steel I girder (L=253m, W=8.89m, Each lane separated structure) <b>【ON Ramp】</b> 3 span continuous steel box girder (L=150.9m, W=6.39m) <b>【OFF Ramp】</b> 3 span continuous steel box girder (L=123.6m, W=6.39m)
	Deck Slab	Steel Concrete Composite Slab (A=18,150m <sup>2</sup> )
	Erection Method	Crane vent method and Launching erection method (Above railway tracks)
	Substructure	Abutment: Reversed T Abutment, n=4 (Main bridge: n=2, Ramp: n=2)

Section	Item	The contents of the facility and renovation
		Pier: (P1~P5, P9~P16) Cylindrical Pier (with Beam), n=30 (Main bridge: n=26, Ramp: n=4) (P6~P8) Frame rigid with cylindrical pier, n=6 Foundation: (A1~P10) Rotary Penetration Steel Pipe Pile (φ1000, t=14mm, n=167, L=897m), (P11~A2) Spread Foundation, n=12
	Accessory	Road lighting, Drainage, Heat insulating plate, Guard fence, Unseating prevention device
<b>2. East Approach Road</b>		
	Road Length	Main road: 515 m 【With earth wall: 167m, Without earth wall: 348 m】、 Side road: 700 m 【North side: 350m, South side: 350m】 , Service road: 510m
	Other Facility	Drainage, Guard fence, Road marking, Street lighting, Anti-skid pavement, Gravity retaining wall, Reinforced earth wall (Terre Arme)
<b>3. West Approach Road</b>		
3.1 Approach Road		
	Road Length	1000 m 【With earth wall: 167m, Without earth wall : 833m】
	Other Facility	Drainage, Road marking, Street lighting
3.2 Levee Construction		
	Levee Length	915 m (Crown width: 3.0m, Slope Gradient: 1:2.0)
	Other Facility	Concrete covering slope, Ramp way to Dund river
3.3 West Industrial Road		
	Road Length	1,370m
	Other Facility	Drainage, Guardrail, Road marking, Street lighting
<b>4. Intersection:</b>		
	Location	5 locations: Beginning of this project, Connect with west industrial road, Crossing with railway feeder line, Under grade separation at Narny road, End of this project
	Other Facility	Drainage, Road marking, Street lighting, Traffic light

## 7.5 APPLICATION OF JAPANESE TECHNOLOGY

In implementing this project, it is crucial to apply the following Japanese technologies to achieve successful completion of the construction work. Significance of these technologies has been verified in the construction work of Narny Bridge completed in November 2012 under Japan's Grant Aid.

### (1) Rotary Penetration Steel Pipe Pile Method

Ajilchin Flyover has a road alignment which strides over the railway premises where the railway main lines and feeder lines are closely laid. Therefore, multiple piers need to be placed in the railway premises despite railway tracks are closely laid and limit space for arranging the piers. The rotary penetration steel pipe pile method enables to conduct construction in a limited space without harmful impact against railway operations.

### (2) Rational Structure Bridge

It is necessary to consider the site conditions, i.e. it is not possible to conduct construction work in winter and it is strongly required to safely conduct girder erection work above railway tracks. Therefore, steel concrete composite slab and steel rationalized girder structure need to be adopted to reduce site works as well as to take advantage of fabrication in winter period.

### (3) Launching Erection Method

Erection work above railway tracks shall have no influence to railway operations, and thus launching erection method applied for Narny Bridge is the best way to erect girders above railway tracks. It is required high level construction technology because road alignment has a tight 200m radius.

## 8. ENVIRONMENTAL AND SOCIAL CONSIDERATIONS

### 8.1 PROCEDURE FOR ENVIRONMENTAL IMPACT ASSESSMENT

(1) Status of GEIA for the Project

The Road Department of Ulaanbaatar City Government submitted a GEIA application to MNET on 05 April 2012. As a reply, MNET provided the department with the result of GEIA on 26 April 2012, as per attached, with instruction to carry out the DEIA.

(2) Latest Status of DEIA

DEIA for the Project was executed with assistance of Ulaanbaatar City and JICA Survey Team. The DEIA report, following confirmation by Ulaanbaatar City, was submitted to Ministry of Environment and Green Development (re-named from MNET by restructuring of government organization) on 07 December 2012 and was concurred in January 2013.

### 8.2 RESULT OF DEIA

The following table proposed mitigation measures for expected environmental impact for the Project.

Table 8.1 Prospective Environmental Impact and Mitigation Measures for the Project

Stage	Issue	Mitigation or Safeguard Measures	Executing Organization (Responsible Organization)
During Preparation/ Construction	Air Quality	<ul style="list-style-type: none"> <li>For dust emission reduction, (i) use sheet covers and (ii) spray water on construction sites and material handling areas where dust is generated.</li> <li>For mitigation of negative impacts from vehicle emissions, (i) plan routes and timetable carefully, (ii) comply with the speed limit, and (iii) conduct maintenance activities of vehicles and machinery appropriately.</li> </ul>	Construction company (PIU)  Construction company (PIU)
	Waste Management	<ul style="list-style-type: none"> <li>Recycle construction residuals as much as possible. For the un-recyclable construction waste and soil, hand over them to the approved contractors and make sure that they are disposed at the disposal site designated by UB City Government.</li> </ul>	Construction company (PIU)
	Soil Contamination	<ul style="list-style-type: none"> <li>Appropriately store chemicals and hazardous materials such as oils for construction machinery.</li> </ul>	Construction company (PIU)
	Noise and Vibration	<ul style="list-style-type: none"> <li>Use low-noise and low-vibration machinery and apply such methods.</li> <li>Use mobile noise barriers and comply with the environmental standard on noise.</li> <li>Carry out any other measures which mitigate noise and vibration, i.e., (i) restrict construction activities at night, (ii) plan carefully routes and timetable of construction vehicles and (iii) appropriate maintenance of construction machinery and vehicles.</li> <li>Monitor noise and vibration around construction sites.</li> </ul>	Construction company (PIU) Construction company (PIU) Construction company (PIU)
	Topography and Geology	<ul style="list-style-type: none"> <li>Design access road to minimize difference of elevation between access road and the existing road.</li> </ul>	Detailed design consultant (PIU)

		<ul style="list-style-type: none"> <li>• Ensure conformity with the Dound River embankment planned by UB City Government.</li> </ul>	Construction company (PIU)
	Resettlement	<ul style="list-style-type: none"> <li>• Conduct land acquisition appropriately by Department of Road and Department of Land Administration in accordance with Resettlement Report prepared by the JICA Survey Team.</li> </ul>	UB Land Dept. (PIU)
	Existing social infrastructures and services	<ul style="list-style-type: none"> <li>• Pay special attention to routes and timetable of construction vehicles and place traffic control officers in order not to cause traffic jam.</li> <li>• Apply methods which requires least time for flyover construction above the railway, and coordinate with the railway authority in order to minimize the construction impacts to railway timetables.</li> <li>• Secure users' access to existing facilities along the access roads.</li> </ul>	Construction company/ Traffic police (PIU)  Construction company (PIU)  Detailed design consultant
	Landscape	<ul style="list-style-type: none"> <li>• Consider applying a method with many piers and less walls, which secure least-obstructed view.</li> <li>• The expansion of access road along Naryn Zam near the Ulaanbaatar central station will require felling of trees. Transplant stumps/ roots of such trees if possible or replant similar trees.</li> </ul>	Detailed design consultant  PIU
	Working Conditions (Occupational Safety)	<ul style="list-style-type: none"> <li>• Pay attention to working conditions and occupational safety of construction workers in line with Mongolian laws and regulations and take measures in accordance with international standards on occupational health set by International Labor Organization, if necessity arises.</li> </ul>	Construction company (PIU)
	Accident Prevention	<ul style="list-style-type: none"> <li>• Measures to prevent work-related accidents are mentioned above.</li> <li>• Consult and coordinate with traffic police before the construction starts, and follow their advices.</li> <li>• Place traffic control officers near exit/entrance points of traffic vehicles in order to secure pedestrians' safety and avoid traffic jam.</li> </ul>	Construction company (PIU)  Construction supervising consultant/ PIU  Construction company
During Operation	Noise and Vibration	<ul style="list-style-type: none"> <li>• Consider employing consecutive bridge-girder method which requires fewer joints; as a result, noise and vibration caused by running over joints will be minimized.</li> <li>• Monitor noise and vibration around the project site, and take necessary measures such as placement of noise barrier, if necessity arises.</li> </ul>	Detailed design consultant  PIU/Road Dept. of UB City
	Poverty	<ul style="list-style-type: none"> <li>• Secure sidewalks for pedestrians along the access roads.</li> </ul>	Detailed design consultant
	Existing social infrastructures and services	<ul style="list-style-type: none"> <li>• Take safety measures such as placement of traffic lights and traffic signs of speed limits, etc, and also construction of medians.</li> </ul>	Detailed design consultant/ Construction company

### 8.3 LAND ACQUISITION AND RESETTLEMENT FOR THE PROJECT

The following are major findings from the preparatory survey.

1) “Possessed Land” are subject to the land acquisition for the Project. No owned land and or private land locate in the Project site.

2) The Project will not induce involuntary resettlement.

Table 8.2 and Table 8.3 respectively show the area of lands to be acquired and facility to be relocated and/or compensated. Table 8.4 illustrates proposed implementation schedule for land acquisition issues.

Table 8.2 Area of Land Acquisition

Item No.	Possessor	Land Use	Area to be acquired (m <sup>2</sup> )
PAP-02	SJBU LLC	Commercial	63.2
PAP-03	UB Railway Mongolian-Russian Joint Venture	Commercial	375.6
PAP-03(2)	UB Railway Mongolian-Russian Joint Venture	Green tract	3410
PAP-05	Railway Department 2	Commercial	1,919.1
PAP-06	Railway system’s Commercial business center	Commercial	4,701.8
PAP-07	Just Group LLC	Commercial	512.4
PAP-08	Railway Fire Station	Railway facility	1,890.0
PAP-09	Road transport service center of Railway	Railway facility	1,786.4
PAP-10	Khuvsgul Trade LLC	Commercial	687.5
PAP-11	Tsuurden LLC	Commercial	797.6
PAP-12	Gatsuurt LLC	Commercial	147.7
PAP-13	NOTS LLC	Commercial	2,797.2
PAP-14	Mon Carotage LLC	Commercial	1230
PAP-15	Erdenebaatar	Commercial +Housing*	400.0
PAP-16	Erdenebayar	Commercial	488.2
PAP-17	Mongol Tulkhuur LLC	Commercial	559.6
Total			21,766

Source: JICA Survey Team

\* No relocation is required.

Table 8.3 Affected Facilities and Buildings

No.	Type of Structure	Unit	Quantity	Remarks
PAP-01	Steel Fence w/concrete foundation	m	50	
PAP-02	Steel Fence w/concrete foundation	m	20	
PAP-03	Steel Fence w/concrete foundation	m	120	
PAP-03(2)	Steel Fence	m	477	
PAP-04	Gas Station (Roof and Petrol Pump)	L.S.	1	
PAP-05	Fuel Storage Tank	L.S.	1	
	2 Story building	m <sup>2</sup>	2,304	1 Nos

	Brick Building	m <sup>2</sup>	106.2	3 Nos.
	Cement square	m <sup>2</sup>	54.6	
	Removable Concrete Panel	M	117	
	Steel Fence w/concrete foundation	m	26	
	Wooden Garage	m <sup>2</sup>	1100	1 Nos.
PAP-06	Warehouses for vegetable storage pit	m <sup>2</sup>	2,138	3 Nos.
	Removable Concrete Panel	M	220	
PAP-08	Office Building	m <sup>2</sup>	1206.6	1 Nos.
	Shelter (corrugated-roof)	m <sup>2</sup>	12.6	1 Nos.
	Cement square	m <sup>2</sup>	124.5	
	Fountain	Nos.	1	
	Steel Fence w/concrete foundation	M	235	
PAP-09	2 story building for office	m <sup>2</sup>	829	1 Nos.
	Guard Post	m <sup>2</sup>	62	2 Nos.
	Cement square	m <sup>2</sup>	135	
	Wooden fence / wire net	M	210	
PAP-10	Removable concrete panel	M	65	
	Steel Fence w/concrete foundation	M	16	
PAP-11	Concrete Block Building	m <sup>2</sup>	15	1 Nos.
	Latrine	Nos.	1	
	Steel Fence w/concrete foundation	M	176	
PAP-12	Removable Concrete Panel	M	44	
PAP-13	Building	m <sup>2</sup>	245.6	1 Nos.
	Pre-fabricated building	m <sup>2</sup>	1000	1 Nos.
	Bick Building	m <sup>2</sup>	50	1 Nos.
	Garage (Brick)	m <sup>2</sup>	72.5	1 Nos.
	Cement square	m <sup>2</sup>	120	
	Iron shed for high-voltage facilities	Nos.	1	
	Latrine	Nos.	1	
	Water kiosk	Nos.	1	
	Steel Fence w/concrete foundation	M	320	
PAP-14	Pre-fabricated building	m <sup>2</sup>	133	1 Nos.
	Brick building	m <sup>2</sup>	36	1 Nos.
	Green House	m <sup>2</sup>	288	2 Nos.
	Latrine	Nos.	1	
	Removable Concrete Panel	M	244	
PAP15	Wooden Fence	M	37	
PAP-16	Wooden Building	m <sup>2</sup>	52	2 Nos.
	Latrine	Nos.	1	
	Wooden Fence	M	53	
PAP-17	Steel Fence w/concrete foundation	M	150	



Table 8.4 Implementation Schedule for Land Acquisition

Work Items	1 <sup>st</sup> Year				2 <sup>nd</sup> Year				3 <sup>rd</sup> Year				4 <sup>th</sup> Year				5 <sup>th</sup> Year				6 <sup>th</sup> Year			
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
Detailed engineering design	█																							
Tender and construction					█				█				█				█							
Public consultation					█																			
Cadastral survey	█																							
Identification of affected plot and buildings	█																							
Review of Land Acquisition and Resettlement Plan					█																			
Valuation of compensation cost					█																			
Disclosure of compensation framework to PAPs					█																			
Approval for land acquisition plan					█																			
Processing of payment					█																			
Securing land for relocation					█				█															
Restoration of affected structures on the remaining land and/or replacement land									█															
Implementation of livelihood rehabilitation measures									█				█				█							
Internal monitoring	█				█				█				█				█							
External monitoring					█				█				█				█							
Formation of Grievance Redress Committee	█																							

## 9. CONSTRUCTION PLAN

### 9.1 BASIC POLICY OF THE CONSTRUCTION PLANNING

(1) Procurement of Materials and Equipment and Work Schedule

As site construction work can be implemented only in the period between May and September, shop fabrication and procurement and transport of materials and equipment will be implemented during the rest of the year. A plan with careful consideration for the efficient implementation will be formulated so that the project can be completed in the shortest schedule. Such construction materials as concrete, asphalt, etc. will be procured from the closest existing plants as much as possible.

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.
Construction period	Severe winter season				Period for outdoor construction work				Severe winter season			
Rainy season						Rainy season						
Activities	Shop fabrication and transport of materials and equipment				Concrete work, paving work and girder erection work				Shop fabrication and transport of materials and equipment			

Figure 9.1 Basic policies for the formulation of work schedule

(2) Bridge Girder Erection Methods

Either the “launching erection method” or the “crane erection method” will be applied for construction of the viaduct in accordance with the positional relation between the construction sites, the railway lines and the existing roads. Although the schedules of international passenger trains on the main tracks cannot be changed, those of freight trains may be rescheduled for the construction work subject to prior coordination with the railway company. It is estimated that the length of such time in which trains can be stopped (window time) is approx. six hours per day.

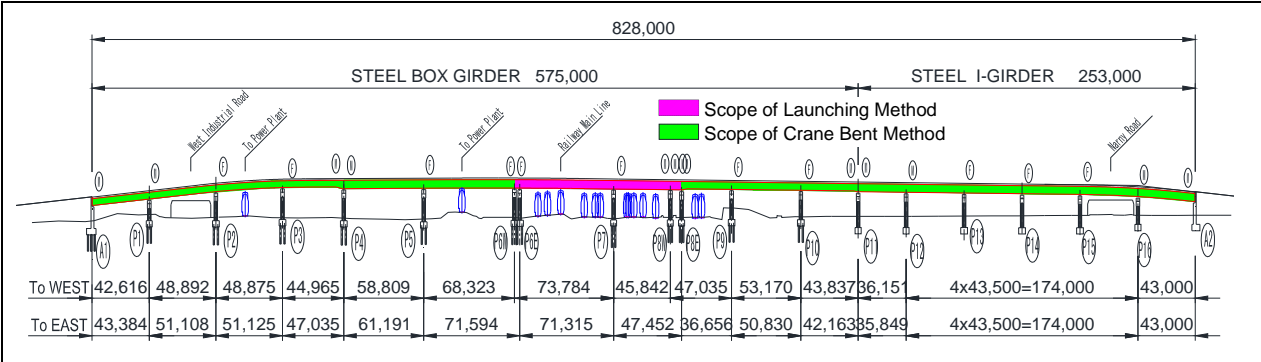


Figure 9.2 Girder erection methods for the construction of the viaduct

### 9.2 WORK SCHEDULE

Work schedule for the construction is shown in Figure 9.3. Total construction period will be 48 months.

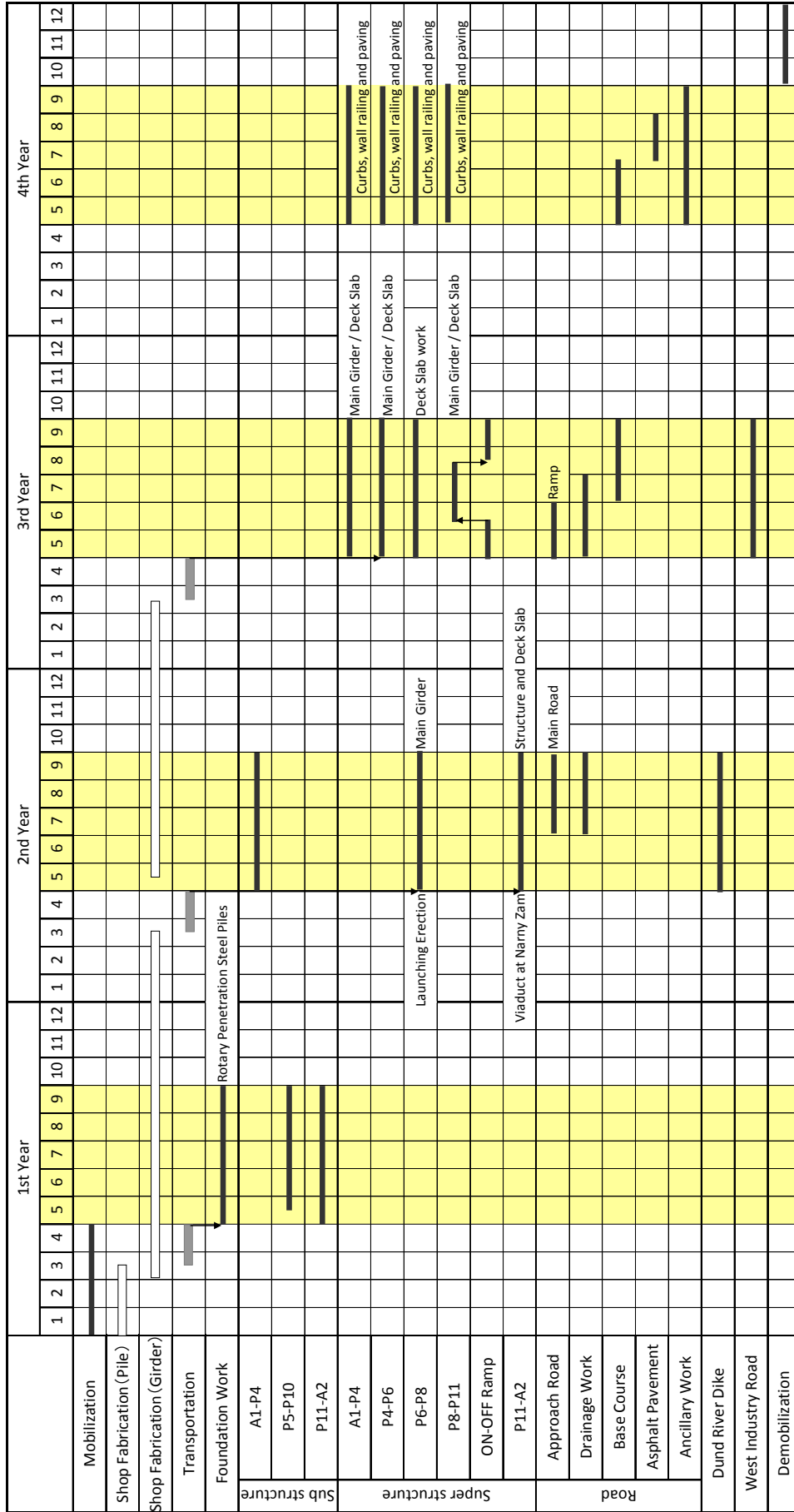


Figure 9.3 Schedule of Construction Work

## 10. OPERATION AND MAINTENANCE SYSTEM

### 10.1 INSTITUTIONAL FRAMEWORK OF PROJECT IMPLEMENTATION

According to “the Law of Mongolia on Coordination of Foreign Loans and Grant Aid (2003)”, it is stipulated that Project Implementation Unit (PIU) shall be organized in the implementation agency (e.g. Ministry of Roads and Transportation for the Project) to manage implementation of the individual project financed by foreign loan and/or grant aid.

For implementation of road projects in Ulaanbaatar City, Ulaanbaatar City has to play a role as an implementing agency such as coordination with connecting roads improvement, drainage plans, relocation of underground utilities and land acquisition. Therefore, it is important that a PIU shall be organized at the starting time of the detailed design with the staff members of the Road Department and Engineering Facility Office in charge of utility relocation and Land Administration Office in charge of land acquisition.

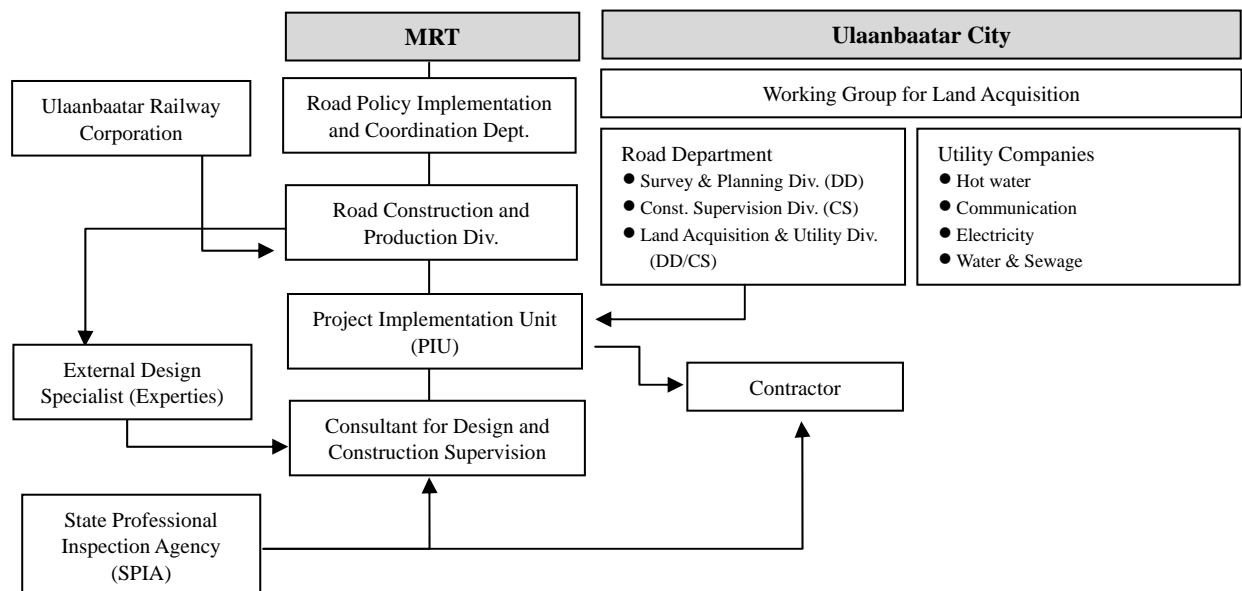


Figure 10.1 Institutional Frame of Project Implementation

### 10.2 MAINTENANCE SYSTEM

After completion of the Project, maintenance is managed by the Road Department in Ulaanbaatar City. As special maintenance work without routine maintenance such as cleaning and minor repair of surfacing of the bridge is not required for the Ajilchin Flyover for 10-20 years after construction, it is expected that Ulaanbaatar City will accumulate and improve their technologies necessary for steel bridge maintenance through several opportunities such as Technical Cooperation Scheme by JICA.

## 11. PROJECT COST ESTIMATE

Table 11.1 Summary of Project Cost

	Item	Local Cost (1000MNT)	Foreign Cost (1000JPY)	Total (1000JPY)	Remark
[1]	Construction Cost	<b>29,276,305</b>	<b>5,698,582</b>	<b>7,455,160</b>	
	(1) Direct Construction Cost	20,911,646	4,650,415		
	(2) Indirect Cost	6,723,494	845,792		30% of direct construction cost*
	(3) Overhead Cost	2,091,165	202,375		10% of direct construction cost*
[2]	Consultant Service	<b>3,683,765</b>	<b>718,308</b>	<b>939,334</b>	
	(1) Design	1,157,180	271,564		
	(2) Supervision	2,526,585	446,744		
[3]	Contingency	<b>18,396,366</b>	<b>908,431</b>	<b>2,012,213</b>	
	(1) Price Escalation	15,950,822	559,606		((1)+[2])×2.1%(JPY) ×9%(MNT)
	(2) Physical Contingency	2,445,545	348,825		((1)+[2]+[3](1))×5%
[4]	Administrative Expense	<b>9,457,441</b>		<b>567,446</b>	((1)+[2]+[3]+[5])×5%
[5]	Preparation Expense	<b>15,703,706</b>		<b>942,222</b>	
	(1) Land Acquisition Cost	8,994,091			
	(2) Utility Relocation	3,594,000			
	(3) Price Escalation	2,367,820			
	(4) Physical Contingency	747,796			
[6]	TAX	<b>5,135,644</b>	<b>732,532</b>	<b>1,040,671</b>	VAT : 10%
[7]	Interest	<b>301,525</b>	<b>46,815</b>	<b>64,907</b>	
	(1) Interest during Construction	198,415	32,101		((1)+[3] <sup>1</sup> )×0.1%, ((2)+[3] <sup>2</sup> )×0.01%
	(2) Front-End Fee	103,110	14,715		((1)+[2]+[3]+[7](1))×0.2%
	Grand Total	<b>81,954,753</b>	<b>8,104,668</b>	<b>13,021,954</b>	

Exchange Rate 1.0 MNT = 0.06 JPY/1.0 USD = 89.2 JPY = 1390.5 MNT ■ : Scope of Japanese Yen Loan

Table 11.2 Annual Fund Requirement

Unit: UP Local: 1,000 MNT  
DOWN Foreign: 1,000 JPY

		1 <sup>st</sup> Year	2 <sup>nd</sup> Year	3 <sup>rd</sup> Year	4 <sup>th</sup> Year	5 <sup>th</sup> Year	6 <sup>th</sup> Year	7 <sup>th</sup> Year	8 <sup>th</sup> Year	Total
Construction Cost	Local			3,591,266	9,250,776	8,930,674	7,503,589	0	0	29,276,305
	Foreign			1,862,656	1,857,210	1,292,905	685,810	0	0	5,698,582
Consultant Service	Local	968,636	692,301	503,757	503,757	503,757	503,757	3,900	3,900	3,683,765
	Foreign	221,338	138,550	88,324	88,324	88,324	88,324	2,562	2,562	718,308
Price Escalation	Local	87,177	130,222	1,208,150	4,014,786	5,081,611	5,421,775	3,229	3,871	15,950,822
	Foreign	4,648	5,880	125,511	168,645	151,250	102,807	401	463	559,606
Physical Contingency	Local	52,791	41,126	265,159	688,466	725,802	671,456	356	389	2,445,545
	Foreign	11,299	7,222	103,825	105,709	76,624	43,847	148	151	348,825
Administrative Expense	Local	253,168	954,744	2,095,346	2,572,796	2,103,011	1,472,353	2,967	3,055	9,457,441
	Foreign									0
Preparation Expense	Local	0	15,703,706	0	0	0	0	0	0	15,703,706
	Foreign	0	0	0	0	0	0	0	0	0
TAX	Local	110,860	86,365	556,833	1,445,778	1,524,184	1,410,058	749	816	5,135,644
	Foreign	23,729	15,165	218,032	221,989	160,910	92,079	311	318	732,532
Interest	Local	111	197	5,149	18,940	33,468	46,803	46,850	46,897	198,415
	Foreign	24	39	2,130	4,262	5,782	6,614	6,621	6,628	32,101
Front-End Fee	Local	103,110								103,110
	Foreign	14,715								14,715

Yen Loan	Local	1,108,715	863,846	5,573,481	14,476,72	15,275,31	14,147,38	54,336	55,057	51,554,852
	Foreign	237,309	151,691	2,182,446	2,224,150	1,614,885	927,403	9,733	9,805	7,357,421
OTHERS	Local	467,138	16,744,81	2,652,179	4,018,575	3,627,196	2,882,411	3,716	3,871	30,399,901
	Foreign	38,443	15,165	218,032	221,989	160,910	92,079	311	318	747,247
TOTAL	Local	1,575,853	17,608,66	8,225,660	18,495,30	18,902,50	17,029,79	58,052	58,928	81,954,753
	Foreign	275,752	166,856	2,400,477	2,446,139	1,775,796	1,019,482	10,044	10,122	8,104,668
JPY Equivalent		<b>370,303</b>	<b>1,223,376</b>	<b>2,894,017</b>	<b>3,555,857</b>	<b>2,909,946</b>	<b>2,041,269</b>			<b>13,021,954</b>

Exchange Rate 1.0 MNT = 0.06 JPY 1.0 USD = 89.2 JPY = 1390.5 MNT ■ : Scope of Japanese Yen Loan

## 12. ECONOMIC EVALUATION

### 12.1 PROJECT BENEFIT

#### (1) Road Network for Evaluation

Applying road network model of traffic demand forecast, the study in principle evaluates effectiveness of the railway bridge project to traffic congestion mitigation of the nearby road network as below.

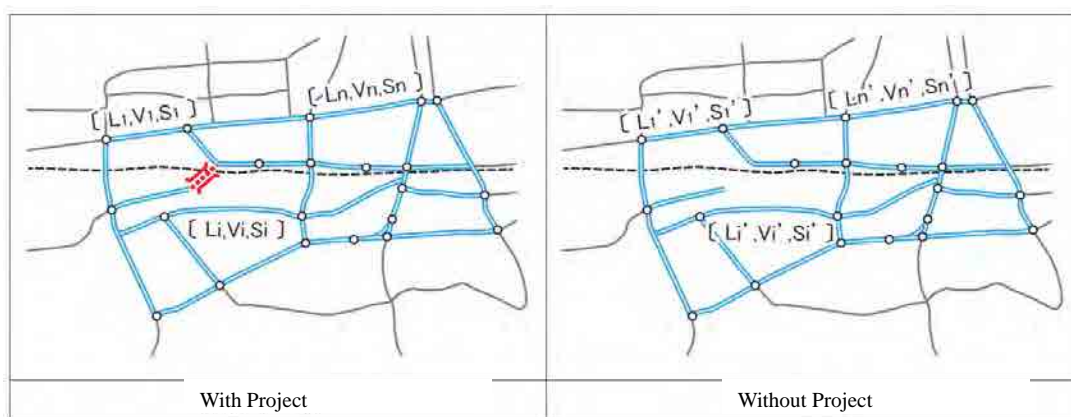


Figure 2.1 Road Network for Economic Evaluation

#### (2) VOC and Time Value

Vehicle Operation Cost (VOC) and Time Value for the Economic Evaluation have been defined as below.

Table 12.1 VOC (Unit: USD/km)

Speed	Car	Truck
10km/h	0.461	0.922
20km/h	0.274	0.547
30km/h	0.209	0.418
40km/h	0.174	0.348
50km/h	0.157	0.314

Table 12.2 Time Values per Vehicle

Unit	Time Value	
	MNT/Vehicle	USD/Vehicle
Car	1,197	0.83
Truck	1,158	0.81

## 12.2 RESULT OF ECONOMIC EVALUATION

Table 12.3 Result of Economic Evaluation

EIRR	NPV	B/C
15.8%	3,978 Million JPY	1.61

Table 12.4 Sensitivity Analysis (EIRR)

		Benefit				
		-20%	-10%	±0%	+10%	+20%
Cost	-20%	15.8%	16.9%	17.9%	18.8%	19.7%
	-10%	14.8%	15.8%	16.8%	17.6%	18.5%
	±0%	14.0%	14.9%	15.8%	16.7%	17.5%
	+20%	13.2%	14.1%	15.0%	15.8%	16.6%
	+20%	12.5%	13.4%	14.0%	15.1%	15.8%

### 13. ROAD BRIDGES CONDITION IN ULAANBAATAR CITY

(1) General

The bridge condition survey was implemented on existing 67 road bridges in Ulaanbaatar City. Soundness and seismic resistance was analyzed and evaluated for each bridge on the basis of inventory survey (collection of drawing data), visual inspection of structures, measurement of major structural dimensions, concrete strength, bar arrangement and grade of damage.

(2) Survey Result

Among all bridges in Ulaanbaatar City, most of which are Reinforced Concrete Bridges, with one steel bridge and one wooden bridge. The oldest bridge was constructed in 1960 and about 25% of all bridges were constructed more than 30 years ago. Regarding soundness of bridges, serious damages to be repaired urgently were observed in seven bridges (10% of all bridges), damages to be rehabilitated were observed in 48 bridges (72% of all bridges). Regarding seismic resistance, a relatively small number of bridges would be considered high risk due to the limited height. However, five bridges (7% of all bridges) have serious issues on safety and thus require certain measures on enhancement of seismic resistance.

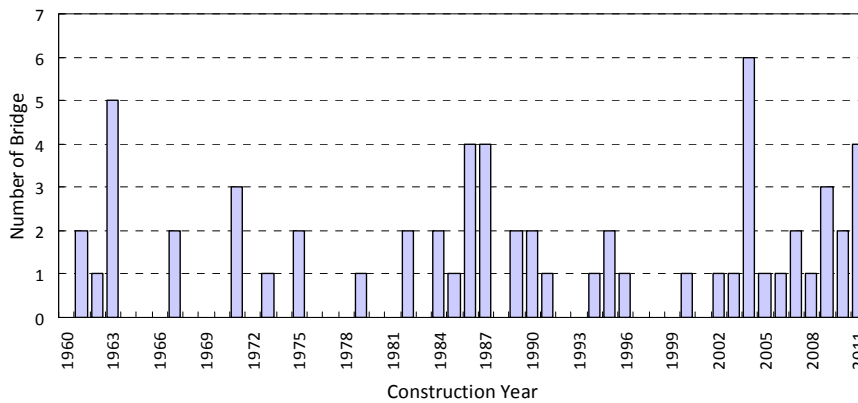
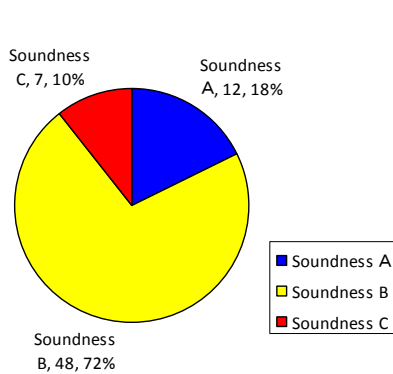
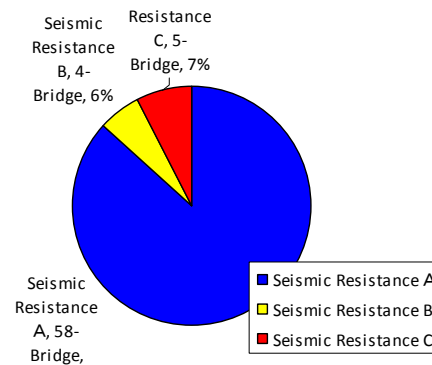


Figure 13.1 Construction Year of Road Bridge in Ulaanbaatar City



A: less damage and problems in bridge soundness  
 B: some damage but the risk of the entire bridge is low  
 C: damages in the wide area and low soundness

Figure 13.2 Summary of Bridge Soundness



A: Less problem in earthquake resistance  
 B: Seismic resistance is partially deteriorated.  
 C: low earthquake resistance

Figure 13.3 Summary of Seismic Resistance

## 14. PROJECT IMPLEMENTATION PLAN

(1) Selection of the Consultant

Six (6) months will be expected for the selection of the consultant from delivery of Request for Proposal (RFP) to designated consulting firms up to conclusion of the contract agreement after contract negotiation through preparation, submission and evaluation of the proposal.

(2) Detailed Engineering Design

Twelve (12) months will be expected for detailed engineering design (DD) including preparation and approval of bid document after the conclusion of contact agreement. In the stage of the Detailed Engineering Design, Definitive Plan Formulation based on review of topographic condition and traffic condition will be completed within five (5) months after the Contract.

(3) Land Acquisition and Relocation of Existing Utility

Land acquisition will be started immediately after the Definitive Plan Formulation during the DD stage and have to be completed in twelve (12) months before selection of the Contractor. Detailed Plan for the utility relocation will be prepared by each administration office and the relocation work will be carried out in next summer season for seven (7) months from April until October.

(4) Selection of the Contractor

Bidding process for the selection of the Contractor is described as below. The procedure on Pre-Qualification will be started immediately after Definitive Plan Formulation during the DD to minimize the period of the bidding.

Pre-Qualification (PQ)

• Preparation of PQ Documents	: 1.5-month	}	<u>5.0-month in total</u> (During the DD)
• Preparation and Submission	: 1.5-month		
• Evaluation and Approval	: 2.0-month		

Bidding

• Preparation of Bids	: 3.0-month	}	<u>10.0-month in total</u>
• Bid Evaluation and Approval	: 3.0-month		
• Contract Negotiation and Approval	: 3.0-month		
• Opening of Letter of Credit	: 1.0-month		

Note; Period for preparation of Bid Documents and its approval are included in the DD period.

(5) Construction Work

As referred to Construction Schedule, 48 months will be required for the construction work in case the contract is concluded in December. However, depending on contract date, it may be required to modify construction schedule. Accordingly, it is important to finalize the contract process as early as possible.



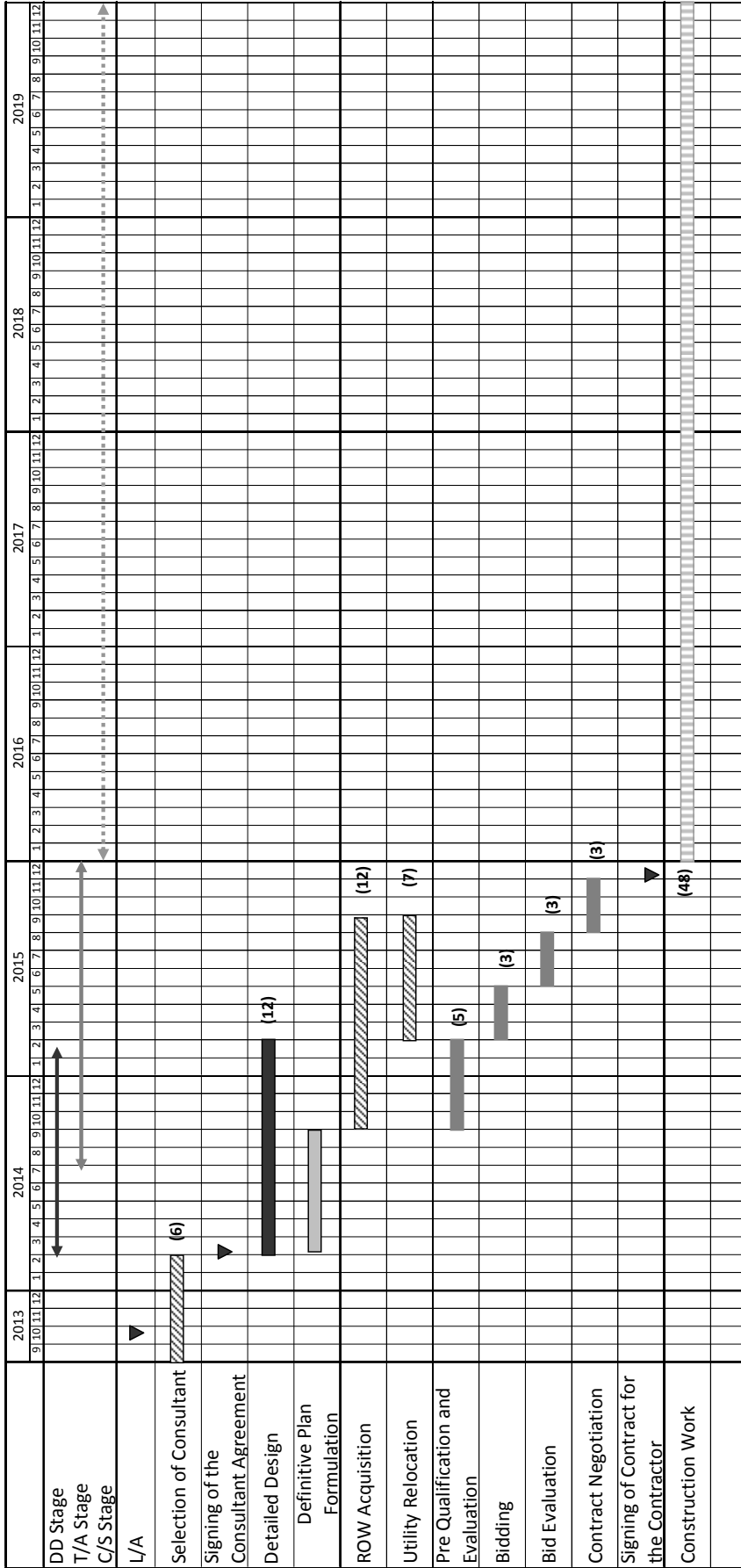


Figure 14.1 Project Implementation Schedule

## 15. PROJECT EFFECT

### 15.1 OPERATION INDICATOR

Daily traffic volume (vehicles/day) is defined as an indicator to quantitatively measure operational indicator of the Project.

Table 15.1 Daily Traffic Volume as Operation Indicator for the Project

		Base Line (as of 2012)	2021 (vehicles/day)	
			WO/ Case	W/ Case
1	Ajilchin F.O.	--	--	29,640
2	Narny Bridge <sup>1)</sup>	24,120	30,760	24,960
3	Peace bridge	49,300	49,240	46,900
4	Gulvaljin Bridge	48,700	67,640	52,870
5	Peace Avenue <sup>2)</sup>	66,900	70,180	55,270

WO/Case; Without Project, W/Case; With Project

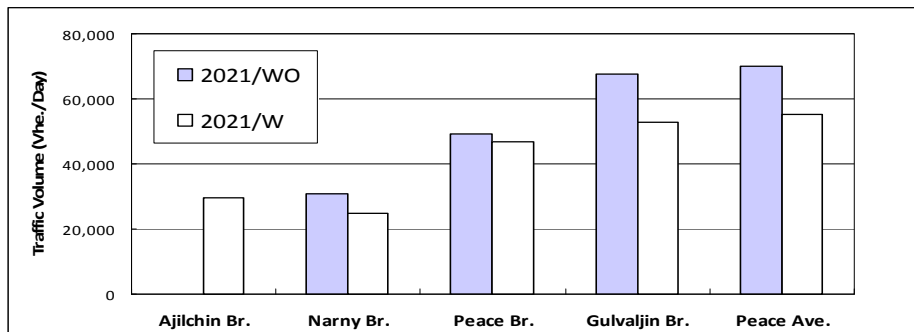


Figure 15.1 Daily Traffic Volume in 2020 (Without Case / With Case)

### 15.2 EFFECT INDICATOR

#### i) Travel Time

Travel time is one of the Effect Indicators for the Project. Average of inbound and outbound from Ulaanbaatar railway station to intersection of Ajilchin Street and West Industrial Road (L=3.5km) is the Base Line as of 2012. "With Case" is measured by the Travel Time of Project road including Ajilchin Flyover (L=2.25km).

Table 15.2 Travel Time Indicator

	2012	2021
	BASE LINE	Target
A.M. Peak Hour (8:00-10:00)	17 minutes	-
Mid day (12:00-14:00)	14 minutes	
P.M. Peak Hour (18:00-20:00)	28 minutes	
Daily Average	20 minutes	4minutes <sup>*1</sup>

\*1: Average Vehicle Speed  $V_{ave} = 31\text{km/h}$  (based on JICA STRAD)

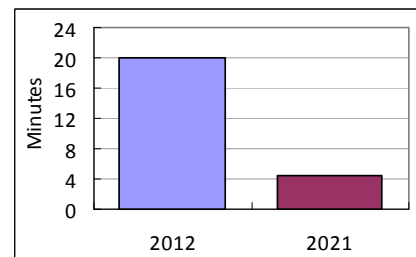


Figure 15.2 Comparison of Travel Time

#### ii) Travel Time Saving

Based on the travel time estimated as above, Daily Travel Time Saving will reach to 7,736 hours/day in 2021 with Project as shown below

Table 15.3 Travel Time Saving

	Daily Traffic Volume	Travel Time	Travel Time (Vehicle-Hour/day)
1) 2021 Without Case	29,640 (vehicle./day)	0.33-hour (20minutes)	9,781
2) 2021 With Case		0.069-hour (4minutes)	2,045
Travel Time Saving 1)–2)			7,736

iii) Vehicle Operation Cost (VOC) Saving

VOC Costs on With Case and Without Case in 2020 are estimated below. Difference between VOC Saving With and Without is defined as the Effect Indicator. It is expected that 46.1Million MNT per day will be saved after the Project in 2020.

Table 15.4 VOC Saving in 2021

	Daily Traffic Volume	Distance (km)	VOC (MNT-Vehicle./km)	Daily VOC (Million MNT/day)
1) 2021 Without Case	29,640 (vehicle./day)	3.50km	699	72.5
2) 2021 With Case		2.25km	307	20.5
VOC Saving 1)–2)				52.0

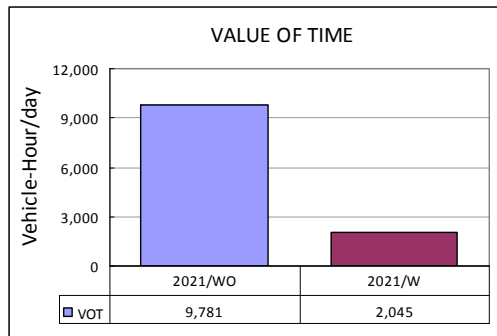


Figure 15.3 Comparison of Travel Time

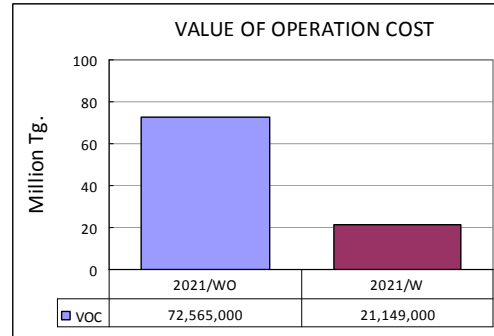


Figure 15.4 Comparison of VOC

## 16. CONCLUSION AND RECOMMENDATION

### 16.1 CONCLUSION OF PREPATORY SURVEY

- The Project is feasible from the viewpoints of technical, environmental and economic aspects. The Project fully complies with Ulaanbaatar Master Plan and Ajilchin Flyover will function as a part of east-west major corridor in the prospective road network of Ulaanbaatar City.
- Realization of the Project will induce alleviation of traffic congestion and travel time saving in the Project area resulting in significant economic effect.
- It is quite effective to apply advanced bridge construction technology from Japan pertinent to girder erection above the railway, piling work adjacent to railway in service, stable structure with highly durable steel members and so forth.

## **16.2 RECOMMENDATION FOR IMPLEMENTATION OF THE PROJECT**

- Project Implementation Unit (PIU) shall be established under the Ministry of Roads and Transportation (Implementing Agency of Mongolian Government) at the commencement of detailed engineering design work to execute ultimate management for the implementation of the Project including construction of 828m long bridge.
- It is crucial to complete relocation of existing utilities prior to commencement of construction work. To attain this task, it is necessary to identify the utilities to be relocated and to execute actual relocation work in the stage of detailed engineering design. It is also required for Ulaanbaatar City to control the Project site so that no additional utilities are installed prior to project implementation.
- It is necessary to review and update resettlement action plan in the stage of detailed engineering design in accordance with the final Right-of-Way. For thorough completion of land acquisition prior to commencement of construction work, it is crucial to start resettlement action along with detailed engineering design work.
- It is recommended to carry-out i) widening of road in front of Power Plant No.3 to 4-lane and ii) grade separation of Ajilchin Road.
- Drainage design in urbanized area shall be carefully studied during the detailed engineering design.
- After completion of the Project, maintenance will be managed by the Road Department in Ulaanbaatar City. Thus it is important that Ulaanbaatar City will accumulate and improve their technology necessary for steel bridge maintenance through Technical Cooperation Scheme by JICA.

## Abbreviations

### **A. Relevant Ministries and Agencies**

AASHTO	American Association of state Highway and Transportation Officials
ADB	Asian Development Bank
ASTM	American Society for Testing and Materials
CLEM	Central Laboratory of Environment and Meteorology
DOR	Department Of Roads
EOJ	Embassy Of Japan
GOJ	Government Of Japan
GOM	Government Of Mongolia
ITS	Intelligent Transport System
JGS	Japan Geometrical Society
JICA	Japan International Cooperation Agency
JRA	Japan Road Association
MOFE	Ministry Of Finance and Economy
MRT	Ministry Of Road, Transport
MRTCUD	Ministry Of Road, Transport, Construction and Urban Development
UB	Ulaanbaatar
WB	World Bank

### **B. Others**

A/P	Authorization to Payment
B/A	Banking Arrangement
BCR	Benefit / Cost Ratio
BH	Borehole
BP	Beginning Point
CBR	California Bearing Ratio
D/D	Detail Design
DEIA	Detailed Environmental Impact Assessment
ECC	Environmental Clearance Certification
EIA	Environmental Impact Assessment
EIRR	Economic Internal Rate of Return
EL	Elevating
EMA	External Monitoring Agency
EMP	Environmental Management Plan

E/N	Exchange of Notes
EP	End Point
F/S	Feasibility Study
GDP	Gross Domestic Product
GEIA	General Environmental Impact Assessment
GL	Ground Level
GNP	Gross Nation Product
GRDP	Gross Regional Domestic Product
GVW	Gross Vehicle Weight
HWL	High Water Level
I/C	Inception Report
JIS	Japanese Industrial Standard
JPY	Japanese Yen
Kh	Horizontal Seismic
MNT, Tg	Mongolian Tugrik
M/P	Master Plan
N	N. Value
NPV	Net Present Value
OCC	Opportunity Cost of Capital
ODA	Official Development Assistance
PAPs	Project Affected Persons
PC	Pre-stressed Concrete
PCU	Passenger Car Unit
PIU	Project Implementation Unit
RC	Reinforced Concrete
ROW	Right of Way
S	Scale
STA	Station
TL	Traffic Load
UBMP	Ulaanbaatar Master Plan
USD	United States Dollar
V	Voltage
Veh/day	Vehicle per Day
VOC	Vehicle Operation Cost
W/F	Weight Factor
$\sigma$	Concrete Compressive Stress

$\sigma_{ca}$	Concrete Allowable Comp
$\sigma_{ck}$	Concrete Specified Compression Strength
$\sigma_{py}$	Concrete Yield Point Stress
$\sigma_s$	Steel Compressive Stress
$\sigma_{sa}$	Steel Allowable Compressive Stress
$\Phi, \varphi$	Diameter

PREPARATORY SURVEY  
FOR  
THE CONSTRUCTION OF AJILCHIN FLYOVER PROJECT  
IN  
ULAANBAATAR CITY

FINAL REPORT

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# CHAPTER 1

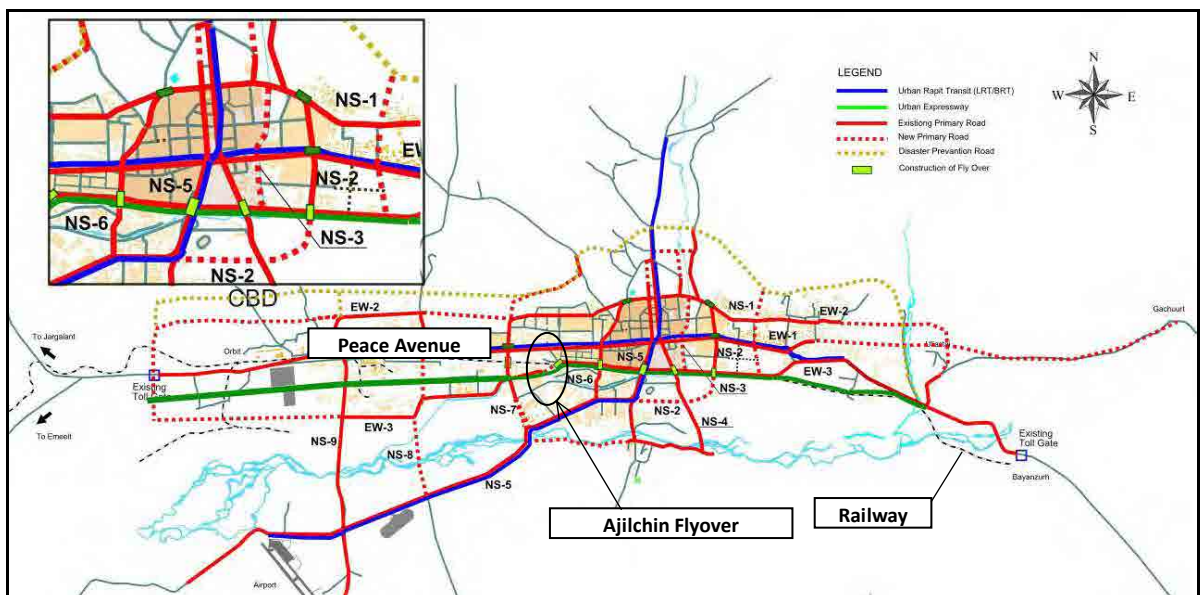
## BACKGROUND AND BASIC CONCEPT OF THE SURVEY

### 1.1 BACKGROUND

In Ulaanbaatar City, the capital city of Mongolia, where more than 40% of the national population is concentrated, traffic volume of vehicles has been rapidly increasing over the past few years as a consequence of the economic growth, and this trend is expected to be maintained in the future.

It was concerned that the worsen traffic situation would adversely affects to the socioeconomic in Ulaanbaatar City. In addition, the railway which is most important logistic system for Mongolia has been crossing center of Ulaanbaatar City from east to west, and it is accordingly hamper the road traffic flow of north-south direction since only three (3) railway crossing bridge are existing. Traffic congestion on the bridges and its access roads are much serious so that new road network development crossing the railway has been urgently required.

To improve such situation, JICA executed “The Master Plan Study on Improvement and Rehabilitation of Road Network in Ulaanbaatar in Mongolia” in 1999 to formulate the Road Network Master Plan and conduct the feasibility study (F/S) of prioritized projects based on the Ulaanbaatar City Planning Master Plan (2020) formulated by the Ulaanbaatar City Government at that time. In addition, to accommodate the progress of urbanization at a greater-than-expected speed, “the Study on City Master Plan and Urban Development Program of Ulaanbaatar City” (by JICA, 2007 to 2009; hereinafter referred to as “the JICA M/P”) was implemented. The JICA M/P suggested that new road networks and public transportation system be established by 2030.



Source: Study on City Master Plan and Urban Development Program of Ulaanbaatar City (JICA, March 2009)

Figure 1.1.1 Road Network Development Plan (2030) Proposed under the JICA M/P.

The JICA M/P was reviewed and modified by the Construction Urban Development and Planning Department in Ulaanbaatar City (hereinafter referred to as UB M/P) and was approved by the diet in January 2013. The Construction of Ajilchin Flyover (hereinafter referred to as “the Project”) is one of the highest priority projects in the UB M/P, which will eliminate several missing-links caused by railway in the center of Ulaanbaatar City.

Based on such situation stated above, Government of Mongolia discussed with JICA to conduct a preparatory survey for the Project and Minutes of Discussion was concluded among JICA and Government of Mongolia on 7<sup>th</sup> December 2011.

## **1.2 OBJECTIVE OF THE SURVEY**

The objective of the preparatory survey is to provide such crucial data and information as the project outline, cost estimate, implementation plan, environmental and social impact and so forth for appraisal of the Project realization under the scheme of Japanese yen loan.

## **1.3 SURVEY ITEMS**

The following surveys and studies have been carried out in the respective stages of the Survey:

- Stage 1: Formulation of Project Components based on Background and Necessity of the Project
  - i) Preparation of Inception Report and discussions on the methodology of the Survey
  - ii) Investigation and confirmation of the background of the Project/Data collection on laws and regulations related to the road and transport sector
  - iii) Site condition survey/study on road alignment, bridge location and project coverage
  - iv) Investigation on condition of existing roads and bridges in Ulaanbaatar City
  - v) Survey on environmental and social considerations
  - vi) Formulation of project components and framework
- Stage 2: Study on the Basic Contents of the Project
  - i) Natural Condition Survey
  - ii) Selection of bridge type and road planning for access roads
  - iii) Construction planning/Operation and maintenance planning
  - iv) Maintenance plan for existing bridges in Ulaanbaatar City and proposal of technical assistance plan
  - v) Proposal of basic contents of the Project
- Stage 3: Basic Design of the Project and Examination of Project Effect
  - i) Basic design of the Project
  - ii) Project implementation plan
  - iii) Cost estimate of the Project
  - iv) Evaluation of the Project
- Stage 4: Reporting
  - i) Preparation and presentation of Draft Final Report
  - ii) Seminar on technology of bridge design and construction
  - iii) Preparation and submission of the Final Report

#### 1.4 SURVEY IMPLEMENTATION FRAMEWORK

The JICA Survey Team conducted the preparatory survey from 26 March 2012 until the beginning of 2013 in corroboration with MRTCUD, UBC and the JICA Mongolia Office through a series of discussions in the Working Group (WG) meetings chaired by the Deputy Mayor of Ulaanbaatar City and the Joint Coordination Committee (JCC) meetings chaired by the State Secretary of MRTCUD. Practical and specific discussion in the above meetings, premised on project implementation, were held to obtain a consensus with the Ulaanbaatar Railway, utility agencies relevant to relocation, and the Land Administration Department of Ulaanbaatar City.

Though the members of the JCC were replaced after July 2012 due to reorganization of the implementing agency, i.e. from MRTCUD to newly established Ministry of Roads and Transport (MRT), the preparatory survey was carried out without significant delay. The meetings and their agenda are as shown in the table below.

Table 1.4.1 List of Meetings held in the Survey

<b>Meeting</b>	<b>Date</b>	<b>Agenda</b>
Kick-off Meeting	29 March 2012	Methodology of the Survey and its Schedule based on the Inception Report.
1 <sup>st</sup> WG Meeting	26 April 2012	Result of site condition survey based on the Progress Report
2 <sup>nd</sup> WG Meeting	03 May 2012	Traffic Study and Route Selection
1 <sup>st</sup> JCC Meeting	03 July 2012	Confirmation of Bridge Route and Project Components
3 <sup>rd</sup> WG Meeting	19 October 2012	Presentation of Road and Bridge Plan based on the Interim Report.
2 <sup>nd</sup> JCC Meeting	07 November 2012	Confirmation of Road and Bridge Plan
4 <sup>th</sup> WG Meeting	27 February 2013	Presentation of Basic Design and Project
3 <sup>rd</sup> JCC Meeting	27 February 2013	Presentation of Basic Design and Project Confirmation of the Draft Final Report.

#### 1.5 MEMBERS OF THE JICA SURVEY TEAM

The members of the JICA Survey Team are as shown in the following table.

Table 1.5.1 List of Members of the JICA Survey Team

<b>Name of Expert</b>	<b>Designation/Expertise</b>
Mr. NAGATA Tsunemi	Team Leader/Road Planning
Mr. OKAZAKI Akio	Deputy Team Leader/Bridge Planner (1)
Mr. KANEKO Kimio	Traffic Planner
Mr. NAKAMURA Hitoshi	Bridge Planner (2)
Mr. OYAMA Mitsuhiro	Construction Planner/Existing Utility Survey Expert
Mr. GOTANDA Ichiro	Economic Analysis Expert
Ms. OISHI Misa	Natural and Social Environment Consideration Expert
Mr. KITAMURA Takayoshi	Existing Bridge Inspection Expert/Technical Assistance Advisory
Mr. SATO Toshiyuki	Bridge Design Assistant/Survey Coordinator
Mr. OGAWA Tsutomu	Natural Condition Survey Expert
Mr. WATANABE Masatoshi	Procurement Planner and Cost Estimator

## CHAPTER 2

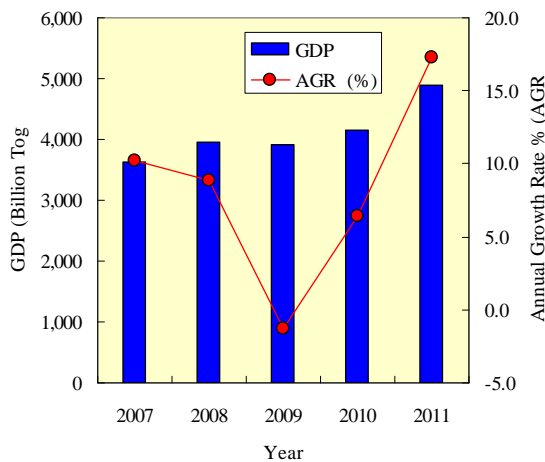
### CURRENT SOCIO-ECONOMIC AND ROAD TRANSPORT CONDITIONS

#### 2.1 SOCIO-ECONOMIC CONDITION

##### (1) Gross Domestic Product (GDP)

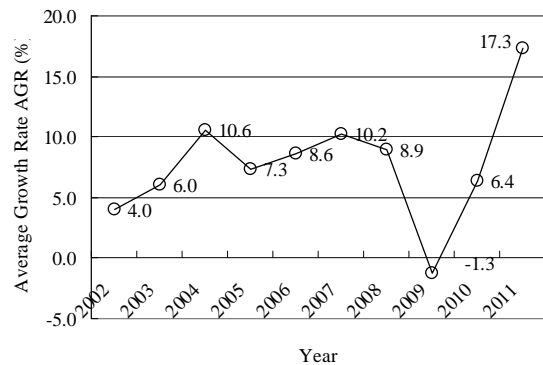
After dissolution of socialist system in 1992, the economic growth in the Mongolia has been changed by low growth until 2000 along with development of market economy. However, mainly in appreciation of steep rise of price in the global market of the mineral resources which are main export commodities, Mongolia continues stable economic growth from 2001 through 2008.

In 2008, the economic growth declined to a negative economic growth at -1.3%, due to the sudden increase of the domestic inflation rate by the steep rise of oil products price and grain price as well as the influence of the worldwide economic crisis of Lehman Shock. Nevertheless, the economic growth in 2011 recovered to 17.3% through the financial support program of the International Monetary Fund (IMF), the World Bank (WB) and the Asian Development Bank (ADB), the government policy of financial restraint, the economic recovery of China which is the largest export market for Mongolia and the re-ascension of mineral resource prices. In the near future, the economy of Mongolia is expected to have a stable growth in a similar condition before 2008 through the stable increase of the income by resource development such as coal and other minerals.



Source: Mongolian Statistical Yearbook, 2002-2011

Figure 2.1.1 GDP and Annual Average Growth Rate



Source: Mongolian Statistical Yearbook, 2002-2011

Figure 2.1.2 Trend of Annual Average Growth Rate

## (2) Gross Domestic Product by Industry

In 2007-2011 with influence of the worldwide economic crisis of Lehman Shock, the growth rate of gross domestic product by industry registered 0.86% for primary industry, 1.91% for secondary industry and 13.3% for tertiary industry. The tertiary industry is the most predominant and constant. Annual growth rate of each industry varies widely such as -7.1% to 4.7% for primary industry, -9.8% to 12.5% for secondary industry and -3.5% to 25.6% for tertiary industry (see Table 2.1.1). In 2010, the second and tertiary industries greatly rebound compared with the previous year, and contributes to the GDP growth rate of 6.4%. On the other hand, the growth of primary industries became negative due to heavy Zud (snow) damage to agriculture and livestock in spite of steep rise in price of mineral resources. With the stable price of mineral resources, however, a favorable economic growth is predicted.

Table 2.1.1 Gross Domestic Product (GDP) in Mongolia (2007-2011)

Year	Gross Domestic Product (GDP) by Industry (Billion Tog)						Total	AGR
	Primary Industry		Secondary Industry		Tertiary Industry			
	Production	AGR	Production	AGR	Production	AGR		
2007	1,417.9	-	439.7	-	1,782.4	-	3,640.0	-
2008	1,441.1	1.6	442.7	0.7	2,080.2	16.7	3,964.0	8.9
2009	1,507.8	4.6	399.3	-9.8	2,006.8	-3.5	3,913.7	-1.3
2010	1,401.1	-7.1	421.5	5.6	2,340.1	16.6	4,162.7	6.4
2011**	1,467.4	4.7	474.3	12.5	2,939.8	25.6	4,881.5	17.3
2007-2011	-	0.86	-	1.91	-	13.3	-	7.6

Source: Mongolian Statistical Yearbook, 2002-2011

Note: \*\* Preliminary estimates; AGR: Average Growth Rate (%)

## (3) Economic Growth in Ulaanbaatar City

In last years of 2007-2011, the growth rate of Gross Regional Domestic Production (hereinafter referred to as "RGDP") in Ulaanbaatar City is 14.1% in average, which far exceeds 7.6% of the GDP in Mongolia. Though GRDP in Ulaanbaatar City in 2008 was 6.9%, less than 16.7% in 2007 by 9.9%, drastic annual growth rate of 21.9% in average has been recorded from 2009 through 2011.

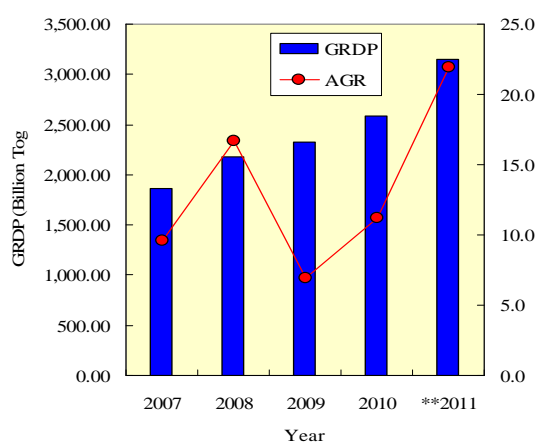
As for the share of GRDP by industry in Ulaanbaatar City in 2011, the share of primary industry is limited to 0.4%, and secondary industry and tertiary industry show high shares at 30.7% and 68.8%, respectively. The share of industry constitution generally continues to be stable from 2006, and thus it is estimated that the tendency will be continued by increment of trade scale due to development of mineral resources and certain enhancement of transport sectors.

Table 2.1.2 Gross Regional Domestic Product (GRDP) in Ulaanbaatar City (2007-2011)

Year	GRDP (Billion Tog)	AGR
2007	1,862.2	-
2008	2,173.7	16.7
2009	2,324.2	6.9
2010	2585.9	11.2
2011**	3151.3	21.9
2007-2011	-	14.1

Source: Mongolian Statistical Yearbook, 2002-2011

\*\* Preliminary estimates; AGR: Average Growth Rate (%)



Source: Mongolian Statistical Yearbook, 2002-2011

Figure 2.1.3 GRDP and Annual Growth Rate in Ulaanbaatar City

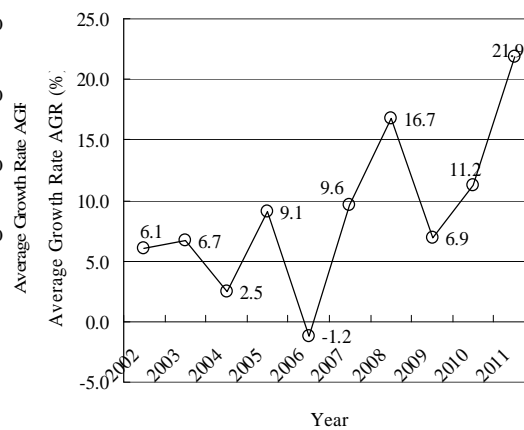


Figure 2.1.4 Annual Growth Rate of GRDP

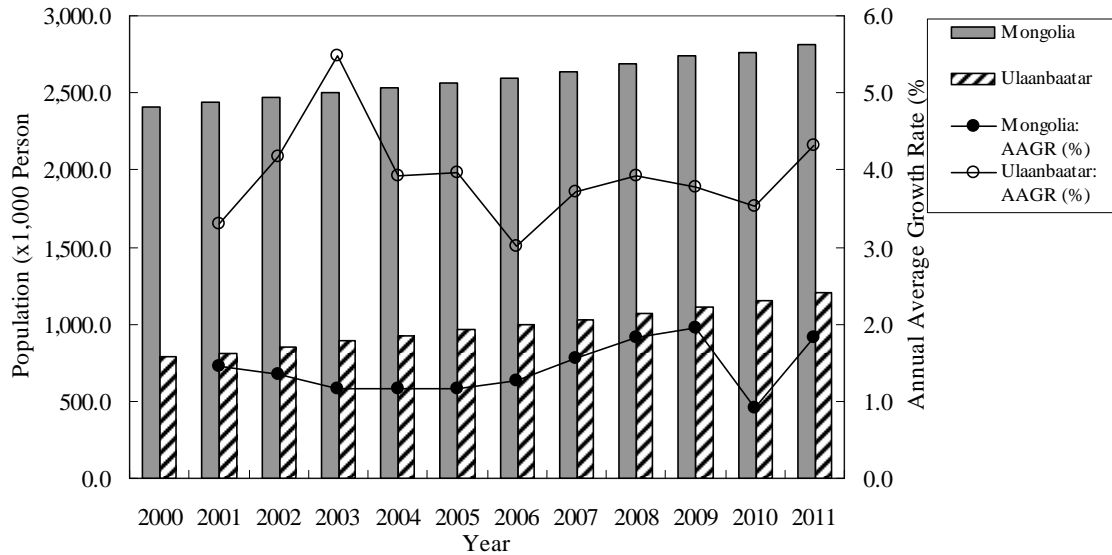
## 2.2 POPULATION AND CAR OWNERSHIP

### (1) Population

The national population of Mongolia in the last decade increased from 2,475,000 persons in 2002 to 2,800,000 persons in 2011, i.e. approximately 1.13 times. Meanwhile, the population of Ulaanbaatar City increased from 847,000 persons to 1,201,000 persons, i.e. approximately 1.42 times, in the same period. The population growth rate of Ulaanbaatar City has reached up to 3.96% (annual range of 3.0%-5.5%), which clearly illustrate rapid increase of population inflow from the local region to the urbanized area.

The population movement in the country was managed by immigration control until early 1990s. However, the population inflow to Ulaanbaatar City increased with the liberalization of movement in 1997. Mongolia experienced heavy Zud (snow) damages in 2003, and the annual population growth rate in Ulaanbaatar City significantly increased to 5.5%. Afterwards, the growth rate has been kept around 3.5% or more. In connection with population growth and

economic growth in Ulaanbaatar City, it is predicted that traffic congestion in the city will become more serious corresponding to the increase in traffic volume.



Source: Mongolian Statistical Yearbook, 2000-2011  
 Note: AAGR, Annual Average Growth Rate

Figure 2.2.1 Annual Trend of Population in Mongolia and Ulaanbaatar City (2000-2011)

Ulaanbaatar City is composed of six (6) administrative districts and three (3) satellite cities (see Figure 2.2.2). The population growth rate in the past decade (2001-2010) of Songinokhairkhan District (population share by 24.8%) and the Bayanzurkh district (population share by 26.2%) occupying about half of the whole city population is remarkably high at 5.0% and 6.3%, respectively (see Figure 2.2.3). In future, it is predicted that trips derived from east-west direction turning out to the city center will increase.

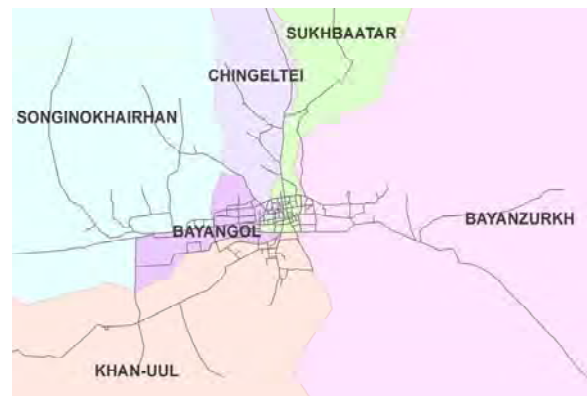


Figure 2.2.2 Administrative Districts in Ulaanbaatar City



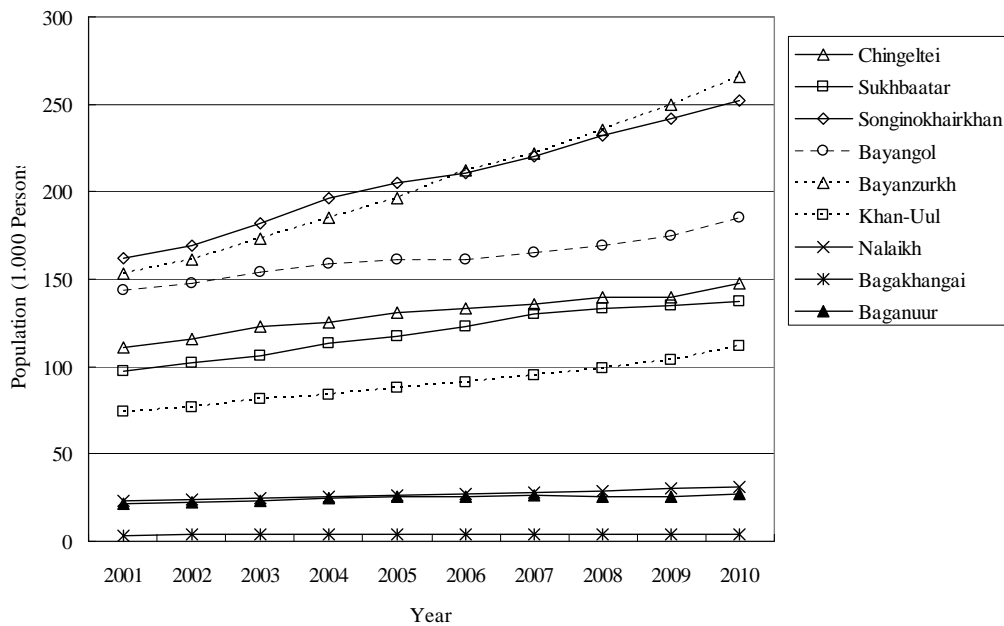
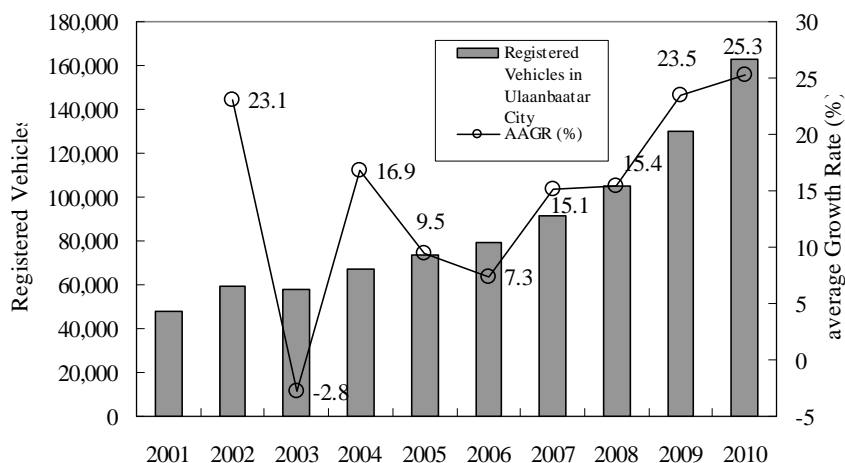


Figure 2.2.3 Annual Trend of Population by District in Ulaanbaatar City (2001-2010)

## (2) Car Ownership

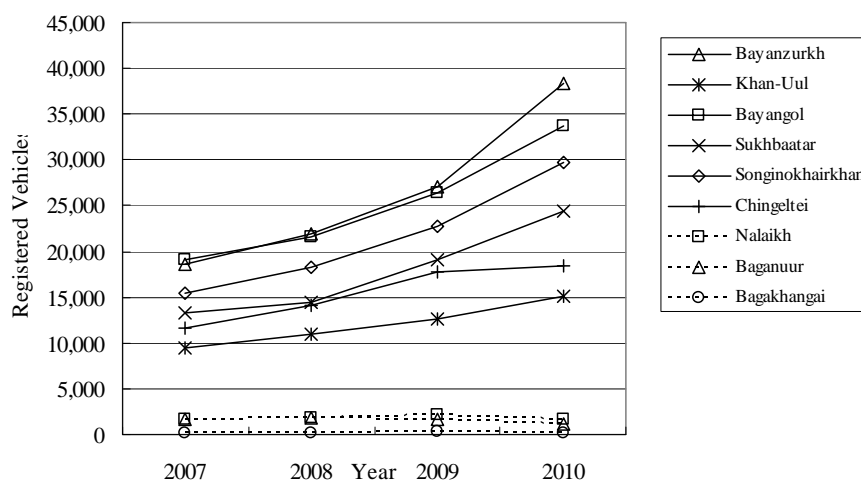
The number of car ownership in Ulaanbaatar City increases 14.4% in annual average growth in the last decade of 2001-2010 (see Figure 2.2.4). The growth rate of car ownership decreased temporarily due to the influence of heavy Zud (snow) damages in 2003; however, the growth rate increased significantly in 2007-2010. The number of car ownership increased from 48,000 vehicles in 2001 to 162,000 vehicles in 2010, i.e. approximately 3.4 times in the past ten years indicating annual average growth rate of 25.3%.

Figure 2.2.5 shows the trend of car ownership number in Ulaanbaatar City in 2007-2010. In 2010, the districts with high car ownership ratio were Bayanzurkh District (23.6%), Bayangol District (20.7%) and Songinokhairkhan District (18.3%) in proportion to their population, and the total number of car ownership in these three districts accounts for approx. 63%. Particularly, the annual average growth rate is high in the populous Songinokhairkhan District (24.8%) and Bayanzurkh District is (24.6%).



Source: Mongolian Statistical Yearbook, 2002-2010, Department of Roads, Ulaanbaatar City, 2011

Figure 2.2.4 Annual Trend of Car Ownership Number in Ulaanbaatar City (2001-2010)



Source: Mongolian Statistical Yearbook, 2002-2010, 2002-2010, Department of Roads, Ulaanbaatar City, 2011

Figure 2.2.5 Annual Trend of Car Ownership by District in Ulaanbaatar City (2001-2010)

## 2.3 CURRENT SITUATION OF THE ROAD NETWORK IN ULAANBAATAR CITY

The road network density in Ulaanbaatar City (6 administrative district excluding satellite towns) is approximately 0.14 km/km<sup>2</sup>, which indicates extremely low grade of road improvement ratio compared with major cities in foreign countries. The traffic congestion on main roads in the Ulaanbaatar City is becoming chronic due to a rapid increase in car ownership that exceeds 14% per year as described above. Specifically, the daily traffic volumes of 50,000 to 70,000 at “Peace Avenue” which is the only arterial road crossing the inner-city from east to west, and 62,200 at Peace Bridge located on the arterial road connecting north and south in the center of Ulaanbaatar City, both observed in May 2012, indicate that current traffic volume has already reached the critical limit of traffic capacity of the respective main roads in Ulaanbaatar City.

To cope with this serious situation, JICA M/P and the UB M/P recommend improvement of arterial road and development of public transportation system such as BRT and MRT. Consequently, Ulaanbaatar City has established a medium-term development plan for future road network including grade separation at main intersections (see 2.4) and 212 km long new road development (see 2.5) targeting the year 2016 in conformance with the UB M/P to expand the road network and to eliminate the traffic bottleneck at the existing intersections.

UB M/P states that establishment of efficient road network in Ulaanbaatar City is a principal issue to facilitate further land utilization including development at western area of Ulaanbaatar City and southwestern area in the vicinity of the existing airport as a sub-center of Ulaanbaatar City.

On the other hand, although the railway running east-west in Ulaanbaatar City is, an important infrastructure functioning as main logistics system in the country, it is one of the deterrent factors for road traffic by dividing Ulaanbaatar City into north and south regions. Currently, there are only 6 railway crossings in the central city; Peace Bridge, Narny Bridge, Gurvaljin Bridge, and the other 3 at-grade crossings. Flyovers for grade separation of road and railway are limited to three (3) locations including Narny Bridge completed in October 2012 under Japan’s Grant Aid scheme.

Table 2.3.1 Urban Road Network Rate of Various Countries

	Road Extension (km)	Urban Area (km <sup>2</sup> )	Road Network Rate (km/km <sup>2</sup> )
UB City	460	3,257	0.14
Tokyo 23 Wards	11,841	622	19.04
Fukuoka City	3,938	342	11.51
London	14,681	1,570	9.35
Seoul	7689	605	12.70

Source: JICA Fact-Finding Team

Table 2.3.2 Current Situation of Railway Crossing in Ulaanbaatar City

Location	Current Situation
1. Peace Bridge	Constructed in 1960 by Chinese assistance. Heavy vehicles are excluded due to insufficient durability to traffic loads.
2. Naryn Bridge	Constructed in 2012 by Japan's Grant Aid. Sufficient design capacity for heavy vehicles.
3. Gurvaljin Bridge	Constructed in 1980s by Russian assistance. Superstructure was replaced in 2011 due to progressive deterioration. Problem in seismic resistance.
4. Crossing in front of Narantuur Market	Grade separation plan was cancelled due to financial constraints. At-grade crossing was opened in 2012. Serious congestion induces safety problem.
5. Crossing on Olympic Avenue	Dual single lane crossing with quite limited traffic capacity.
6. Crossing at Sonsogolon	Intersection of Peace Avenue and Ulaanbaatar Railway. Grade separation with ADB fund was proposed. Details have not been fixed.

This situation induces traffic bottleneck at intersections and corresponding access roads near the railway crossings, and is accelerating traffic congestion in the center of Ulaanbaatar City represented by average traveling speed below 20 km/hour in the day time and below 10 km/hour in the peak hours on such main roads as Peace Avenue, Chinggis Avenue, and Ajilchin Street [see 3.3(2)].

As an urgent measure for the above-mentioned problems, another flyover is required to form a part of east-west trunk road network as well as to cross over the railway.

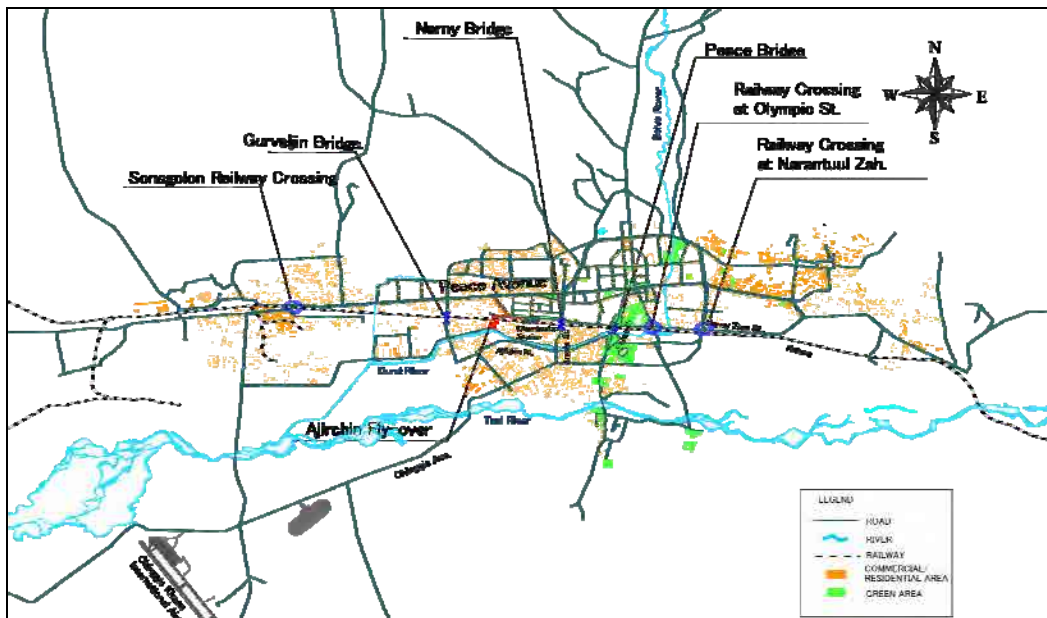


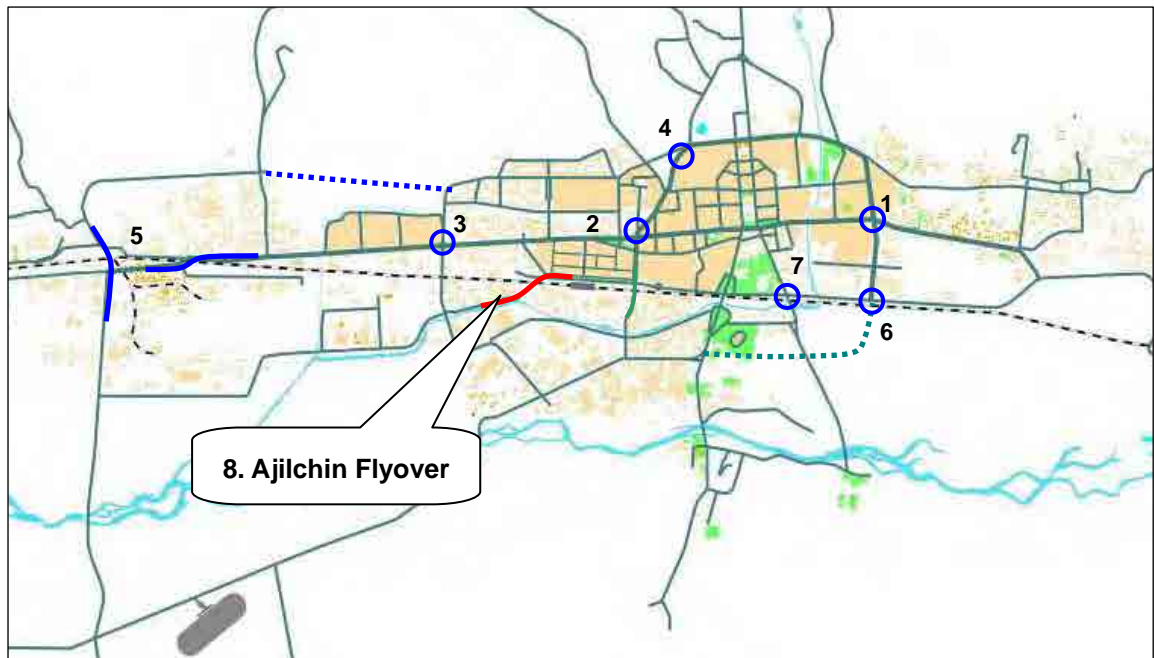
Figure 2.3.1 Railway Crossing Locations in Ulaanbaatar City

## 2.4 FLYOVER CONSTRUCTION PLAN OF MAIN INTERSECTIONS AND ITS PROGRESS

The flyover construction plan of main intersections being planned by Ulaanbaatar City consists of 8 locations as shown below including the Ajilchin Flyover Construction Project. Among the 4 flyover construction projects of which China expressed its assistance, detailed engineering design for the West Intersection has been completed and the tender process is ongoing. The other 3 intersections are going to be implemented under the Design Build Method scheme (called as “Turn-Key Method” in Mongolia).

Table 2.4.1 Intersections Subject to Ulaanbaatar City Flyover Construction Plans and their Progress

Item No.	Name of Intersection	Finance Resource	Progress	Remarks
1	East Intersection	Mongolian Government	(terminated)	Designing is finished.
2	West Intersection	Chinese Government	(terminated)	No coordination with Metro project
3	Sapporo Roundabout	Chinese Government	(terminated)	Designing is finished.
4	Bayanburd Intersection	Chinese Government	(terminated)	
5	Sonsogolon Intersection.	ADB	F/S completed	
6	Narantuul Flyover	Mongolian Government	Detailed Design	Opened at-grade crossing
7	Olympic Street Flyover	Chinese Government	(terminated)	
8	Ajilchin Flyover	-	JICA Preparatory Survey is ongoing.	JICA Survey Team



Source: JICA Study Team

Figure 2.4.1 Location of Proposed Ulaanbaatar City Flyover Construction Plan

## 2.5 ULAANBAATAR CITY ROAD RESTORATION PLAN

Ulaanbaatar City formulated the medium-term plan aiming at improvement of road network and new construction of 212 km road by 2016. With the budget for fiscal year 2012, the construction work indicated in Figure 2.5.1 and Table 2.5.1 (road extension is approximately 164 km and bridge length is approximately 1,046 m) is expected to be implemented. The following 3 projects are pointed out as associated projects with the Ajilchin Flyover Construction Project.

(1) Naryn Road Widening Project (Project No. 2.3)

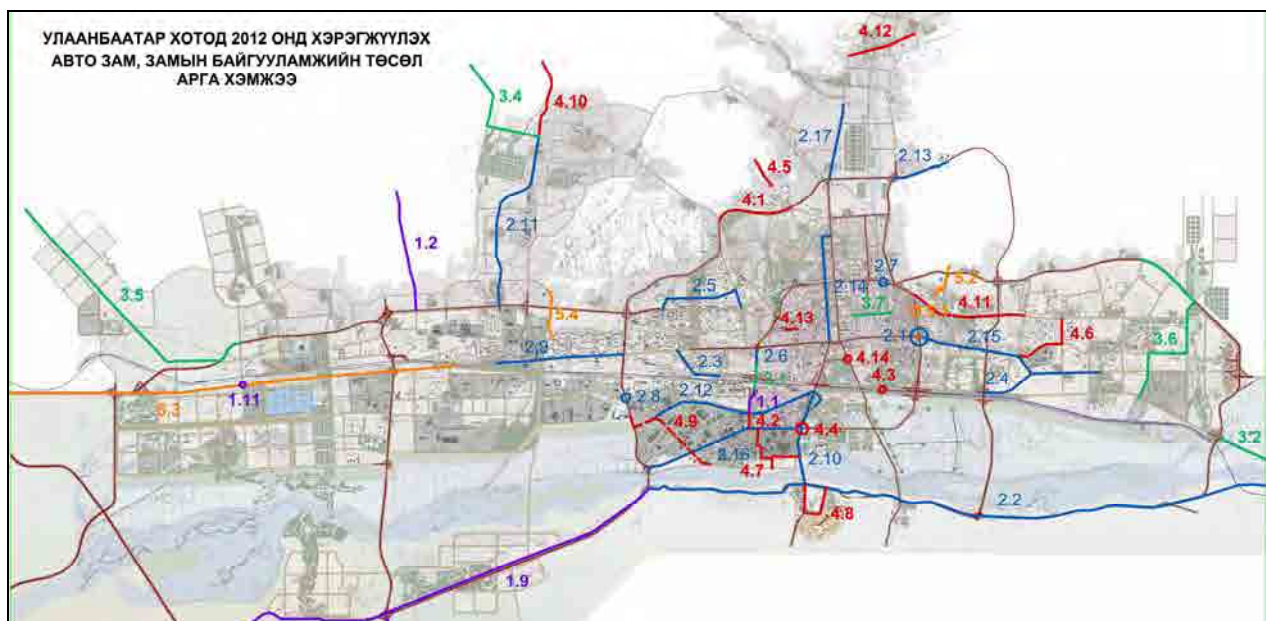
Approximately 1.0 km long road in the west end of Naryn Road (From Ulaanbaatar Station to the intersection of Peace Avenue) is to be widened from 2 lanes to 4 lanes. Detailed engineering design was completed and the construction work is ongoing.

(2) Dund River Bridge 4-Lane Plan (Project No. 2.8)

Existing bridge is currently a bottleneck of Ajilchin Street. Improvement of Dund River Bridge to 4-lane bridge by installing a new 2-lane bridge as duplication of the existing 2-lane Dund River Bridge is ongoing. According to Ulaanbaatar City, the contractor is being selected.

(3) Dund Gol Street 4-Lane Plan (Project No. 2.12)

Widening of 2-lane Dund Gol Street (4 km section from the intersection of Engels Street to the intersection of Ajilchin Street) to 4-lane road is scheduled. Detailed engineering design was completed and the contractor is being selected.



Source: Department of Roads, Ulaanbaatar City

Figure 2.5.1 Ulaanbaatar Inner City Road Improvement Project 2012

Table 2.5.1 Ulaanbaatar Inner City Road Improvement Project, 2012

Item No.	Projects	Length		Schedule	Cost (M. Tg.)	Funded in 2012
		km	l/m			
<b>1. State Budget</b>						
1.1	Angles (Naryn) bridge gate through to the Ulaanbaatar railway's company facilities funded by grant aid of Japanese Government /Ulaanbaatar			2010-2013	1,300.0	663.0
1.2	Expansion work for 48m bridge through the Dund Gol River, and rehabilitation of 0.3 km road at Angles Street (Ulaanbaatar)	0.3	48	2011-2012	3,500.0	2,000.0
1.3	Road improvement /Buyany Road, Nos. 2, 3 and 26 horoo's for Songino Hairhan District, UB			2012	1,600.0	1,600.0
1.4	Improvement of 5 km road to Belkh /Sukhbaatar District, UB	5.0		2012	3,000.0	3,000.0
1.5	5 km road from Sharga morit-Jigjid Junction to Guntiin Davaa, UB	5.0		2012-2013	3,495.7	1,000.0
1.6	Inter road's for the microregion's road rehabilitation and replacement work / Bayangol District, UB			2012	1,000.0	1,000.0
1.7	Yarmag bridge's -Airport inspection point,13.7 km road from Sonsgolon's junction to Yarmag's inspection point/ UB	13.7		2012-2013	29,000.0	10,529.6
1.8	22.5 km road for airport inspection point-Biocombinat-Shuvuun factory's direction's /UB/	22.5		2012-2014	30,489.7	2,000.0
1.9	Parallel RC bridge, 18 m, through flood protection dike in Baruun naran		18	2012	1,080.0	1,080.0
1.10	Cover force work for road through the twin line for heating facility to apartment region at the Bayangol vallye.(UB)			2012	461.0	461.0
	<b>Sub-Total</b>	<b>46.5</b>	<b>66</b>		<b>74,926.4</b>	<b>23,333.6</b>
<b>2. Ulaanbaatar City</b>						
2.1	Grade Separation of East cross road			2011-2014	28,000.0	28,000.0
2.2	17,1 km new road from Bayanzurkh inspection point on the backside through of the Bogd-Uul mountain road to go Yarmag bridge	17.1		2011-2014	15,800.0	15,800.0
2.3	Improvement and expansion for West point from Narnii zam and Railway station to the railway depot shop junction	1.0		2011-2012	1,500.0	1,500.0
2.4	Road improvement and expansion work for east side of Narnii zam, Narantuul market junction to Chuluun-Oboot junction	2.0		2011-2012	3,100.0	3,100.0
2.5	Rehabilitation and Expansion of Hasbaatar Street	2.3		2011-2012	3,200.0	3,200.0
2.6	Rehabilitation and Expansion of Constitution Street / From West cross road's multy-level's cross to Naryn flyroad bridge/	0.3		2011-2012	1,400.0	1,400.0
2.7	Rehabilitation for parallel bridge at the Selbe river L= 58x2 l/m		116	2011-2012	1,200.0	1,200.0
2.8	Newly construction of the parallel bridge, and rehabilitation of down-stream for Dund gol, Ajilchin street 35 l/m		35	2011-2012	1,100.0	1,100.0
2.9	Road expansion and rehabilitation from west area	3.2		2011-	6,500.0	6,500.0

Item No.	Projects	Length		Schedule	Cost (M. Tg.)	Funded in 2012
		km	l/m			
	of Enkhtaiwan avenue, Sapporo's safety ring to Moscow street- Trade union street junction and 5 shariin junction			2012		
2.10	Road expansion and rehabilitation from Zaizan road, junction a front of the Olympic committee building to Agricultural University	1.3		2011-2012	1,400.0	1,400.0
2.11	Road expansion and rehabilitation from Trade Union street direction to Bayanhoshuu road	3.4		2011-2012	4,100.0	4,100.0
2.12	Road expansion and rehabilitation backside of 19th region, Industrial street, Dund gol /From west direction Gandii's street up to Ajilchin street/	4.0		2011-2012	6,000.0	6,000.0
2.13	North area of Outlet's ring road's 4th section /From Dari-eh road to Gants hudag-Tsaiz-Tsagaan davaa direction/	1.1		2011-2012	1,000.0	1,000.0
2.14	Road improvement from Sukhbaatar street, South -east junction for central post office up to north direction outlet ring, Nagoon nuur street.	2.0		2011-2012	3,000.0	3,000.0
2.15	Road rehabilitation from East area for Enkhtaiwanii avenue, East 4 cross road up to Officer's palace-Chuluun Oboo-terminal staion for trolleybus	4.5		2011-2012	11,400.0	11,400.0
2.16	Road rehabilitation Chingis avenue, Yarmag bridge up to Enkhtaiwan bridge (3rd phase)	4.1		2011-2012	6,100.0	6,100.0
2.17	Road expansion and rehabilitation from Chingis avenue, MT's gasoline station up to 7 terminal station	1.9		2011-2012	3,200.0	3,200.0
	<b>Sub-Total</b>	<b>48.2</b>	<b>151</b>		<b>98,000.0</b>	<b>98,000.0</b>
<b>3. Donors Loan and Grant Aid</b>						
3.1	Naryn bridge will built the Japanese government grant aid project	0.6	262	2010-2012		
3.2	Road expansion and rehabilitation from junction form Uliastai road up to Bayanzurkh bridge	3.4	300	2011-2013		
3.3	Road expansion and rehabilitation from Bayanzurkh bridge to Nalaih Terelj junction	15.9		2011-2013		
3.4	Road Baruun salaa 4,1 km, and 18.64+27.68 m bridge	4.1	46.32	2010-2013		
3.5	7,1 km road of Orbit-Talhilt direction and 27.68+9.56 bridge	7.1	37.24	2010-2013		
3.6	6.5 km road of Botanica-Sharhad direction	6.5		2010-2013		
3.7	Expansion and Rehabilitation for Beijing street for grant aid Chinese government	0.9	75	2011-2013		
	<b>Sub-Total</b>	<b>38.5</b>	<b>720.56</b>			
<b>4. Ulaanbaatar City Road Department</b>						
4.1	1,6 km remaining work for road construction from Chingeltei district, 12th horoo, Khuchit shonhor market to Khuvisgalchdyn street junction	1.6		2011-2012	1872.0	1310.4
4.2	0,29 km road expansion and rehabilitation of Khan-Uul district 3rd horoo, Angels street /From Dund gol bridge to Tagaan haalga, at the Chingis avenue/	0.29		2012	1300.0	1300.0
4.3	Approach road and tunnel type gate for 26th horoo of Bayanzurkh district and Bayan mongol			2012	900.0	900.0



Item No.	Projects	Length		Schedule	Cost (M. Tg.)	Funded in 2012
		km	l/m			
	microregion					
4.4	Construction work for 120,000's junction, Han-Uul district			2012	1000.0	1000.0
4.5	1,2 km road from Terminal station for Denjiin-1000 to north direction area of 12th horoo, Chingeltei District	1.2		2012	1100.0	1100.0
4.6	1,5 km road improvement from Escadron memorial (Ulaanhuaran road 16th horoo, Bayanzurkh dist) to Shar hadny road through the front of National Defense University	1.5		2012	2200.0	2200.0
4.7	Road's improvement from Zaisan street to Ulaanbaatar recreation facilities and from left side junction of Tsagaan haalga to secondary school No.115. Total length of road= 2.35 km.	2.35		2012	1645.0	1645.0
4.8	1,7 km road rehabilitation for Zaisan area, 11th horoo, Han-Uul district	1.7		2012	1250.0	1250.0
4.9	Drain ditch construction for Ajilchin street road, 3rd horoo, Han-Uul district			2012	500.0	500.0
4.10	3,6 km Road rehabilitation of Zuun salaa 25th horoo, Songino hairhan district and built 1,2 km new road	4.8		2012-2013	3840.0	1545.0
4.11	2,8 km road Expansion and rehabilitation for Dorjiin street , 4th, 5th and 22nd horoo of Bayanzurkh district north side road of Tuul Jin Pang	2.8		2012-2013	5700.0	3000.0
4.12	1,6 km road improvement from police station of the Dambadarjaa to terminal station of Dambadarjaa, 18th horoo, Suhbaatar district	1.6		2012	1099.6	1099.6
4.13	0,24 km new built approach road connect for Baruun Selbe Street to Tumurchii sStreet	0.24		2012	700.0	700.0
4.14	Road expansion and improvement and arrangement to cross junction for Olympic street to Gendengiin junction			2012	450.0	450.0
	<b>Sub-Total</b>	<b>18.08</b>			<b>23,556.6</b>	<b>18,000.0</b>
<b>5. Carried-Over Project</b>						
5.1	Tunnel type pedestrians gate for Outlet ring road Sansariin tunnel		108.30	2012	1,321.6	
5.2	1,0 km road improvement from front of the 805th force division to terminal well, 4th horoo, Bayanzurkh district	1.0		2012	997.7	
5.3	Road expansion and Rehabilitation direction to 22 inspection point	10.6		2012	12,095.1	
5.4	Ger area's road back side of 34th apartment, 1st micro-region	1.3		2012	744.9	
	<b>Sub-Total</b>	<b>12.9</b>	<b>108.30</b>		<b>15,159.4</b>	

## 2.6 TREND OF ASSISTANCE FROM JAPAN

Technical and economic assistance by the Japanese Government in the past related to the Mongolian road and transport sectors are as summarized below. JICA study on “The Project for Construction of Railway Fly-Over in Ulaanbaatar City” was completed as Naryn Bridge in October

2012 and, together with the Naryn Road, the “Project for Improvement of the Roads in Ulaanbaatar” (1998 to 2003) contributes to formulating major road network in the central part of Ulaanbaatar City.

Table 2.6.1 Summary of Road and Transport Sector Projects Assisted by the Japanese Government

Cooperation	Implementation Fiscal Year	Project/Plan Name	Outline
Development Investigation	1998-1999	The Master Plan Study on Improvement and Rehabilitation of Road Network in Ulaanbaatar in Mongolia	Master plan and feasibility study related to road network development in Ulaanbaatar City (hereinafter referred to as UB City)
	2001-2002	The Feasibility Study on Construction of Eastern Arterial Road in Mongolia	Feasibility study of intercity main road development
	2007-2009	The Study on City Master Plan and Urban Development Program of Ulaanbaatar City	City structure and city infrastructure system development desired for UB City
Grant Aid	1994-1995	Project for Enhancement of Public Transportation in Ulaanbaatar City	Enhancing bus transport in the city (3.399 billion yen)
	1994-1997	The Project for the Pilot Construction Work of Ulaanbaatar-Baganuur Section of the State Road	Repair of approximately 18 km existing road between Nalaikh (suburb of UB) and Erdenet, pilot construction of approximately 13 km long new road, procurement of equipment (2.638 billion yen)
	1998-2003	The Project for Improvement of the Roads in Ulaanbaatar	Widening and rehabilitation of existing approximately 8.4 km long road, including improvement of 3 intersections, reconstruction of a bridge (L=51.12 m), and procuring equipment for road maintenance (1.948 billion yen)
	2005-2008	The Project for Construction of the Eastern Arterial Road and Improvement of Equipment for Road Construction and Maintenance in Mongolia	Intercity main road development and procurement of road construction equipment (2.856 billion yen)
	2008-2012	The Project for Construction of Railway Fly-Over in Ulaanbaatar City	Building a flyover (262 m) for crossing the railway in the east side of Ulaanbaatar Station (3.658 billion yen)
Grassroots Technical Cooperation	2010-2012	Niigata Prefectural Technical Assistance Project for Implementation of Street Drainage in Ulaanbaatar	Road drainage plan in Ulaanbaatar and construction technology transfer
	2007	Technical Assistance Project for Road Construction by Community Participation for Creation of Employment	Technical assistance in planning, designing, and constructing community roads at low cost
Dispatching Experts	2011-2013	Advisor on Improvement of Urban Traffic System in	Establishing an appropriate urban traffic system, planning details, providing

		Ulaanbaatar City	advice and guidance of urban traffic project requested to Japan
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Source: JICA Survey Team

## 2.7 TREND OF ASSISTANCE FROM OTHER DONORS/INSTITUTIONS

Assistance in the road and transport sector provided by other donors and institutions are listed in the table below. Grade separation projects planned at major intersections and railway crossings in Ulaanbaatar City with prospective loans from China were terminated in 2013. ADB launched a technical assistance project for capacity development on operation and maintenance of road sectors in 2012 under the Japan Fund for Poverty Reduction (JFPR).

Table 2.7.1 List of Assistance Projects with Funds from Other Donors

Implementation Fiscal Year	Name of Institution	Name of Plan/Project	Amount (Million USD)	Assistance Form	Outline
1995-2001	World Bank	Silk Road A	25.00	Non-free	Improvement of existing asphalt pavement; Construction of asphalt pavement road and new bridge
2001-2004		Silk Road B	25.00	Non-free	Construction of new asphalt pavement road
2004		Silk Road C	23.90	Non-free	Construction of new asphalt pavement road.
1996-2000	ADB	Asian Highway Route 3, Phase I	9.78	Non-free	Construction of low-cost pavement road (gravel paving)
2000-2005		Asian Highway Route 3, Phase II	30.13	Non-free	Reconstruction of the existing asphalt pavement. Construction of low-cost pavement road (laterite surface)
2012-2013	ADB (JFPR)	Road Sector Capacity Development Project	2.00	Technical assistance	Technical assistance project related to road maintenance operation, and quality control
2006-2009	ADB/ Korea Collaboration	Asian Highway Route 3, Phase III	3.60	Non-free	Reconstruction of the existing asphalt pavement road
1996-2002	Kuwait Fund	Asian Highway Route 83, Phase I	18.20	Non-free	Construction of asphalt pavement road
2004-2007		Asian Highway Route 83, Phase II	19.50	Non-free	Construction of asphalt pavement road
2005-2007		Local Road	5.00	Non-free	Reconstruction of existing asphalt pavement road
2005-2007	Turkish International Cooperation and Development Agency	Silk Road	4.80	Non-free	Reconstruction of the existing asphalt pavement road

Source: JICA Survey Team

## CHAPTER 3

### TRANSPORT PLANNING AND ANALYSIS

#### 3.1 REVIEW OF URBAN DEVELOPMENT PLAN IN ULAANBAATAR CITY

##### (1) Ulaanbaatar Urban Development Master Plan in 2030

###### i) Background

The study on land use plan for Ulaanbaatar City was carried out before 1980 and the Ulaanbaatar Urban Development Master Plan 2020 was formulated in 2001. To address the rapid population growth, the City Master Plan and Urban Development Program for Ulaanbaatar City was formulated by JICA in the period 2007-2009. In this study, JICA M/P was formulated by updating and/or revising the Urban Development Master Plan 2020. JICA M/P was reviewed and updated by the Urban Development Department of Ulaanbaatar Municipal Government, and was approved by the National Diet in January 2013 as UB M/P.

###### ii) Plan Overview

###### (a) Future Population Framework

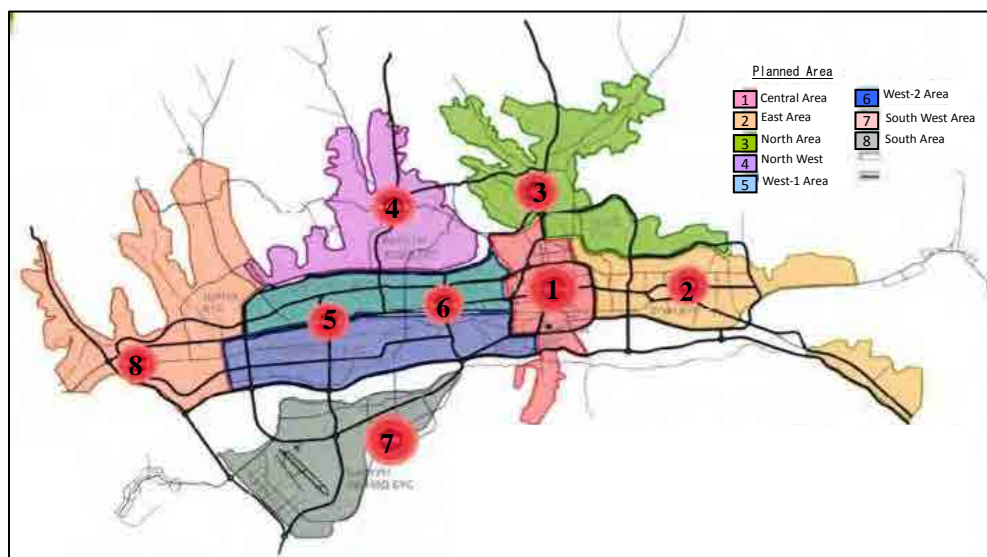
The future population framework in the Ulaanbaatar Urban Development Master Plan 2020 shows 1,250,000 persons in the target area of 35,200ha in 2020. On the other hand, the UB M/P specifies 1,400,000 persons in the target area of 47,000ha which is divided into eight (8) zones. The population framework assumed the urbanized pattern in the “compact city scenario” based on the JICA M/P. Population, urbanized area and population density are formulated corresponding to four (4) regional zones, i.e. central business district (hereinafter referred to as “CBD”), central area, urban area and suburban area. For the population frame in Ulaanbaatar City in 2030, the future population in the JICA M/P was predicted to be 1,740,000 persons (see Table 3.1.1); however, the future population in the UB M/P was reduced to 1,240,000 persons in 2020 and 1,400,000 persons (19.5% decrease) in 2030 by the UB M/P (see Figure 3.1.1).

Table 3.1.1 Comparison of Urbanization between Trend and Compact City Scenarios

Area	(A) Population			(B) Urbanized Area (ha)			(C) Population Density (A/B) (Person/ha)		
	Present (2007)	Trend (2030)	Compact (2030)	Present (2007)	Trend (2030)	Compact (2030)	Present (2007)	Trend (2030)	Compact (2030)
CBD	77,800	107,200	134,900	540	570	570	144.1	188.1	236.7
Central	469,100	588,100	657,400	4,490	5,690	4,800	104.5	103.4	137.0
Urban	243,200	394,800	547,800	4,300	6,130	5,950	56.6	64.4	92.1
Suburban	155,600	648,900	398,900	6,590	12,670	8,010	23.6	51.2	49.8
Total	945,700	1,739,000	1,739,000	15,920	25,060	19,330	59.4	69.4	90.0

Note: Urbanized Area in the “Compact City Scenario” includes the urbanized area outside of the Urbanization Promotion Area (UPA). The total area of UPA in the Zoning Map is about 18,500 ha.

Source: JICA Survey Team



No.	Zone	Total Area (ha)	2010		2020		2030	
			Households (x1,000)	Person (x1,000)	Households (x1,000)	Person (x1,000)	Households (x1,000)	Person (x1,000)
1	Central area	2,025	59.8	228.8	71.1	263.0	74.9	269.8
2	East area	3,642	42.2	159.7	51.5	190.5	59.8	215.1
3	North area	4,233	41.3	166.3	53.9	199.6	59.4	213.7
4	North-west area	2,819	31.6	127.2	33.0	122.0	33.3	120.0
5	West-1 area	2,036	58.8	239.9	86.2	241.2	66.2	238.4
6	West-2 area	3,414	16.4	60.7	24.1	89.3	28.9	104.0
7	South area	3,288.8	12.4	49.0	20.4	75.6	47.4	170.6
8	New area	4,791	39.7	19.8	14.7	54.4	19.1	68.8
Total		26,249	302.2	1,051.4	354.9	1,235.6	389.0	1,400.4

Source: Department of Roads, Ulaanbaatar City, 2012

Figure 3.1.1 Future Population Frame in Ulaanbaatar City in 2030

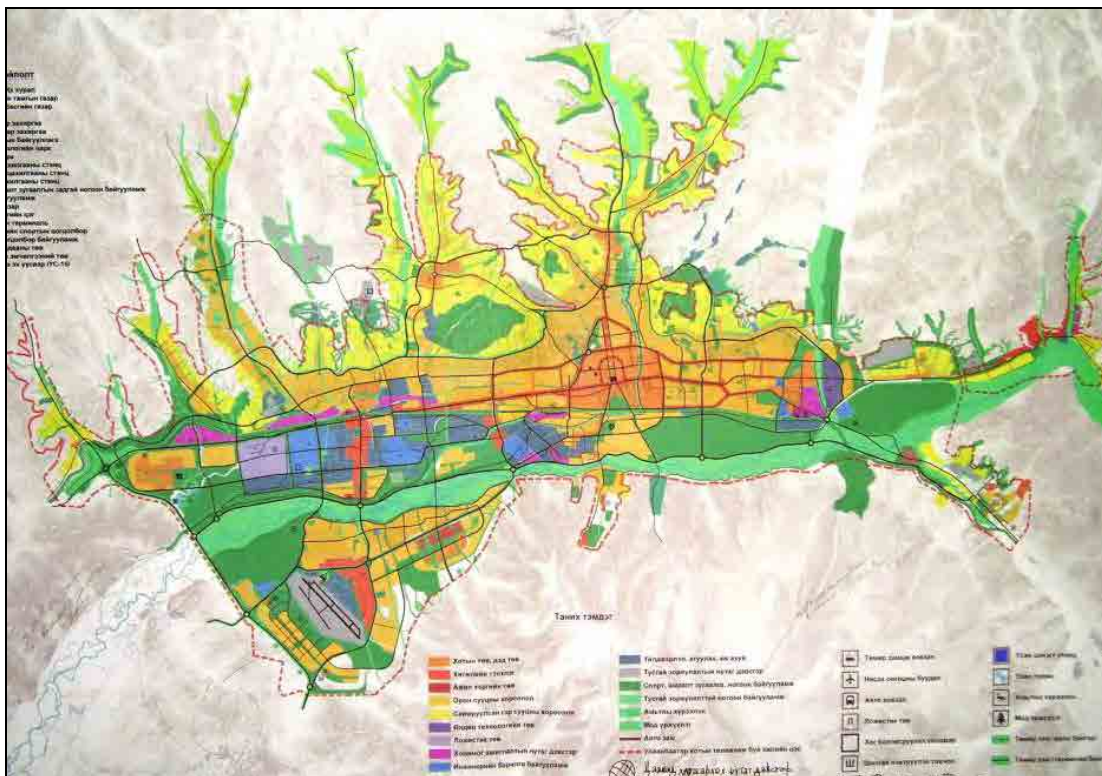
(b) Land Use Plan

Figure 3.1.2 shows the land use plan provided in the UB M/P 2030. To conceptualize the alleviation of traffic congestion and decentralization by new city center and satellite cities, Ulaanbaatar City is divided into eight (8) centers and six (6) sub-centers such as residential, commercial and government facilities, aiming to alleviate excessive concentration of daily shoppers at commercial centers.

The land use plan is to keep the existing industrial area in the western area of Ulaanbaatar City, to move factories consuming a large amount of water to the northern area of the city, and to allocate hi-technology industries in the eastern city. The mixed area of industry and residence (pink color zone) is only 20% in 2020, but will be expanded to 70% in 2030. The existing residential area (thin yellow color zone) located at the northern area of the city consists of 30% of apartments and 70% of gel houses in 2020, but the shares of apartment and gel house will be lead to 70% and 30%, respectively in 2030.

The outline of the land use plan is almost similar to the JICA M/P of 2007; and no new development plan is added. The land use plan and the population distribution are almost based on the JICA M/P, and there are only a few differences in each zone.

The urban development plan largely concerned with the traffic demand of the Ajilchin Flyover Construction Project is a development program of large-scaled new town in the southwestern area of the city. The population frame in the new town plan is reduced to 170,000 persons from the 200,000 persons of the JICA M/P. The development plan for the central area 160ha of the new town has already been approved by the government, and construction has started.



Source: Department of Roads, Ulaanbaatar City, 2012 (under revision by the Government)

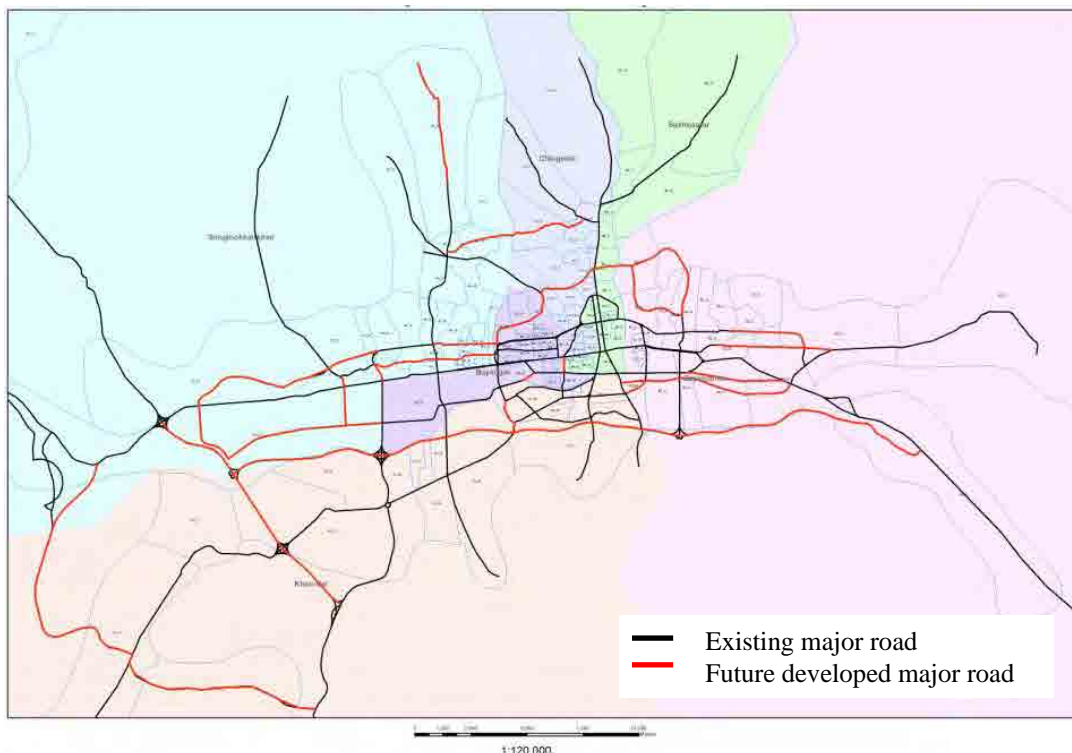
Figure 3.1.2 Land Use Plan in the UB M/P

### c) Road and Public Transport Infrastructure Plan

The road infrastructure programs in the UB M/P are proposed as below (see Figure 3.1.3). Among the program, three programs i through iii are scheduled to be completed by 2016.

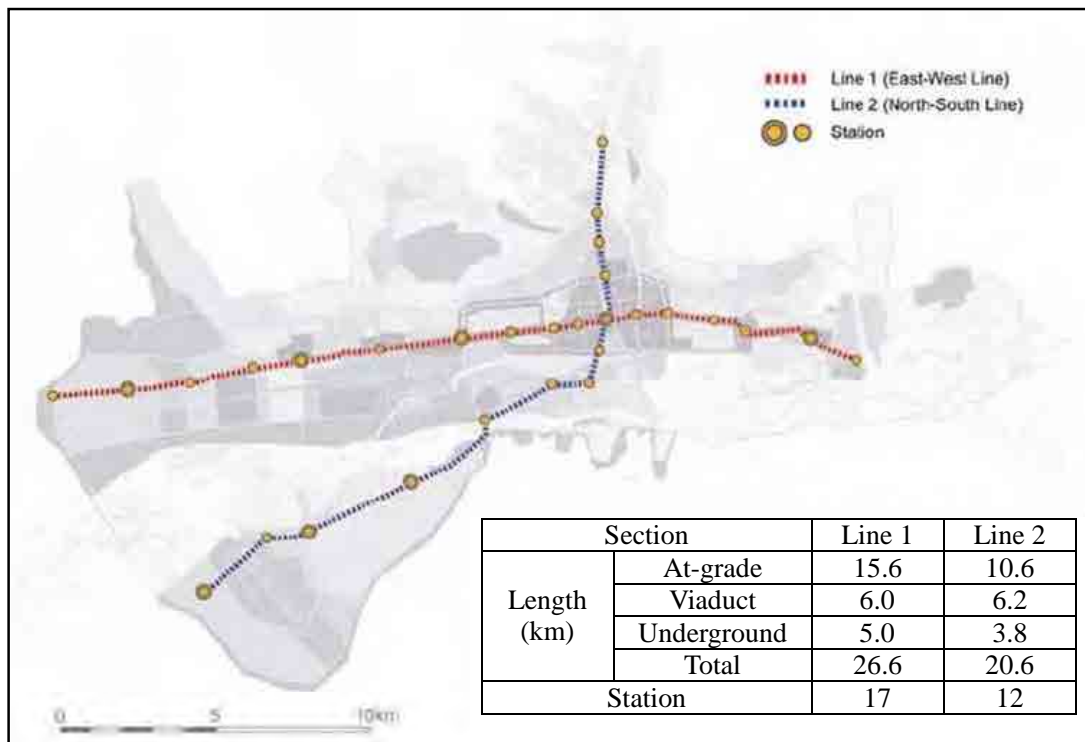
- i. Construction plan of two (2) east-west arterial roads parallel to Peace Avenue in the north-south direction;
- ii. Construction plan of an inner ring road and an outer ring road in the central city;
- iii. Construction plan of three (3) north-south arterial access roads between the east-west arterial roads;
- iv. Construction plan of an expressway along the eastern city fringe; and
- v. Construction plan of an east-west sub-expressway in the southern city.

One of two east - west arterial road mentioned above “i” has indicated the route connecting the Power Plant Road and Naryn Road going through Ajilchin Fly-over. On the other hand, the present public transport service depends on the city public bus and trolley bus. In the UB M/P, to alleviate vehicle traffic congestion and environmental influence due to exhaust gas, introduction of MRT system (Metro) into the central area and BRT system in east-west and north-south directions is planned along with operational improvement of existing trolley bus system (see Figure 3.1.4).



Source: Department of Roads, Ulaanbaatar City, 2012

Figure 3.1.3 Future Road Network Plan for Ulaanbaatar City in 2030



Source: JICA: The Study on City Master Plan and Urban Development Program of Ulaanbaatar City (UBMPS), 2009

Figure 3.1.4 Public Transport Service Plan for Ulaanbaatar City in 2030

## (2) Ulaanbaatar Urban Transport Development Project (ADB BRT Project)

### i) Plan Overview

The Ulaanbaatar Urban Transport Development Project (hereinafter referred to as the “ADB BRT Project”) is a feasibility study financed by ADB under its long-term investment program (Multi-Tranche Financing Facility: MFF) based on the financial loan of 88.0 million USD in 2013 and 88.0 million USD in 2015. The detailed design of the project is to be started in 2013. The project consists of (1) the BRT system plan (BRT corridor design, station design, bus terminal design in gel area and BRT operation plan); (2) the road improvement plan (road and bridge improvement, BRT Corridor improvement and trolley bus improvement); (3) the traffic management plan (intersection improvement, road safety improvement and traffic circulation); and (4) the parking operation and NMT plan (CBD parking control, parking control along the BRT route and the NMT plan).

### ii) BRT Operation Network Plan

The BRT operation network plan is shown in Figure 3.1.5. The BRT operation network is composed of five (5) routes such as the east-west routes centering on Peace Avenue and the three (3) north-south routes centering on Sukhbaatar-Chinggis Avenue though the CBD area (including the airport southern extension route) and other north-east route.





Source: ADB ULAANBAATAR SUSTAINABLE URBAN TRANSPORT DEVELOPMENT PROJECTS, 2012

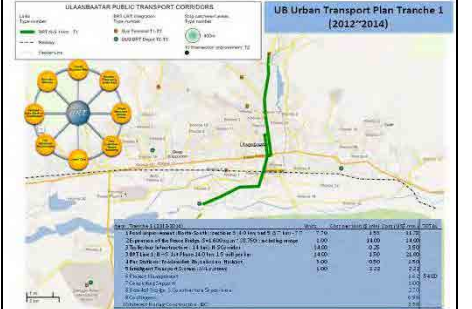
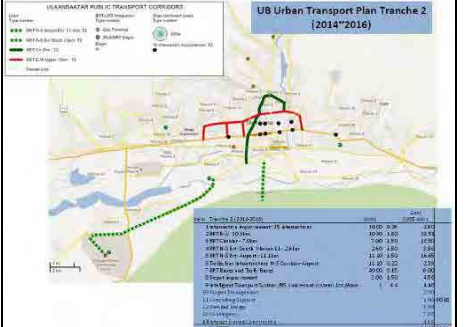
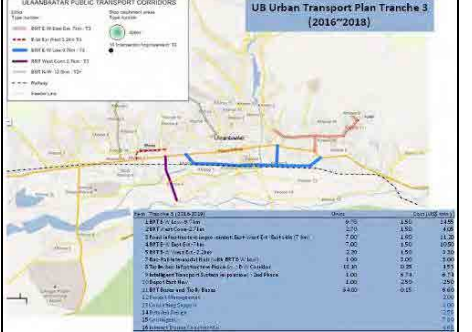

Figure 3.1.5 Ulaanbaatar Urban Transport Development Project (ADB BRT Project) (Tranche 1-3: 2012-2019)

iii) Implementation Plan of the BRT System

The BRT system will be implemented in three (3) stages: the First Stage (T1) in 2012-2014; the Second Stage (T2) in 2014-2016; and the Third Stage (T3) in 2016-2018 (see Table 3.1.2). The BRT route largely concerned with the traffic demand of the Ajilchin Bridge Construction Project is 14km long north-south route via Chinggis Avenue in the First Stage (T1 in 2012-2014) and the extension route from the airport to southern newtown in the Second Stage (T2 in 2014-2016). Of the total traffic demand volume for the Ajilchin Flyover, it is predicted that the trips generated from the airport and southwestern new town will be diverted to the BRT public transport mode.

As for the current operation of trolley bus system, the north-south route BRT located on the northern side of Peace Avenue has been terminated. It is required to re-furbish trolley buses and to improve operation schedule in accordance with the commencement of the BRT system and the Metro system. In addition, it is planned to provide pedestrian crossing facilities and to introduce Non-Motorized Transport (NMT) such as walking and/or bicycle.

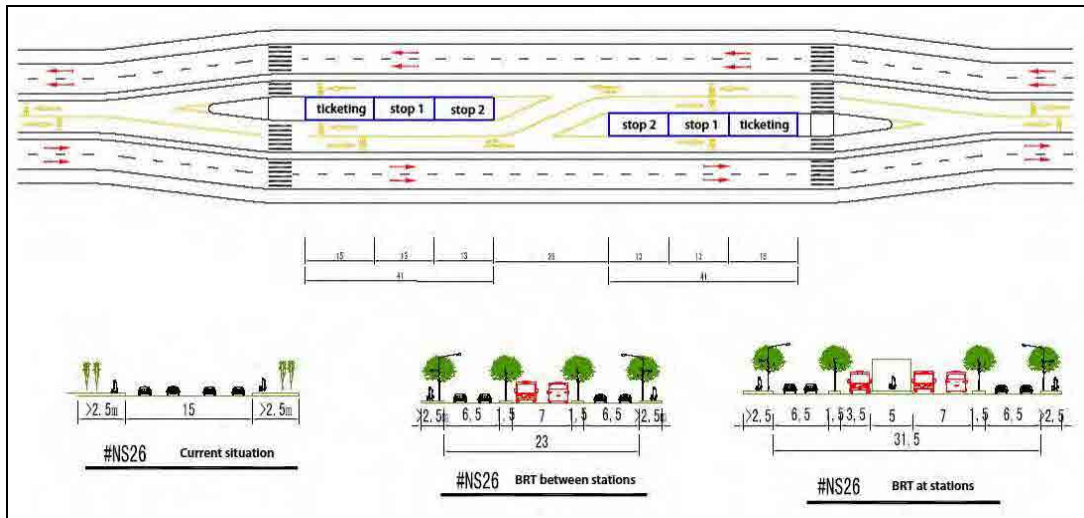
Table 3.1.2 Operation Plan of Ulaanbaatar BRT System in 2030 (Tranche 1-3: 2012-2019)

Operation Stage of BRT System	Operation Route																									
<p>BRT System:Tranche 1 (2012~2014)</p> <p>1) N-S Route:14km</p>	 <table border="1" data-bbox="981 533 1300 622"> <thead> <tr> <th>Line</th> <th>Route</th> <th>Length (km)</th> <th>Stations</th> <th>Stops</th> </tr> </thead> <tbody> <tr> <td>1</td> <td>N-S Route</td> <td>14.00</td> <td>14</td> <td>14</td> </tr> </tbody> </table>	Line	Route	Length (km)	Stations	Stops	1	N-S Route	14.00	14	14															
Line	Route	Length (km)	Stations	Stops																						
1	N-S Route	14.00	14	14																						
<p>BRT System: Tranche 2 (2014-2016)</p> <p>1) Ring Route: 7km                  2) E-W Upper Route: 10.3km                  3) N-S Airport Extension Route: 11.1km                  4) N-S Extension South Route: 2.6km</p>	 <table border="1" data-bbox="981 846 1300 958"> <thead> <tr> <th>Line</th> <th>Route</th> <th>Length (km)</th> <th>Stations</th> <th>Stops</th> </tr> </thead> <tbody> <tr> <td>1</td> <td>Ring Route</td> <td>7.00</td> <td>7</td> <td>7</td> </tr> <tr> <td>2</td> <td>E-W Upper Route</td> <td>10.30</td> <td>10</td> <td>10</td> </tr> <tr> <td>3</td> <td>N-S Airport Extension Route</td> <td>11.10</td> <td>11</td> <td>11</td> </tr> <tr> <td>4</td> <td>N-S Extension South Route</td> <td>2.60</td> <td>2</td> <td>2</td> </tr> </tbody> </table>	Line	Route	Length (km)	Stations	Stops	1	Ring Route	7.00	7	7	2	E-W Upper Route	10.30	10	10	3	N-S Airport Extension Route	11.10	11	11	4	N-S Extension South Route	2.60	2	2
Line	Route	Length (km)	Stations	Stops																						
1	Ring Route	7.00	7	7																						
2	E-W Upper Route	10.30	10	10																						
3	N-S Airport Extension Route	11.10	11	11																						
4	N-S Extension South Route	2.60	2	2																						
<p>BRT System: Tranche 3 (2016-2018)</p> <p>1) E-W Low Route: 9.7km                  2) E-W East Extension Route: 7km                  3) E-W Extension West: 2.2km                  4) West Connection Route: 2.7km</p>	 <table border="1" data-bbox="981 1193 1300 1305"> <thead> <tr> <th>Line</th> <th>Route</th> <th>Length (km)</th> <th>Stations</th> <th>Stops</th> </tr> </thead> <tbody> <tr> <td>1</td> <td>E-W Low Route</td> <td>9.70</td> <td>9</td> <td>9</td> </tr> <tr> <td>2</td> <td>E-W East Extension Route</td> <td>7.00</td> <td>7</td> <td>7</td> </tr> <tr> <td>3</td> <td>E-W Extension West</td> <td>2.20</td> <td>2</td> <td>2</td> </tr> <tr> <td>4</td> <td>West Connection Route</td> <td>2.70</td> <td>2</td> <td>2</td> </tr> </tbody> </table>	Line	Route	Length (km)	Stations	Stops	1	E-W Low Route	9.70	9	9	2	E-W East Extension Route	7.00	7	7	3	E-W Extension West	2.20	2	2	4	West Connection Route	2.70	2	2
Line	Route	Length (km)	Stations	Stops																						
1	E-W Low Route	9.70	9	9																						
2	E-W East Extension Route	7.00	7	7																						
3	E-W Extension West	2.20	2	2																						
4	West Connection Route	2.70	2	2																						
<p>LRT (Metro) System: Long-Term Plan</p> <p>1) LRT (Metro) E-W Route</p>	 <table border="1" data-bbox="981 1608 1300 1675"> <thead> <tr> <th>Line</th> <th>Route</th> <th>Length (km)</th> <th>Stations</th> </tr> </thead> <tbody> <tr> <td>1</td> <td>LRT (Metro) E-W Route</td> <td>10.00</td> <td>10</td> </tr> </tbody> </table>	Line	Route	Length (km)	Stations	1	LRT (Metro) E-W Route	10.00	10																	
Line	Route	Length (km)	Stations																							
1	LRT (Metro) E-W Route	10.00	10																							

iv) Typical Cross-Section of BRT Station

The typical cross-section of the BRT system on Chinggis Avenue which is adjacent to the route of the Ajilchin Flyover Construction Project is shown in Figure 3.1.6. At the marginal section of the road, the existing 4-lane road (carriageway 15m + sidewalk 5m = 20m) will be

widened to 6-lane road (carriageway 23m + sidewalk 5m = 28m). On the other hand, in front of the station, the existing road will be widened to 36m in whole section.



Source: ADB ULAANBAATAR SUSTAINABLE URBAN TRANSPORT DEVELOPMENT PROJECTS, 2012

Figure 3.1.6 Ulaanbaatar Urban Transport Development Project (ADB BRT Project) (Tranche 1-3: 2012-2019)

### 3.2 FUTURE SOCIO-ECONOMIC FRAME IN ULAANBAATAR CITY

#### (1) Future Population in Ulaanbaatar City

The future population forecast projected in the JICA M/P are based on the predicted values from the NSO-UNFPA (National Statistics Office, United Nations Population Fund) and the UBMP-2020 (Existing Ulaanbaatar M/P targeting the year 2020) as shown in Table 3.2.1. The average annual growth rate of population in the central 6 districts of Ulaanbaatar City was presumed at 4% until 2010 by reducing the average annual growth rate of 4.2% in 2000-2005, and the JICA M/P projected the future average annual growth rates from 2008 to 2030, as shown in Table 3.2.1, gradually decreasing from 4.2% in 2001-2005 to 2.0% in 2020-2025, and to keep this level in 2026-2030. Based on the above formulation, the future population of Ulaanbaatar City in 2010, 2020 and 2030 was projected at 1.107 million, 1.438 million and 1.739 million respectively (see Table 3.2.1 and Figure 3.2.1).

Through the comparison between the past record of population and the population projection of the JICA M/P for 2005-2010, it was observed that the JICA M/P predicted population of 1.107 million persons (average annual growth rate: 4.0%) is almost close to 1.09 million persons (ditto 3.7%), although the population decreased once in 2009 due to the economic crisis of Lehman Shock.

As for the future population framework after modification by the Urban Development Department of the Ulaanbaatar Municipal Government, the future population of Ulaanbaatar City (6 districts) was projected at 1.051 million persons (ditto 3.0%) in 2010, 1.236 million

persons (ditto 1.6%) in 2020 and 1.400 million persons (ditto 1.3%) in 2030. The future traffic demand in the Study for the Ajilchin Flyover Construction Project will adopt the future population framework adjusted by the Urban Development Department of the Ulaanbaatar Municipal Government.

Table 3.2.1 Future Population Forecasts for Ulaanbaatar City (6 districts) until 2030 (JICA M/P)

Classification		2005	2010	2015	2020	2025	2030
JICA M/P	Central UB (6 Districts) (x 1,000)	909.0	1,107.2	1,250.6	1,437.8	1,585.5	1,739.1
	Ave. Annual Growth Rate (%)	4.2	4.0	3.2	2.3	2.0	2.0
Past Record (2005-2010)	Central UB (6 Districts) (x 1,000)	909.0	1,089.9	-	-	-	-
	Ave. Annual Growth Rate (%)	4.2	3.7	-	-	-	-
Ulaanbaatar M/P	Central UB (6 Districts) (x 1,000)	909.0	1,051.4	*1,138.2	1,235.6	*1,318.0	1,400.4
	Ave. Annual Growth Rate (%)	-	*3.0	-	*1.6	-	*1.3

Source: JICA: The Study on City Master Plan and Urban Development Program of Ulaanbaatar City (UBMPS), 2009  
MONGOLIAN STATISTICAL YEARBOOK, 2002-2010

Note: \* Calculation based on the UB set value

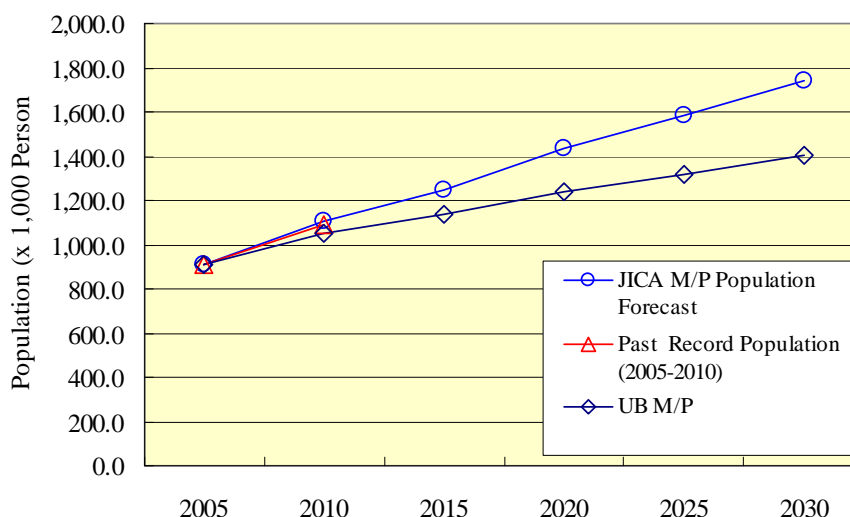


Figure 3.2.1 Future Population Forecasts for Ulaanbaatar City (6 districts) until 2030 (JICA M/P)

## (2) Future Gross Regional Domestic Production (RGDP) in Ulaanbaatar City

In the JICA M/P, the average growth rates of GDP in Mongolia and GRDP in Ulaanbaatar from 2008 through 2030 were formulated based on the IMF annual report and the annual statistics book of Mongolia as shown in Table 3.2.2.

The JICA M/P projected 8.3% GDP growth rate for Mongolia and 7.0% GRDP growth rate in Ulaanbaatar City for 2008-2010 following the growth rate in the recent years. For the period of 2011-2015, the mining industry will continuously contribute to the GDP growth of Mongolia, and the GRDP growth rate of Ulaanbaatar City will increase due to development of urban

economy. The growth rate of Ulaanbaatar City will exceed that of the entire Mongolia. Therefore, the JICA M/P projected 7.0% GDP growth rate for Mongolia and 7.5% GRDP growth rate for Ulaanbaatar City. The GDP and GRDP growth rates will follow the same trend as in 2015-2020. For the period 2020-2030, the growth rates of Mongolia and Ulaanbaatar City will slow down due to the decrease in population growth and maturing of the economy; however, it is presumed that the growth rates of Ulaanbaatar City and Ulaanbaatar City will follow the stream of stable growth rate. In this context, it was projected that the GDP growth rate of Mongolia is 6.4% and the GRDP growth rate of Ulaanbaatar City is 6.8%. The growth rate of Ulaanbaatar City will still be higher than that of Mongolia because of concentration of population and industries in the city.

The actual achievement of GDP and GRDP in 2008-2010 resulted in a certain deviation from the predicted rate due to the negative growth of -1.3% caused by economic factors such as economic depression by the sudden rise of domestic inflation in 2009 and the economic crisis (Lehman Shock). Although the average growth rate of GRDP decreased from 16.7% to 6.9%, the influence to the GRDP of Ulaanbaatar City was less than the influence to the GDP of Mongolia and the GDP in Mongolia and GRDP in Ulaanbaatar City were high at 6.1% and 12% respectively.

Based on the foregoing, the economy of Mongolia will further stabilize with the increase of revenue from the large-scale development of such mineral resources as coal and the rise of prices, and thus the economic growth rate equal to the GDP and GRDP projected in the JICA M/P is expected.

Table 3.2.2 Assumed Growth Rates of Mongolia's GDP and Ulaanbaatar's GRDP

Period	GDP in Mongolia	GRDP in Ulaanbaatar City
2008-2010	8.3%	7.0%
2011-2015	7.0%	7.5%
2015-2020	7.0%	7.5%
2020-2030	6.4%	6.8%

Source: JICA: The Study on City Master Plan and Urban Development Program of Ulaanbaatar City (UBMPS), 2009

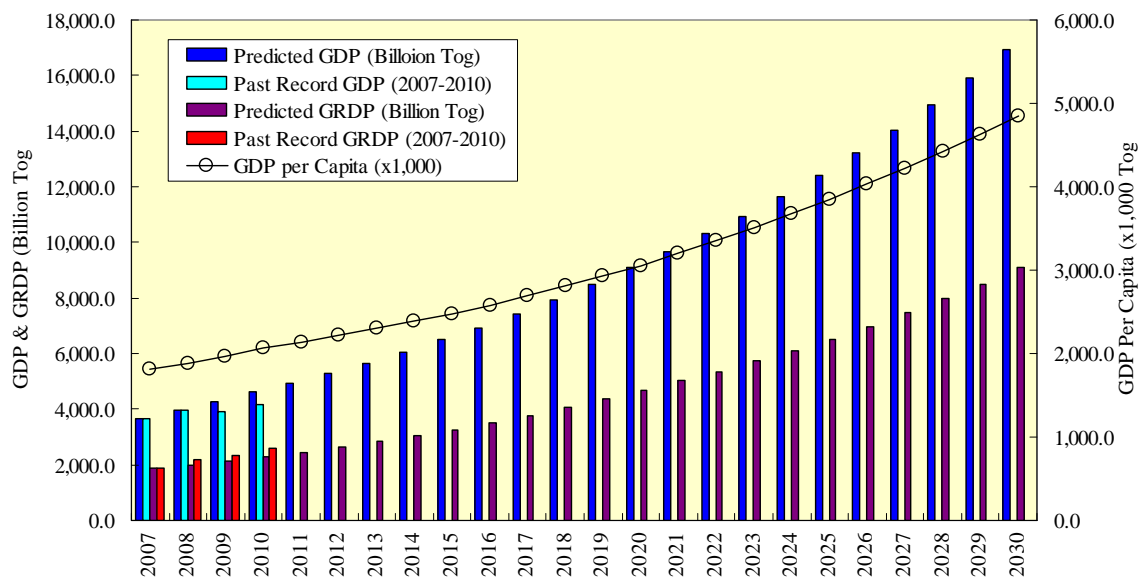


Figure 3.2.2 Assumed Growth Rates of Mongolia's GDP and Ulaanbaatar's GRDP

### 3.3 CURRENT TRAFFIC CONDITION AND CHARACTERISTICS IN THE STUDY AREA

#### (1) Result of Traffic Count Survey

The daily vehicle traffic flow condition in the study area in 2012 is shown in Figure 3.3.1. High traffic volumes (two-way, 16-hours) were observed at Chinggis Avenue and the Peace Bridge of Chinggis Avenue with 69,000-62,000 vehicles and 57,000 vehicles respectively. On the other hand, traffic volumes at Energy Street, Ajilchin Street and Narny Road which connect with the western, southern and central parts of the city were 19,000, 44,000 and 38,000 vehicles respectively. With regard to Dund Gol Street which runs in parallel with the railway and the Dund River and used as a detour for the Chinggis Avenue in the east-west direction, the traffic volume was approximately 14,000 vehicles (see Table 3.3.1).

As to the difference of traffic volume between weekdays and holidays, the holiday traffic volume at Peace Avenue, Chinggis Avenue and Narny Road shows about 20-30% decrease in comparison with weekdays. On the other hand, the traffic volume of Energy Street and Dund Gol Street shows about 40-50% of decrease, which reflects that these roads accommodate commuter traffics on weekdays.

The ratio between 16-hour volume and 24-hour traffic volume based on the result of the 24-hour traffic volume counting survey at Ajilchin Street, Narny Road and Chinggis Avenue are 90.7%, 92.2% and 87.8%, respectively on weekdays and 91.1%, 93.1% and 86.5%, respectively on holidays. Based on the ratio of 16-hour volume to 24-hour traffic volume, the highest daily traffic volume of about 75,000-67,000 vehicles is seen at Peace Avenue and the second highest daily traffic volume of 62,000 vehicles is observed at Peace Bridge on Chinggis Avenue. Daily

traffic volumes on Energy Street, Ajilchin Street and Narny Road are about 21,000, 49,000 and 41,000 vehicles, respectively (see Figure 3.3.1).

Since the east-west railway in the study area has only two bridges, i.e. the Peace Bridge in the east area and the Gurvaljin Bridge in the west area (at present, the Narny Bridge at the midpoint of these bridges is under construction), the two-way daily traffic volumes reach 62,000 and 49,000 vehicles, respectively. Obviously these two bridges are the bottlenecks from the analysis result of congestion degree (ratio between traffic capacity of 12,000 veh./day<sup>1</sup> and actual daily traffic volume) at 1.30 and 1.01, respectively. Especially, two-way daily traffic volume at the Sapporo roundabout on Peace Avenue intersecting with Ajilchin Street is 75,000 vehicles, and the congestion degree reaches 1.05 indicating capacity over. It was observed that this situation brings the spillback effect from the starting point of the Sapporo roundabout to the succeeding intersections in the peak periods.

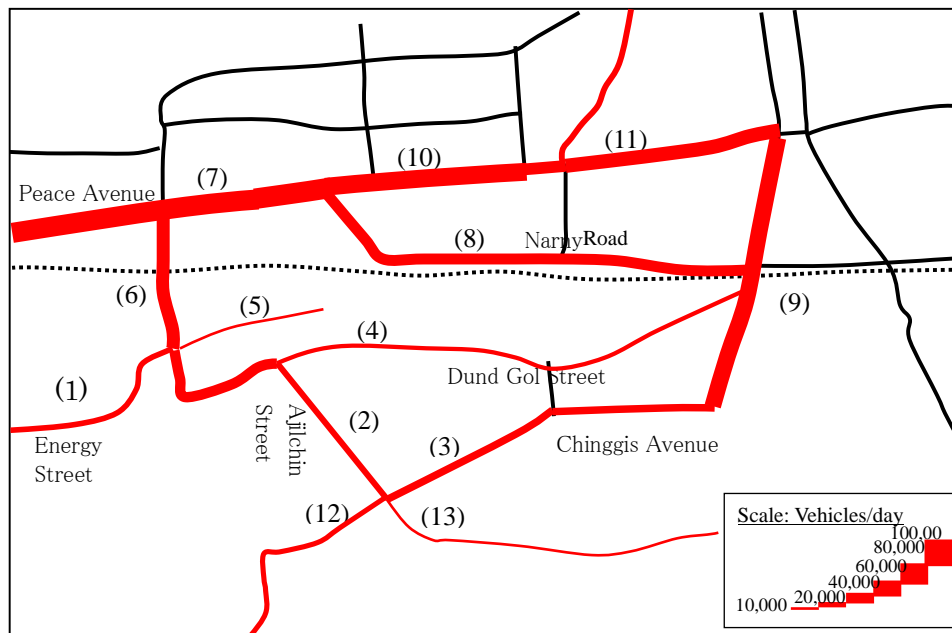


Figure 3.3.1 Current Daily Vehicle Traffic Flow Condition

<sup>1</sup> Road Capacity of 12,000 veh/day is the capacity of Class -1 road of Category 4 stipulated in Article 5 of [Road Structure Ordinance](#), Japan, 2004.

Table 3.3.1 Sixteen (16) -Hour Traffic Volume and Daily Traffic Volume in the Road Network in 2012

Traffic Counting Point	Existing Traffic Volume in 2012 (Vehicles)			
	Weekday		Holiday (Sunday)	
	16-Hours	24-Hours	16-Hours	24-Hours
(1) Energy Street	19,492	21,100	11,794	12,900
(2) Ajilchin Street	19,876	22,600	12,643	14,600
(3) Chinggis Avenue	24,908	28,356*	20,628	23,861*
(4) Dond Gol Street	14,601	16,600	6,044	7,000
(5) West Industrial Road	3,940	4,300	893	980
(6) Gurvaljin Bridge	44,135	48,673*	28,260	30,990*
(7) Peace Avenue	69,530	75,400	60,059	64,500
(8) Narny Road	37,579	40,757*	32,089	34,457*
(9) Peace Bridge	57,363	62,200	47,800	51,300
(10) Peace Avenue	61,653	66,900	49,847	53,500
(11) Peace Avenue	48,373	52,500	36,416	39,100
(12) Teberchit Street	16,863	19,200	15,405	17,800
(13) Zaisan Street	7,176	8,200	377	440

Source: JICA: Ajilchin Br. Study, 2012

Note: \* Actual counting volume, the others are calculated volumes based on the factor of 16 hrs/24 hrs.

## (2) Result of Travel Time Survey

### i) Survey Overview

The peripheral roads around the project site of Ajilchin Bridge were selected as the survey routes for the travel time survey to obtain the current travel speed condition affecting traffic congestion mitigation in the study area (see Figure 3.3.2). The survey was carried out by round trip travel in the morning and evening peak hours and midday off-peak hour. The survey items were time of passing checkpoints, major stopping causes, and frequency.

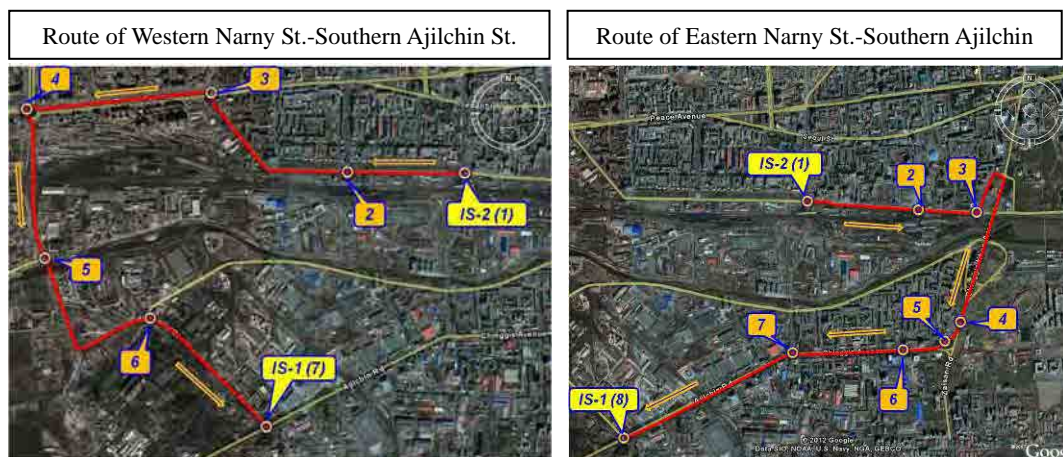


Figure 3.3.2 Survey Route for Travel Time Survey



ii) Travel Time Distribution

a) Route of Western Narny Road-Southern Ajilchin Street

In the counterclockwise direction from Western Narny Road to Southern Ajilchin Street, travel time in the morning peak period and the midday period are almost same at 24.8 to 24.9 minutes (average travel speed, about 16km/h). On the other hand, travel time in the evening peak period is double at 45.5 minutes (average travel speed, about 9km/h), which means traffic congestion caused by the perceived bottlenecks at the three-leg intersection (No. 3 point in the Figure) on Peace Avenue with Narny Road and the Sapporo Roundabout (No. 4 point in the Figure) on Peace Avenue with Ajilchin Street.

For the clockwise direction from Southern Ajilchin Street to Western Narny Road, the travel times during the morning peak period and the evening peak period are not much different at 26.6 to 23.8 minutes (average travel speed, 15-17km/h), indicating partial traffic congestion. In the midday period, the travel time is 17.9 minutes (average travel speed, about 22km/h), indicating no traffic congestion.

Table 3.3.2 Travel Time by Peak Period and Average Travel Speed

Route	Morning Peak Period (8:00-10:00)		Midday Period (12:00-14:00)		Evening Peak Period (18:00-20:00)	
	Travel Time (Min.)	Average Travel Speed (km/h)	Travel Time (Min.)	Average Travel Speed (km/h)	Travel Time (Min.)	Average Travel Speed (km/h)
Western Narny Road- Southern Ajilchin Street (6.72km)	24.8	16.3	24.9	16.4	45.5	8.9
Southern Ajilchin Street-Western Narny Road (6.57km)	26.6	14.8	17.9	22.0	23.8	16.6

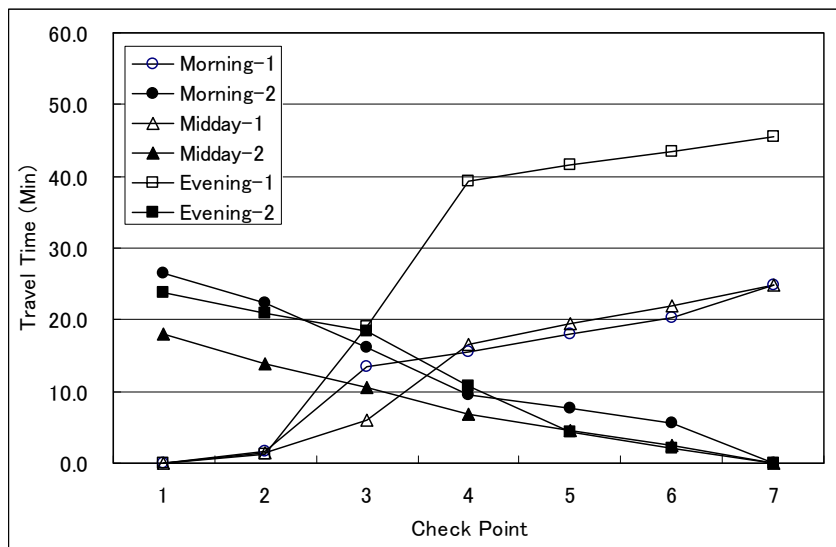


Figure 3.3.3 Travel Time and Distance Diagram

b) Route of Eastern Nary Road-Southern Ajilchin Street

In the clockwise direction from Eastern Nary Road to Southern Ajilchin Street, the travel time in the midday from morning peak period is 25.3-22.2 minutes (average travel speed, 13-15km/h), indicating a slight traffic congestion. However, the travel time in the evening peak period is 33.0 minutes (average travel speed, 10km/h), showing a serious traffic congestion.

On the other hand, for the counterclockwise direction from Southern Ajilchin Street to Eastern Nary Road, the travel times of morning peak period and the midday period are 44.8 to 53.0 minutes (average travel speed, 7-8km/h), showing chronic traffic congestion. In the evening peak period, the travel time is reduced by half at 24.6 minutes (average travel time, 14km/h) in comparison with the morning peak period, indicating minor traffic congestion. It was observed that these traffic congestions are caused by the bottlenecks of signalized intersection on the Peace Avenue with the Ajilchin Street in the neighborhood of Peace Bridge.

Table 3.3.3 Travel Time by Peak Period and Average Travel Speed

Route	Morning Peak Period (8:00-10:00)		Midday Period (12:00-14:00)		Evening Peak Period (18:00-20:00)	
	Travel Time (Min.)	Average Travel Speed (km/h)	Travel Time (Min.)	Average Travel Speed (km/h)	Travel Time (Min.)	Average Travel Speed (km/h)
Eastern Nary Road-Southern Ajilchin Street (5.37km)	25.3	12.8	22.2	14.5	33.0	9.8
Southern Ajilchin Street-Eastern Nary Road (4.77km)	44.8	7.7	53.0	6.5	24.6	14.1

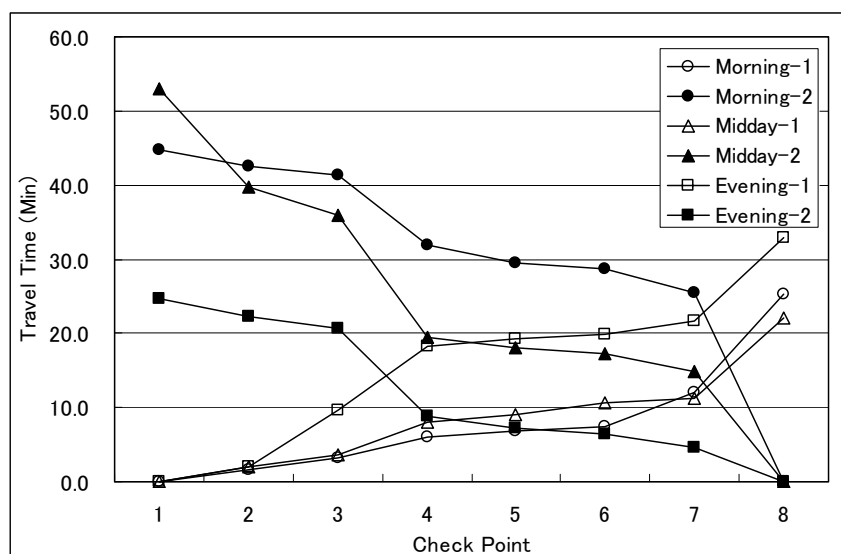


Figure 3.3.4 Travel Time and Distance Diagram

iii) Average Travel Speed by Segment and Major Stopping Causes

Distribution of average travel speed by segment in the periods of morning peak (8:00-10:00), midday (12:00-14:00) and evening peak (18:00-20:00) is shown in Figure 3.3.5.

In the morning peak period, the segments of Chinggis Avenue and Naryn Road were identified as heavily congested areas in terms of travel speed of 10km/h or less. Most stoppages were the result of intersection waiting time by the concentration of commuter traffic and the spill-back effect due to the bottleneck at the signalized intersections. Obviously, the intersection of Peace Bridge with Naryn Road, the three-leg intersection cranking to the right from southern Peace Bridge and four-leg signalized intersection on the Chinggis Avenue with Ajilchin Street are recognized as bottlenecks.

Traffic congestion is almost alleviated in the midday period, indicating travel speed at 20km/h-40km/h; however, traffic congestion still remains around the intersection of Peace Bridge and Naryn Road on the Chinggis Avenue in the same manner as the morning peak period with average travel speed of less than 10km/h. The major stoppages are resulting from the spill-back effect due to the bottlenecks of signalized intersection. The bottlenecks are therefore limited to the intersection of Peace Bridge with Naryn Road, the three-leg intersection and the four-leg signalized intersection on the Chinggis Avenue with Ajilchin Street in the same manner as the morning peak period.

In the evening peak period, the Sapporo roundabout on Peace Avenue, the west entrance of Naryn Road with the Peace Avenue and the intersection of the Peace Bridge and Naryn Road on the Chinggis Avenue in the same manner as the morning peak and midday periods were identified as heavily congested area, indicating travel speeds of 10km/h or less. The major stoppages are resulting from the spill-back effect due to the bottlenecks of signalized intersection. The bottlenecks are the Sapporo roundabout and the intersection of Peace Bridge with Naryn Road.

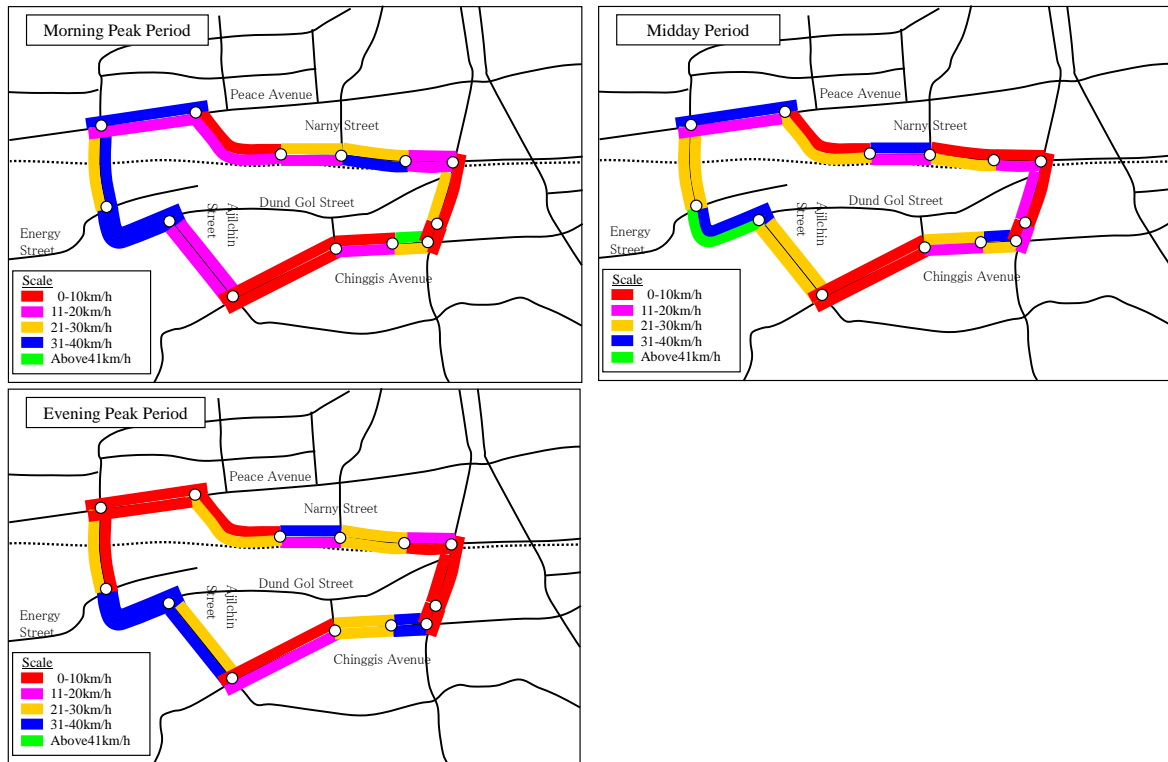


Figure 3.3.5 Distribution of Average Travel Speed by Segment

### (3) Analysis of Traffic Bottleneck in the Study Area

#### i) Identification of Bottleneck for Factors of Traffic Congestion

As shown by the analysis of the traffic count survey, the existing Gurvaljin Bridge and the Peace Bridge will be the bottlenecks of traffic congestion due to the concentration of traffic between western/southern city and central city in the peak periods. In addition, as shown by the analysis of the travel time survey, it was observed that the roads located in these existing bridges will be the bottleneck segments of traffic congestion judging from the situation of excess traffic capacity of existing roads, because the average travel speed is remarkably low. The locations and segments of traffic bottleneck that becomes the factors of traffic congestion in the study area are shown in Figure 3.3.6.

#### ii) Factors causing Traffic Congestion and Necessity of Ajilchin Bridge Construction

The factors causing traffic congestion in the study area are pointed out as below:

- Insufficient traffic capacity of major intersections
- Concentration of traffic to the limited number of existing bridges over the east-west railway (Gurvaljin Bridge and the Peace Bridge)

Especially, since the bridges on the east-west railway in the study area are only the Peace Bridge in the east area and the Gurvaljin Bridge in the west area, these bridges are bottlenecks causing traffic congestion by the traffic concentration. In this context, it is assumed that the

construction of Ajilchin Bridge on the east-west railway is highly required to avoid the traffic bottleneck on the Gurvaljin Bridge and the Peace Avenue.

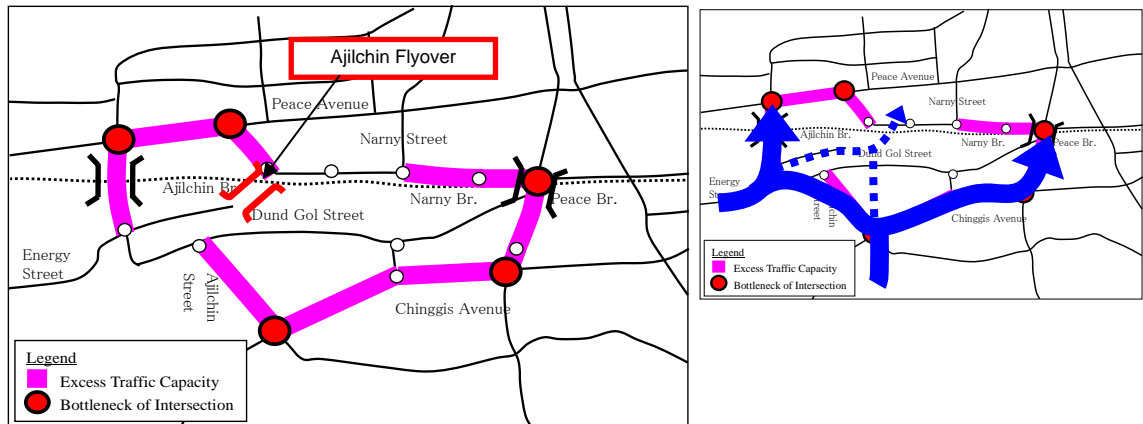


Figure 3.3.6 Bottlenecks and Segments with Excessive Traffic and Change of Traffic Flow

(4) Verification for Construction Effect of Ajilchin Bridge

The distribution of daily average travel speed by segment after the construction of Ajilchin Bridge as the results of the existing traffic assignment simulation on the basis of existing vehicle OD survey is shown in Figure 3.3.7 and Figure 3.3.8.

By comparison of the existing travel speed in the morning/evening peak periods obtained through the travel time survey and the traffic assignment simulation, the construction effect of Ajilchin Bridge is as summarized below.

- With construction of Ajilchin Bridge, average travel speeds are increased at; Peace Avenue (+7%), Ajilchin Street (+11~21%), Chinggis Avenue (+3~7%) and Narny Road (+6%), which will induce significant alleviation of traffic congestion in these roads.
- Especially, average travel speed of Ajilchin Street (from Gurvaljin Bridge connecting to Chinggis Avenue) is drastically increased. It means diversion of traffics from western part of Ulaanbaatar City to Ajilchin Bridge will duly contribute to alleviation of traffic congestion at Gurvaljin Bridge and Chinggis Avenue.

Based on the above aspects, construction of Ajilchin Bridge has significant effect of alleviation of current traffic congestion.

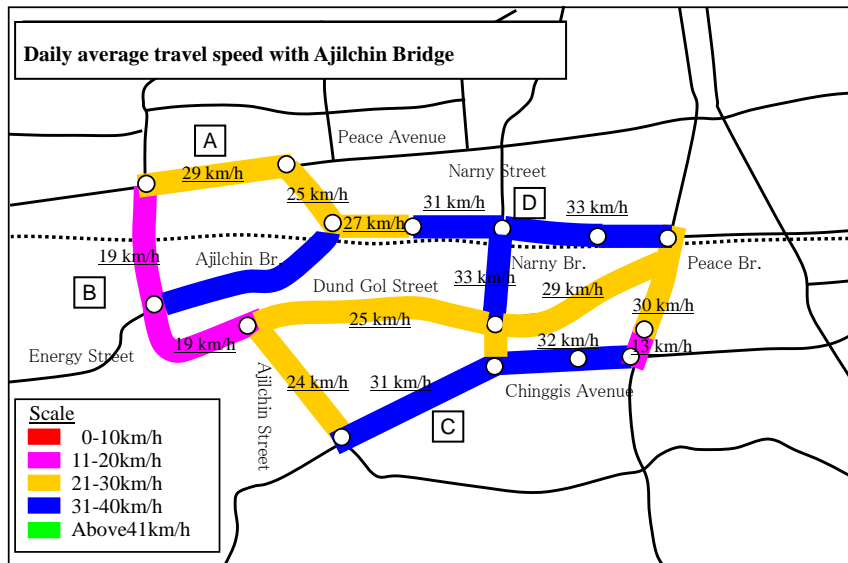


Figure 3.3.7 Distribution of Daily Average Travel Speed by Existing Traffic Assignment Simulation (after construction of Ajilchin Bridge)

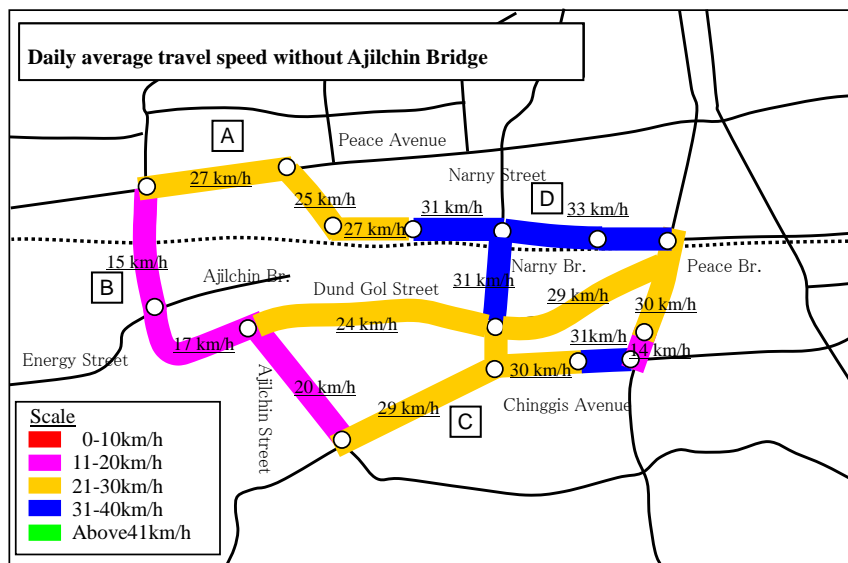


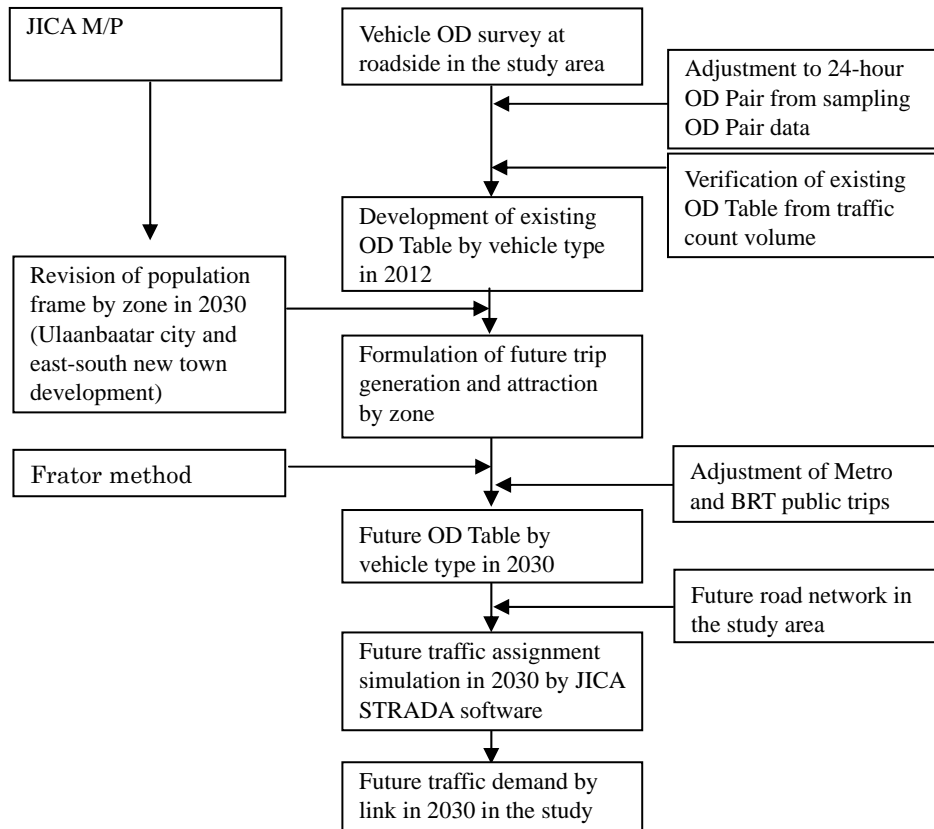
Figure 3.3.8 Distribution of Daily Average Travel Speed by Existing Traffic Assignment Simulation (before construction of Ajilchin Bridge)

It must be noted that average travel speed in Figure 3.3.7 and Figure 3.3.8 are simulation output of JICA STRADA, and waiting time at traffic signals is not taken into account. Accordingly, these figures of average travel speed shall be used only for comparison of two (2) cases, i.e. with Ajilchin Bridge and without Ajilchin Bridge, and thus do not give exact travel speed.

### 3.4 FUTURE TRAFFIC DEMAND FORECAST

#### (1) Method of Future Traffic Demand Forecast

The future traffic demand forecast of the Ajilchin Bridge in the study area was carried out based on the flow chart shown in Figure 3.4.1. The task of traffic demand forecast is presented as below.



Note: OD Survey is an interview survey to clarify origin and destination with purpose of trip

Figure 3.4.1 Flow Chart of Future Traffic Demand Forecast in the Study Area

#### i) Development of Existing OD Table in 2012

Based on the result of sampling OD data of the vehicle OD survey at nine (9) locations in the study area for the Ajilchin Bridge construction, the existing OD Table by vehicle type in 2012 was formulated. The existing and future road network and zoning was generally uniformed with the report of JICA M/P in 2007. However, the traffic assignment simulation was carried out based on the sixteen (16) zones (dividing only 3 zones around Ajilchin Bridge into smaller zones) in the study area of Ajilchin Bridge construction and eight (8) integrated zones in the outside study area (outside 9 locations of vehicle OD survey) of Ajilchin Bridge construction (see Figure 3.4.2).

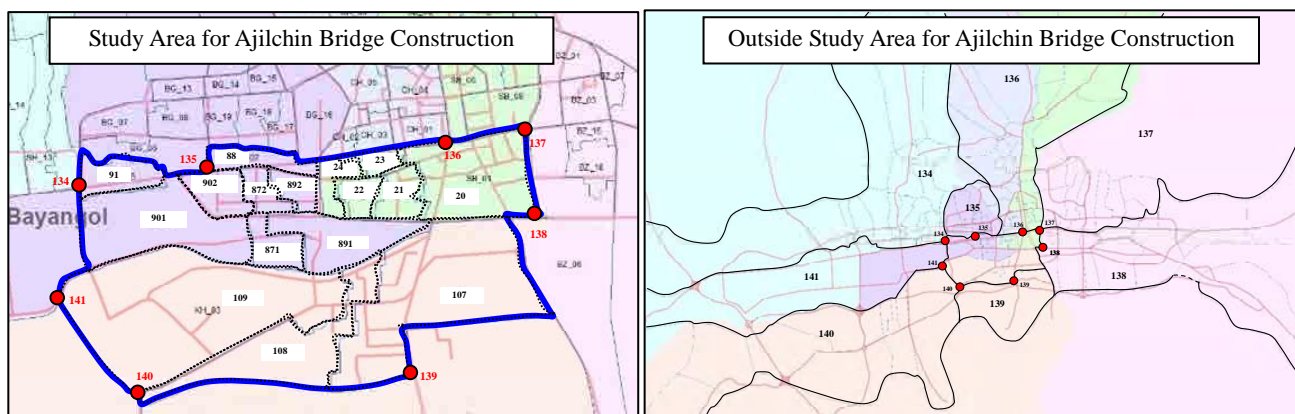


Figure 3.4.2 Existing Road Network in 2012 and Traffic Zones

ii) Development of Future OD Table in 2030

The future OD Table by vehicle type in 2030 was formulated from the existing OD Table with the process of combined future zonal population of the Ulaanbaatar City in the JICA M/P. As to the future population framework, the zonal future generation and attraction volumes in 2030 resulted in a decrease of 80.5%, because the future population in the UB M/P was brought down at 1,400,000 from the 1,740,000 in the JICA M/P. Furthermore, with regard to the development program of the southwestern city (large-scaled new town), the zonal future generation and attraction volumes in related development area also resulted in a decrease of 85.0%, since the population frame in the new town plan was reduced from 200,000 of the JICA M/P by 170,000.

In this study, diverted trips to the public transport mode such as Metro and BRT system in the city was equated with the OD trips of public transport in the future vehicle OD Table; therefore, the traffic assignment in 2030 without the zonal generation and attraction trips of public transport mode was carried out.

iii) Future Traffic Assignment

Based on the future OD Table in 2020 and 2030, the future traffic assignment was carried out on the future road network, in both cases of “with” and “without” the Ajilchin Bridge construction, through the simulation model of JICA STRADA software.

(2) Future Traffic Demand

The future traffic demand (daily two-way traffic volume) at the major locations in 2020 and 2030 in both cases of “with” and “without” the Ajilchin Bridge construction is shown in Table 3.4.1 and Figure 3.4.3. The OD Pair desire line and traffic volume flow map are shown in Figure 3.4.4 (1)(2) and Figure 3.4.5 (1)(4).



i) Future Traffic Demand in 2020

The future traffic demand in 2020 at the Ajilchin Bridge was estimated at 26,600 vehicle/two-way day. By comparison between the future traffic demand by links “with the Ajilchin Bridge” and “without the Ajilchin Bridge,” the impact situation to the surrounding roads is pointed out as below:

- The traffic load at the Gurvaljin Bridge of the Ajilchin Street will be reduced at approximately 19%.
- At the same time, the traffic load at the Peace Avenue and the Chinggis Avenue where there are existing competitive routes with the Ajilchin Bridge will be reduced at approximately 18% and 14% respectively, in segments of significant change.
- On the other hand, the in-and-out traffic to the Naryn Road will be increased, and the traffic load is increased at approximately 22%, in segments of significant change.

ii) Future Traffic Demand in 2030

The future traffic demand in 2030 at the Ajilchin Bridge was estimated at 57,600 vehicle/two-way day. By comparison between the future traffic demands by links “with the Ajilchin Bridge” and “without the Ajilchin Bridge,” the impact situation to the surrounding roads is pointed out as below:

- The traffic load at the Gurvaljin Bridge of the Ajilchin Street will be reduced at approximately 34%.
- At the same time, the traffic load at the Peace Avenue and the Chinggis Avenue where there are existing competitive routes with the Ajilchin Bridge will be reduced at approximately 48% and 19% respectively, in segments of significant change.
- On the other hand, the in-and-out traffic to the Naryn Road will be increased, and the traffic load is increased at approximately 39%, in segments of significant change.
- 

Table 3.4.1 Future Traffic Demand (Daily Two-Way Traffic Volume) in 2020/2030 in the Future Road Network

Location	Daily Two-Way Traffic Volume (Vehicle)			
	In 2020		In 2030	
	With	Without	With	Without
(1)	26,600	-	57,000	-
(2)	21,000	22,700	24,200	29,700
(3)	31,600	24,600	52,300	31,800
(4)	54,600	67,000	51,300	98,800
(5)	50,300	62,300	76,000	115,700
(6)	35,600	35,600	99,300	99,300
(7)	55,200	52,900	103,900	100,800
(8)	22,100	21,900	45,300	47,400
(9)	6,900	8,500	13,100	15,500
(10)	22,600	28,600	46,200	50,200
(11)	26,700	21,200	49,200	44,600

Location	Daily Two-Way Traffic Volume (Vehicle)			
	In 2020		In 2030	
	With	Without	With	Without
(12)	44,300	46,600	70,300	72,400
(13)	11,800	23,000	25,300	24,800
(14)	33,400	31,600	64,100	62,900
(15)	30,000	34,400	53,300	63,400
(16)	29,900	37,100	55,300	67,900
(17)	25,500	28,000	40,000	40,200

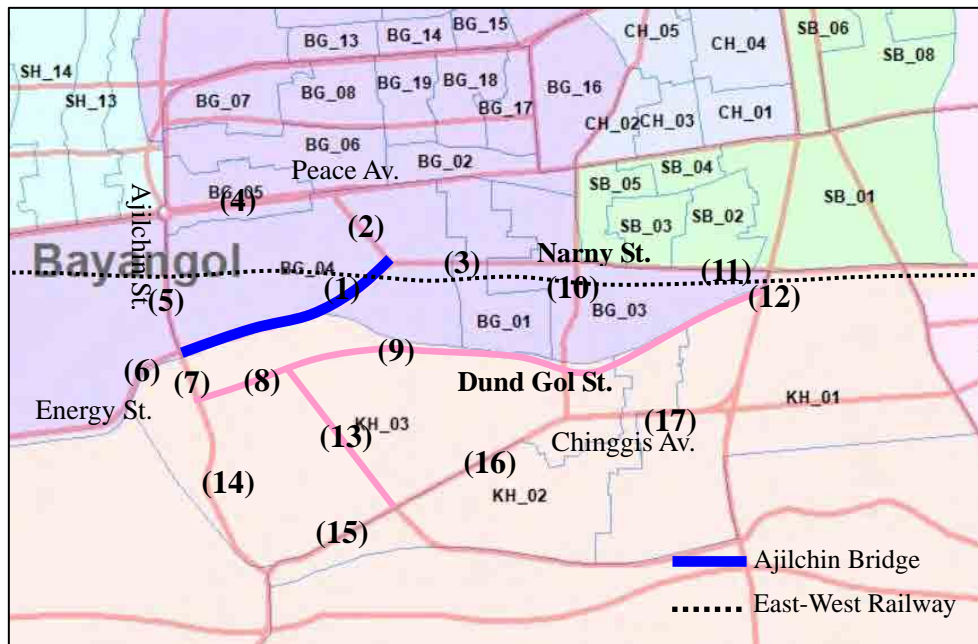


Figure 3.4.3 Location of Future Traffic Dead in Future Road Network

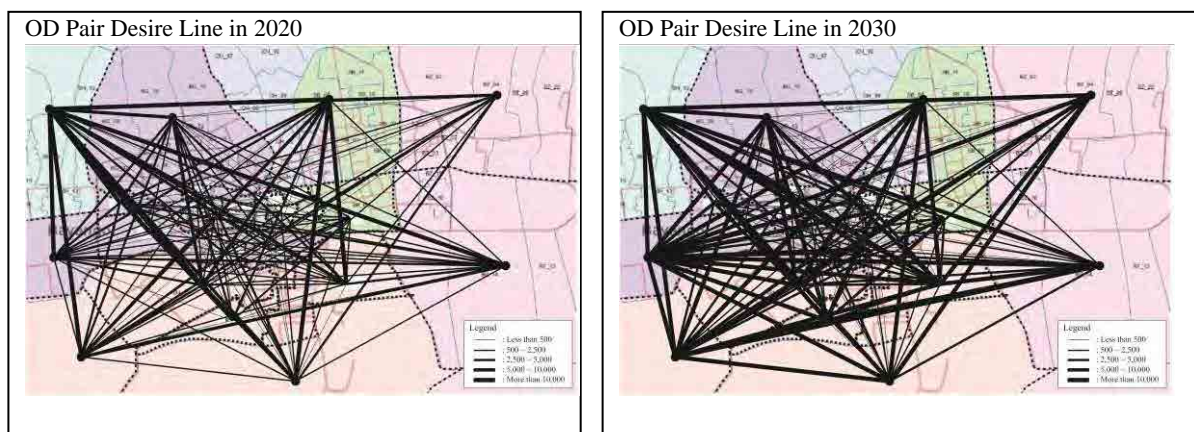


Figure 3.4.4 OD Pair Desire Line in 2020/2030

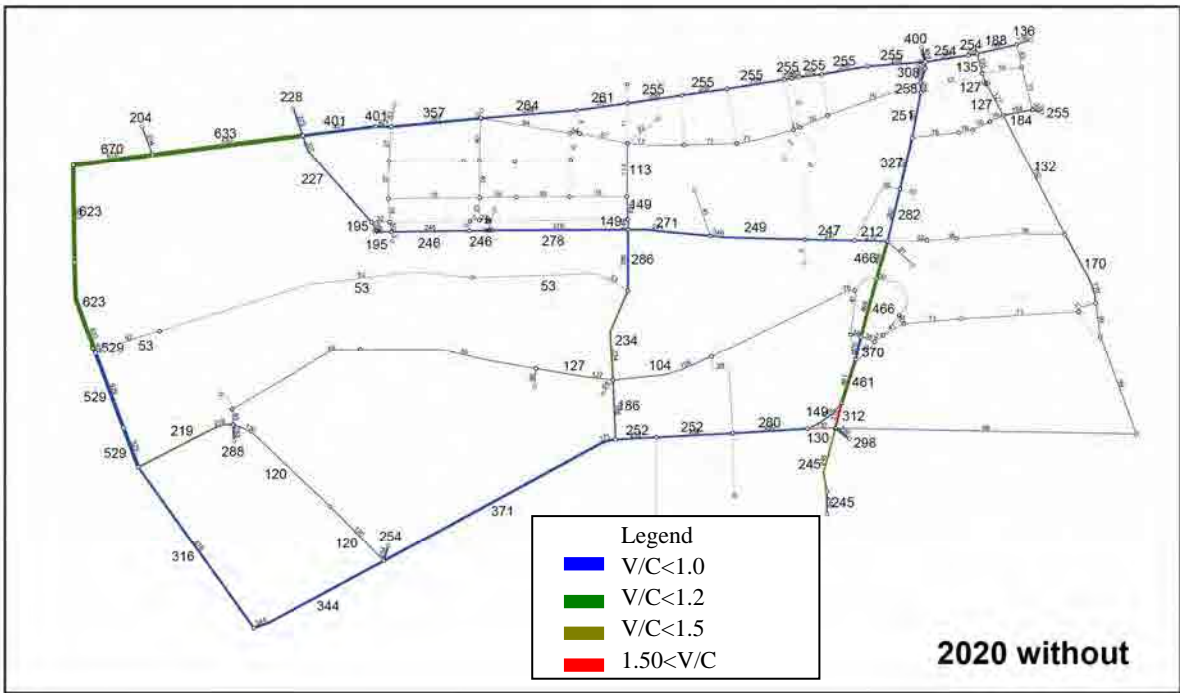


Figure 3.4.5(1) Daily Draffic Demand in 2020 (WithCase)

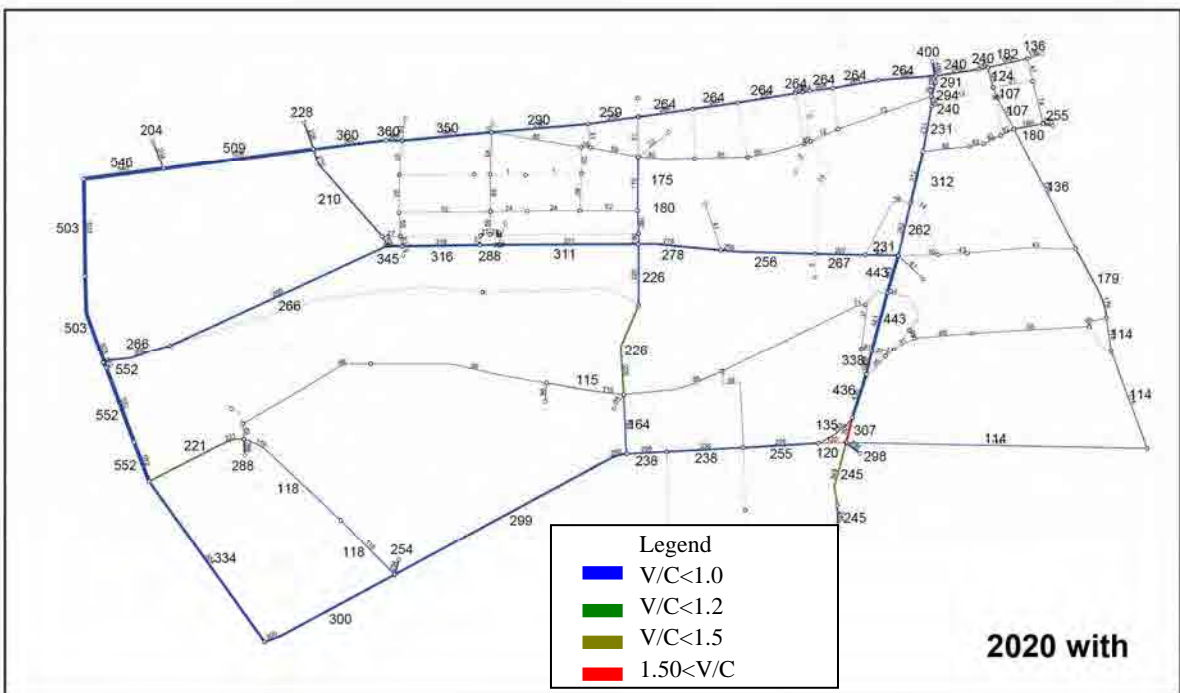


Figure 3.4.5(2) Daily Draffic Demand in 2020(WithoutCase)

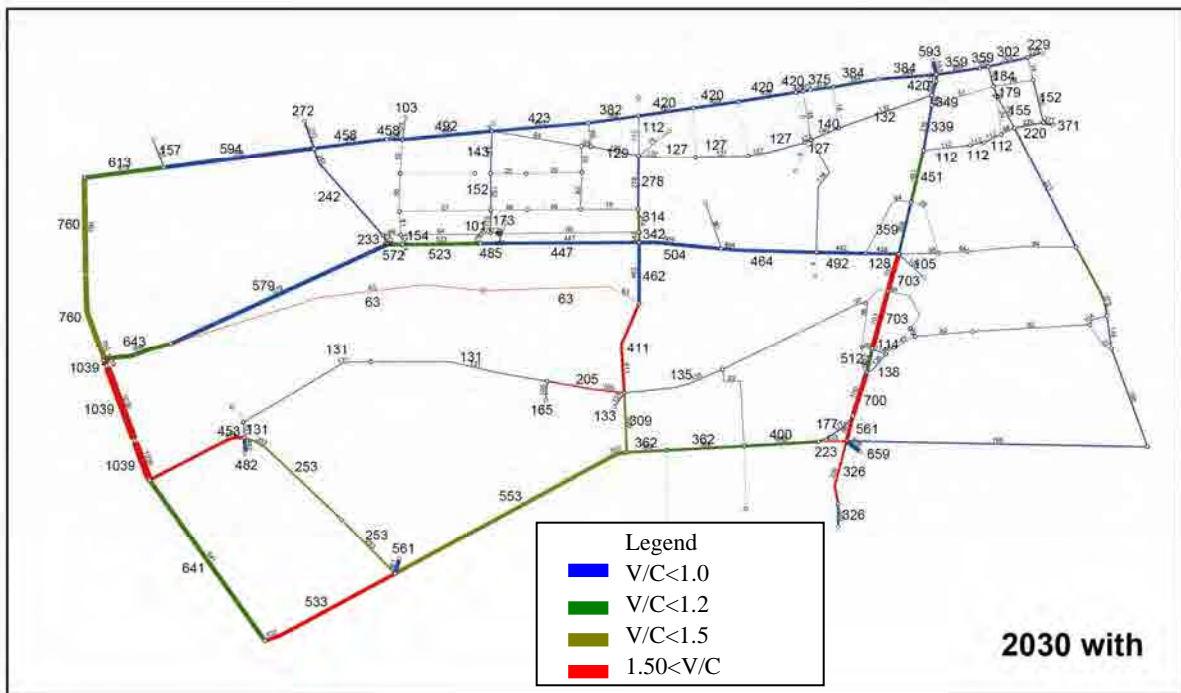


Figure 3.4.5(3) Daily Draffic Demand in 2030 (WithCase)

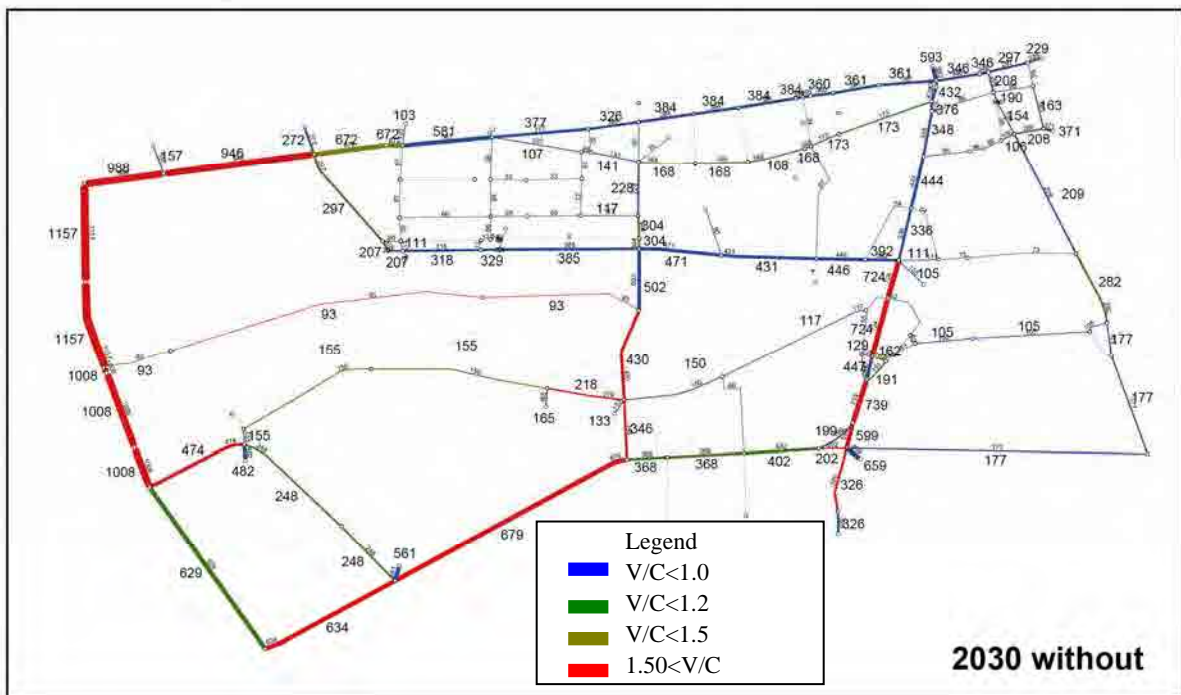


Figure 3.4.5(4) Daily Draffic Demand in 2030 (WithoutCase)

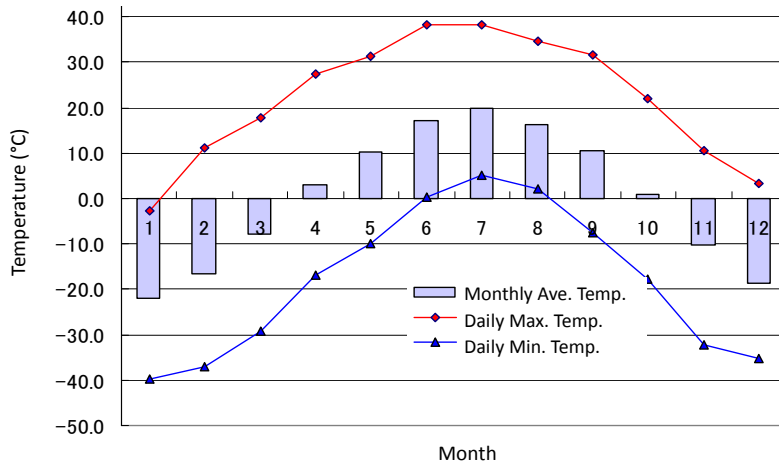
# CHAPTER 4

## NATURAL CONDITIONS

### 4.1 CLIMATE

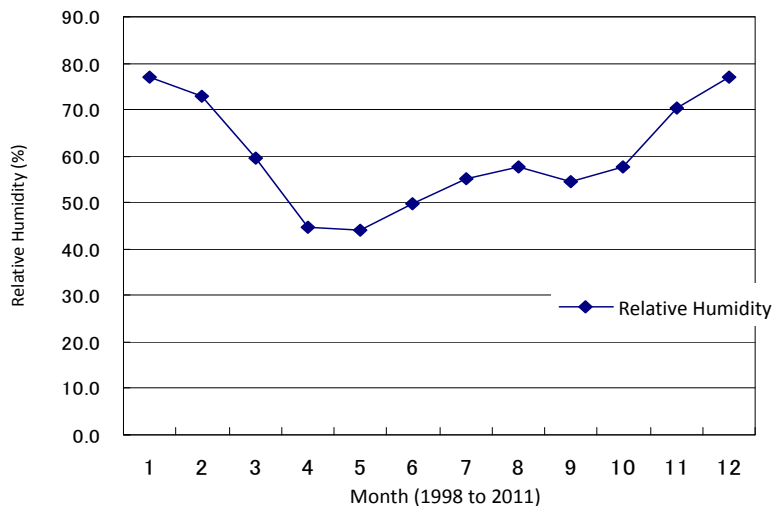
#### (1) Temperature and Humidity

Ulaanbaatar City has a continental climate, which is characterized by a cold climate from October to April with an average temperature of about 0°C or below (daily lowest temperature in January is -40°C) and a long spell of hot summer (daily highest temperature is 40°C) from May to September. Furthermore, daily temperature fluctuation reaches as high as 30°C to 40°C. Humidity exceeds 70% in winter season from November to February, and is less than 60% in March through October.



Source: JICA Survey Team

Figure 4.1.1 Temperature Data (1998-2011: Ulaanbaatar Station)

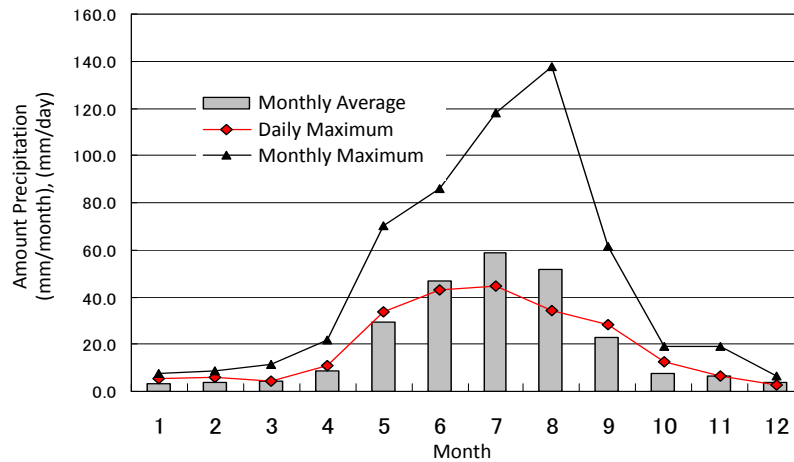


Source: JICA Survey Team

Figure 4.1.2 Humidity Data (1998-2011: Ulaanbaatar Station)

(2) Precipitation

According to meteorological data for the past 14 years (1998 to 2011), the annual average precipitation is 247.8 mm/year. As for monthly precipitation, they have comparatively large amounts of rain from May to September with the maximum monthly average precipitation occurring in July at 58.6 mm/month. The maximum monthly precipitation amount in the past 14 years is 137.7 mm/month in August 2000. Focusing on daily precipitation amounts, the maximum amount is 44.8 mm/day in July 2009.

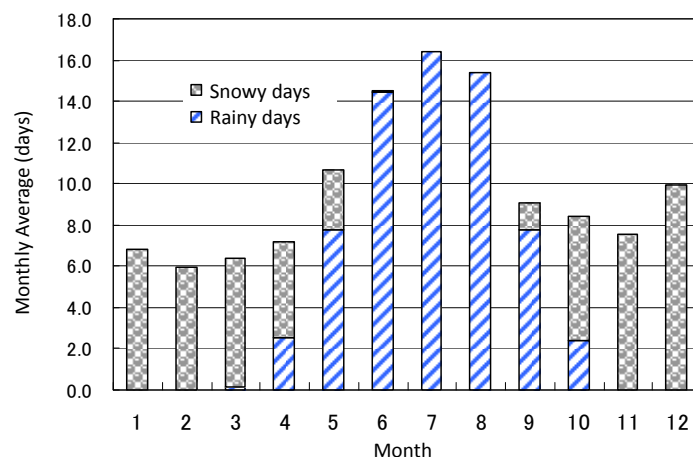


Source: JICA Survey Team

Figure 4.1.3 Precipitation Data (1998-2011: Ulaanbaatar Station)

(3) Number of Days with Rainfall and Snowfall

There is snowfall but no rainfall from October through April, and the number of days with snowfall is approximately 6-8 days a month. The number of days with rainfall from May through September, when the construction work is scheduled, is 10-16 days a month.

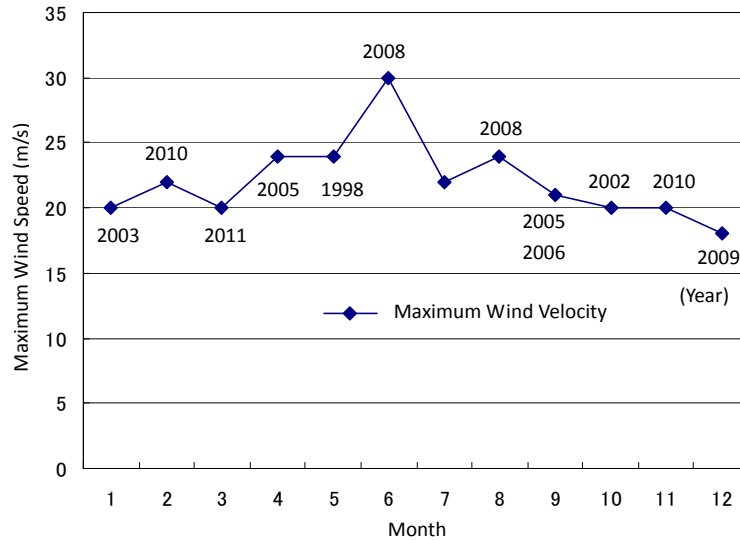


Source: JICA Survey Team

Figure 4.1.4 Number of Days with Rainfall and Snowfall (1998-2011: Ulaanbaatar Station)

(4) Wind Velocity

Figure 4.1.5 shows the monthly maximum wind velocity data. The maximum value is  $V=30\text{m/s}$  (June 2008), but values from  $V=20\text{m/s}$  to  $25\text{m/s}$  are recorded throughout the year.



Source: JICA Survey Team

Figure 4.1.5 Monthly Maximum Wind Speed Data (1998-2011: Ulaanbaatar Station)

## 4.2 TOPOGRAPHIC AND GEOLOGICAL CONDITION

(1) General

Ulaanbaatar City stretches about 5km long north to south and about 30km long east to west, and the altitude is around 1,300m. On the southern part of the city, the Tuul River runs from east to west along the foot of Bogdkhan Mountain Conservation Area. There is a series of virtually bare mountains and hills on the northern part of the city. The Selbe River (of which downstream is called as the Dund Gol River) flows into the Tuul River from the south slope in the northern part of the city. The Project site is located on the lowland consisting of diluvium terrace deposit and alluvial river sediments.

As for the geological condition of Ulaanbaatar City, the mountain area consists of sandstone and shale of the Carboniferous period in the Paleozoic era and the Cretaceous period in the Mesozoic era and, in particular, granite of the Jurassic period in the Mesozoic era is distributed on the south mountains.

Quaternary diluvium is distributed as terrace deposit, and alluvium sediment is distributed in the vicinity of river. Figure 4.2.1 shows the geological segmentation of Ulaanbaatar City.

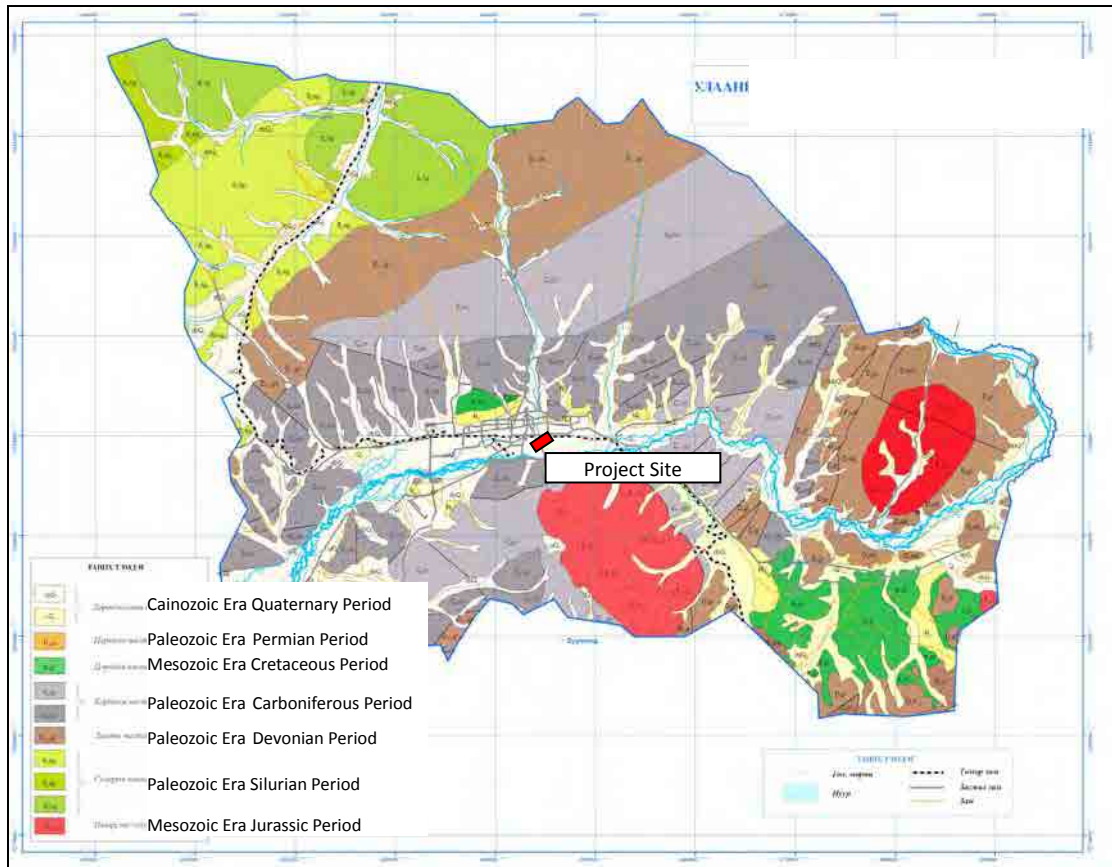


Figure 4.2.1 Geological Segmentation Diagram of Ulaanbaatar City

(2) Soil Property at the Project Site

The Project site belongs to the Bayanggol District No. 4. This area becomes a line of which the east end starts at Narny Road in front of Ulaanbaatar Station, going across the railway, passing West Industry Road along the Dund Gol River (the Selbe River) and reaching Ajilchin Street.

The geological formation of the Project site is classified as Diluvium and Alluvium of Quaternary Period in Cenozoic mainly consisting of loose sand, clayey gravel and sand with boulder (maximum diameter of 75mm).

(3) Field Test Results

At the site, (a) boring investigation with Standard Penetration Test (SPT), (b) test-pit digging for CBR test, and (c) field permeability test were carried out. Each test point is indicated in the figure below.



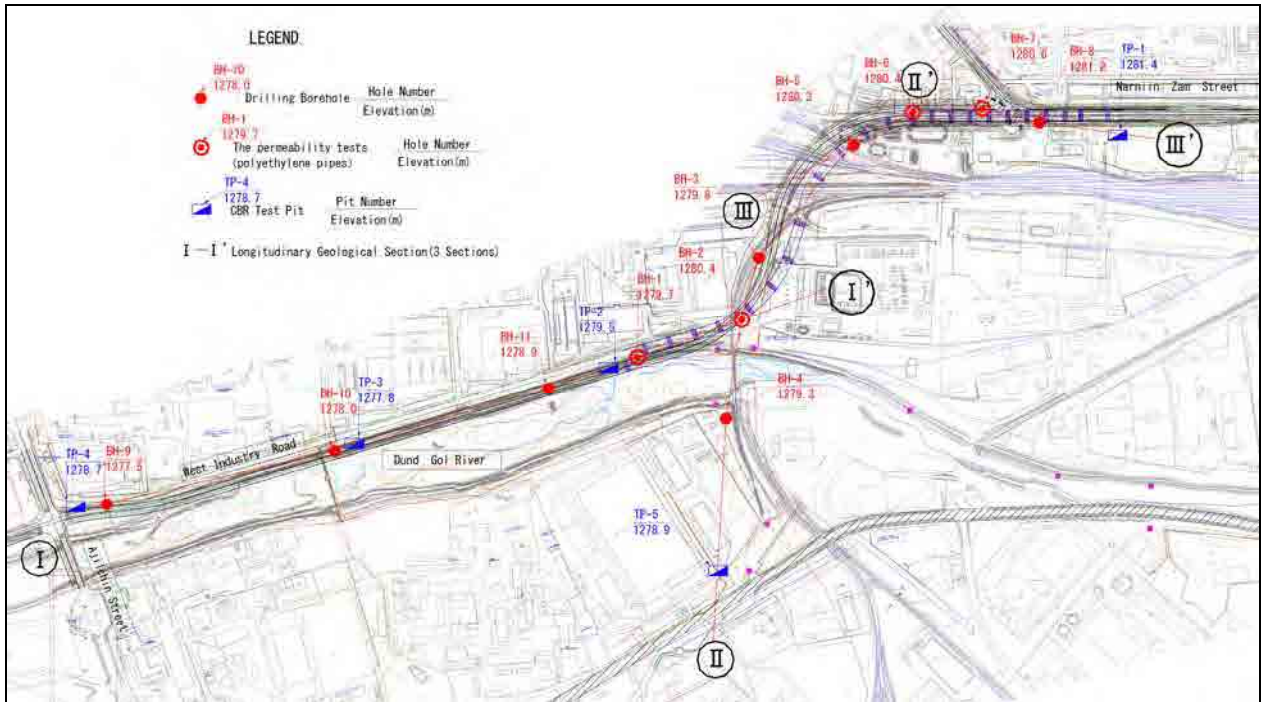


Figure 4.2.2 Field Test Location Map

The machine boring accompanied with SPT were carried out at 11 points in total: five (5) points at the flyover section, four (4) points at West Industry Road, one (1) point at South Road opposite side of the Dund Gol River, and one (1) point at Naryn Road. As for CBR Tests test-pit digging and material sampling were carried out at five (5) locations in total: three (3) locations at West Industry Road, one (1) location at South Road opposite side of the Dund Gol River, and one (1) location at Naryn Road.

Table 4.2.1 Details of Field Tests

Items	Positions	Ground Elevation (m)	Depth (m)	Laboratory Test
Machine Boring with SPT	BH-1	1,279.7	19.0	Specific gravity of soil particle, unit weight, Atterberg limit, particle size and natural water content
	BH-2	1,280.4	18.0	
	BH-3	1,279.8	12.0	
	BH-4	1,279.3	19.0	
	BH-5	1,280.3	16.0	
	BH-6	1,280.4	16.0	
	BH-7	1,280.6	12.0	
	BH-8	1,281.2	14.0	
	BH-9	1,277.5	12.0	
	BH-10	1,278.0	14.0	
	BH-11	1,278.9	13.0	
CBR Test (sampled from test-pit)	TP-1	1,281.4	2.0	Unit weight, particle size, natural water content, compaction test, and immersion CBR test
	TP-2	1,279.5	2.1	
	TP-3	1,277.8	2.0	
	TP-4	1,278.7	2.0	
	TP-5	1,278.9	2.0	
Field Permeability Test (Unsteady Method)	BH-1	1,279.7	3.0	
	BH-2	1,280.4	3.0	
	BH-6	1,280.4	3.0	
	BH-7	1,280.6	3.0	

As a result of boring investigation at 11 locations in the Project site, embankment consisting of a gravel layer with clay and sand exist with 1 - 2m thick. Especially, the top layer of embankment up to one meter deep from the surface is loose. Relatively dense sand and gravel bearing boulders underlies with 4 – 8m thick. Groundwater level is stably observed at around 3.2 – 4.5m below existing ground surface (approx. elevation of 1,275m). No permafrost soil was observed in the Project site.

As for particle size, particles exceeding 4.75mm reached 50% or more by weight and the layer consist of comparatively large-sized particles. Low natural water content in the range of 3 to 17% was observed. The CBR values show a high level of more than 17% at all five points.

Furthermore, field permeability test (an unsteady method) was conducted at four points in total; two points at West Industry Road (along the Dund Gol River) and two points at the railway site maintenance road were implemented. The permeability coefficient of gravel layer was  $1.8 \times 10^{-3}$  to  $2.7 \times 10^{-3}$  cm/sec.

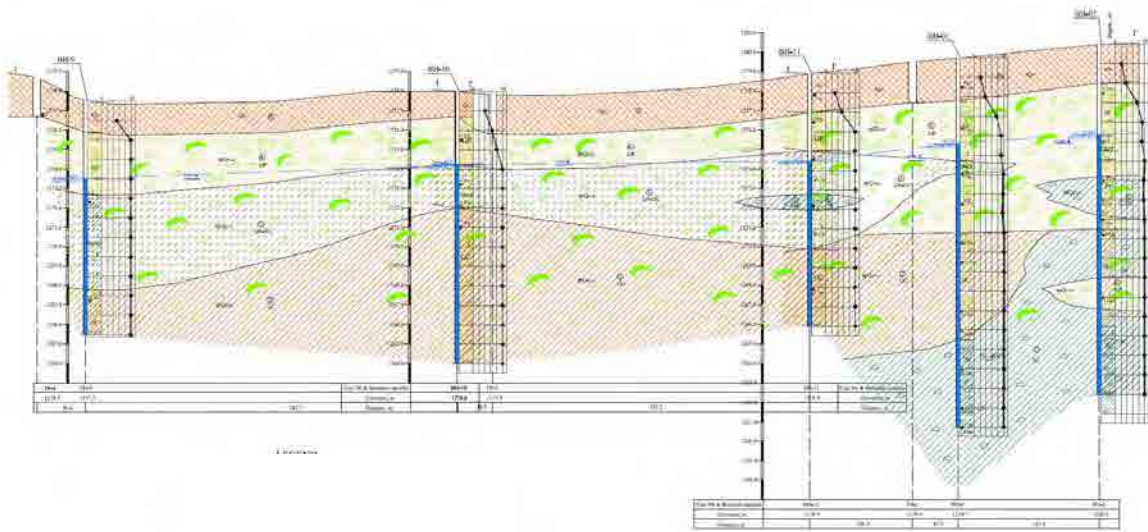


Figure 4.2.3 Geological Section I - I'

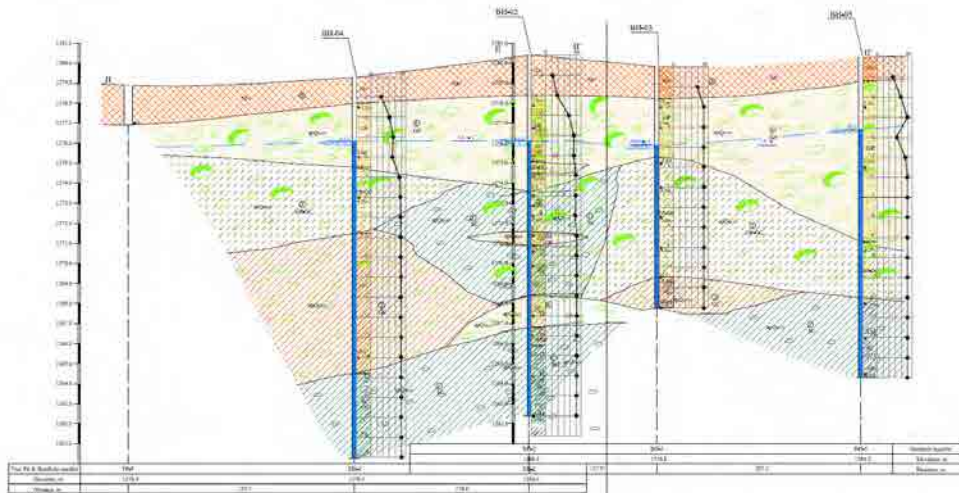


Figure 4.2.4 Geological Section II - II'

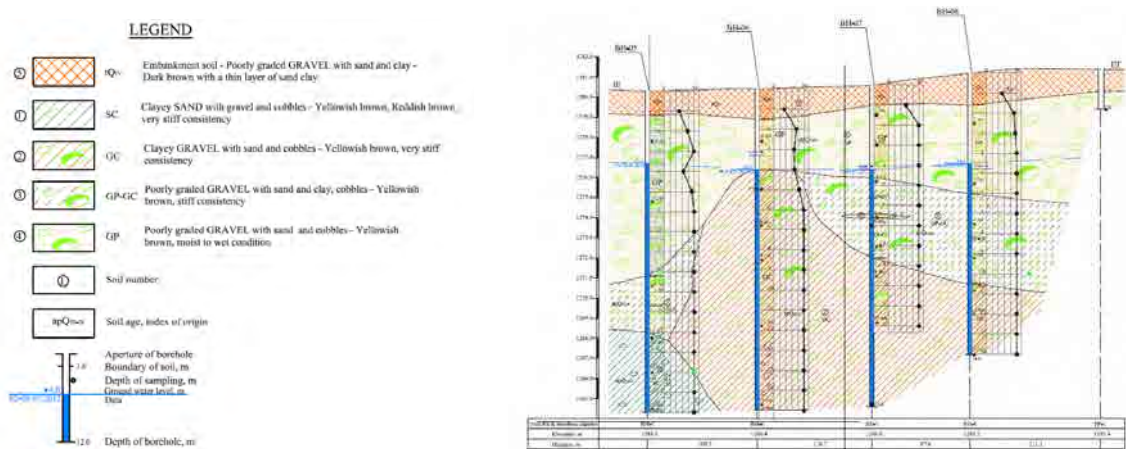


Figure 4.2.5 Geological Section III - III'

### 4.3 TOPOGRAPHIC SURVEY

Topographic survey was conducted for basic design of this project. The scope of topographic survey is described in Figure 4.3.1. In order to study the alternative routes (East-West route and South-North route, refer to Section 5), the scope of the survey covers the south route of Dund River. Centerline survey and cross sectional survey were conducted only for the east-west route based on the result of alternative route comparison. The content of survey conducted is shown in Table 4.3.1.

Table 4.3.1 Contents of Topographic Survey

No	Item	Unit	Quantity
1.	Control point survey (Temporary BM inst./ Differential leveling)	Location	7
2.	Plane survey (Preparation plan, Scale:1/500)	m <sup>2</sup>	550,000
3.	Centerline survey / Profile leveling	km	2.7
4.	Cross sectional survey (Width:50m@20m)	Cross Section	121

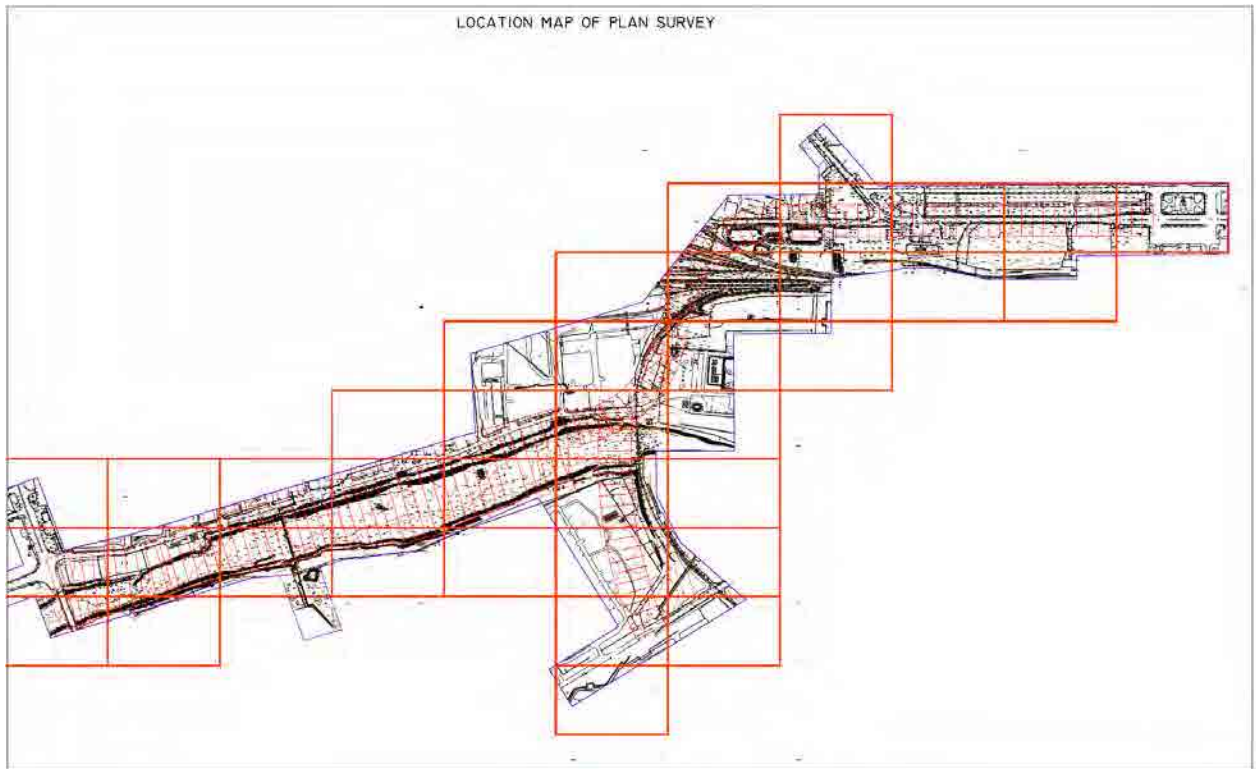


Figure 4.3.1 Scope of Topographic Survey

## CHAPTER 5

### ROUTE SELECTION FOR AJILCHIN FLYOVER

#### 5.1 NECESSITY OF AJILCHIN FLYOVER

Among the four (4) routes in the north-south direction crossing the railway running through the central part of Ulaanbaatar City, only two (2) routes are provided with existing flyovers; namely, the Peace Bridge (62,200 vehicles/day) and the Gurvaljin Bridge (48,673 vehicles/day).

Table 5.1.1 Traffic Volume of Existing Railway Flyover  
(Unit: vehicles/day)

Year	2012	2020	2030
Peace Bridge	62,200	46,600	72,400
Gurvaljin Bridge	48,673	62,300	115,700
Nary Bridge	--	28,600	50,200
Total	110,873	137,500	238,300

Though the traffics may be dispersed after completion of Nary Bridge under Japan's Grant Aid, the traffic volume is estimated to greatly exceed the traffic capacity of each bridge (48,000 vehicles/day) by 2030. Furthermore, due to limited accessibility for the railway crossing, the neighboring arterial roads such as Peace Avenue, Ajilchin Street and Chinggis Avenue will be congested and the average travel speed at peak hours may decrease below 10 km/h. In addition, the section from the west side of the junction between Nary Road and Peace Avenue to the Sapporo Roundabout (the intersection with Ajilchin Street) suffers from congestion (75,400 vehicles/day) since no arterial road is available in the east-west direction to complement Peace Avenue, resulting in a bottleneck by traffic accessing to the city center.

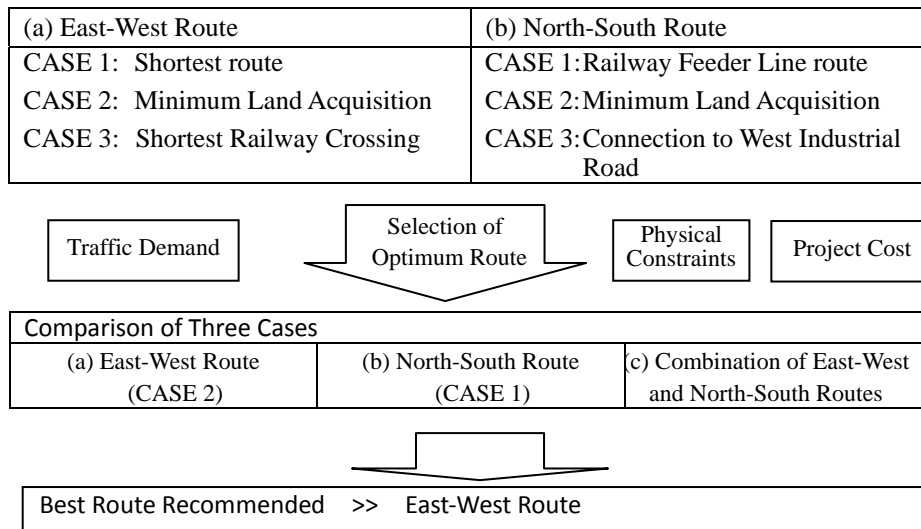
On the other hand, Nary Bridge is about 3km away from Gurvaljin Bridge, and the proposed location of the Ajilchin Flyover is almost at the middle of the these bridges. Accordingly, in appreciation of traffic dispersion from Peace Avenue, prospective Ajilchin Flyover will contribute to improvement of the north-south network crossing the railway and reduction of traffic volume at the section from the junction of Peace Avenue and Nary Road to Sapporo Roundabout by 48% in 2030.

In the future, a major east-west direction trunk road parallel to the Peace Avenue, which is proposed in the Urban Development Master Plan 2030, will be formulated after completion of Ajilchin Flyover, and thus it is expected to reduce the traffic load at Peace Avenue and strengthen the road network in the east-west direction. Therefore, construction of Ajilchin Flyover at the proposed location is highly required for the road network in the future.

## 5.2 STUDY OF BRIDGING ROUTE

### (1) Outline of Bridging Route Comparison

As described in Chapter 3 Traffic Planning, the possible alternative routes of Ajilchin Flyover are: (a) the East-West route, and (b) the North-South route. Based on the traffic characteristics mentioned above, comparison of the two routes is as diagrammatically shown in the figure below in order to decide the best route.



Note: The approximate cost of the above cases, including the effect of price increase and exchange fluctuation based on the construction cost of Naryn Bridge (a Grant Aid Project), is estimated.

Figure 5.2.1 Flow Chart of Decision on Bridge Route and Project Area

The results of comparative study are shown in the following pages. In conclusion, the East-West Route (CASE 2: Minimum land acquisition) shall be prioritized as the best possible option for the construction work in the aspects of traffic safety, project feasibility and environmental issues.

(2) Comparison of East-West Route

	CASE-1 : Shortest Route	CASE-2 : Minimum Land Acquisition	CASE-3 : Shortest Railway Crossing
Plan View			
Profile			
Affected Buildings	10 buildings (9,042m <sup>2</sup> )	9 buildings (3,667m <sup>2</sup> )	20 buildings (9,646m <sup>2</sup> )
Resettlement	No-resettlement is required	Same as Case-1	Same as Case-1
Effects of Natural Environment	<ul style="list-style-type: none"> <li>Though the Dund River is filled up partially, the effects on water quality, vegetation and rare animals are small.</li> <li>The problems such as noise and vibration during construction and operation are also small because of the surrounding industrial district and commercial area.</li> </ul>	Same as Case-1	Same as Case-1
Affected Utilities	<ul style="list-style-type: none"> <li>Underground high voltage lines for Golden Park (35kV)</li> <li>Hot-water pipes (Dia.350x2)</li> </ul>	<ul style="list-style-type: none"> <li>Underground high voltage lines for Golden Park (35kV)</li> <li>Hot-water pipes (Dia. 350x2)</li> </ul>	<ul style="list-style-type: none"> <li>Hot-water pipes (Dia.350x2)</li> </ul>
Total Road Length	2,250 m	2,250 m	2,250 m
Road Geometry	Minimum curve radius : 300m / maximum longitudinal grade : 4.5%	Minimum curve radius : 200m / maximum longitudinal grade : 4.5%	Minimum curve radius : 200m / maximum longitudinal grade : 4.5%
Total Bridge Length	400 m	600 m	725 m
Construction Cost	<b>4.7 billion JPY (1.00)</b>	<b>6.3 billion JPY (1.34)</b>	<b>7.4 billion JPY (1.55)</b>
Evaluation	<ul style="list-style-type: none"> <li>The construction cost is the least, but relocation of the oil product factory building and its compensation of which negotiation may be protracted are required.</li> <li>Since the connection to West Industrial Road is at-grade crossing, the traffic safety is unfavorable since the intersection must be located at the entrance of grade separation.</li> </ul>	<ul style="list-style-type: none"> <li>The bridge length is longer than that of CASE-1, but land acquisition are less because there is no factory relocation.</li> <li>A part of the fuel storage facility site is occupied, but there is no effect on the buildings.</li> <li>Since the connection to West Industrial Road is done by a grade separated crossing, the route is better than CASE-1 regarding traffic safety.</li> </ul>	<ul style="list-style-type: none"> <li>Though the railway flyover section is the shortest, the total bridge length is the longest and the construction cost is the highest.</li> <li>Since the fuel storage facility standing on the south side of the railway is to be split, compensation is required. In addition, the buildings on the north side of the railway are involved, and the number of obstacles will increase.</li> <li>The intersection between Nary Road parallels with the approach road longer, and it worsens the traffic safety.</li> </ul>
	<b>Fair</b>	<b>Good</b>	<b>Bad</b>

(3) Comparison of the North-South Route

	CASE-1 : Railway Feeder Line Route	CASE-2 : Minimum Land Acquisition	CASE-3 : West Industrial Road Connection
Plan View			
Profile			
Affected Buildings	7 buildings (7,750m <sup>2</sup> )	17 buildings (3,640m <sup>2</sup> )	12 buildings (16,352m <sup>2</sup> )
Resettlement	7 households (33 people)	No-resettlement is required	No-resettlement is required
Effects of Natural Environment	<ul style="list-style-type: none"> <li>Though the route crosses the Dund River, the effects on water quality is small.</li> <li>The problems such as noise and vibration during construction and operation are also small because of the surrounding industrial district and commercial area.</li> </ul>	Same as Case-1	Same as Case-1
Affected Utilities	<ul style="list-style-type: none"> <li>Underground high voltage lines for Golden Park (35kV)</li> <li>Hot-water pipes (Dia.800 x 2)</li> </ul>	<ul style="list-style-type: none"> <li>Hot-water pipes (Dia.800 x 2)</li> </ul>	<ul style="list-style-type: none"> <li>Removal of the existing pedestrian bridge</li> </ul>
Total Road Length	1,550 m	1,200 m	1,000 m
Road Geometry	Minimum curve radius : 300m / maximum longitudinal grade : 4.5%	Minimum curve radius : 200m / maximum longitudinal grade : 4.5%	Minimum curve radius : 200m / maximum longitudinal grade : 4.5%
Total Bridge Length	615 m	630 m	495 m (Flyover)+35m (Dund River crossing bridge)
Construction Cost	6.1 billion JPY	6.0 billion JPY	4.9 billion JPY
Evaluation	<ul style="list-style-type: none"> <li>Travelling performance is the best since the curve radius is the largest among alternatives.</li> <li>Relocation of the oil product factory building and its compensation of which negotiation may be protracted are required.</li> <li>The road can not be connected with West Industrial Road since the distance from railway is insufficient.(in case connected to the West Industrial Road, the vertical grade is over 5% which is Mongolian Regulation)</li> <li>Inverse impact on social environment is the worst since 26 people must be resettled.</li> <li>Although land acquisition and resettlement issue are big issues, this route is selected as the best among the alternatives in terms of traffic safety.</li> </ul> <p style="text-align: center;"><b>Good</b></p>	<ul style="list-style-type: none"> <li>Although the number of buildings to be relocated is large, their sizes and compensation amount are the smallest among the alternatives.</li> <li>Traffic safety at the intersection with Narry Road is the worse in terms of driver's visibility due to its shape.</li> <li>The road can not be connected with West Industrial Road since the distance from railway is insufficient.</li> <li>The intersection with Dund Gol Street is too close to end of the approach road, which will affect to traffic safety.</li> <li>Resettlement issue is the least, however traffic safety at intersections with Narry Road and Dund Gol Street is considerable.</li> </ul> <p style="text-align: center;"><b>Fair</b></p>	<ul style="list-style-type: none"> <li>Land acquisition issue is the largest although bridge section is the shortest among alternatives.</li> <li>Traffic safety at the intersection with Narry Road is the worse in terms of driver's visibility due to its shape. In addition, it is likely to cause traffic jams because the entrance of grade separation is closer to the next intersection in front of railway station.</li> <li>Although it is possible to connect with West Industrial Road, the intersection is too close to the end of approach road, which will affect to traffic safety.</li> <li>The largest land relocation issues may be impediment to implement the Project although the construction cost is the lowest</li> </ul> <p style="text-align: center;"><b>Bad</b></p>



(4) Comparison between East-West Route, North-South Route and Combined Case

	(a) East-West Route	(b) North-South Route	(c) E-W, N-S Combined Plan
Plan			
Profile			Same as the Route of (a)
Traffic Characteristics	<ul style="list-style-type: none"> <li>It forms a new traffic axis in the east-west direction parallel to Peace Avenue, and works for development of the Western area of the UB City in the future. The estimated traffic volume of the flyover (in 2030) is about 58,000 vehicles a day.</li> <li>Traffic demand is larger than that of the North-South route by more than 30%. (The traffic volume of Narry Road plus 31% to 44%)</li> <li>The major traffic flow using this route is concentrated in Power Plant Road (62%) and Chinggis Avenue- Ajiichin Road (30%), and many of them are large size trucks from the west side of the Power Plant Road.</li> <li>It reduces the traffic load of the existing Gurvaljin Bridge by about 20%.</li> <li>It reduces the traffic volume of Peace Avenue by 2% to 19% depending on the section.</li> </ul>	<ul style="list-style-type: none"> <li>The access in the north-south direction is improved by adding a crossing point over the railway and Dund Gol River. The estimated traffic volume of the flyover (in 2030) is about 41,000 vehicles a day.</li> <li>The traffic demand is smaller than that of the east-west route by more than 30%.</li> <li>The major traffic flow using this route is diverged into Power Plant Road, Chinggis Avenue- Ajiichin Road and Dund Gol Street.</li> <li>It reduces the traffic load of the existing Gurvaljin Bridge by 11%.</li> </ul>	<ul style="list-style-type: none"> <li>The estimated traffic volume (in 2030) of the flyover is about 55,000 vehicles a day. Among them, the number of vehicles which use the north-south access ramp is about 8,000 vehicles a day.</li> </ul>
Environmental Aspect	<p>Social Environment : Nine affected buildings (3,667m<sup>2</sup>) Resettlement: None</p> <p>Natural Environment : Though the Dund River is partially filled up, the effects on water quality, fauna and flora are small. The problems such as noise and vibration during construction and operation are also small because of the surrounding industrial district and commercial area.</p>	<p>Social environment : Seven affected buildings (7,750m<sup>2</sup>) / Seven Gers (33 residents to be resettled)</p> <p>Natural environment : Through the route crosses the Dund River, the effects on water quality, fauna and flora are small. The problems such as noise and vibration during construction and operation are also small because of the surrounding industrial district and commercial area.</p>	<p>Social environment: 19 affected buildings (21,000m<sup>2</sup>) / Seven Gers (33 residents to be resettled)</p> <p>Natural environment: Through the route crosses the Dund River, the effects on water quality, fauna and flora are small. The problems such as noise and vibration during construction and operation are also small because of the surrounding industrial district and commercial area.</p>
Affected Utilities	<ul style="list-style-type: none"> <li>Underground high voltage lines for Golden Park (35kV)</li> <li>Hot-water pipes (Dia.350x2)</li> </ul>	<ul style="list-style-type: none"> <li>Underground high voltage lines for Golden Park (35kV)</li> <li>Hot-water pipes (Dia.800x2)</li> </ul>	<ul style="list-style-type: none"> <li>Underground high voltage lines for Golden Park (35kV)</li> <li>Hot-water pipes (Dia.350x2) and (Dia.800x2)</li> </ul>
Road Length	2250m	1,550 m	2,200m + On-Off Ramp 790m
Road Geometry	Minimum curve radius : 200m / maximum longitudinal grade : 4.5%	Minimum curve radius : 300m / maximum longitudinal grade : 4.5%	Minimum curve radius : 200m / maximum longitudinal grade : 4.5%
Total Bridge Length	600 m	615 m	600m plus Ramp bridge (180m)
Approximate Construction Cost	6.3 billion JPY (1.00)	6.1 billion JPY (0.96)	The Route of (a) plus about 2 billion JPY
Evaluation	<ul style="list-style-type: none"> <li>Although the bridge length is shorter than that of the north-south route, the construction cost is higher by 4% because of the longer access road length. On the other hand, land acquisition is the less and the costs for compensation and utility relocation will be less in comparison with the north-south route. Therefore, there is no big difference in Project Costs. (Compensation cost for buildings and others specified by Cabinet Order-336: 400,000 to 600,000 Tg/m<sup>2</sup>)</li> <li>Passing over the main and feeder lines of railway by the flyover, the route can eliminate risks of traffic jam and accidents affected by the railway.</li> <li>The project effect can be produced by this project independently.</li> </ul>	<ul style="list-style-type: none"> <li>Negative impact to the social environment is larger than the east-west route due to relocation of oil product factory building (about 5,400m<sup>2</sup>) and resettlement (33 residents) .</li> <li>This route cannot eliminate risks of traffic jam and accidents affected by the railway since the a part of user shall pass at grade railway crossing.</li> <li>Effect of the Project is subject to completion of widening to 4-lane at Dund Gol Street to be implemented by UB City.</li> </ul>	<ul style="list-style-type: none"> <li>As relocation and compensation are required for the buildings in the oil product factory and facilities in the adjacent cement factory, the compensation cost is estimated to be a huge amount.</li> <li>The construction cost is about 30% higher than that of the route of (i) due to On-Off ramp and its access road.</li> <li>It is possible to construct the On-Off ramp and its access road stage wise if land acquisition and resettlement issues are solved.</li> </ul>
	<b>Recommended</b>	<b>Not Recommended</b>	<b>Not Recommended</b>

### 5.3 PROJECT SCOPE DESCRIPTION

As mentioned in the previous chapter, since the superiority of the East-West Route has been verified, the project scope is defined as follows.

(1) Starting/Ending Points of Project

Starting Point: At the intersection between Ajilchin Street and West Industrial Road

Ending Point: Intersection of Naryn Road in front of Ulaanbaatar Railway Station

(2) Flyover: From Naryn Road to West Industrial Road

(3) Access Road

North Side: Since the 4-lane widening of Naryn Road is ongoing, the area of access road for Ajilchin Flyover shall be adjusted to the widening plan.

South Side: The west side from the railway feeder line to Power Plant No. 3 to the intersection with Ajilchin Street

(4) Dund River Crossing Bridge

It is rather difficult for the initially requested location of the Dund River Bridge to connect to the new flyover due to several constraints. Furthermore, since the area is densely occupied by railway feeder lines, factories and gers, land acquisition for the access road to a Dund River crossing bridge will encounter serious difficulties. On the other hand, the existing Dund River crossing bridge is, as mentioned in Paragraph 2.4, scheduled to have 4-lane widening and rehabilitation by the fund of Ulaanbaatar City, which means whole section of Ajilchin Street will be improved to 4-lane.

Figure 5.3.1 shows an alternative location of the Dund River crossing bridge. However, there are few merits in the construction of a new Dund River crossing bridge at the alternative location as described below:

- (i) The benefit is limited to only certain users in the relevant area.
- (ii) Additional installation of intersection to the arterial road induces decline of mobility.
- (iii) Land acquisition for access road is difficult at the property of newly constructed factories.

Accordingly, the Project scope shall be limited to the following aspects excluding construction of new Dund River crossing bridge.

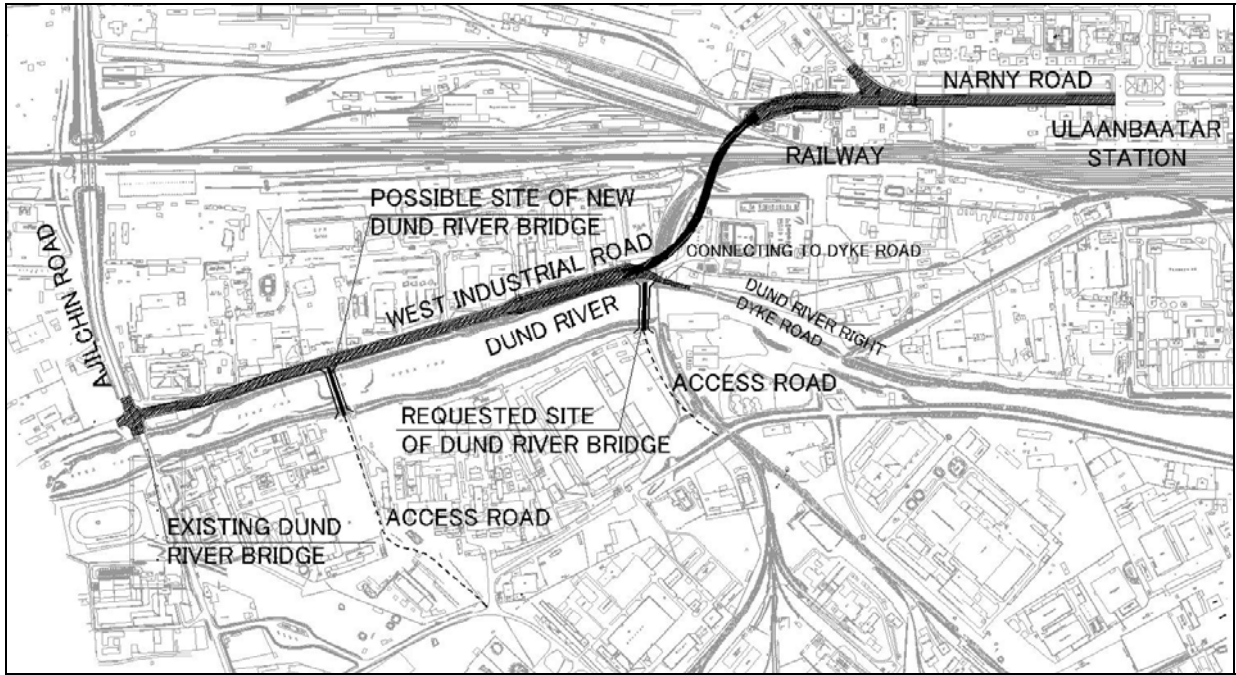


Figure 5.3.1 Candidate Site for Dund River Bridge

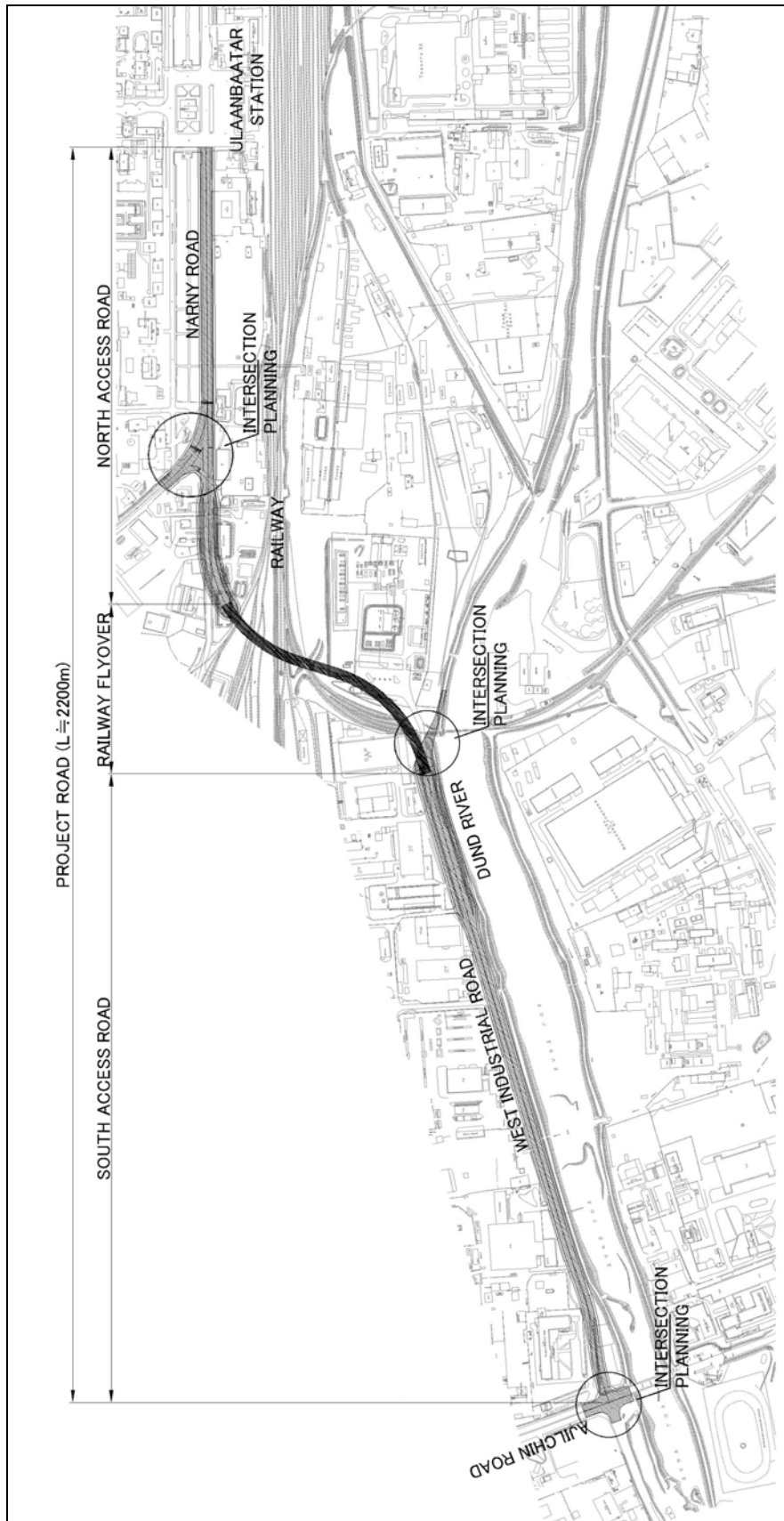


Figure 5.3.2 Project Area

## CHAPTER 6

### UTILITY SURVEY

#### 6.1 EXISTING UTILITIES

There are various utilities installed both above and under the ground in the Project site. Although the Construction and Urban Development Department of Ulaanbaatar City manages the utility information as CAD data which consist of utility line with topographic data and type and spec of Usability, there is still certain possibility of unknown underground utilities in the Project site since all information are not managed in totality. Therefore, the relevant data was obtained from each utility administrator, and the Survey Team updated the utility information map in the Project site. The utility types and administrators are as indicated in Table 6.1.1.

Table 6.1.1 Utilities and Administrators

<b>Type</b>	<b>Details</b>	<b>Administrator</b>	<b>Remarks</b>
Hot-water pipe	Pipe, Manhole	Ulaanbaatar Heating Distribution Network Company; Housing and communal service authority in Ulaanbaatar City	
Water supply	Pipe, Manhole	The Water Supply and Sewerage Authority	
Sewage line	Pipe, Manhole	The Water Supply and Sewerage Authority	
Electricity	High voltage: Electric power cable (In the air/Underground), Pylon	Ulaanbaatar Electricity Distribution Network Company; Energy Authority	
	Low voltage: Electric power cable (In the air/Underground)		
Communication cable	Cable (Above the ground/Underground), Pit	ICT Network Company	
CATV	Main line, Sub-cable, Pit	ICT Network Company	Not included in this project.
Gas station	Pipe, Pit	Ministry of Mineral Resources and Energy	
Drainage	Pipe, Manhole	Water Facility Public Corporation	
Ulaanbaatar Railway	Railway Track	Ulaanbaatar Railway (UBTZ)	
	Electricity, Communication, etc.		

The outline of utilities in each section considered to be affected by the Project is summarized below.

(1) West Side Access Road

Table 6.1.2 Utility Outline of West Side Access Road

Type	Specifications	Remarks
Hot-water Pipe	Above the ground: φ350mm (Materials are steel pipes and guard pipes.)	They cross the road for this project near STA. 0+440.
Water Supply	Steel Pipe φ100mm to φ200mm etc.	Most of them are built along the roads for this project.
Sewage Line	Plastic Pipe φ600mm, φ200mm, etc. Cement Pipe φ500mm, φ400mm, etc.	Some are installed along the roads for this project; others are installed across roads and rivers. There are main pipes (collecting pipes) and branch pipes which connect buildings to the main pipes.
Electricity	Buried: Approx. φ50mm	Both high and low voltage lines are buried in the ground. Some are installed along the roads for this project; others are installed between buildings.
	Above the ground: Low voltage line	Low voltage lines are installed along the roads for this project.
Communication Cable	φ100mm, φ150mm, etc.	Some are installed along the roads for this project; others are installed across the roads.

(2) Bridge Section

i) Between A1 and P2

Table 6.1.3 Utility Outline between A1 and P2

Type	Specifications	Remarks
Sewage line	Plastic pipe φ600mm	Going through the north side of the A1 abutment to the P1 pier, sewage lines go across horizontally in the ground between P1 and P2 piers. Relocation may be required depending on the construction method of the piers.
Electricity	Buried: Approx. φ50mm	They are buried on the north side of the A1 abutment to the P1 pier. Relocation is required since there may be interference with the planned location for the P2 pier and the A1 abutments.
	Above the ground: High voltage line	High voltage lines are planned to be installed on the southern side of the P2 piers.
Communication Cable	Approx. φ150mm	They are installed on the north side of the A1 abutments to the P1 pier.

ii) Between P2 and P5 Piers

Table 6.1.4 Utility Outline between P2 and P5

Type	Specifications	Remarks
Hot-water Pipe	Buried: Steel Pipe $\phi$ 200mm	They run between the P2 and P3 piers in the ground.
Water Supply	Steel Pipe $\phi$ 50mm to $\phi$ 100mm etc.	They are installed on the eastern side of the P3 to P5 piers.
Electricity	Buried: High voltage line (Pipe diameter is unknown.)	Power cables of railways are installed along the railway spur to the third thermal plant. Though high voltage lines are planned to be installed on the eastern side of the P2 to P5 piers, relocation is required to avoid the bridges.
	Above the ground: Low voltage line	Low voltage lines are installed. Relocation is required due to interference with the bridge.
Communication Cable	Approx. $\phi$ 150mm	Almost all are built along the bridge between the P3 and P5 piers. Relocation is required due to interference with the piers.

iii) Between P6 and P8 Piers

Table 6.1.5 Utility Outline between P6 and P8

Type	Specifications	Remarks
Hot-water Pipe	Above the ground: Specifications are unknown.	Since there is interference with the P8 pier, relocation is required. Additionally, the P9 pier may require relocation depending on the construction method.
Water Supply	Steel pipe $\phi$ 500mm	Since there is interference with the P7 pier, relocation is required.

(3) East Side Access Road

Table 6.1.6 Utility Outline between P9 and A2

Type	Specifications	Remarks
Hot-water Pipe	Buried: Steel Pipe $\phi$ 1000mm, $\phi$ 800mm, $\phi$ 40mm etc.	The $\phi$ 300m pipe is installed horizontally along the bridge in the ground or on the ground. Since there is interference with the piers, relocation is required. Additionally, the $\phi$ 1000mm pipe goes underground around the P17 pier, and the $\phi$ 40mm pipe goes underground around the A2 abutment.
	Above the ground: $\phi$ 300mm (Steel pipes with concrete Box)	The $\phi$ 300m pipe is installed horizontally along the bridge in the ground or on the ground. Relocation is required due to interference with the piers.
Water Supply	Steel Pipe $\phi$ 500mm	They are installed horizontally along the bridges. As there is interference with the piers, relocation is required.
Sewage Line	Corrugated Pipe $\phi$ 1,200mm	Under construction in the ground of the green belt of Nary road.

## 6.2 RESULTS OF TRIAL EXCAVATION

The test pits were dug as per the updated utility information map in order to confirm actual installation conditions of utilities in the Project site. Firstly, ten areas (D-1 to D-10) were set in the Project area and preliminary exploration of underground utilities was conducted using sonar test.

Secondly, the 19 locations of test pits were selected on the basis of preliminary exploration, and exact installation conditions of the existing underground utilities was visually confirmed. The results of trial excavation are summarized in Table 6.2.1 and the following pages. Detailed utility location is shown in Annex: Drawings.



Table 6.2.1 Outline of Trial Excavation Results

Test Area	Pit No	Confirmed Utility	Remarks
D-1	P-1	Power cable x 1 Communication cable x 7	
	P-2	Heating pipe (Not included in the utility information map.)	
D-2	P-3	Communication cable x 8, $\phi$ 13cm to 17cm	
D-3	P-4	Power cable x 2, $\phi$ 5cm	(Not included in the utility information map.)
	P-6	Power cable x 1, $\phi$ 5cm Communication cable x 1, $\phi$ 15cm	
	P-7	Power cable x 3, $\phi$ 5cm	(Some are not included in the utility information map.)
D-4	P-8	Power cable x 1, $\phi$ 5cm	
	P-9	Power cable x 3, $\phi$ 4cm to 5cm	
D-5	P-10	Concrete Box 70cm x 70cm Communication cable x 1, $\phi$ 12cm Power cable x 1, $\phi$ 5cm	There is a possibility they are not used at the same time. (Power cable is not included in the utility information map.)
	P-20	None	
D-6	P-11	None	
D-7	P-18	Power cable x 1	
D-8	P-12	Water supply x 2, $\phi$ 13cm	
	P-13	Communication cable x 2, $\phi$ 13cm	
D-9	P-17	None	
	P-19	Power cable x 1	
D-10	P-14	Heating pipe x 1 Power cable x 1, $\phi$ 1cm	
	P-15	Power cable x 2, $\phi$ 5cm to 10cm	
	P-16	Heating pipe x 1	



Figure 6.2.1 Overall View of Test Trench Location

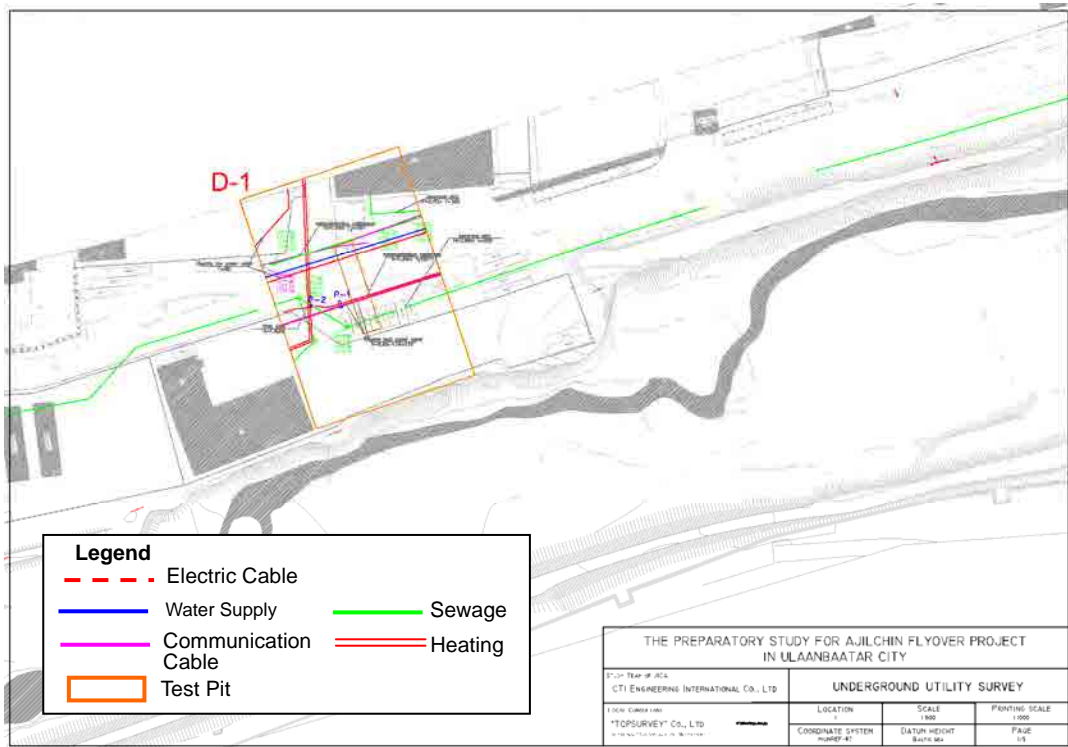


Figure 6.2.2(1) Detailed Figure of Test Trench Location (D-1)

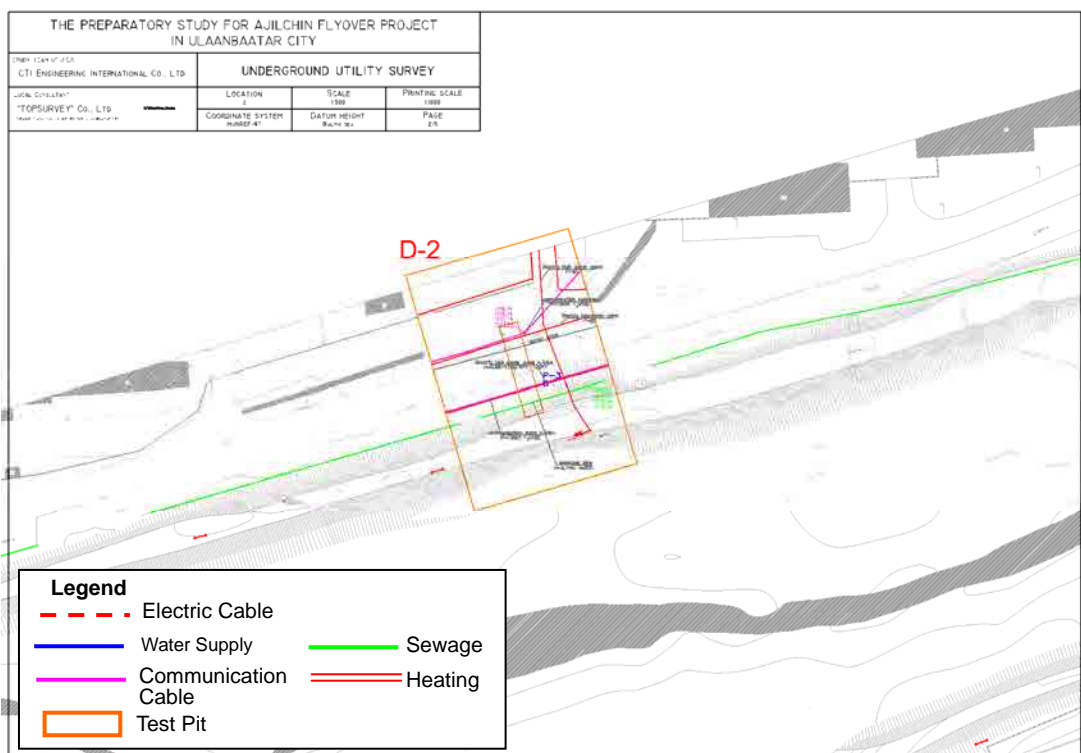


Figure 6.2.2(2) Detailed Figure of Test Trench Location (D-2)

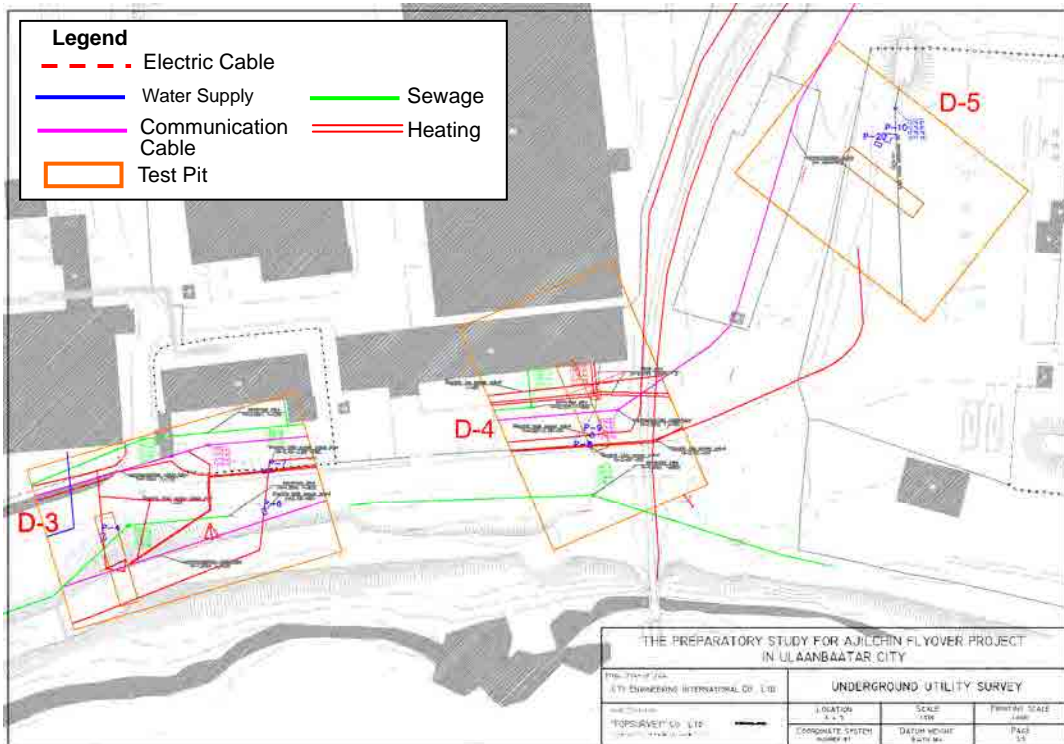


Figure 6.2.2(3) Detailed Figure of Test Trench Location (D-3 to D-5)

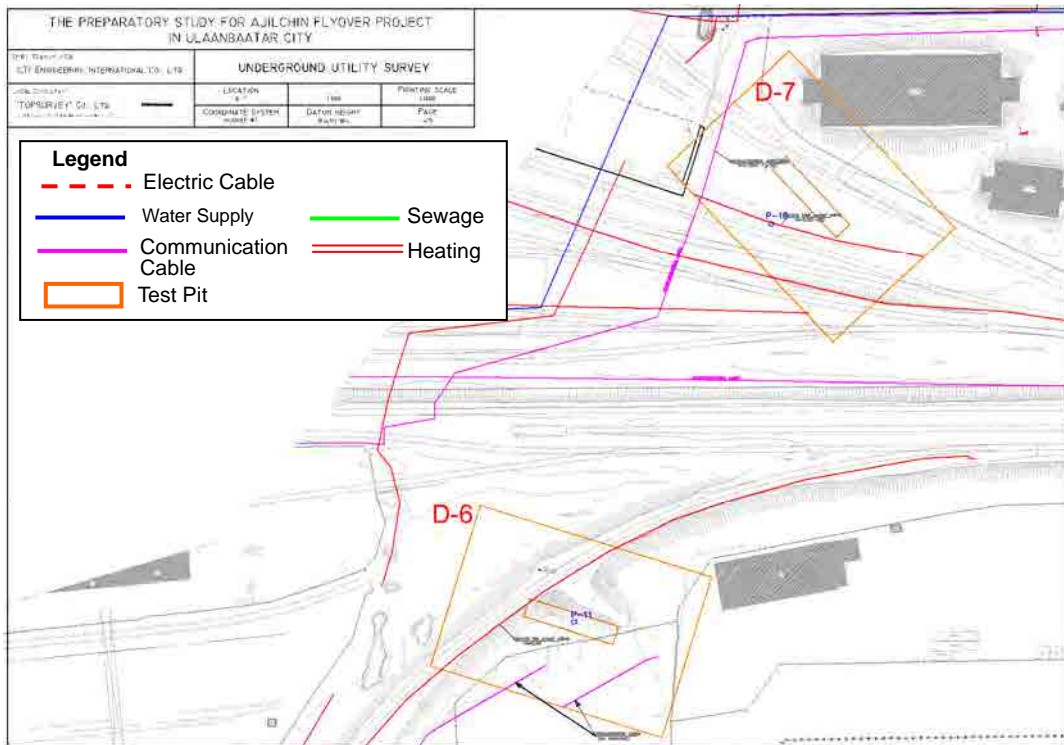


Figure 6.2.2(4) Detailed Figure of Test Trench Location (D-6 to D-7)

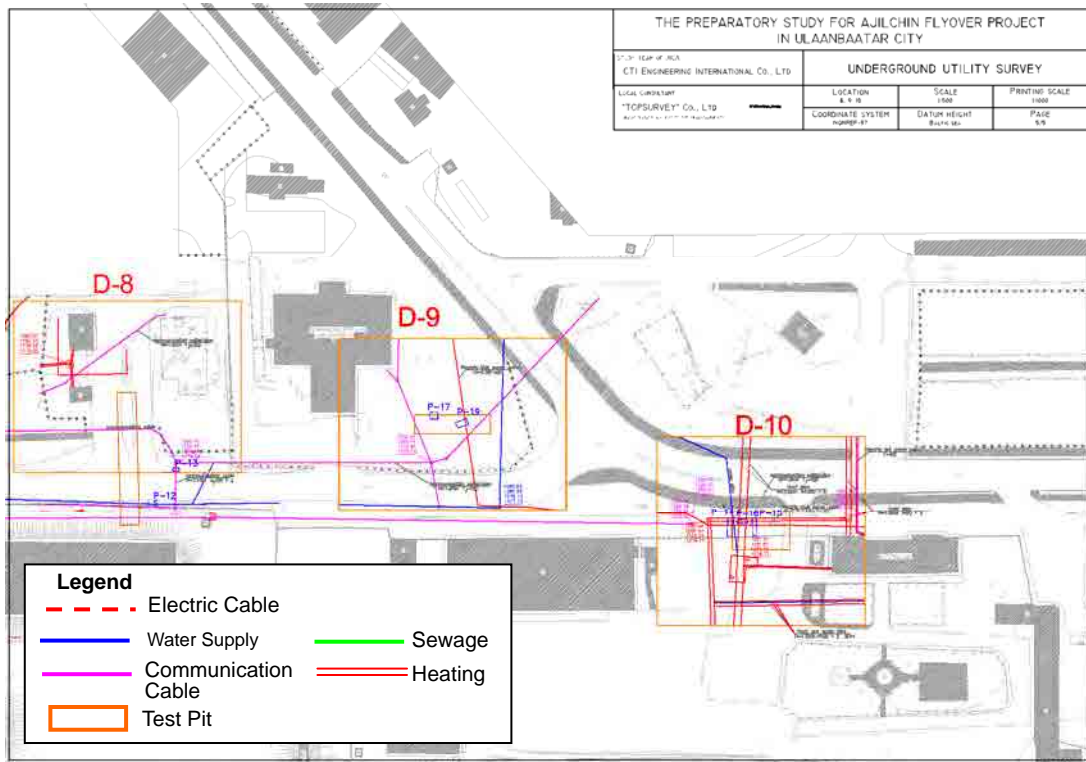


Figure 6.2.2(5) Detailed Figure of Test Trench Location (D-8 to D-10)

### 6.3 FUTURE UTILITY PLAN

Installation of high voltage electric power cables/pylons and sewerage pipes has been in progress since 2012. Though double-tracking of railway is allegedly scheduled, specific plan and schedule are not yet fixed. The following is a summary of information pertinent to the future utility plan.

Table 6.3.1 Future Utility Plan

Type	Details	Progress	Remarks
Electricity	High voltage electric power cable and pylons	Under construction	With the support of the World Bank, a new substation will be built and high voltage electric power cables (35kV) and pylon for high voltage (H-26m) will be installed.
		Construction will begin in 2012.	Branch electricity distribution from the high voltage electric power cable described above to the newly built railway staff quarters (Golden Park). (Underground buried cable; GL-0.7-1.0m). The construction will be done in 2012 by the fund of Ulaanbaatar City.
Sewage line	Sewage pipe	Under construction	Sewage pipes of approx. $\phi 1$ m will be installed horizontally through Naryn Road intersection on the terminal side of this project.
Railway	Track	Concept only. Timing of implementation and the detailed plan have not been decided.	There is a plan to increase the track of the main line from one to three; however, the timing and detailed widening area has not been decided.

## 6.4 UTILITY RELOCATION PLAN

### (1) West Industrial Road

#### i) Underground Utilities

In the West Industrial Road, parking space and/or median strip with sufficient width will be installed between the existing road and the new road. Therefore, existing underground utilities below the carriage way of prospective new road shall be relocated to the space of parking space and/or median strip.

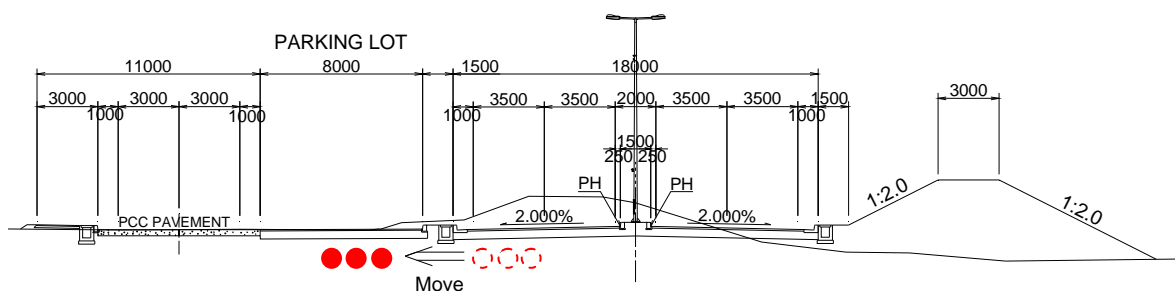


Figure 6.4.1 Relocation Image of Utilities of West Industrial Road

ii) Hot-water Pipe

Near STA. 0+440, hot-water pipes ( $\phi 350$ ) go across the proposed road of the Project. These pipes encroach into the road construction gauge, and thus need to be relocated prior to implementation of the Project.



Figure 6.4.2 Hot-water Pipes around STA. 0+440

(2) Railway Flyover Section

There are many utilities which may interfere to substructure/foundation work of the piers and abutments. Besides, even no interference to the permanent structures, some utilities will interfere to such temporary work as excavation and diversion/coffering. Therefore, these utilities need to be relocated to an area where interference to the bridge construction work can be eliminated.

(3) Narny Road Area

Underground utilities below the carriageway should be relocated to below the side walk to secure prospective maintenance. Utilities crossing the roads should be protected by overlying layer with adequate thickness (0.8 m or more) to withstand the traffic load.

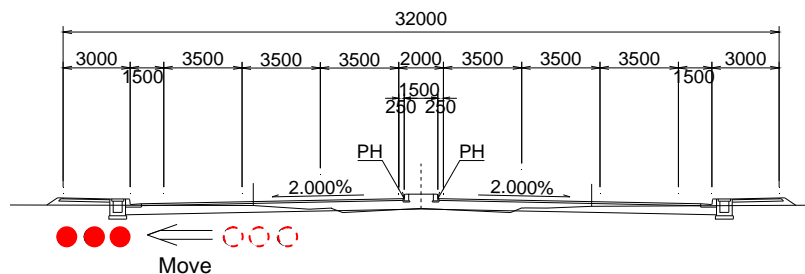


Figure 6.4.3 Relocation Image of Utilities on Narny Road

Hot-water pipes ( $\phi 300$ ) connected from Narny Road to the premises of railways may interfere to foundation of the bridge near STA1 +500, and thus proper relocation is required

In addition to above, hot-water main pipes ( $\phi 800 \times 2$ ,  $\phi 1,000 \times 2$ ) are installed below Narny Road. Since relocation of these main hot-water pipes are difficult, locations of abutment and piers were soundly determined so that large-scale relocation of main pipes could be eliminated.



Figure 6.4.4 Hot-Water Pipe around STA. 1+500

#### (4) Relocation Plan

As the result of utility survey and subsequent discussion with related utility administration offices, following relocation works have been identified to be necessary for smooth implementation of the Project. Underground utilities will be relocated principally to outside of carriage way such as under the sidewalk for easy maintenance.

Existing utilities can be classified as:

- Utilities possible to relocate prior to land acquisition; and
- Utilities possible to commence relocation work without land acquisition.

Cost for relocation has been estimated as follows through objective-wise discussion with concerned agencies as well as mutual confirmation in WG and JCC meetings. (Route for relocation shall be referred to drawings enclosed in ANNEX)

Table 6.4.1 Utility Relocation Plan

Type	Type (Title)of Utility	Specification	Relocation Plan	Implementation	Cost (MNT)
Hot-water Pipes	SOT-3	$\phi 350\text{mm} \times 2$	Relocate to cross the new road ensuring regulated vertical clearance (H=5.0m)	After Land Acquisition	500 Million
Electricity	Underground cable at Intersection of Narny Road	10 kV x 2 L=250m	Relocate to sidewalk at south side of new road.	After Land Acquisition and Relocation of Railway Facility	801 Million
	Underground cable in the existing river dike along Dund River	10 kV x 2 L=500m	Relocation to new traffic strip.	Before Land Acquisition	
	Underground cable at intersection with West Industrial Road.	10 kV x 2 L=50m	Elevation shall be change in accordance with new road profile..	Before Land Acquisition	



	Cables along Water Pipe crossing Dund River.	10 kV x 4 L=50m	Elevation shall be change in accordance with new road profile.	Before Land Acquisition	
	Underground Cable at intersection with Ajilchin Road.	10V x 1 L=100m	Elevation shall be change in accordance with new road profile..	Before Land Acquisition	
	POL-J 42/1x120-240	35kV L=250m	Relocate to under the new side walk along Narny Road.	After Land Acquisition and Relocation of Railway Facility	
	Underground High Voltage Line	ø50(x2) 5000V L=30m	Relocate to northern side where is in the side of private facility near P2.	Before Land Acquisition	
		ø50(x2) 5000V L=20m	Relocate with protection at the location of water pipe bridge to withstand new road widening.	Before Land Acquisition	
	Low Voltage Overhead Line and Poles	220V L=1200m Pole 16pcs	Relocate the overhead cable and poles along existing dike to road side of West Industrial Road.	Before Land Acquisition	
Water Supply and Sewage	Water Supply Steel Pipe	Ø500 L=20m	Relocate to cross the new road and dike with appropriate clearance.	After Land Acquisition	11.5 Million
	Sewage Pipe (Under Construction)	ø1200 L=380m	Relocate the extent interfered by bridge foundation to north side side-walk of new road.	After Land Acquisition and Relocation of Railway Facility	600 Million
	Sewage Pipe (No.24)	ø600 L=380m	Relocate to under the side walk on the north side subjecting to the section interfering in piers/foundations of bridge.	After Land Acquisition and Relocation of Railway Facility	150 Million
Communication	Main Cable	M1-7-14 SC1-7-13 SD10-2-3 SD10-2-4	Deepen to withstand the improvement of intersection at Ajilchin Street.	Before Land Acquisition	81 Million
		81(0) L=60m	Re-routing along West Industry Road	After Land Acquisition	2 Million
		55(B) L=220m	Re-routing along railway feeder line.	After Land Acquisition	6 Million
Railway Facility	High Voltage Underground Line	9.6kV 3*185: 20m 6.0kV 3*185: 20m 6.0kV 3*185: 5m No5 3*240: 5m No6 3*240: 5m Joint: 10 Locations	Re-routing in the Railway Premises to avoid piers.	Before Land Acquisition	145 Million
		Fiber Optics Cable for Communication	Ø130x2 L=200m	Relocate to northern side walk to avoid P9-P11.	After Land Acquisition
	Communication	Ø4x4	Re-routing in the Railway Premises to	Before Land Acquisition	100 Million

	Cable for Traffic Signal		avoid piers.		
	Heating Pipe for Railway	Ø300x2 L=250m	Relocate to railway premises at south side of new road or to under the new side walk.	After Land Acquisition	805 Million
	Water Supply	Ø150 L=750m Protection Cover Valve φ 200 x 2 Valve φ 1000x1 Joint φ 200 x 12	Relocate to southern side of new road in railway premises. Pipe shall be under passing of Railway.	Before Land acquisition	152 Million
Total					3,594 Million

Note: Management company of communication cable has an intention to install relocated cable along the newly constructed bridge. Accordingly, further discussions will be made during the detailed engineering design stage regarding availability of cabling space and so forth.

## 6.5 NECESSARY PROCEDURES FOR RELOCATION OF UTILITIES

Relocation of utilities for any project in Ulaanbaatar City is conducted according to the following procedures after approval of project implementation. Relocation work and its management are conducted under the responsibility of Ulaanbaatar City.

STEP-1 Technological Facility Department in Ulaanbaatar City asks administration offices of the objective utilities for specific design and cost estimate for required relocation.

STEP-2 Each administration office of the utilities orders specific design to the consultant.

STEP-3 Following design by the consultant, specific design and relocation cost are submitted to Ulaanbaatar City.

STEP- Ulaanbaatar City approves the budget for relocation.

STEP-5 Ulaanbaatar City orders the relocation work.

In “The Project for Construction of Railway Fly-Over in Ulaanbaatar City (2009 to 2012)”, delay of some utility relocation work seriously affected the construction schedule of the flyover. Accordingly, the following points shall be duly considered for implementation of the Project:

- 1) Project Implementation Unit (PIU) shall be organized prior to commencement of detailed engineering design for the Project.

Organizing PIU was expected when the detailed design of “The Project for Construction of Railway Fly-Over in Ulaanbaatar City” (hereinafter referred to as Naryn Bridge) had started. As a result, however, PIU was organized at the start of construction work. Although Ulaanbaatar City took the initiative for the relocation work, the work was not completed prior to commencement of the construction work for Naryn Bridge. Based on this experience, it is important to ensure organizing PIU prior to commencement of detailed engineering design.

- 2) The staff members of Engineering Facility Department in Ulaanbaatar City must participate in PIU as a key staff.

In order to coordinate the schedule of detailed engineering design and construction of the flyover with the schedule of utility relocation in terms of design and site work, staff members of the Engineering Facility Department in Ulaanbaatar City shall be assigned as a key staff of PIU until at least the early stage of the construction work. Since there was not satisfactory coordination was not satisfactory, between PIU and the Engineering Facility Department in Ulaanbaatar City in Naryn Bridge project, it took much time to solve the problems pertinent to utility relocation.

- 3) Strengthening Management on Utility Relocation Work

In the construction of Naryn Bridge, it was revealed that many underground utilities supposed to “must have been relocated” had not been relocated by Ulaanbaatar City. It was not confirmed whether or not the relocation work had been processed appropriately based on the contract by Ulaanbaatar City since the staff who was in charge of the transaction had already been shifted to another department. Therefore, the key staff of the Engineering Facility Department of Ulaanbaatar City who may be dispatched to the prospective PIU is required to be involved in whole process of relocation works to secure ultimate completion of the relocation work with unwavering responsibility.

- 4) Allocation of Discretionary Reserve

Since the record and management of existing underground utilities is not perfect, it is difficult to know the entire situation even if a detailed survey is conducted. Therefore, it is crucial to cope with newly discovered underground utilities during the construction in a flexible manner. In this sense, it is recommended to allocate contingency budget for relocation works urgently required to secure construction schedule of the Ajilchin Flyover.

Detailed design of utility relocation and the budgetary allocation should be done during detailed engineering design of the Ajilchin Flyover. Relocation work should be completed prior to hand over of the Project site to the Contractor.

The relocation schedule should be adjusted so that the latest utility information after relocation work could be provided to the contractor and the consultant in charge of supervising the construction work.