

JAPAN INTERNATIONAL
COOPERATION AGENCY

CAPITAL DEVELOPMENT CORPORATION
CITY OF ASTANA

THE STUDY
ON
THE MASTER PLAN
FOR
THE DEVELOPMENT OF THE CITY OF ASTANA
IN
THE REPUBLIC OF KAZAKHSTAN

FINAL REPORT
VOLUME II : MAIN REPORT

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JUNE 2001

KISHO KUROKAWA ARCHITECT AND ASSOCIATES
NIPPON KOEI CO.,LTD.
INTERNATIONAL DEVELOPMENT CENTER OF JAPAN

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PREFACE

In response to the request from the Government of the Republic of Kazakhstan, the Government of Japan decided to conduct the Study on the Master Plan for the Development of the City of Astana and entrusted the study to the Japan International Cooperation Agency (JICA).

JICA selected and dispatched a study team headed by Dr. Kisho Kurokawa of Kisho Kurokawa Architect & Associates and consists of Nippon Koei Co., Ltd. and International Development Center of Japan to the Republic of Kazakhstan between February 2000 and May 2001.

The team held discussions with the officials concerned of the Government of the Republic of Kazakhstan and conducted field surveys in the study area. Upon returning to Japan, the team conducted further studies and prepared this final report.

I hope that this report will contribute to the promotion of this project and to the enhancement of friendly relationship between our two countries.

Finally, I wish to express my sincere appreciation to the officials concerned of the Government of the Republic of Kazakhstan for their close cooperation extended to the team.

June 2001



Kunihiko Saito

President

Japan International Cooperation Agency

June 2001

Mr. Kunihiro Saito
President
Japan International Cooperation Agency
Tokyo, Japan

Dear Mr. Kunihiro Saito,

LETTER OF TRANSMITTAL

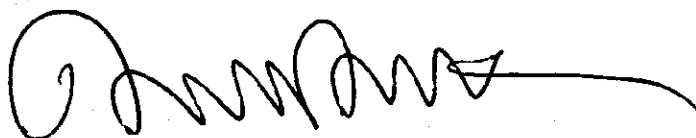
It is with great pleasure that we submit to you the Final Report of the Study on the Master Plan for the Development of the City of Astana in the Republic of Kazakhstan. The report was completed owing to the cooperative efforts of the Capital Development Corporation and the Municipality of Astana in particular, as well as other agencies and organizations of Kazakhstan. The report has been prepared for the Government of the Republic of Kazakhstan to implement comprehensive multi-sector development of the new capital city of Kazakhstan, Astana City over the next 30 years.

The report consists of three volumes; the Summary Report, Main Report and Supporting Report. The Summary Report presents an outline of the entire study results. The Main Report provides all the conclusions and proposals of the study regarding the socio-economic development, urban planning, infrastructure planning, engineering protection, environmental management, implementation and economic analysis, institutional framework and planning from regional aspects. The Supporting Report provides methodologies, assumptions, investigation findings, calculations and relevant data.

Taking this opportunity, I would like to express my appreciation on behalf of the Study Team to the people concerned from both Kazakhstan and Japan who extended support and cooperation for the successful completion of this Study. My heartfelt thanks go to the Capital Development Corporation, Municipality of Astana, Ministry of Economy and Trade, Ministry of Foreign Affairs and other government bodies of the Government of the Republic of Kazakhstan. The Japanese Ministry of Foreign Affairs, the Embassy of Japan in Kazakhstan and the Japan International Cooperation Agency also receive my warm appreciation for assistance given.

The Study Team is confident that this Report shall pave the road for successful implementation of the development of Astana into a truly attractive and lively new capital of Kazakhstan in the twenty-first century.

Yours faithfully,



Kisho Kurokawa
Team Leader

the Study on the Master Plan for the
Development of the City of Astana

Terminology

Abbreviations

AAKR	Astana, Akmola and Karaganda Region	ITU	International Telecommunication Union
ACT	Australian Capital Territory	JBIC	Japan Bank for International Cooperation
ACTPA	ACT Planning Authority	JICA	Japan International Cooperation Agency
ADB	Asian Development Bank	JSC	Joint Stock Company
ADP	Area Development Program	KEGOC	Kazakhstan Electricity Grid Operation Company
AES	Astanaenergyservice	LCB	Local Competitive Bid
ASEZ	Astana Special Economic Zone	LMC	Limited Liability Company
ATC	Automatic Telecommunication Center	lpcd	liter per capita per day
ATCS	Automatic Traffic Control System	LP	Low Pressure
AV	Added Value	LPG	Liquefied Petroleum Gas
BOD	Biochemical Oxygen Demand	LRT	Light Railway Transit
BOT	Build Operate and Transfer	MCM	Million cubic meter
°C	Centigrade	MDF	Main Distribution Frame
CDC	Capital Development Corporation	MP (M/P)	Master Plan
cmpd	Cubic Meters per Day	MSW	Municipal Solid Waste
CIS	Commonwealth of Independent States	MVA	Megavolt-ampere
CPI	Consumer Price Index	MW	Megawatt
CSC	Closed Stock Company	MWh	Megawatt-hour
dB	Decibel(s)	n.a.	Not available / Not applicable
DEL	Direct Exchange Line	NCDC	National Capital Development Commission
DF	Distribution Frame	NOx	Nitrogen Oxide
DLC	Digital Loop Carrier	ODA	Official Development Aid
EBRD	European Bank for Reconstruction and Development	OECD	Organization for Economic Cooperation and Development
EIRR	Economic Internal Rate of Return	O&M	Operation and Maintenance
ESP	Electrostatic Precipitator	OJSC/OSC	Open (Joint) Stock Company
f.o.b.	Free on board	PIP	Public Investment Program
EIA	Environmental Impact Analysis	PLP	Permissible Level of Pollution
EPR	Extended Producer Responsibility	ppm	Parts per Million
FBS	Family Budget Survey	PPP	Polluter Pay Principle
FDI	Foreign Direct Investment	p.s.u.	Parking Space Unit
FIC	Foreign Investors' Council	PV	Present Value
FIDIC	Federation Internationale Des Ingenieurs- Conseils (International Federation of Consulting Engineers)	R&D	Research and Development
FTTB	Fiber To The Building	PS (P/S)	Pumping Station
FTTC	Fiber To The Curb	RDF	Refuse Derived Fuel
FS (F/S)	Feasibility Study	SDH	Synchronous Digital Hierarchy
FSU	Former Soviet Union	SEZ	Special Economic Zone
GDP	Gross Domestic Product	SDP	Sector Development Program
GOK	Government of the Republic of Kazakhstan	SME	Small and Medium Enterprise
GOJ	Government of Japan	SNiP	Technical Standard and Norms
GRDP	Gross Regional Domestic Product	SOx	Sulfur Oxide
HC	Heat Center	S/S	Sub-station
HP	High Pressure	STM	Synchronous Transfer Mod
HSW	Hospital Solid Waste	STP	Sewerage Treatment Plan
ICB	International Competitive Bid	TACIS	Technical Assistance to the Commonwealth of Independent States
IKC	Irtys-Karaganda Canal	Tcal	Trillion calorie
ISW	Industrial Solid Waste	TFP	Total Factors of Productivity
IMF	International Monetary Fund	T/L	Transmission line
IP	Internet Protocol	USSR	United Soviet Socialistic Republic
ISDN	Integrated Services Digital Network	UNDP	United Nations Development Program
ISW	Industrial Solid Waste	VAT	Value-added Tax
IT	Information Technology	WTP	Water Treatment Plan

Russian/Kazakh Words				(Printed in <i>Italics</i>)
<i>Akim</i>	Mayor/Governor	<i>Micro Rayon</i>	Sub-district	
<i>Akimat</i>	Municipality	<i>Oblast</i>	Province	
<i>ASA</i>	<i>Astana Su Aransy</i> (Astana Water Company)	<i>Rayon</i>	(Intra-city) Region/(Inter-city) District	
		<i>SNiP</i>	Construction Norm and Regulation	
<i>Dacha</i>	Farm house	<i>TETs</i>	Thermal Power Station	
<i>Gorcommunkhos</i>	City Communal Management	<i>TOO</i>	Limited Liability Company	
<i>Gorvodokanal</i>	City Water Company (= ASA, if applied to Astana)	<i>TSUM</i>	Central Department Store	
<i>Kazstroicommite</i>	Committee for Construction	<i>Yulta</i>	Traditional tent house	
<i>Muslikhat</i>	City Congress	<i>Zelen Stroi</i>	Section of Greenery Planting	

Kurokawa's Terminology		(Printed in <i>Italics</i>)
<i>Symbiosis</i>	New, creative relationship born from competition and tension, or a positive relationship in which the participants necessarily attempt to understand each other, despite opposition	
<i>Metabolic city</i>	A linear zoning system, where the nature and urban life are in parallel, relieving a city from the limit of structural growth, which is a counter-proposal for a commonly practiced concentric city.	
<i>Abstract Symbolism</i>	A design methodology in architecture extended upon use of abstract forms and geometric features	

Exchange Rate

US\$ 1.0 = K Tenge 144.0 = J Yen 108.0, as of November 2000.

S.1 Overview

S.1.1 Conclusions and Recommendations¹

The capital has an inherent inseparability for the nation that it represents. This is the major reason that a number of new nations seek to establish a new capital. In light of this, the motivation of the move is quite straightforward and understandable.

Although faced with criticism and resistance in the beginning, the new capital is surviving its most difficult times. Construction of the new capital was one of the most important and significant decisions in the new RK, and it needs to be substantiated, as this is the basis on which the future of RK will be expanded.

The economic analysis revealed that the projects proposed under this Master Plan, consisting of urban and architectural development, infrastructure development and engineering protection, have economic viability as a whole over a 30 years planning period. This analysis is the first of the sort to scrutinize the economic cost and benefit of the entire capital development from an objective economic perspective

Three key factors could be delineated for the successful implementation of capital development. First, the issue of an implementation body; second the issue of implementation planning and programming; and third, the issue of financing.

- Stable and capable implementation body with coordination and implementation capacity
- Formulation and facilitation of detail plan for implementation
- Robust Finance for uninterrupted implementation of the capital development

Presented below are the major recommendations for immediate action

(Organizational strengthening)

- Establish firmly an implementation body with sole responsibility for the development of Astana with clear demarcation of responsibility and strengthened capacity for implementation of the Master Plan.
- Facilitate an organization with high capability of project management, staffed by specially trained personnel adaptive to the international practices of project

¹ Full text of Conclusions and Recommendations appears in Chapter 11 of Main Report.

implementation to effectively manage projects financed by international soft loans.

- Formulate a coordination committee with representatives from the provincial and republican governments to discuss and facilitate the regional development strategies proposed in this Master Plan, and implement them in due course.
- Allocate necessary budgets and resources and strengthen the functions of Astana Municipality with regard to the construction and improvement of infrastructures and engineering protection, based on readily formulated sector-wise detail plans.

(Financing)

- Seek an international soft loan on the improvement of water supply and sewerage, on which the feasibility study is being completed.
- Prepare for a feasibility study on the power and heat supply sector of Astana to improve the facilities, by investigating the possibility of grant-based technical assistance.
- Investigate options for providing a stable and favorable financing source for the telecommunication sector, appropriate to the semi-public nature of this sector, and accelerate pre-financing studies appropriate for the financing source.
- Harness a stable and institutionalized system to safeguard the indigenous rights of investors to promote foreign direct investment, and provide a system to support small and medium enterprises (SME) with good business plans.

(Implementation of Master Plan)

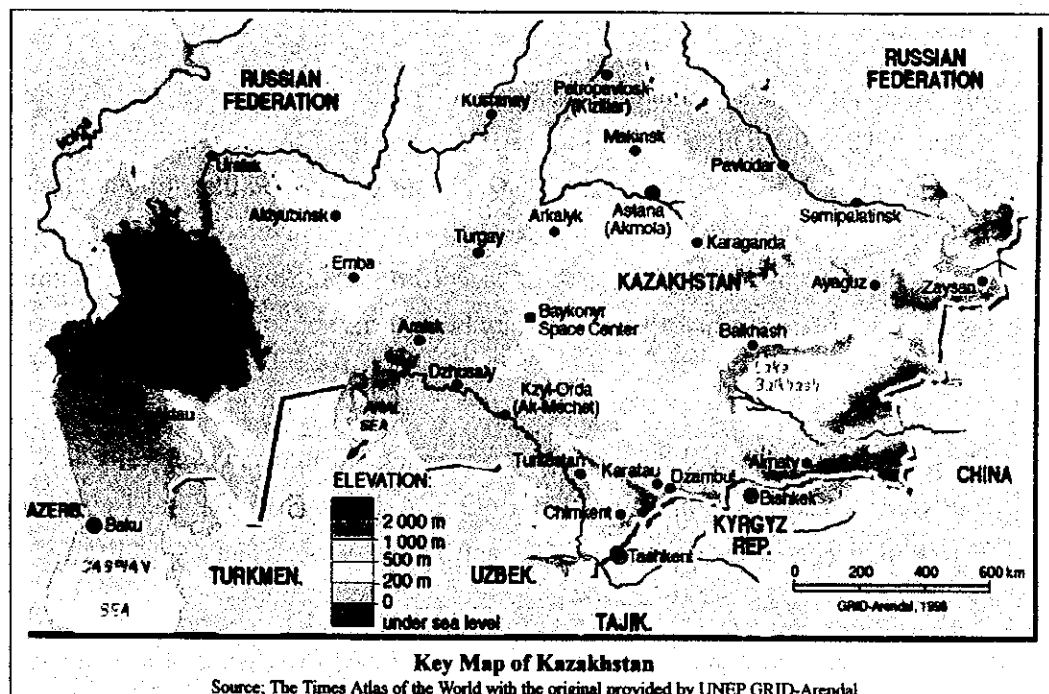
- Formulate plans to implement this Master Plan over a ten-year period by clearly stipulating the necessary construction and rehabilitation needs in specific districts with solid timeframe, reflecting the due appreciation of the present conditions therein.
- Work out a detail plan ready for implementation for the new development area (particularly New City Center area) on the left bank of the Ishim, following the District Planning and Townscape Guidelines established in this Master Plan.
- Work out a detail plan ready for implementation for the existing urban areas following the improvement plans for the existing urban areas, roads and parks.

- Work out a detail plan for the improvement of the Northern Industrial Area, with possible introduction of technical assistance from an international donor, to substantiate and strengthen the industries appropriate for the new capital.
- Promote agricultural development in the hinterland of Astana, primarily catering for the growing food demand with an option in the future for strategic agriculture to cater for wider regional and international demands.

S.1.2 Background

In December 1997, the Government of the Republic of Kazakhstan² officially announced that the new capital of the republic was to be Astana

Astana City is located in the central part of the republic, which was a clear advantage to the former capital, Almaty located too close to the rim of the republic to the southeast. Astana City is situated in the Middle Asia steppe along the Ishim River, and the topography here is part of the Kazakhstan low hill zone with gentle slopes. Astana finds itself in the central part of the republic with good access to all the major cities of the republic by rails and roads, which was part of the considerations for the capital transfer.



The new capital is gradually transforming itself to be a real capital. Besides Ministries and Agencies, a new museum opened in 2000. A number of new and

² In this report, the spelling of the republic "Kazakhstan" is adopted. For its derivative form, Kazakhstani will be used throughout the report.

rehabilitated buildings are now in use, including residential building, a museum, theaters and shopping centers.

This Master Plan provides multi-sector master plan over the planning period of 30 years for this fast-changing new capital of RK, conducted under the technical assistance program of JICA.

S.1.3 Objectives

The purpose of the Study on the Master Plan are the following.

- (1) To formulate a Master Plan for the development of Astana City to the year 2030 in order to support its function as a new national capital and to improve the quality of life of the residents,
- (2) To conduct Feasibility Study for the priority project proposed under the Master Plan, and
- (3) To strengthen the institutional capacity of both Central and Municipal Governments through technology transfer to counterpart personnel in the course of the Study.

S.1.4 Study Area

The Study Area, as stipulated in the Scope of Work, encompassed the boundary of Astana City with an area of 258 km² as of 1st January, 2000. On 8th August, 2000, a Presidential decree of Republic of Kazakhstan was issued that stipulated that the expansion of the city boundary to 710 km² by newly including parts of surrounding areas. The Study Area accordingly follows this new boundary. Figure 1.4.1 presents the old and new city boundaries.

S.1.5 Authority

The Study was executed based on the Scope agreed upon between the Japanese and Kazakhstani sides on 5 October, 1999 in Astana. The Capital Development Corporation (hereafter called "CDC") and the City of Astana are the executing agencies.

On 15th April 2000, the Scope of Work for the Feasibility Study for water supply and sewerage was signed by the Kazakhstani and Japanese sides, whereupon the Feasibility Study was incorporated as an integral part of the Master Plan.

S.1.6 Organization of The Study Team

The organization of the Study Team consists of the Study Team under the direction of JICA and JICA Advisory Committee, located in JICA headquarters in Tokyo.

Study Team

1) Team Leader	Dr. Kisho KUROKAWA
2) Deputy Team Leader/Urban Planner I	Koji YAMADA
3) Urban Planner II	Seric I. RUSTAMBEKOV
4) Regional Development Planner	Haruo YAMANE
5) Social and Economical Expert	Yasuyuki KURODA
6) Land Use Planner	Hank CHERIEX
7) Deputy Team Leader/Architectural Planner I	Tadao SHIBATA
8) Architectural Planner II	Yuji MAKABE
9) Transportation Planner	Akio NAKAMURA
10) Water Resource Planner	Takatsugu ABE
11) Water Supply Planner	Shin-ichi OSAKA
12) Sewerage Planner	Masayuki FUJII
13) Drainage and Flood Control Planner	Hideo TSUTA
14) Electric and Heat Supply Planner	Yoshiaki NOMURA/ Kenichi IWAI
15) City Gas Supply Planner	Yoshinobu KATO
16) Telecommunication Planner	Yoshio TANII
17) Solid Waste Planner	Shungo SOEDA
18) City Greenery Planner	Shigeru SAI
19) Forestation Specialist	Victor GRIBOV
20) Environment Expert	Phisenko ARKADIY
21) Natural Environment and Hydrogeological Expert	Masao HIGUCHI
22) Urban Institutional and Administrative Expert	Hiro OKUDA
23) Cost Estimator	Kiyohito YAMAZAKI

24) Interpreter

Yukichi GOTO/

Hiromi WATANABE

25) Coordinator

Takafumi KADONO/

Jun KUWABARA

JICA

1) Vice President

Kenjiro IZUMI

2) Managing Director, Social Development
Study Department (until June 2000)

Yukihisa SAKURADA

3) Managing Director, Social Development
Study Department (from July 2000)

Takanori JIBIKI

4) Director, Planning Division, Social
Development Study Department

Fumio KIKUCHI

5) Director, 1st Social Development Study
Division, Social Development Study
Department (until September 2000)

Takao KAIBARA

6) Director, 1st Social Development Study
Division, Social Development Study
Department (from October 2000)

Toshio HIRAI

7) Deputy Director, 1st Social Development
Study Division, Social Development
Study Department

Eri HONDA

8) 1st Social Development Study Division,
Social Development Study Department

Jitsuya ISHIGURO

9) Development Specialist

Nobuhiro KOYAMA

10) Development Specialist

Keiko YAMAMOTO

11) Development Specialist

Tomikazu INAGAKI

S.2 SOCIO-ECONOMIC PLANNING

S.2.1 Socio-Economy

The Kazakhstan Government initiated the capital transfer in late 1997, which coincided with the economic difficulties following its Independence. They included a considerable GDP decrease, a rapid expansion of fiscal deficit and unemployment. GDP before the Independence amounting to \$50 billion dropped to a half. One of the important decisions made in this regard eventually was the transfer of the capital.

The Capital of the Republic of Kazakhstan was Almaty (formerly known as Alma-Ata), when the independence of the nation was achieved in 1991. Almaty is but located too far from the actual geographical center of the republic, and the city was already overbuilt with its population reaching 1,500,000 with no further prospect for expansion. Discussion of transferring the capital city to another location started as early as 1994 at a high level in the republican Government. As the result of a thorough comparative research upon the socio-economic, natural and infrastructural conditions, Astana (then called Akmola) was selected as the new capital.

In the course of the decision making for capital transfer, there were reportedly five important considerations.

(1) Geographical Location of the capital

The former capital, Almaty, is located but too far from the geographic center of the Republic, which means that costs of transportation of goods and materials are expensive and energy consumption inefficient. Astana, on the other hand, is located close to the geographical center of the Republic, and is closer to major cities within the Republic.

(2) Transportation Network

Astana is conveniently located at the cross-road of rails and highways. Astana is on the northern route of the Siberian Rail connection. Astana is connected with the major cities, including Karaganda, Kostanai, Semey and Almaty by rails and highways.

(3) Strategic Aspect

Almaty is located close to the international borders with the neighboring nations. Although this may not create any immediate issues, location of the capital well apart from the international borders shall be favorable from the strategic point of view.

(4) Limitation to Development

Almaty is surrounded by steep hills around the existing city bounds, and does not provide much contingency for future development. The existing urban areas is already fairly built-up. Astana on the other hand has almost unlimited open space around it, and is capable of accommodating the development needs in the future.

(5) Ethnical Considerations

The ethnical composition of the republic is historically not uniform, with higher ratio of Russian population in the northern part. The proposed transfer of the capital from Almaty to Astana was expected to accelerate mixing of ethnic groups and thereby realize better harmonization.

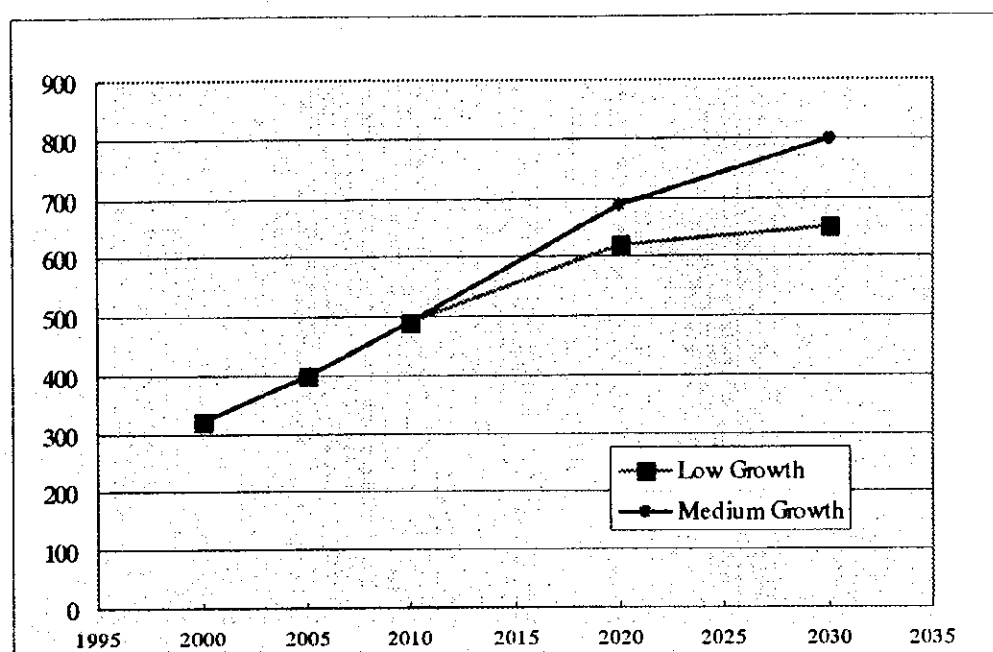
Since 1997, a substantial annual investment of nearly Tenge 40 billion has been provided for the construction of a new capital in Astana City, comprising mainly of large-scale infrastructure projects. In 1999, public investments of the central and city governments combined accounted for 60% of this total investment. Astana is realizing a substantial and rapid growth of GRDP with this investment. The Kazakhstan Government estimated that a high level of investment exceeding the present level will continue during the five-year period from 2001 and 2005.

The population of Astana today is 322,000 and is growing. The economy of Astana is active, as the per capita GRDP of the city is 36% higher than that of the national average. The present Astana economy seems to be powered by the construction industry that constitutes 27% of GRDP today. Social conditions generally compare well with the national average, although the existence of below poverty line population should not be neglected.

S.2.2 Population and Economic Framework

In this Master Plan, the population projection was conducted in conjunction with the estimation of growth in regional output, paying attention to the increase in the per capita output through comparison with other NIES countries, as the major source of population increase in the capital city such as Astana comes from the social increase factor. The historical increase of the former capital of RK, Almaty, was also contemplated as a benchmark. Accordingly, the following projection was adopted. Detailed results of economic forecast is shown in Table 2.2.6.

Population and Economic Development Framework of this Master Plan



Item	2000	2010	2020	2030	Growth rate (%)
Population (persons)	322,000	490,000	690,000	800,000	3.1
GRDP (Tenge million)	52,000	206,000	409,000	571,000	8.3
Per Capita GRDP (Tenge / person)	160,000	420,000	592,000	713,000	5.1
Ditto (US\$ / person)	1,111	2,916	3,250	4,111	5.1

S.2.3 Financial Framework

The cost of development of the capital city will include the components such as urban development and architecture, infrastructures and engineering protection. From the nature of projects, these component could be divided into the following three categories; *profit-seeking*, *less profit seeking* and *non-profit seeking* works.

The *profit seeking* works would include commercial building, offices and residential complexes mainly financed by foreign or domestic investments or commercial banks if the investors could ascertain that an adequate level of robust profit would be generated. The *less profit seeking* works include infrastructures such as various utilities, public transport facilities, mainly financed by government budgets. *Non-profit seeking* works consist mainly of public works such as government offices, roads, bridges, parks, water resources and flood mitigation, ordinarily financed by the government budgets.

The following table shows an image of finance to the three categorized works. It is important to reduce the burden of government budgets with the introduction of private investments to infrastructures. Deregulation in public service tariffs or

improvement of management public sectors would promote the private investments.

Finance framework to the thirty (30)-year investment to the new capital construction

Use of fund	Source of fund
Non-profit seeking works	Government budget
(infrastructure)	↑ promotion of private investments
Less-profit seeking works	Private investment
Profit-seeking works	Foreign investment

S.2.4 Social Framework

Astana should pursue a role model for building a welfare city. At present, Astana Municipality has substantially more budget per capita in education, health care and culture activities than the national averages. It is essential that Astana improves its social welfare level by effectively using this budget and presents the outcome to others in Kazakhstan.

Differentiation of income in different segments of the population imposes a basic issue of affordability. About a quarter of the population is said to be below the minimal monthly wage set by the Municipality. One basic condition of the above is to ascertain affordability of various urban services provided not only to the average citizen, but also the citizen with limited means of living. Maintaining the affordability of housing and utility payment will be an indispensable concern in this Master Plan, as will be revisited in S.8.

S.3 MASTER PLAN OF URBAN DEVELOPMENT

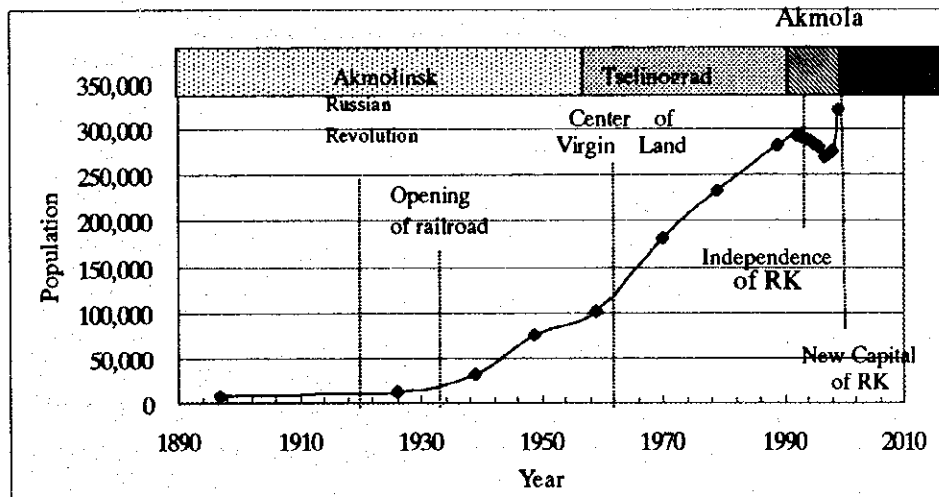
S.3.1 Historical Background of Astana City and Capital Development

The history of Astana traces back to 1824. In 1960, the city was designated as the center city of the Soviet Union's plan to boost wheat production called Virgin Land Scheme, and the name of the city was changed to Tselinograd. This triggered rapid construction of urban infrastructures and fast growth of population by influx of people for agricultural and industrial activities.

After the independence of the republic the city (then renamed to Akmola) experienced recession due mainly to drastic decline in industrial and agricultural

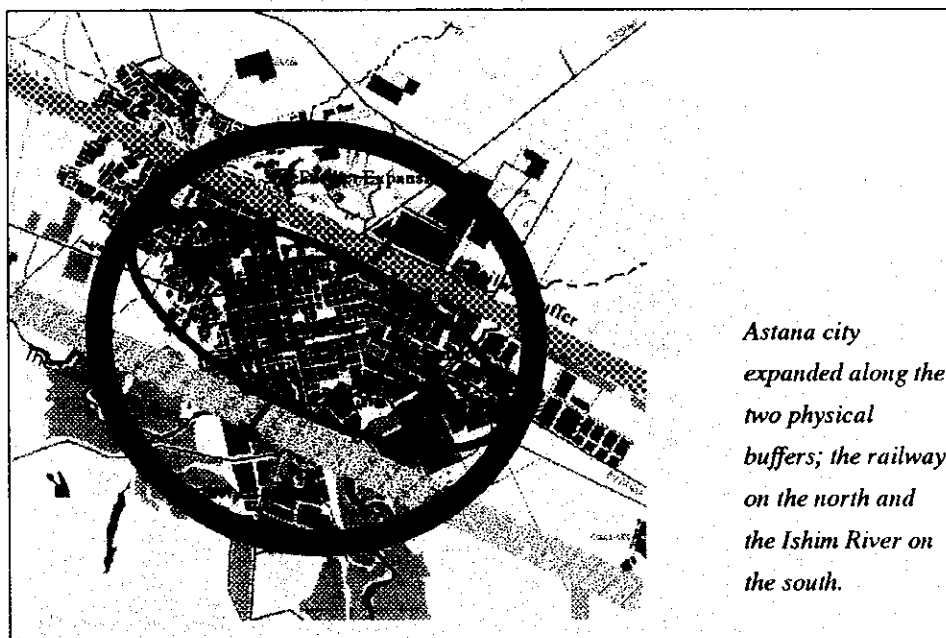
production and stagnation of economic activities. The designation as the new capital of RK came in such an occasion.

Historical Changes of Population of Astana



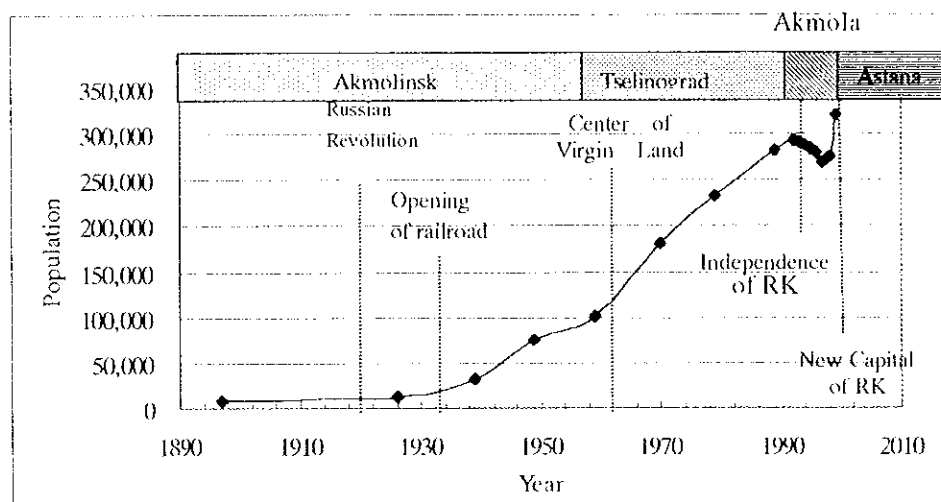
S.3.2 Present Conditions of Urban Planning, Architecture and Land Use

The original urban areas of Astana were located between the two buffers; the railway track on the north and the Ishim River on the south. They extended beyond the railway track to form the industrial city on the north, and the residential areas expanded within the two buffers east and westwards. Recently residential development crossed the Ishim River to the south on the left bank of the Ishim.



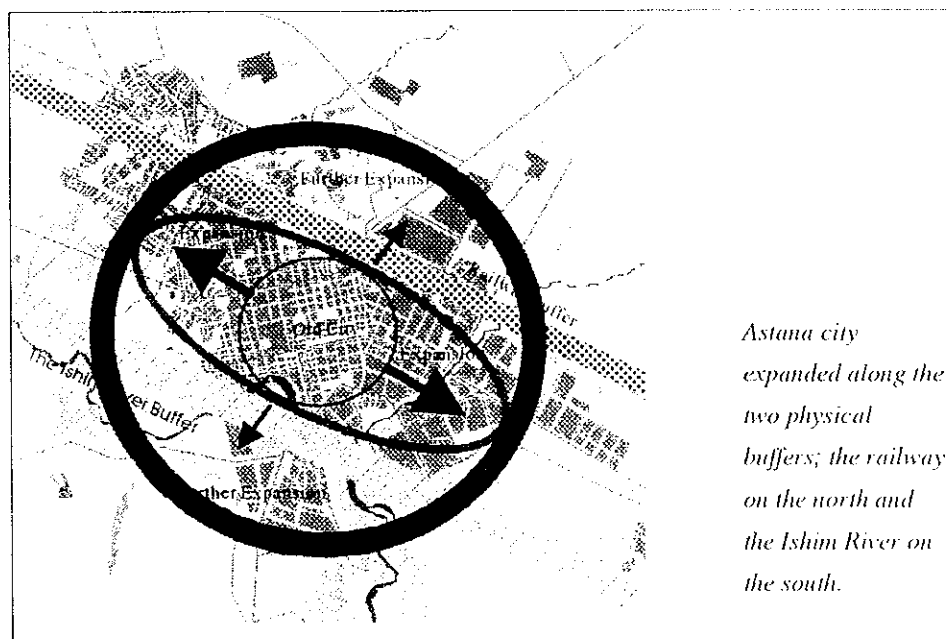
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Historical Changes of Population of Astana



S.3.2 Present Conditions of Urban Planning, Architecture and Land Use

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S.3.3 Basic Concept of the Master Plan

This Master Plan adopts the basic philosophy and structure of the first prize-winning entry by Kurokawa to the international design tender held in 1998 by the Kazakhstan Government. The first prize winning plan by Ak Orda at the 1996 domestic competition, together with the present master plan worked out by a Saudi group, which is an approved master plan of Astana today, shall also be consolidated into the present Master Plan.

The basic philosophy of this Master Plan is based on *symbiosis* and *metabolism*. Astana will be a *sysmbiotic* city in the sense that the city's past and future will be consolidated in harmony. The city will be created on the both banks of the motherly river of the Ishim, which will be safely protected against endangering citizens with floods. Astana embodies a City of *metabolism* with application of the linear zoning system enabling to adapt to the ever continuing development of the city.

The 20th century was the era of the machine principle, but the 21st century will be the era of life principle. The concept of the era of life principle is represented by the keywords of *metabolism*, recycling, *symbiosis*, ecology, and environment. Astana City, based on the above concept with the most important keywords such as *symbiosis*, recycling, ecology, and *metabolism*, will become the model city of the 21st century.



First Sketch of Kisho Kurokawa

The Ishim River was flowing along the border of the historical Akmola City, but was not actively utilized, for it caused spring floods due to melting snow and ice. For the protection against floods, a dam was constructed at the upper stream part of the river. A safe and beautiful Ishim River as part of city life will be created by the reconstructing of the dyke, the construction of a balancing pond and the adjustment of the river width.

Tree planting will be implemented on both banks of the Ishim River to form a River Park and the new housing area (River city) there. By this means, River City will emerge in *symbiosis* with the Nature (the forest and the river). Thus, the Ishim River will not constitute a border of the city any more. Astana City will be created on the banks of the motherly Ishim River that is flowing across the city similar to Paris on the Seine River, London on The Thames, and Moscow on the Moscow River.

The Master Plan of Astana may be the first, and may also well be the last one for a new capital to be constructed during 21st Century. An ideal city of 21st Century, not only for the people of Kazakhstan but also for the mankind, needs to be realized, and for this purpose experts of Japanese as well as Kazakhstan sides must collaborate to achieve this historic construction.

S.3.4 Urban Planning Framework

This section describes the numerical framework that defines the future image of Astana, developed from the basic concept detailed in Section 3.3.

(1) Architecture

Based on the socio-economic framework established above, the architectural framework as pertaining to the housing, office and commercial and retail floor areas, is formulated as below.

Projected Housing Floor Areas (gross)				(1000m ²)
Year	2000	2010	2020	2030
Total Housing Floor	5,016	7,968	12,429	15,197
Total Office Floor	1,838	3,175	4,800	5,625
Commercial & Retail floor	168	301	462	760

(2) Land Use

The residential areas have been calculated as shown below. The gross area includes the requirements for urban greenery area, the area required for roads and other hard surfaces, areas required for community services and

taking into account the necessary open spaces and green buffer areas between the various residential zones.

Projected Residential Areas and Densities

Year	2000	2010	2020	2030
Net residential area (ha)	3,356	4,512	6,016	6,767
Net population density (person/ha)	98	109	115	124
Gross Residential Land Area (ha)	4,052	5,726	7,840	9,075
Net population density (person/ha)	81	86	88	88

The total land use framework can be summarized as follows:

Projected Total Land Use Framework

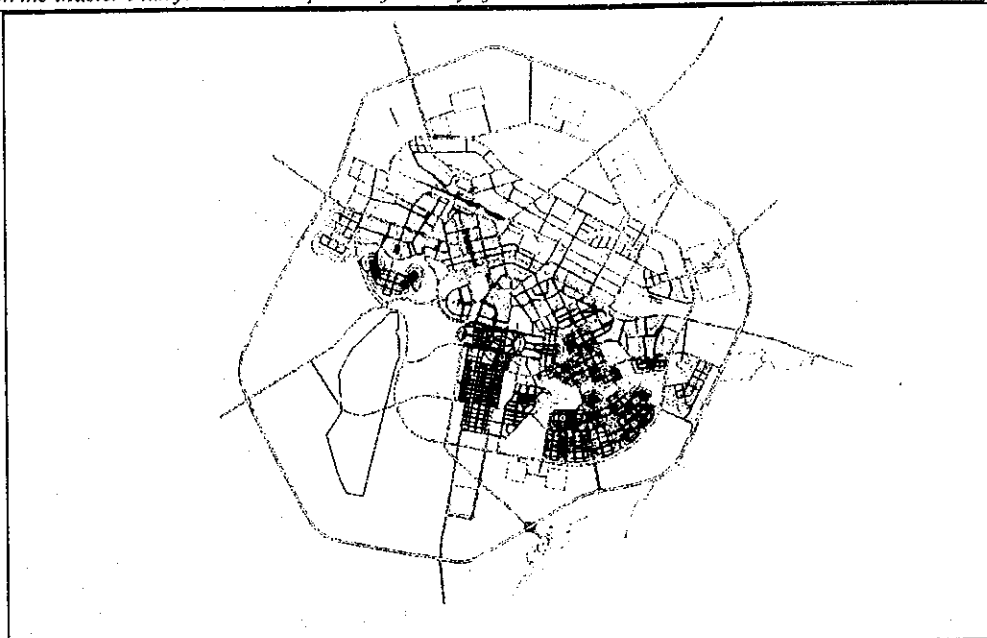
Year	2000	2010	2020	2030
Gross Residential Land Area (ha)	4,052	5,726	7,840	9,075
Government, Diplomat and New Business City (ha)	-	750	850	950
Expansion Area of New Business (ha)	-	-	-	300
Industrial Areas (ha)	7,000	7,000	7,000	7,000
Other buffer and unusable areas (ha)	59,948	57,524	55,310	53,675
Total Land Area Astana City (City Boundary) (ha)	71,000	71,000	71,000	71,000

S.3.5 Future Land Use and District Plan

Figures 3.5.5, 3.5.6 and 3.5.7 respectively present the Master Plan of future land use of 2010, 2020 and 2030, respectively. The following is the essence of the spatial allotment of land use.

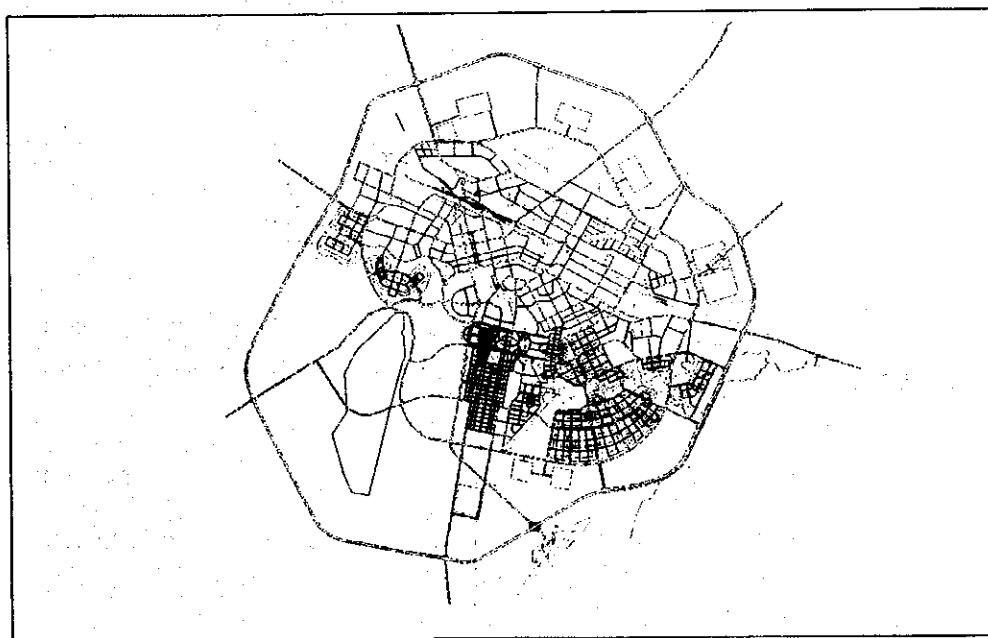
(1) Residential District

The allotment of residential districts in Astana is delineated mostly along the Ishim River on the both banks. This allotment follows the basic concept of forming a riverine city in Astana, which presently extends on one side of the river (right bank). With the extension of residential districts on the both sides of the river, the Ishim River shall form a natural greenery and water axis leading the development of the city symbolizing the motherly flow of livelihood.



(3) Central Business District

Aside from the existing central business district, located in the southern part of the urban fabric near the river, a new central business district is planned in the center of development area on the left bank. The area around the business district will accommodate most of the central government functions, such agencies and ministries, and houses most of the diplomatic missionaries. This new business district will be the symbol of the new capital of RK.

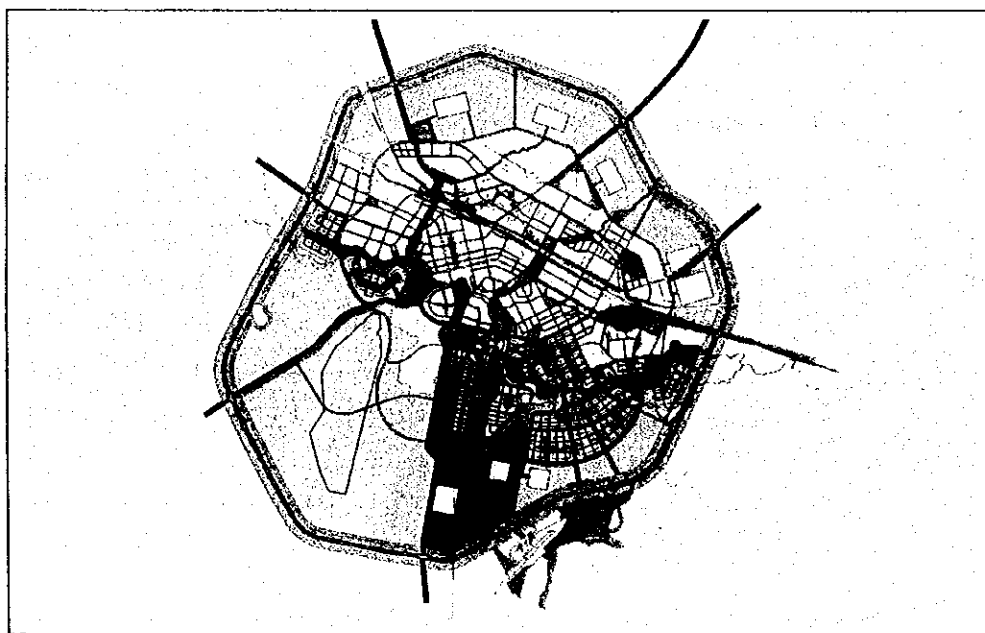


The basic structure of the new business district follows the pattern established in the existing Master Plan by a Saudi group in essence, although new ideas were put in to strengthen the integrity of the area consolidating the

business, governmental and diplomatic functions within the spacious and well-designed super blocks appropriate for the new capital.

(4) Green Areas

To create a symbiotic city, where the city dwellers could enjoy the abundant greenery and water bodies in the close vicinity from their living quarters, a green corridor along the Ishim River is to be introduced. This will serve as the eco-corridor of the city where not only human beings, but also small animals and insects could reside in harmony. Around the proposed new development, a belt of greenery will be created to serve as an eco forest that will protect the city from the florid winds in winter, and dusty storm in summer.



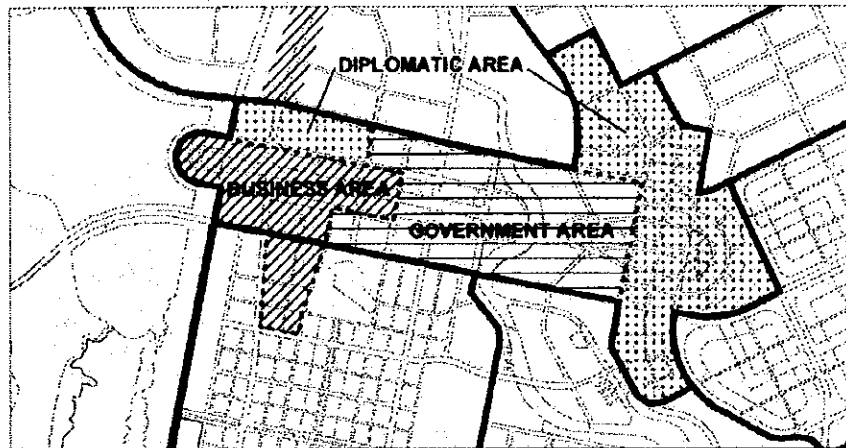
S.3.6 Guidelines for Urban Facilities

In order to depict the allotment and control the spatial structure of district level structure, guidelines of various urban facilities were formulated. The major items of the guidelines includes;

- Commercial facilities such as shopping centers, bazaars and district centers
- Educational facilities such as kindergartens, secondary schools, colleges and higher education institutions
- Health care facilities such as hospitals and health centers
- Police and fire-fighting facilities

S.3.7 District Planning for New City Center

The New City Center is the total of the Government City (District 13) and Business City (District 14) which include the Diplomatic areas, as shown below.



New City Center

The New City Center area is where the development of the new capital of RK is most prominent. If the existing city center pertains to the city and the nation's past and present, the New City Center will symbolizes its future and dreams.

The New City Center will create an excellent environment with shady greenery lining streets and lively urban parks where the residents and visitors alike could relax and enjoy the amenity in the city. The newly build citizen's park will house cascades, streams and fountains, and provide information and vending stations accommodated in *Yulta's*.

The skyline of the New City Center will have rhythmic changes as in a piece of symphony, created by strict limitation of the maximum height of buildings according to the blocks they are located. For the New City Center to form a memorable and integral townscape, control of building lines shall be enforced by which a vista along major streets wide open to the sky even at the ground level shall be created.

In consideration of the severe weather condition in winter, covered promenades and pedestrian decks will be provided to provide shelter to shoppers and workers. Parking spaces shall be covered with roofs in the future as the city grows. Shops and cafes shall be placed mostly on the first and second floors of commercial buildings in Business City area.

Religious facilities will be provided in the cultural area. Consideration will be given to the multiplicity of religion in Astana, land areas will be reserved not only for mosques but also Russian Orthodox churches and others, which will be an important measure for symbiosis of ethnic groups.

In the core area of the New City Center automobiles will have restricted entry, while shuttle buses and city buses will circulate for easy movement within the area. Refer to Figures 3.7.1 and 3.7.2 for plan and image of the New City Center.

S.3.8 Townscape Guidelines

For creating and maintaining the favorable and harmonious urban townscape and environment in Astana, an integrated approach for townscape creation shall be necessary. This guideline shall cover the central parts of the new and existing urban areas in Astana City. Major points in the proposed Townscape Guidelines are summarized in the table below.

Table Major Points in the Proposed Townscape Guidelines

Object	Item	Contents
New City	Architectural Control	<ul style="list-style-type: none"> • Height Limitation (Business Area 100 to 200m; Government area 30m; Residential area 15 to 20m) • Building Limitation Line (Inclined building limitation line regulation along major streets in Government City) • Set-back (A 20 m set back along major streets in Government City and promotion of planting in the set-back areas) • Proposal of Color Management Plan
	Street	<ul style="list-style-type: none"> • Tree-planting of streets reflecting the characteristic of each street • Naming of street after famous people and others
	Parking System	<ul style="list-style-type: none"> • Ground level parking for a time being • Provision of roofs and connection to pedestrian network in the future
	Public Transport	<ul style="list-style-type: none"> • Provision of circular public buss route within Government City
	Pedestrian Spaces	<ul style="list-style-type: none"> • Provision of internalized (covered) pedestrian bridges and malls in Government City • Connection with shopping malls
	Parks	<ul style="list-style-type: none"> • Provision of green belt for protection against strong winds and formation of urban axis
	Cultural and Religious Facilities	<ul style="list-style-type: none"> • Designation of land plot not only for an Islamic Mosque but also for Russia Orthodox and Catholic Churches
	Lighting	<ul style="list-style-type: none"> • Lighting for safe and amenity of city environment • Night-time lighting of individual buildings (Presidential Palace, Presidential Administrative Office, Parliament) • Night-time lighting of monuments (Independence Monument) • Night-time lighting of Citizen's Park
Existing City	Green Corridor	<ul style="list-style-type: none"> • Provision of greenery in the belt between Respublika Avenue and Pobeda Street • Preservation of historic buildings and architectural heritage • Provision of transit mall (Improvement of Beibitshilik Street for better amenity for pedestrians)
	East-West Parkways	<ul style="list-style-type: none"> • Promotion of greenery planting along Abai Street • Promotion of greenery planting along Bogemba Avenue
	Business Corridor	<ul style="list-style-type: none"> • Induction of high-rise buildings along Respublika Avenue and Pobeda Street
Preservation of Townscape Heritage	Preservation Subjects and Guidelines	<ul style="list-style-type: none"> • architecture of historical value • architecture functioning as landmarks • vernacular architecture
	Planning of Scenic Zone	<ul style="list-style-type: none"> • Beibitshilik and Akjzhayk Streets Precincts also to propel orderly development to improve the amenity of the area by improving the appurtenant components of the city such as parks, pavements, street furniture, etc.

S.3.9 Transportation Planning

There are about 30,000 vehicles registered in Astana, which corresponds to 92 vehicles per 1,000 of population. This rate is considerably lower than cities with similar nature. With future increase in the income and expansion of the city, the number of cars is expected to grow substantially.

With the future increase of population and heavy dependency on the private passenger vehicles, due consideration needs to be made in transportation planning in order to avoid concentration of traffic at specific locations that would create congestion.

The following table shows the framework for future demand forecast for transportation.

Planning Framework for Transport Planning

Year	1999	2030
Population	320,000	800,000
Vehicle ownership (ver./1000 person)	92	350
Number of vehicles (ver.)	29,000	280,000

The basic concept for the transportation planning is established as the following;

Basic Concept for Transportation Planning

Item	Content
Avoidance of Traffic Concentration	<ul style="list-style-type: none"> Effective connection between the existing and new urban center by ring roads
Creation of Effective Transportation environment in new city	<ul style="list-style-type: none"> Introduction of grid pattern road network
Flexibility for Future Changes	<ul style="list-style-type: none"> Wide road cross sections at major roads allowing for future introduction of rail type public transportation

Based on the basic concept above, the proposed road network thus obtained is shown in Figure 3.9.5. A series of simulations of traffic flow has been conducted to find the bottleneck of the future roads and find out any necessary modifications, and consequently the road hierarchy structure of the network was established as shown in Figure 3.9.6. The projected traffic flow in all the roads is generally within the reasonable range.

For the public transportation sphere, buses will continue to play an important role, possibly in combination with trolley buses. To further strengthen the role of public transportation, a light railway transit (LRT) system is proposed for implementation between the existing railway station and the airport by 2010.

S.3.10 City Greenery Planning

In Astana, the existing green areas account for 121.2 ha, including a 104 ha park called the City Park on the left bank of the Ishim. This corresponds to the per capita greenery of 3.7 m²/person, which is considered to be considerably low for a future international city.

The formation of the environmental protection forest was started in 1997. The Committee of Forestry, Fishery and Hunting under Ministry of Natural Resources and Environmental Protection conducts the forestation. A feasibility study on the green zone formation allocated 29,300 ha, of which 23,900 ha have already been surveyed. Planting of trees has been started and continued for the last three years.

The targets for parks within the urbanized fabric is set at 12 m²/person, as stipulated in Snip, while the target for forestation outside of the urbanized areas is set at 250 m²/person. The following table summarizes the framework.

Planning Framework for City Greenery and Forestation

Year	2000	2010	2020	2030
Urban Greenery Area (ha)	121	401	681	960
Urban Greenery Area per person (m ² /person)	3.8	8.2	9.9	12.0
Forestation Area (ha)	10,200	13,400	16,726	20,000
Forestation Area per person (m ² /person)	316	275	242	250

The greenery axes are planned as shown in Figure 3.10.4, major components of which are the following.

- Green belt along the outer ring road
- Main greenery axis in the city area along the Ishim River
- Minor greenery axes comprising the belts along the Akbulak and Sarybulak and belt from Maiblyk Lake towards Telman Village.
- Greenery cores within the city area consolidated by new parks
- Environmental protection area outside of the city forming *Eco-Forest*.

S.4 Infrastructures Development Planning for Astana City

S.4.1 Approaches for Infrastructures Planning

The basic approaches to infrastructures planning in this Master Plan are set as the following;

- (1) High reliability of facilities appropriate for the nation's capital

Infrastructures are a staple lifeline of urban dwellers as well as necessity for economic activities in a city. Uninterrupted, high level urban services and utility by the infrastructures network are essential in sound development of a city. This is more true for Astana, as this is the new capital of RK. As the capital, various central administrative functions will continue to accumulate in Astana. Providing a stable and robust infrastructure network is therefore an indispensable element in the development of the new capital.

- (2) Environmental Consideration

As discussed in Section 3.1, this Master Plan places an emphasis on *symbiosis* and *metabolism*, which relate to the environmental aspect of the

city. The capital is, and will always be, a model followed by other cities. The nation will be known by its capital, and on this token the capital is the "face" of a nation. A development strategy with due consciousness on the environment is thus adopted. Various measures will be contemplated as to promote re-use and recycle of resources. This principle will be followed in the planning of infrastructure.

(3) Manageable Investment

Necessary costs for investment are another important consideration. Due attention will be paid to utilize the existing facilities as much as possible with rehabilitation, so as to control the necessary funding to a manageable size. New investments will be considered wherever rehabilitation of facilities is either difficult or unrealistic.

The planning terms are established as the following

- Medium Term; Up to the year 2010,
- Long Term; Up to the year 2020,
- Ultimate Term; Up to the year 2030, describing the ultimate image of development in the very long term.

S.4.2 Planning of Water Resources

Astana City depends on the Ishim River for its water resource, extracted mainly from Vyacheslavsky Reservoir, located 51km upstream. The annual yield of the Vyacheslavsky Reservoir was analyzed and the annual yield was estimated to be 89.2 MCM with a dependability of 95%.

The future water demands were estimated for different categories of water use as shown in the following. A deficit of 15.3 MCM would accrue as soon as 2010 if no countermeasures are taken up.

Annual Water Demand in Target Years (MCM)

Item	1999	2010	2020	2030
Drinking	50.4	55.4	79.2	96.6
Technical water	6.5	8.5	9.7	11.2
Irrigation* ¹	2.7	20.7	25.2	30.8
Greenery	0.1	0.3	0.4	0.5
Sanitary flow	5.0	5.0	5.0	5.0
Landscaping, fire-fighting and miscellaneous use	-	3.0	3.0	3.0
Water loss	-	12.0	12.5	13.1
Total	64.7	104.9	135.0	160.2

Note *1: Water requirement for limited period for forestation is not considered in this table.

A comparative study on the alternative source of water resources for Astana revealed that the transfer of the water in the Irtysh-Karaganda Canal to the Ishim was found to be the preferred strategy. In view of the necessity for a large scale facility to transfer the IKC water, it is recommended to implement the IKC pipeline project in two stages, namely, to develop one half (90 MCM/year) of the water transfer capacity of the project in the first stage by 2003, and to develop the remaining one half (90 MCM/year) in the second stage by 2025. It is proposed to adopt stage-wise countermeasures for practical solution of water quality of IKC, as the water quality measurements indicate high content of copper in the water.

The Study Team also considers groundwater to be a future water resource option. Details need to be clarified as to the available production capacity of groundwater, together with monitoring of water quality.

S.4.3 Planning of Water Supply

Water supply of Astana is operated by the municipal water company, ASA. Separate networks exist for drinking water and technical water. The water treated at the purification plant is supplied for drinking water, while the raw water extracted from the Ishim River is supplied for technical water without treatment.

The existing purification plant was constructed in 1969 and expanded in 1982. Despite its original design capacity of 200,000 m³/day, the plant has been operated at 140,000 m³/day in summer and 120,000 m³/day in winter. Due to the superannuating of mechanical and electrical equipment, the plant shall face difficulty in providing the necessary quality and volume of water in near future.

Distribution pipes are generally old and a large quantity of water, 26%, is lost by leakage in distribution, and 20% lost as leakage and wastage in consumers' facility.

The basic approaches for the improvement of the water supply system in Astana is

- Enhanced reliability appropriate for the new capital
- Reduction of loss and wastage for effective use of limited water resources
- Contribution to managerial improvement of ASA by facility improvement

The following table summarizes the water demand with the loss and wastage reduction in effect.

Daily Average Water Demand

Year	2010	2020	2030
Drinking Water (m³/day)			
- Water Demand	115,200	165,000	201,100
- Loss and Leakage	36,500	52,100	63,500
- Raw Water Demand	151,700	217,100	264,600
Technical Water (m³/day)			
- Water Demand	22,200	25,300	29,200
- Leakage	1,200	1,300	1,500
- Raw Water Demand	23,400	26,600	30,700
Raw Water Demand - Total	175,100	243,700	295,300

This water demand has been discussed thoroughly between the Study Team and the relevant authorities including Construction Committee, and was accepted duly by the Kazakhstan side, as mentioned in Subsection 1.5.1. (8). The following table summarizes the overall comparison between the estimation herein and those stipulated in SNIIP. The proposed facility development is shown in Figure 4.3.3.

Comparison of Water Consumption Projection and SNIIP

Year		2010		2020		2030	
Unit		Lpcd	m ³ /day	Lpcd	m ³ /day	Lpcd	m ³ /day
JICA M/P		230	112,840	252	173,820	272	217,970
SNIIP	Min	200	98,135	225	155,574	237	189,624
		301	147,495	342	235,858	357	285,712

The proposed facility expansion is summarized in the table below.

Facility Expansion for Water Supply up to 2030

Planning Term	Medium (Up to 2010)	Long (Up to 2020)	Ultimate (Up to 2030)
Construction Period	2003-2007	2011-2013	2017-2019
Water Source	Vycheslavsky Reservoir, the Ishim River		
Intake Pump	200,000m ³ /day; New	75,000m ³ /day; New	75,000m ³ /day; Exp.
Raw Water Transmission Pipe	-	150,000m ³ /day; New	-
Water Treatment Plant	100,000m ³ /day; New	120,000m ³ /day; New	100,000m ³ /day; Exp.
Distribution Pump	140,000m ³ /day; New	168,000m ³ /day; New	100,000m ³ /day; Exp.
Distribution Network	98km Reh./73km New	62km New	40km New

Nte: New; New construction Exp; Expansion Reh.; Rehabilitation

S.4.4 Planning of Sewerage

The existing sewerage network connects to 73% of population with the service population of 220,100. The population who are not connected to the sewerage system have night soil collected by septage collection vehicles.

The existing sewerage treatment plant utilizes activated sludge process with a design capacity of 136,000 m³/day. The actual amount treated at STP is estimated to be 100,000 m³/day. Effluent from the SPT is estimated to have a

BOD of 20 mg/L, which is considered to be normal. The effluent is discharged to Taldy Kol Reservoir for storage, evaporation and infiltration.

In accordance with the increase in the volume of water supply, the generated sewage is projected to grow, as shown below.

Sewage Generation Forecast up to 2030

Year	1999	2010	2020	2030
Sewage Generation (m ³ /day)	104,133	112,224	171,273	216,842

In the next fifteen years, the existing SPT will be subject to extensive rehabilitation. Expansion of the capacity in the same plant shall be commissioned by 2015. The treated water shall continue to be discharged to Taldy Kol Reservoir. Reuse of the treated water for agricultural purpose will be promoted for effective water use.

The existing sewer pipes and pumping facilities will be rehabilitated and the additional sewerage connections be provided to the new residential areas. The planned connection rate is 95% in 2030. The proposed facility development is shown in Figure 4.4.1.

S.4.5 Planning of Power and Heat Supply

Electric power and heat is supplied by *Astanaenergyservice*, which operates 2 thermal power stations (*TETs-1* and 2), the heat supply network and power distribution network.

TETs-2, the coal-fired thermal power station, provides most of the electric power necessary for the city. It is composed of five units of 420 t/h steam generating boilers and three units of 80MW turbine generators. Most of the facilities will have been operated for more than 30 years within 10 to 15 years time, needing replacement. The electric power for Astana City is provided through 110 kv transmission lines.

The main sources of heat are *TETs-1*, with the usual heat supply amount 300 to 330 Gcal/h; and *TETs-2* with 470 Gcal/h only in the winter season. The hot water heated at about 115 °C at the sources is transmitted to demand ends through the district heating system that cover about 80% of population. There are five heat centers in the city, which balance the supplied heat evenly among consumers.

The following are the results of demand forecast of power and heat.

Demand for Electric Power and Heat

Year	2000	2010	2020	2030
Peak Electric Power (MW)	226	362	485	570
Peak Heat Demand (Gcal/h)	764	1,306	1,619	1,974

With the expansion of the city, existing capacities for both the electric and heat supply is expected to be insufficient. In consideration of the superannuation of the present facility and necessity for occasional scheduled stoppage for maintenance, construction of 115MW conventional coal-fired electric power and heat energy generation plant is proposed at TETs-2 by 2006. To minimize atmospheric pollutant load, low SO_x and NO_x boiler type was selected together with adoption of a suspended particle control device.

After 2010, natural gas-fired combined cycle plant for power and heat supply is proposed for commissioning in two stages. The following table shows the proposed plan of facility expansion. The proposed facility development is shown in Figure 4.5.1 and 4.5.2.

Facility Expansion for Power and Heat Supply up to 2030

Planning Term	Medium (Up to 2010)	Long (Up to 2020)	Ultimate (Up to 2030)
Power and Heat Source	115MW (Coal-fired)	150MW (Natural gas-fired combined cycle)	200MW (Natural gas-fired combined cycle)
Scheduled Commissioning	2006	2011	2021
New Substation	2 110kV/10kV S/S	2 110kV/10kV S/S	1 110kV/10kV S/S
New Trans. lines	62km 11kV T/L	Airport to Western, 500kV S/S to Western	500kV S/S to TETs2 To High Tech Park
Heat Distribution Pipelines	To NCC 12 and 17	To NCC 4B, 18, 15, 16, 19	To NCC 11, 14, 16
New Heat Centers	-	6 natural gas-fired	1 new and 6 extension

Note; NCC – New City Center

S.4.6 Planning of Natural Gas

Introduction of natural gas would play an important role in the energy sector of Astana. Although the cost of natural gas may be higher than coal, natural gas provides higher operability and easier maintenance, and more importantly, natural gas is environmentally superior in every aspect (CO₂, NO_x and SO_x) compared with oil and coal. Presently, a feasibility study is ongoing based on a bilateral agreement between RK and Russian Federation. It is assumed in this Master Plan that natural gas would be available to Astana by 2010.

The potential demand for natural gas in Astana City is estimated to be as follows.

Domestic and Public Demand for Natural Gas

Year	2000	2010	2020	2030
Domestic Use (Million Nm ³ /y)	34.4	51.0	71.5	82.8
Public Use (Ditto)	13.9	20.2	29.0	33.5
Independent Boiler (Ditto)	-	5.0	10.3	16.7
Sub-Total (Ditto)	48.3	76.2	110.8	133.0
Thermal Station Use (Ditto)	-	100.7	206.8	333.7
Total (Ditto)	48.3	176.9	317.6	466.7

The supply network of natural gas will be connected to the proposed Trans National Gas Pipeline (7.5 MPa), and proper pressure adjustment be done for high-pressure (1.2 MPa) distribution. The distribution network is planned in such a way as to minimize the river crossing, and cover all the heat centers to pick up all potential demands. The proposed facility development is shown in Figure 4.6.1.

The following considerations need to be made in implementing the plan.

- Adaptation to the natural gas based energy system at individual new buildings
- Implementation of the natural gas distribution system in compliance to the proposed Trans National Gas Pipeline Project
- Effective use of the existing LPG facilities as contingency for future uncertainty of natural gas introduction

S.4.7 Planning of Telecommunications

In Astana the telecommunications services are offered by Astanatelecom, a regional affiliate of OSC Kazakhtelecom. There are 64,500 telephone lines, which correspond to an average telephone density of 20.1 lines per 100 of population. Although renewal of the telecommunication facility is rapidly in progress, 37% of the switches are still the old analogue types. The existing subscriber network mostly utilizes conduit insulated, lead sheathed cables installed more than 20 to 25 years ago, which account for frequent disruptions.

As the new capital of Kazakhstan, demand for telecommunication connection is expected to grow rapidly in the future, as the telecommunications network provide basic and new services for the new businesses and government offices. The following table summarizes the demand projection for the new development area of Astana.

Demand for Direct Exchange Lines for Telecommunication

Year	2000	2010	2020	2030
DEL demand in the existing town area	64,500	145,400	194,400	228,200
DEL demand in the new residential area	-	70,500	148,100	209,700
Total	64,500	215,900	342,500	437,900
Telephone Density (/100 Population)	20.1	44.1	49.8	55.0

The proposed facility development is shown in Figure 4.7.2. The proposed plan for facility expansion for the new development area is summarized below.

Facility Expansion for Telecommunication

Planning Term	Medium (Up to 2010)	Long (Up to 2020)	Ultimate (Up to 2030)
Additional Switching Capacity (DEL)	63,800	84,500	61,600
SDH Local Ring	1 system (New)	1 system (Expansion)	-
DLC Facility	3 stations (New)	3 stations (New)	Expansion
Outside Plant Facilities	3 stations (New)	3 stations (New)	Expansion
Power supply facility and building	3 stations (New)	3 stations (New)	Expansion
Administrative Data Communication Network	1 system (new)	-	-

S.4.8 Planning of Solid Waste Management

Landfill is currently the only disposal method adopted in Astana. There is a landfill site located 6 km northeast of the city center, which has operated since 1972. The landfill will have to be closed earlier than 2010 because of rapid increase in the city's MSW generation and/or serious ground water pollution caused by the landfill, which would call for a need of a new landfill site with appropriate environmental countermeasures.

The table below summarizes the generation and collection volume of MSW, incorporating the effects of substantial waste reduction programs.

Projected Generation and Collection volume of MSW

Year	2000	2010	2020	2030
Projected MSW Generation Volume (m ³ /y)	463,287	737,393	1,175,058	1,526,339
Waste Reduction Target Rate (%)	0%	1.0%	10.5%	20.0%
Collection Rate (%)	80%	95%	100%	100%
Projected MSW Collection Volume (m ³ /y)	370,427	691,652	1,046,206	1,209,957

Waste generated at medical institutions is collected and handled as non-hazardous waste like MSW, although it may contain infectious waste such as human blood and blood products and cultures and stocks of infectious agents.

Measures to be conducted by 2010 include expansion of the present landfill site to an adjacent site and a small-scale batch type incinerator for hazardous HSW

treatment. In the 10 years between 2010 and 2020, another landfill site will be needed. Introduction of intermediate processing such as RDF and incineration will be considered in this period. The latter landfill site will have to be further expanded in the next 10-year term. The proposed facility development is shown in Figure 4.8.5.

S.5 Planning of Engineering Protection

S.5.1 Flood Protection

The maximum discharge ever recorded of the Ishim River was 1,200 m³/sec in 1948. Ever since the operation of the Vyacheslavsky Reservoir in 1970, there has not been inundation in Astana, except in 1993 when a mechanical problem at one of the gates caused flooding.

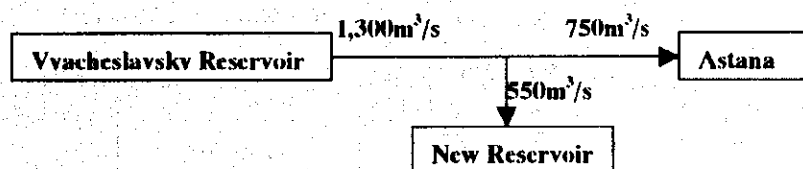
A probable flood analysis revealed that the peak discharge of the 10-year flood at Astana is 700 m³/sec, while that of the 100-year flood is 1,200 m³/sec. Low lying areas on the left bank of the Ishim may be subject to flooding by a 10-year flood or even smaller one. Flood protection measures thus are necessary.

Estimation of Probable Flood

Return Period (Year)	Probability (%)	Vyacheslavsky (m ³ /s)		Astana (m ³ /s)
1,000	0.1	1,900	2,100*	1,700
100	1.0	1,400		1,200
15	7	850		750
10	10	790		700

Note) *: Astana Municipality Estimation

There is a flood plain where large floods frequently inundates, and thereby cuts the flood peak. The function of this flood plain will be strengthened in the future. The scheme for flood flow distribution is shown below. Flood flow corresponding roughly to 100-year return period after retardation is estimated to be 750 m³/sec.



Flood Distribution Plan

In the medium term, dykes along the Ishim river shall be heightened near the new development areas on the left bank of the Ishim, as planned by Municipality. In the long and ultimate term, while the dykes continue to be heightened, retardation capacity of the upstream flood plain shall be strengthened.

The following table summarizes the proposed plans for the flood protection of Astana.

Proposed Flood Protection Plan

Planning Term	Medium (Up to 2010)	Long (Up to 2020)	Ultimate (Up to 2030)
River Improvement Work	L = 7km; Riverbed Width: 150m; Bank Slope: 1:3	L = 14km Riverbed Width: 150m; Bank Slope: 1:3	L = 9km
New Flood Regulating Basin		Area 120 km ² ; Volume 360 MCM Crest of Dyke EL+359.5; L = 20km Flood Control Gate; 6.5x12x5nos.	

The proposed facility development is shown in Figure 5.1.1.

S.5.2 Storm Water Drainage

Nearly all the present storm water drainage network in Astana had been constructed before 1975. The network was installed on the right bank of the Ishim River, while there is no drainage network on the left bank. The total length of the network is approximately 39 km, with pipes ranging in diameter between 200 mm and 1,000 mm.

Present issues of storm water drainage are summarized as follows;

- Insufficiency of drainage network existing in the city on the right bank and no drainage network on the left bank
- Insufficiency of treatment facilities for storm water
- No or little operation and maintenance of drainage network

The probable intensity with a 1.5 year return period was estimated as 24.2 mm/hr and was adopted as the design intensity of rainfall for Astana in this Master Plan. The following table shows the proposed plan for the respective planning terms.

Facility Expansion for Power and Heat Supply up to 2030

Planning Term	Medium (Up to 2010)	Long (Up to 2020)	Ultimate (Up to 2030)
Dia. < 1,000mm	L = 22km	L = 19km	L = 5km
1,000mm < Dia. < 1,500mm	L = 168km	L = 39km	L = 10km
1,500mm < Dia.	L = 14km	-	-
Total	L = 204km	L = 58km	L = 15km

The proposed facility development is shown in Figure 5.2.1.

S.6 Environmental Management Planning

S.6.1 General Principle for Environmental Management Planning

This Master Plan has been formulated in full consideration of the necessity of mitigating the possible effects accruing from a large scale development on the environment. As the development of Astana is in essence an undertaking under the administrative framework of RK, the basic principle for the environmental management must follow the standards established in and are in effect in RK.

S.6.2 Mitigation Measures Adopted in this Master Plan

Development and expansion of a city generally would cause, among others, increase in generation of wastewater and solid waste and emission of air pollution. This would normally lead to increase in the pollution loads on the environment. Such increase in pollution loads will normally materialize in the form of worsening air quality, water quality, noise levels, etc. In order for preparing Master Plan for city development that will establish the basis on which to create and maintain pleasant and sustainable living environment, an appropriate environmental framework needs to be established. For this purpose, basic principles for countermeasures to mitigate the expected negative impacts caused by the development are essential.

The present Master Plan has adopted a number of measures to safeguard the quality of the natural and urban environment. The following Sub-sections will discuss the already embedded specific measures for mitigating possible effects in this Master Plan. In order to mitigate the possible future impacts on the environment accruing from the development of Astana, the following measures were identified and incorporated in the Master Plan.

Table Mitigation Measures Adopted in Master Plan for Environmental Managemet

Category	Item	Mitigation Measure
Aquatic Environment	Securing of sufficient flow in the river	<ul style="list-style-type: none"> • Consideration on additional requirement of water for landscaping and sanitary flow for Astana and downstream
	Control of Pollutant load	<ul style="list-style-type: none"> • Expansion of sewerage service area • Improvement of solid waste collection • Better management of land fill • Better management of STP effluent
Atmospheric Environment Master Plan of Akmola	Reduction of pollutant load at TETs	<ul style="list-style-type: none"> • Adoption of boiler with combustion control technologies to minimize NOx emission • Installation of an electrostatic precipitator to collect dust particles in the flue gas • Installation of a flue gas desulfurization plant to remove sulfur oxide in the flue gas
	Consideration of alternative energy at TETs	<ul style="list-style-type: none"> • Use of natural gas as an alternative energy source after the year 2010 at TETs
	Better control of automobile exhaust	<ul style="list-style-type: none"> • Overall transportation planning to avoid traffic concentration • Proposal of LRT for public transport to lessen the dependency on the individual automobile transport
Noise	Reduction of noise effects from automobile traffic	<ul style="list-style-type: none"> • Realignment of residential districts to avoid noise prone areas along the flight line of aircrafts • Additional provision of tree lining and wide sidewalks to safeguard residents along major streets
	Mitigation of noise impacts of airport	<ul style="list-style-type: none"> • Realignment of residential districts to avoid noise prone areas along the flight line of aircrafts
Preservation of Fauna and Flora	Preservation of eco system along Ishim	<ul style="list-style-type: none"> • Green open space along the Ishim to avoid disorderly development
	Careful alignment of new development	<ul style="list-style-type: none"> • Choice of river terrace for new development of the new city to minimize the possibility of impairing fauna and flora

Basically, no serious environmental impacts are expected to take place, if Astana City is to be developed following the Master Plan. The state expertise of the RK approved ecological the Master Plan on 14th May, 2001.

S.7 Integrated Implementation Program and Investment Cost

S.7.1 Basic Principle Policy for Implementation

The following basic principles were adopted in formulating the implementation strategies to facilitate the development targets of Astana:

- Develop Astana City to facilitate and consolidate administrative and business functions
- Balanced and integrated development of urban development including architecture; infrastructure development; and engineering protection, with basically even priority in development, although infrastructure and engineering protection should be provided in advance of urban development works.
- Urban development works to be implemented in the order of the central city

part to suburbs.

- Avoidance of unevenly distributed investment cost over the development period of 30 years in accordance with the staged development of the city, with no sizable front load investment.
- Due consideration for the balance between development and environment

S.7.2 Description of Projects

In all 177 *Projects*, including 89 *Projects*³ for the land and architecture component of *Urban Development Sector* were identified.

Number of Proposed Projects

Type of Project	Urban Development	Infrastructures Development	Engineering protection	Total
Number of Project	122	43	12	177

S.7.3 Phasing the Development

The phasing of Projects in the three Planning Terms, each having 10-year period, were considered. Figure 7.3.1 shows the overall implementation schedule for the development of Astana.

Number of Proposed Projects

Unit: nos.

Sector	Medium Term (2010)	Long Term (2020)	Ultimate Term (2030)	Total 3 Terms
Urban Development	42	40	40	122
Infrastructures Development	20	12	11	43
Engineering protection	7	2	3	12
Total	69	54	54	177

S.7.4 Implementation Program for Medium Term (2001-2010)

Medium Term pertains to the upcoming 10 years is considered herein to be of high urgency and necessity. The following table summarizes the identified Projects in Medium Term. Figure 7.4.1 shows the implementation schedule for urban development in the new city center area.

³ An integrated package of development activities, public or private, designed to achieve the planning goal set for each of the components in the 3 Sectors above, as divided as necessary by time or location thereof

Number of Project to Implement in Medium Term

Sector	No. of Project	Major Project or Contents
Urban Development		
-Land Development and Architecture	29	17-project at Residential District, 4-project at Industrial District, and 8-project at Planning District
- Transportation	12	Roads, Trolley Bus, Bridges, LRT, Terminal, Traffic Management, Airport
-Greenery	1	Parks and greenery at 24-project for Residential, Industrial and Planning District
Infrastructures Development		
- Water resources	1	IKC-Ishim Pipeline
- Water supply	4	3 rd Water Pipeline, Priority Water Supply Project in 1 st stage
- Sewerage	2	STP Rehabilitation, Sewer Collection System Rehabilitation and Expansion
- Electric power supply	3	110/10 kV T/L and S/S, Conventional Electric Power & Heat Energy Generating Plant
- Heat energy supply	4	Repair of Heat Main & Distributions, Extension of Heat Pipes, Construction of Heat Pump Station No.6, and 3 Heat Centers
- Gas supply	1	Gas supply network
- Telecommunication	3	Install, Telephone on Left Bank of Ishim River, New Telecommunication Network, Administration Data Communication Network
- Solid Waste	2	Landfill-1 Project, HSW Incinerator Project (1)
Engineering Protection		
- Storm water drainage	3	Improvement Drainage System
- Flood protection	4	Ishim River Improvement and Bank Protection
Total	69	

S.7.5 Project Cost

An investment cost for the development of the City of Astana *in Medium, Long and Ultimate Terms* was worked out and estimated on the basis of the economic and financial cost on the master plan level. Table 7.5.1 tabulates integrated investment costs on an economic cost basis.

Summary of Economic Basis Integrated Investment Cost

Unit: US\$ million

Region/Sector	Medium (2001-2010)	Long (2011-2020)	Ultimate (2021-2030)	Total	(ratio)
Urban Development	2,926.5	2,498.1	1,808.3	7,232.9	0.81
Infrastructures Development	696.9	516.2	412.8	1,625.9	0.18
Grand total	3,678.9	3,051.8	2,250.1	8,980.8	1.00
(ratio)	0.41	0.34	0.25	1.00	

* The cost includes to each district and region as the "parks and greenery" and as direct construction cost.

1) Price level is in November 2000.

2) Exchange rates applied are US\$ 1.0 = K Tenge 144.0 = J Yen 108.0.

3) An economic basis cost consists the direct construction cost and engineering services cost.

S.8 Cost and Benefit Analysis of the New Capital Construction

S.8.1 Clarification of cost and benefit for the new capital construction

The economic analysis of the capital development was conducted in a macro economic framework. The economic analysis looks into the relation between the necessary inputs for production in the society and their outputs retained for re-production. The inputs in this context are the capital investment and operation/maintenance cost. The outputs further are essentially benefits or earnings from these inputs. If the outputs exceed the inputs in value, the net earning (net benefits) would accrue. These net benefits would be reserved for re-investment and re-production. Thus the wealth in the society would accumulate.

S.8.2 Estimation of the cost and benefit in the New Capital Construction

The cost of the capital transfer would be an aggregate capital investment and the operation/ maintenance cost of all projects for the capital transfer, disbursed over the 30 years of its implementation. With the accumulation of facilities and assets as the result of investment, the necessary operation and maintenance cost would increase every year.

The major benefit would accrue from the increase of GDP by effective demand generation. This benefit could be measured by the increase in added value (Gross Regional Domestic Product: GRDP) in Astana that is projected to take place as the result of the investment as compared with a hypothetical "without project" case.

S.8.3 Approach for Evaluation

The overall EIRR was estimated to be 11% as shown in the attached table. The capital transfer is considered to be economically viable. Implications of this result of the economic analysis need to be carefully elaborated. Unlike the rather widespread speculation that large scale public undertakings such as the transfer of a nation's capital leads to wastage of resources, the economic analysis above clearly indicates the economic justification of the capital transfer over a 30 year planning horizon.

S.8.4 Finance to the investments in the Master Plan

Finance for investments is a crucial issue for the facilitation of the Master Plan. With the magnitude of the necessary financing and diverse and complex nature of the available sources, a clear strategy needs to be established.

The following figure shows the estimated use and source of funds for the capital development.

Use and Source of Fund for Capital Development

Use of Fund			Source of Fund	
non profit seeking works	Land preparation	700	4,560 Government investment (152x30 years)	Government budget
	Parks, greenery			
	Water resources, flood mili.	160		
	Transportation	950		
	Water supply, sewerage power/heat supply, gas, telecommuni. solid waste	1,590		
Profit seeking works	Residential building	3,750	2,970 Private companies (108x30years) or fund of organization	Private investment
	Office	1,850	1,470 Foreign investment (49x30years)	
	Commercial buildings			
total		\$9,000 million	\$9,000 million	

The *non-profit seeking* works or some of the *less-profit seeking* projects will have to be financed chiefly by government budgets, while the *profit-seeking* works could be financed by private investments or FDI. If international soft loans and private investments will be involved in the public works, government expenditures could further be reduced. Deregulation of public service tariffs and operations will promote and stimulate private investment.

Along with this deregulation, management of public sectors must be improved. Reduction of water or power leakage and loss, as mentioned before, needs to be detected and reduced. Also, tariff collection rates should be raised to strengthen the financial condition of public utilities and enhance social justice.

S.8.5 Results of Economic Analysis

(1) Economic Viability

First, judging from the EIRR value of 11% for the capital construction projects as a whole. As EIRR does not relate to its benefit distribution to whom, the rich or the poor, administration measures might be necessary to reduce the income differences among citizen, such as adjustment of taxation

and/or preparation of social safety networks, or provision of employment opportunity particularly for those with limited means of living.

(2) Affordability

Secondly, the growth of incomes will increase affordability for the profit-seeking or less profit-seeking works, such as commercial offices, housing and utility infrastructures. The household burden to pay house rents and utilities would decrease relatively with the development of Astana. Thus, the people could live in a larger space and enjoy better supply of utilities in the future.

Those with limited household budgets, however, might not be able to afford these services. The administration measure to increase the lowest individual income levels will be necessary. Some mechanism for mitigation of the impacts of increased house and utility payments need to be initiated, which may include subsidized public housing provision and/or tariff system with differentiation in favor of small amount users.

(3) Financing of Non and Less Profit Seeking Works

Thirdly, the non-profit seeking works or some of the less-profit seeking projects will have to be financed chiefly by government budgets, while the *profit-seeking* works could be financed by private investments or FDI.

If international soft loans and private investments will be involved in the public works, government expenditures could further be reduced. Deregulation in public service tariffs and operations will promote and stimulate the private investments.

(4) Investment Promotion

Lastly, it must be emphasized that private investments to producing facilities, such as in industries or trades, would sustain the economic development in Astana even under reduced government investment. Promotion and support to expand and develop the private sectors shall be essential to continual development of Astana.

S.9 Urban Administration and Organizational Issues

S.9.1 Urban Institutional and Organizational Improvement

The capital is the central, and single most important city of a country, with core political and central governmental functions. It also represents the image of the nation. Often, the image of a nation is not derived from the hardware of a society but also from the evaluation/perception on institutional and organizational arrangements.

Presently, it seems to be an imperative to establish stable and lasting institutional and organizational structures, as a basis for the development of Astana City and for Kazakhstan, based on the following considerations;

- Almost ten years have passed since Kazakhstan became independent. With the disintegration of U.S.S.R, Kazakhstan is no longer protected in a large system. Kazakhstan needs to compete and survive in the international society, which is dominated by a tenet of market economy.
- In order to be competitive, it is critical to improve the efficiency of the administrative system and reduce the so-called "transaction costs". The transaction costs are defined as the costs of coordination among people /organizations.
- The resources, both natural and human, are limited. Effective usages of resources could be derived from better performance and coordination of the development activities of Astana and its economy.

Generally, the responsibilities for one infrastructure development project are shared by multiple agencies and organizations, and clear demarcation of responsibilities is deemed necessary. Functions shared by multiple agencies and organizations need to be duly consolidated in view of executing the complex work of the capital development. Consensus needs to be made as to the general direction of such demarcation and consolidation.

Another important administrative and organizational issue related to the capital development is the framework for the promotion of direct investment. The Government has a set of measures designed to this end, although the system is either difficult to understand or changed too often. There are reportedly cases when potential foreign investors are not capable of making investment decisions due to the above mentioned shortfalls. A systematic approach to the investment promotion and rational operation thereof is expected for establishment.

S.9.2 Proposals of Organizational Structures and Reform in Institutional Arrangements for Effective Implementation of Capital Development

A prerequisite for the development of Astana is to clarify the demarcation between the Republic Government and the Astana Municipality and to control principal development duly. In light of the national significance, it is proposed herein that the Republic Government takes the responsibility for the development of District 13 separately, while Astana Municipality shall take the equivalent responsibility for all other areas.

Regarding infrastructure such as water, sewerage and road, for example, the responsibility for implementation will rest on Astana Municipality. These infrastructure facilities will be interrelated networks, and thereby these have to be controlled integrally by Astana Municipality, which has experience in various field. This demarcation on the responsibilities of city developments will be described as below.

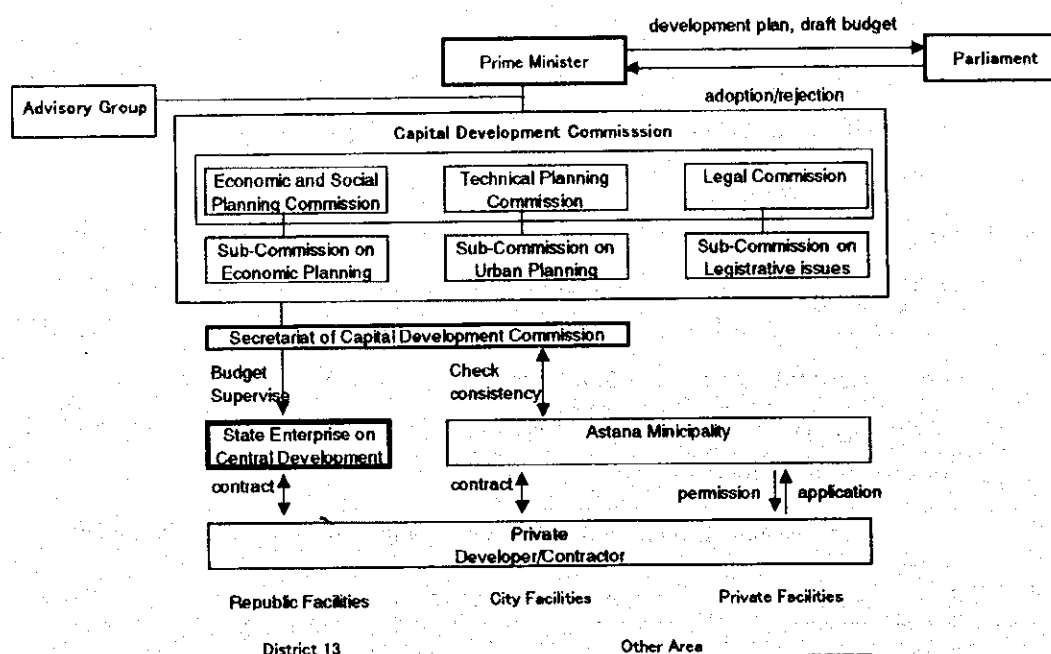
Proposed Demarcation of Responsibilities for Capital Development

Area/Subject	Republic Facilities	City Facilities	Private Facilities
District 13	Republic Government	Republic Government	Republic Government
Areas outside District 13	Republic Government	Astana Municipality	Astana Municipality
Infrastructure	Astana Municipality	Astana Municipality	Astana Municipality

Within the present organizational structure, the Government of RK has no specific organization that could manage the implementation of urban development. It is recommended therefore that the Republic Government will establish an organization in charge of the implementation of District 13 development.

Regarding political decision-making, a choice will be to formalize and stabilize the Working Group for the Development of Astana City as a permanent joint commission (tentatively named Capital Development Committee) at the Republic level. Together with this formalization, it will be advisable to separate political function and practical/technical functions as sub-commission structure. In the implementation stage of the Master Plan, there will be a number of practical tasks that require professional expertise in each functional area. Necessary experts will be appointed based on their expertise. Each commission may well be manned by related ministers (or high ranking officials in the relevant ministries) and each sub-commission will be staffed with specialists of public and private sectors.

This structure of related organizations, particularly the relationship between the Commission, SECD, and Astana Municipality, is shown below.



S.10 Regional Development Plan for Astana City, Akmola Province and Karaganda Province (AAKR)

S.10.1 AAKR in National Context

Astana City, Akmola Province and Karaganda Province Region (AAKR) occupy an area equal to 20% of the national territory. The per capital GRDP index, compared to the national average as 100, indicates 122 for Astana, 102 for Karaganda Province and 46 for Akmola Province, showing the strength of Astana and weakness of Akmola Province. Karaganda Province has accumulation of industrial production facilities, and Akmola Province is predominantly an agrarian province.

S.10.2 Regional Development Policies and Strategies

(1) Regional Development Strategies

The following three regional development strategies are proposed

- a) Promotion of economic development under appropriate division of functions

- b) Development of a spatial structure, which is more balanced and with easier access to other regions
- c) Creation of an appropriate institutional set-up instrumental in promoting a balanced economic development of AAKR

The AAKR's economy could be developed most effectively by taking full advantage of the strengths of each region. AAKR should aim at growing into a leading and model area for other regions in Kazakhstan. The following basic division of functions among the subject areas is proposed.

1) Astana

- Political/administrative center
- Business and commercial center at an international level
- Leading research and development (R/D) center of advanced technologies in Kazakhstan such as information technology and environmental science

2) Akmola Province

- Leading agriculture area in Kazakhstan, expanding the production of the existing crops and introducing new crops
- Agro-processing industry based on its rich agriculture potential and taking advantage of its proximity to Russia and China, potential big markets
- Comprehensive agronomic center with strong distribution function with such facilities as depots and transshipment terminals
- Tourism development area capitalizing on its rich environmental resource
- Research and development (R/D) on farming and bio-technology

3) Karaganda Province

- Center for processing industry in Kazakhstan and CIS
- Research and development on advanced industrial technology, with an emphasis on application to production
- Center for human resource development in industrial technology for Kazakhstan and CIS countries

(2) Sectoral Development Strategies

With regard to the industry, the first priority would be to fulfill the expanding demand in Astana and AAKR as a whole by local products. This is an import-substitution strategy. For certain products already domestically or internationally competitive, upgrading the quality of product

would be needed to expand export to CIS countries, or even to non-CIS countries. This is an export-promotion strategy to be promoted either following or in parallel with import substitution stage.

S.10.3 Measures and Programs Proposed for AAKR

The development policies and strategies for AAKR are formulated in accordance with areas and sectors as in the following;

Tale Major Regional Development Strategies for AAKR

Strategies		Content
Overall strategy		<ul style="list-style-type: none"> • Develop AAKR into Kazakhstan's leading center in advanced research and development (R&D), processing industries and agriculture. • Pursuance of economic development in consideration of the socially vulnerable population and environmental sustainability • Addressing of the rural poverty issue • Appropriate division of functions among regions • Capitalizing on improved access in inter-continental transportation projects • Promotion of human resource development in technical and managerial skills
Regional Strategies	Astana City	<ul style="list-style-type: none"> • Governmental and administrative center • Commercial and business center • R&D center on advanced technology for KZ
	Akmola Province	<ul style="list-style-type: none"> • Agriculture area • R&D center on agriculture and bio-technology • Agro-processing center • Tourism zone
	Karaganda Province	<ul style="list-style-type: none"> • Processing industry center • Development center in advanced industrial technology • Application of R&D results
Sector Strategies	Agriculture	<ul style="list-style-type: none"> • Expansion in supply of food and raw materials to the capital and consumption of industrial goods and urban services • Increase of value added of agriculture products by strengthening linkage to industrial sector • Finding of new crops targeting regional, domestic and international markets • Promotion of R&D in agricultural sector ranging from advanced bio-technology to basic farming technologies • Emphasis on import substitution in a short-run, followed by export promotion in a medium- to long-run
	Industry	<ul style="list-style-type: none"> • Acceleration of production by realizing an economically rational product mix • Improvement of investment environment to attract domestic and foreign investment in technology and management • Emphasis on import substitution in a short-run, followed by export promotion in a medium- to long-run • Support of business activities especially of Small and Medium Enterprises (SME) • Strengthening of R&D function particularly on Information Technology (IT) • Improvement of marketing capabilities • Strengthening of linkages with other sectors • Human resources development in technology and management
	Service	<ul style="list-style-type: none"> • Encouragement of expansion of services by better enforcement of investment privileges • Market development for regional products through strengthening trading companies and others • Establishment of IT center suitable for Kazakhstan and CIS countries • Promotion of tourism by improvement of accessibility and facility renewal

Main Technical and Economic Indicators of the Master Plan of the City of Astana (1/2)

Indicator	Unit	2000	2010	2020	2030
1. Territory					
1.1 Settlement area within the city boundaries	ha	71,000	71,000	71,000	71,000
1.1.1 Residential area		4,052	5,726	7,840	9,075
1.1.2 Government, Diplomat and New Business City		-	750	850	950
1.1.3 Expansion area of New business		-	-	-	300
1.1.4 Industrial area		7,000	7,000	7,000	7,000
1.1.5 River zone, waterbodies and Other open areas		N.A.	6,405	4,191	2,556
1.1.6 Green buffers (316m ² /p to 250m ² /p)		10,180	13,543	16,726	20,000
1.1.7 Buffer zones and open land (non urban areas)		N.A.	37,576	34,393	31,119
2. Population					
2.1 Population taking into account the dependent settlements	th. people	331	490	690	800
2.2 Density of population					
within the residential area	person/ha	99	109	114	118
within the city development area		82	86	88	88
2.3 Number of employed people, total	th. people	147	254	374	436
3. Residential construction					
3.1 Housing stock	th. m ² of the total area	5,016	7,968	12,429	15,197
3.2 Maintained housing resources	th. m ² of the total area	5,016	4,628	7,690	12,299
3.3 Demolition for redevelopment		0	388	278	130
3.4 Floor area per person	m ² /person	15	16	18	19
3.5 New residential development, total	th. m ² of the total area	-	3,340	4,740	2,898
4. Social facilities					
4.1 Kindergartens, total/1000 people	places	8300/25	14700/30	27600/40	40000/50
4.2 Secondary schools, total/1000 people	places	52700/160	83306/170	116863/170	135324/170
4.3 Colleges, total/1000 people		7628/23	10915/33	22685/33	26269/33
4.4 Higher education, total/1000 people		33611/100	39203/80	54995/80	61522/80
4.5 Polyclinics, total/1000 people	visits per shift	4772/14.4	7350/15.0	11730/17.0	16000/20.0
4.6 Hospitals, total/1000 people	bed	2911/8.8	4312/8.8	6049/8.8	7005/8.8
4.7 Police stations (catchment area of 1PS=17500p)	No.	19	28	39	44
4.8 Fire stations	Fire station/No. of fire engines	6/24	11/61	17/69	21/80
5. Transport					
5.1 Length of the main streets and roads, total (to be constructed after 2000)	km				
5.2.1 Special Road			3.76	3.76	3.76
5.2.2 Arterial Road			105.18	177.84	231.58
5.2.3 Primary Road			26.77	62.96	62.96
5.2.4 Secondary Road			41.29	115.86	137.96
5.2.5 Tertiary Road			19.75	67.75	79.60
5.2 Number of vehicle					
Vehicle ownership	(ver./1000 person)	92	(178)	(264)	350
Number of vehicle	ver.	29,000	(112667)	(196333)	280,000
6. Engineering equipment					
6.1 Water Supply					
6.1.1 Total water consumption (including leakage and water loss)		160,320	175,100	243,700	295,300
Drinking water	m ³ /day	138,100	151,700	217,100	264,600
Technical water	m ³ /day	17,800	23,400	26,600	30,700
6.1.2 Capacity of water treatment plants	m ³ /day	165,000	200,000	270,000	320,000
6.1.3 Water supply sources	MCM/year	89.2	152.2	152.2	215.2
Ishim River		89.2	89.2	89.2	89.2
Irishik Karaganda Canal		-	63.0	63.0	126.0
6.1.4 Groundwater reserves confirmed by the relevant State Commission (potential)		4.4 - 6.2	4.4 - 6.2	4.4 - 6.2	4.4 - 6.2
6.1.5 Average daily consumption per capita	l/day	322	235	239	251
6.2 Sewerage					
6.2.1 Total volume of effluent	m ³ /day	104,133	112,224	171,273	216,842
6.2.2 Capacity of the wastewater treatment facilities	m ³ /day	136,000	136,000	176,000	218,000
6.2.3 Sewerage Service Population	person	220,100	421,400	641,700	760,000

Main Technical and Economic Indicators of the Master Plan of the City of Astana (2/2)

Indicator	Unit	2000	2010	2020	2030
6.3 Power supply					
6.3.1 Electric Power Demand Forecast	GkWh/year	1,480	2,374	3,189	3,749
6.3.2 Annual average power consumption per head, including domestic	kWh	4,598	4,845	4,621	4,687
6.4 Heat supply					
6.4.1 Capacity of centralized sources	MW	1,272	1,596	1,841	2,140
6.4.2 Maximum heat energy demand forecast	Gcal/hour	764	1,306	1,619	1,974
6.5 Gas Supply					
6.5.1 Natural gas consumption, total	mln.m ³ /year	0.0	176.9	317.6	466.7
7. Engineering preparation of the territory					
7.1 Network length					
7.1.1 Water Supply Pipe, Dia: 150 - 1,200 mm (accumulated length to be constructed after 2000)	km		72.7	134.7	167.6
7.1.2 Pump stations of water supply (to be constructed after 2000)	unit		1	2	3
7.1.3 Sewer Pipe, Dia: 350 - 1,500 mm (accumulated length to be constructed after 2000)	km		36.1	86.6	101.6
7.1.4 Pump stations of sewerage (to be constructed after 2000)	unit		3	4	4
7.1.5 Stormwater Drainage Pipe, Dia: 500 - 1,800 mm (accumulated length to be constructed after 2000)	km		204.0	262.0	277.0
7.1.6 Pump stations of stormwater drainage (to be constructed after 2000)	unit		19	24	26
7.2 River Improvement					
Widening river cross and dike construction	km		7	21	30