10 PROJECT EVALUATION

10.1 ECONOMIC ANALYSIS

(1) Objective

An economic analysis is carried out to confirm the contribution of the priority project from the viewpoint of a national economy. Economic feasibility is confirmed by a cost –benefit analysis, deriving economic internal rate of return (EIRR), benefit-cost ratio (B/C) and net present value (NPV).

(2) Conditions and Assumptions

The economic evaluation is carried out based on the same assumptions as for the master plan presented in Table III-6. The following are the values specific to the priority project.

a. Costs

Investment cost :	$ 996 thousand in total
Operation and maintenance cost :	$ 50 thousand per year in 2005
Replacement cost :	$ 788 thousand in total

b. The following are the used values and the estimated economic benefit for domestic water.

Economic Benefit by Domestic Water Supply

Item	Unit	Minimum Requirement	Commercial Commodity
Value of water	Tg/m³	1,875	67
	$/m³	2.11	0.08
Net water use in 2005			
Apartment	l/c/d	10.6	139.4
Ger	l/c/d	10.6	0.0
Population in 2005			
Apartment	No.	3,433	
Ger	No.	15,357	
Economic benefit in 2005 and thereafter	10³ $/year	153	13

c. Economic benefit of industrial and institutional water supply is estimated at $ 112

thousand per year.

(3) Result

The following table presents the derived EIRRs, B/C ratios and NPVs of the priority project.

Result of Economic Evaluation of Priority Project

Case	EIRR (%)	B/C	NPV (10^3)
Standard	16.3	1.38	532
Cost 10% up	14.3	1.25	391
Benefit 10% down	14.1	1.24	337
Cost 10% up plus benefit 10% Down	12.3	1.13	196

An EIRR for the standard case is derived at 16.3% indicating high economic return of the priority project, compared with an opportunity cost of capital or cut-off EIRR at 10%. Even in the worst case of cost 10% up pus benefit 10% down, an EIRR is beyond 10% cut-off rate. Table IV-3 shows costs and benefits of the priority project.

10.2 FINANCIAL ANALYSIS

(1) Objective

The objectives of a financial analysis are the following:

- to derive appropriate water charges from the viewpoints of cost recovery and affordability and
- to assess financial viability of the priority project by deriving a financial internal rate of return (FIRR) based on the derived water charges.

(2) Conditions and Assumptions

Basically the same assumptions are applied as those for the analysis on the master plan. The following are the values specific to the priority project.

a. Allocated investment cost

Allocation Proportions and Allocated Investment Cost in Ger and Apartment Areas

Item	Unit	2005	
		Ger	Central Area
Allocation proportions of common facilities	%	19	81
Investment cost (LC)	$ thousand	351	41
Total Investment cost	$ thousand	674	322

b. The total replacement cost discounted to 2000 is estimated to be $92 thousand for the local currency portion and $250 thousand for the total replacement cost.

c. The allocated OM costs are estimated to be $38 thousand per year for the ger area and $18 thousand per year for the central area.

d. The water charges for cost recovery is presented in Table III-12 and summarized below.

Water Charges for Cost Recovery

Item	2005	
	Ger	Central Area
(in $/m^3)		
OM cost recovery	0.64	0.07
OM cost plus investment cost (LC) recovery	1.06	0.08
OM cost plus total investment cost recovery	1.45	0.16
(in Tg/m^3)		
OM cost recovery	566	64
OM cost plus investment cost (LC) recovery	939	74
OM cost plus total investment cost recovery	1,291	145

* LC : local currency

e. The assumed amounts of water use are 10.6 lcd for the ger residents and 150 lcd for the apartment residents.

The expenditures on water under the three cases of cost recovery water charges are compared with the projected income in 2005. The following proportions are derived as shown in Table III-14.

Proportions of Expenditure on Water to Income

(Unit : %)

Area	1998	2005
(Case 1 : O/M cost recovery)		
Ger	3.5	3.1
Apartment	5.0	4.8
(Case 2 : O/M / Investment (LC) recovery)		
Ger	3.5	5.1
Apartment	5.0	5.5
(Case 3 : O/M / Total investment recovery)		
Ger	3.5	7.0
Apartment	5.0	10.9

* LC : local currency

(3) Proposed Water Charges

In the case of O/M cost recovery water charges (Case 1), both water charges clear the condition. For the Case 2, the problem in affordability appears for the ger residents. In Case 3, the cost recovery water charges are too high both for ger and apartment residents. Considering these, the water charges for O/M cost recovery are proposed to be applied. The water charge for apartment residents could remain at the present level. The following are the proposed water charges as of 2005 based on these considerations.

Proposed Water Charges for Domestic Water

(Unit : Tg/m^3)

	Existing	2005
Ger	1,250	566
Apartment	56	64
Industry / Institution	900	900

The water charge for industries and institutions is proposed to remain at the present level at Tg 900 per m^3 in constant term. The fact that the organizations have been paying the existing water charge indicates that they can afford it.

The water charges proposed here are indicative ones. At the stage of actual adoption of the proposed water charges, the water charges to be levied should be determined in due consideration of the following factors.

1) Installation of water meters for apartment residents to realize charging by water

use amount

2) Cost
   - Inflation
   - Indirect cost for APSD

3) Demand/income
   - Actual water consumption rate in relation to water charge
   - Actual household income and affordability limit

4) Step-wise water tariff
   - Consideration for the poorest segment of the population
   - Introduction of a penalizing step tariff system, by which a higher charge is levied beyond certain amount of water use

(4) Financial Internal Rate of Return

A financial internal rate of return (FIRR) of the priority project was estimated under the proposed water charges as shown in Table IV-4. The FIRR for the priority project was derived at 4.5%, indicating that the fund for the implementation could be procured from financial sources with an interest rate lower than 4.6%.

10.3 SOCIAL EVALUATION

Proposed project on water supply system mainly focused on the improvement of water supply in the ger area by increasing chances of water availability. Although the resident of ger area cited yard connection as a preferable choice, it is not technically feasible. As mentioned in social analysis, no negative impact on the proposed project was recognized in terms of religion and social custom, acquisition of land for the project, and water seller

10.4 ANALYSIS FOR THE BENEFICIARIES

While the higher income group of non-piped households approved 161% of increase, the lower income group of non-piped households approved 80% of increase to the current tariff level. As indicated in the result of the household survey, the lower income group of non-piped household consumes less volume of water per day per

person than the higher income group. Since the amount consumed by the lower income group is still insufficient, it is recommended that exemption system of water charge for lower income group - unemployed and single female headed households should be introduced and revised periodically in corresponding local poverty level.

The proposed program for water supply system, which plans the installation of kiosk-type water delivery points in the ger area, will raise the availability of water. This also will lead to the increase in the water consumption for non-piped households. The frequent supply of water will help reduce the habit of stock water and bring about less opportunity of contamination.

However, 20% of non-piped households will not gain the intended benefit of kiosk type of water supply since a fixed single kiosk is designed to cover a radius of 250m. It is recommended that the water supply department promote the use of water carrier

10.5 ENVIRONMENTAL IMPACT ASSESSMENT (EIA)

10.5.1 General Description

(1) Objective

The major objective of Environmental Impact Assessment (EIA) is to determine the impact upon the environment caused by the drilling activities at ten sites around Altai City. It also aims to assess the future trends of water utilization from the chosen groundwater sources and the future construction of water supply systems. The EIA of this project was carried out in line with the provisions of the Law on Environmental Impact Assessment approved by the sitting of the Great State Khural of Mongolia on January 20, 1998.

In keeping with the General Impact Assessment Statement, dated May 22, 1998 and issued from the Ministry of Nature and Environment, it was agreed with the JICA Study Team's leader that the items in the following scope of work are to be carried out.

This chapter is basically a quotation from the Environmental Impact Assessment Study Report by an Approved Mongolian EIA Company, the Environmental

Consulting Company, Ltd. And it has been revised in minor way wit respect to the terms of Master Plan Study

(2) Scope of Work

The items in the scope of work to be performed under the schemes of the Detailed Environmental Impact Assessment of the Project are:

1) To draw up a basic environmental assessment of the site where the project is being implemented (physical, ecological and socio-economic environments);
2) To conduct field surveys on the site during the drilling activities (relevant surveys, observations, inventory and measurements);
3) To conduct nvironmental impact assessment with respect to the drilling activities, future utilization of water sources and future construction of water supply systems.
4) To make recommendations and proposals concerning the measures to be taken to mitigate the impacts of the project upon the environment;
5) To work out plans on environmental management and monitoring; and
6) To submit the Detailed Environmental Impact Assessment statement to the Ministry of Nature and Environment for consideration and making corresponding decisions.

(3) A Brief Description of the Detailed Environmental Impact Assessment of the Project

During the first or preparatory stage, respective activities were carried out with the aim of collecting information on the fauna and flora, making a review of the studies carried out with respect to the project implementation site's geographical, soils, land use, climatological, surface and groundwater characteristics. On top of this, the progress and interim reports issued by the JICA Study Team in connection with the the project during 1996 and 1997 were thoroughly studied as well.

In June, 1998 the General Director of the ENCO Co., Ltd., together with the expert environmentalist of JICA Study Team visited the site to survey and meet with some officials of Gobi-Altai aimag's authorities, Altai City's local residents and some specialized organizations and experts and they have collecting respective materials and data.

In the course of the second stage's activities, field surveys were conducted on the sites of significance for a baseline study of the environmental assessment of the project from 22 to 26 August, 1998.
The following personnel was involved in those field surveys.

1. Dr. A. Namkhai, the General Director of the ENCO Company in charge of the assessment work;
2. Professor D. Sumiya, zoologist;
3. Dr. D. Khishgee, a botanist;
4. Dr. D. Tserenjav, a hydrogeologist;
5. Tsend-Ayush, a land use and soil expert.

During this period the experts' team visited wells A2, B2, B3, B4, B5, B6 where the drillings were later conducted, and well A1, A3, B1 where they were being drilled, The following activities were carried out.

1. Preparation of an inventory of the fauna and flora in the surrounding places
2. Survey of the state of the fauna and flora in the surrounding places.
3. Collection of air, soils, water samples
4. Measurements of such factors as noise and vibration.
5. Questionnaire survey among the residents of houses and Gers (felt dwelling) concerning the land use, water supply, and water quality.

10.5.2 Existing Environment around the Altai City

(1) Physical Environment

1) Climate

Climate is described in the section 2.1 of the EIA report and in the chapter 3 in this report.

2) Surface Water

Surface water is described in the section 2.2 of the EIA report and in the chapter 5 in this report.

3) Groundwater

Groundwater is described in the section 2.3 of the EIA report and in the chapter 5 in this report.

4) Soils

The soils prevailingly spreading in this region are classified as "light brown soils" according to the "oils-geographical zonation of Mongolia". It pertains to the Khan Tayshir range's relatively elevated valleys (1500-2000 m) in the north-west different. As they are referred to the Tayshir's zone, there are a number of types of light brown soils formed depending on the topographical conditions, soil-formation rocksand and sub-soils' water level. Common light brown soils can be found around well B5 and B6 or in comparatively flat places.

Powdery carbonate thin-layered "light brown soils" are spread around Altai City and to the north-east of the city in lowlands, in other words, around wells A1, A2, B1, B2, B3, B4. The soils' upper layer is frequently observed to be formed of light clay.

Drilling activities show that the soil's upper layer to a depth of 3 m (in some places up to 7 m) consists mostly of sand and gravel layer. well A3 in Khadaasan valley is located among small knolls and hillocks and its soil is the "mountain light brown soils".

The humus layer of those soils is 10-12 cm thick at wells A2, B2, B3 and B4, which should be regarded as being very thin. The soils around those wells are stratified, with solonchack salt soils in their structure. As for the soils around wells B5 and B6 in the region of Kharzat and Oloon Nuur they have a comparatively thicker humus layer (15-18 cm).

5) Geology

Geology is described in the section 2.5 of the EIA report and in the chapter 4 in this report.

6) Air quality

The concentrations of SOx and NOx in the samples taken from the atmosphere over wells A1, B1, B5 and B6 were analyzed in the Environmental Central Laboratory. Their values don't exceed the Mongolian standard, which shows that the air is not polluted.

7) Noise

Noise levels were measured with Sound Level Indicator (USA) and the following results were obtained (Table IV-6).

Though the noise level at 1 meter from the drilling machine is higher by 12-13 dB(A) than the highest permissible level at 1 meter, it gradually goes down without any significant effects upon the surrounding places.

8) Vibration

Vibration levels was measured with vibration meter (Vibrometer). The following results (in Table IV-6) were obtained.

The vibration levels in a vehicle's cab and that of the drilling machine were measured, at one meter from vibration center. The result is that the value is higher by 3-13 dB than the standard, however their levels decrease without any significant impact upon the environment.

(2) Ecological Environment

1) Fauna

a) Current state of study

There are not so much past data, information, publications and research works and surveys carried out specifically with respect to the fauna inhabiting around Altai City. However, there are a little data and findings of rather casual character provided by some researchers and scientists while they were passing by this region in the course of their field surveys. For instance, in 1876-1899 G. N. Potanin, 1899-1901 P. K. Kozlov,

from July to September of 1942 and in 1945 A. G. Bannikov carried out the surveys in the region of Gobian Altai, Tayshir range, Econbulag, Tsagaan Olom. In addition to these, some information concerning the city of Altai can be found in the publications issued from the Academy of Science of Mongolia, the Biological Research Institute and published by some other researchers and scientists concerned as well.

b) Exploration methods and techniques

Materials and data have been collected by applying field survey on the routes covering biotopes with diversified ecological conditions. A bird inventory was conducted through registering all the species of birds observed directly during the field surveys and the width of an inventory grid ranges between 25 to 500 m depending upon the bird species at an area within 600 to 900 m around the drilling sites.

c) Animal species registered during the route surveys

Valleys of the Esuitiin Sair river

Studies have been carried out concerning the fauna at the drilling sites A2, B2, B3 and B4 in the valleys of the Esuitiin Sair river, its water-collecting depressions, deltas, hillocks and terraces.

A2 drilling site is located in the feather grass terrace of Esuitiin Sair river at a distance of 400 m from the main road to Ulaanbaatar. Within 800 m around the site there were such species as Northern Wheatear (2), Horned Lark (3), Common Kestrel (1), Golden Eagle (1), Northern Swift (6), Northern Raven (2) and Kite (1), and also in the arid steppe locusts, grasshoppers, Brandt's Vole communities. The above mentioned four wells are subject to some man-induced pressures because they are located near summer cottages, pastures for grazing livestock, and in the surrounding hills and knolls there are many spring and winter camp sites. Also these animals are frequently observed around the aimag's landfills where the waste waters from the treatment plant are discharged into the Esuitiin Sair river waters This will enhance the possibility of its contamination.

At B2, the drilling activities were carried out in the muddy and clayey river-bed terrace and within 800 meters from the well, there were recorded species of Northern Wheatear (4), Northern Swift (1), Corsac Fox(1), locusts, grasshoppers, and ants. Also,

some Golden Eagles and Cinereous Vultures were observed flying over this region.

Within 900 meters from B3 drilling site in the western side of the Esuitiin Sair river, where clayey soils and feather grass are prevailing, the following species were recorded. Northern Wheatear (1), Horned Lark (2), Yellow Wagtail (2), Saker Falcon (1), Golden Eagle (1), Tolai Hare (1). In the feather grass covered area rather dense tunnels of Brandt's Vole were found.

B4 drilling site is in the feather grass lowland not far from the main road in the region of Ustsug Gashuun well. Within 600 m of this drilling site, the following species were recorded. Northern Wheatear (11), Mongolian Lark (2), Horned Lark (3), locusts, grasshoppers and also abandoned and active tunnels of Brandt's Vole were observed. (Lasiopodimys brandti).

Kharzat to Oloon Nuur

B5 drilling site is located in the intermountain valley in the area of Kharzat spring. Close to it, there are feather grass meadows, swamps and springs. Within 900 m of this site such species as Common Kestrel (1) and lots of Northern Swift were observed hunting while in the lowlands and springs and streams' sides Demoiselle Crane (4), Common Snape (3), White Wagtail (4), Yellow Wagtail (2), Herring Gull (1), and Siberian Jerboa were seen.

B6 drilling site was drilled not far from B5 in a place called Bor Den. It is on the gorge's terrace with mountain steppe dry gravel soils. There were dense populations of Brandt's Vole there. Also the site's ground was honeycombed with tunnels of Northern Mole-Vole. As close to the last two drilling sites there are streams, brooks, swamps and Oloon Nuur water body, and some species of birds can be found.

Khadaasan

A3 drilling point was set up in Khadaasan river's terrace. Within 600 m of this site there were met such species of birds as Northern Wheatear (12), Pied Wheatear (1), Isabellinus Wheatear (1), Horned Lark (6), Rock Petronia (2), Eurasian Redstart (2), Common Kestrel (1), Golden Eagle (1), Upland Buzzard (2) and concurrently, Tolai Hare (1), Royle's Mountain Vole and Pallas' Pika in the screes. Also, in an area of 50x30 m, on the southern slopes of Khadaasan hills and knolls, the found are lots of

Northern Mole-Vole's tunnels and numerous tunnels of Brandt's Vole in the southern slopes of mountains so it was difficult to limit somehow the boundaries of their habitats. In the course of a 4km route survey, such species as Northern Wheatear (34), Pied Wheatear (2), Isabellinus Wheatear (2), and Horned Lark (2) were observed.

A3' point is located in Khadaasan's lower valley at the river's dry terrace. Within 600 m around this site, such species as Upland Buzzard (2), Northern Wheatear (6), Northern Raven (2), Rock Petronia (80) and many caterpillars of the nettle butterfly were found. During a 3 km route survey around the hills' southern slopes, gorges, ravines, screes were found such species as Northern Wheatear (23), Common Kestrel (1), Yellow Wagtail (1) while along our 2 km route from A3' to A3 we recorded Northern Wheatear (14).

Near Airport and the State Hero Janchiv's garden

A1 and B1 points are located near the Altai City's airport's light house and the State Hero Janchiv's garden with aspen trees and willow groves. Pallas' Pika's numerous tunnels were made in the garden's base stones of metal enclosure. Around this site, such species as Northern Wheatear (4), gal suult (1), Stone Chat (1), Arctic Warbler (3), Tree Sparrow (31), Yellow Wagtail (4), Brown Shrike (3), Rock Pigeon (1), Hill Pigeon (1), Oriental Turtle-Dove (1) were observed

d) Faunal species diversity around the Altai City

Based upon the observations made during the field surveys, information provided from locals, analyses of the past data and materials, works and papers issued in the part, a list of the faunal species inhabiting this region was prepared in accordance with the classification principles, order and designation proposed by V. E. Fomin, A. Bold (1991). R. P. Reeding, D. Sumiya, R. Sumiya and N. Batsaikhan (1994).

All the Insects, reptiles, birds and mammal species found during this survey are shown in Tables IV-7 to IV-10.

In addition to this, there is enough ground to believe that small mammals such as Satanin's Jerboa (Salphingotus crassicauda), Mongolian Daahai (Stylodipus andresi), Hairy-Sooted Jerboa (Dipus dagita) whose habitats' northern edges extend to the valleys of the Zavkhan river can be found there.

Considering the fact that the number of species of mammals and their population being relatively low and their distribution patterns, all the drilling sites are ecologically vulnerable. It means the sensitivity of their ecological systems that may be easily affected under the influence of external factors.

e) Rare birds and mammals

Bird and mammal species listed in the following books are summarized in Table 7 with brief remarks. Red Book of Mongolia, the Red Book of the Environmental Protection International Association (BBNHOH), Annexes 1 and 2 of the 1973 Washington Convention on International Trade of Rare Species of Wild Animals and Plants and the Mongolian Law on Hunting under the category of rare and endangered species are shown.

Whooper Swan (Cygnus cygnus), Bar-headed (Eulabeia indica) and Daurian Hedgehog (Erenaceus auritus) are in the Red Book of Mongolia. And also Satanin's Jerboa (Cardiocranus paradoxus) and Thick-Tailed Pygmy Jerboa (Salpingotus crassicauda) species are quite likely to be found here.

Bar-headed Goose (Eulabeia indica) is to be observed in limited number during its migration period and Beech (Martes foina) is one of the species settled in this region. These two species are rare species listed in the Mongolian Law on Hunting. Lesser Kestrel (Falco naumanni) is in the category of rare and Manul (Felis manul) and Corsac Fox (Vulpes corsac) are classified into the category of uncertain ones in the Red Book of BBNHOH.

The ten species of birds and mammals put on the list in Annexes 1 and 2 to the 1973 Washington Convention on International Sale of Rare Species of Animals and Plants inhabiting this site are recorded as pertaining to common ones in terms of their population number.

2) Flora

Plant species found during this survey are shown in Table IV-11.

a) The current status of vegetation cover

Valleys of the Esuitiin Sair river

A2 point is located in the feather grass terrace of Esuitiin Sair river at a distance of 400 m from the main road to Ulaanbaatar. The vitality of the most of useful plants is poor, and their average height is just 3 to 5 cm showing how much this site is affected by overgrazing.

B2 point is located in Altai's north-east part called Estiin Amny Sadraga. In the surroundings of this site there grow such plants as Covely achnatherum (dominating) intermittently with Sandy Needlegrass, Aristate Goosefoot, Oakleaf Goosefoot, and Siberian Saltbush species. The vegetation cover is scarce, its coverage is just 2-10%, and 5-7 species were recorded per 100 m^2.

B4 point is located to the north-east of the city in the lower slopes of Ontsgiin valley's microelevations with knolls and small hills where Motley Grass - Fescus community are prevailing. The vegetation cover is made up of such Motley Grasses as the Leymus chinensis and sedge. The average height of most of the plants is 3-5 cm only, the vegetation coverage is 25-30% and 5-10 species are to be sean per 100 m^2.

Kharzat to Oloon Nuur

B5 is located in the south eastern part of the city at a distance of 7 km from the city. The vegetation coverage is 10-15%, and 5-10 species are recorded per 100 m^2.

B6 is also located to south-east of Altai City in a place called Bor Den at a 1.5 km distance from B5. The vegetation coverage is 8-10%. The vegetation yield is of medium rate, and its thin and scanty condition indicates its heavily degraded and overgrazed. 3-7 species of plants are to be recorded per 100 m^2. The vegetation cover is composed of Moley Grass and segmented stemmed field communities. Among the plants growing there a significant portion is made up of the plants that indicate overgrazing and degradation of the site. The vegetation cover looks scarce under the influence of Altai Heteropappus growing in numerous quantities.

Khadaasan

A3 is located in the north-western part of the city in a small valley called khadaasan. The vegetation cover around the site is made of by the Motley Grass-segmented stem field communities. Creepers being indicators of degradation due to overgrazing are densely growing within the above field communities. Leymus serves as a prevailing plant being well-resistant to grazing of cattle. There is another indication of the site's overgrazing and degradation. The vegetation coverage is 10-15%, and 8-10 species are to be recorded per 100 m^2.

Near Airport and the State Hero Janchiv's garden

A1 is located in the north-west of the city. The site is near the city and therefore, has apparently been seriously degraded. Although the Tunkh - Wormwood communities are somehow growing there they fail to form its major communities. Wormwoods and strong rooted plants are frequently observed there as the major indicators of the site's degradation.

B1 is located in the western part of the city. The vegetation projection is 5-8%, 3-5 species of plants can be found per 100 m2 and the predominance of creepers indicates a substantial degree of overgrazing and degradation of the vegetation.

b) Rare species

Around Altai City there can be met, though occasionally, such plants as Rush (Juniperus sabina, A1), Mongolian ephedra (Ephedra equisetina, B2) and Wormwood (Arbemisa xantochroa, A3, A4 and B1) listed in the Red Book of Mongolia and/or as very rare species in the Mongolian Law on Natural Plants.

(3) Social Environment

1) Socio-economic Profile

Socio-economic Profile is described in the section 2.9 of the EIA report and in the chapters 1 and 2 in this report.

2) Land use

The issue of land use with respect to the project implementation territory around Altai

City had not been solved until recently. It is only in 1998 that a new administrative arrangement was worked out by the Geoecological Research Institute together with the Governor's Office of Gobi-Altai Aimag and was approved by the territory of Esonbulag soum's land use scheme. Esonbulag soum and Altai City extend to an area of 216,133 ha in total including 209,146 ha of pasture land, 5,377 ha of settlements and towns, 470 ha occupied by a road network, 1,120 ha of forestry and 20 ha of water bodies.

Most of the territory surrounding the ten sites where the drilling activities took place is referred to as pasture lands. Only the sites where wells A1 and B1 was drilled are classified into the forestry zone.

Within 6-10 km around wells A2, B2, B3, B4 located to the north-east of Altai City, there are springs and winter camps of 14 to 18 households from Esonbulag soum. The area totals 16 km^2 and is used for grazing for 4,800-5,400 head of livestock. The drillings were carried out around those sites for 16 to 47 days and the above mentioned households' livestock was observed staying at the place without moving somewhere else.

The useful area around wells B5 and B6 drilled to the south-east of Altai City accounts for 10 km^2. The amount of biomass around those two wells is higher than in other sites amounting to 200-250 kg/ha which makes it more suitable for livestock to graze. From six to seven households with approximately over 2,000 head of livestock live in summer seasons around the place.

The site in Khadaansan valley where well A-3 was drilled occupy a territory of 6.4 km2. It is winter, spring and summer camp area used by 5 to 6 households with about 1,500 head of livestock.

When the EIA team asked about any impacts caused by the drilling of wells in a herdsmen's estates during the meetings with the authorities of Esonbulag soum it was informed that they did not notice any adverse impacts and that no complains were received from herdsmen concerning this issue. They also assured the locals that if there would arise any discrepancy with respect to the use of pastures, they would be willing to allocate new lands.

10.5.3 Environmental Impacts

(1) Air quality

The samples of the atmosphere around Altai City taken during the drilling activities for determining the concentrations of NOx and SOx and analyzed at the Environmental Monitoring Laboratory have shown that the concentrations of these toxic gases don't exceed the highest permissible levels.
(No negative impacts at construction phase).

(2) Noise

Though the level of noise registered at 1m from the drilling machine is higher by 12-13 dB(A) than the highest permissible level, the noise level goes down without any significant effects upon the surrounding places with distance.
(No negative impacts in the construction phase).

(3) Surface water

the morphological and physio-geographical peculiarities of the study area are relatively small catchment area, bed slope and less roughness of the land cover. Consequently, the flood events will occur in such a way that in short period of time after a storm or intensive rainfall. Economic activities, including construction and operation of water supply facilities(If there was any), in the catchment might change the land vegetation cover, namely, hydro-physical properties of the soil. Therefore runoff coefficient will be increased. It implies that the flood probability will be increased by several times of the undisturbed condition of the nature.
(negative impact in the operation phase)

(4) Groundwater

1) The major impacts of using the wells on the environment are:

a) decline of groundwater level;
b) subsidence of the surface; and
c) disappearing of some plant species.

2) In parallel with this, the reserves of the aquifers might be depleted, leading to an intrusion of inferior quality water from other strata.

(negative impact in the operation phase)

(5) Soil

1) Degradation of subsoil by well drilling

An area of 10-30 m^2 of sub-soil around the wells were disturbed with mud and clay heaped over, trails of vehicles and other man-induced factors.

(a little negative impact in the construction phase).

2) Destruction of subsoil by construction of pipeline and other facilities

The following construction works were planned to be done in the Master Plan:

a) transmission pipeline: 3.5 km (9 ha, damage of subsoil)

distribution pipeline: 7km for G-1 ger and 4km for G-3 ger along roads (37 ha)

The soils along the transmission pipeline are anticipated to be seriously damaged and degraded because the construction will be done in pasture lands.

(negative impact in the construction phase)

3) Waste

The well construction and the future construction of the water supply facilities will produce some construction and domestic wastes.

(negative impact in the construction phase).

(6) Land Use

During the drilling activities for over 20-40 days livestock grazing around the drilling sites may be reduced and some of the livestock may be moved to other places. Drilling activities carried out at night is likely to disturb and frighten the livestock to a considerable extent.

(negative impact in the construction phase).

(7) Flora

The activities to be provided under the schemes of the project are expected to have the following impacts upon the region's flora.

1) Each drilling work will increase the disturbed area by 10-30 m^2. Construction of facilities such as pipelines will cause more disturbed area than the drilling work.
(negative impact in the construction phase)

2) With the heavy use of artesian wells the vegetation cover will be changed fundamentally and some species of plants may vanish completely.
(negative impact in the operation phase)

3) The construction work of water supply system will generate a number of new network of car trails, leading to an increasing degradation of plants and soils. It will obviously result in an increasingly strong pressure upon the vegetation.
(negative impact in the construction phase)

4) Very rare species such as *Juniperus sabina, Ephedra equisetina,* and *Artemisa xantochroa* were found around Altai City. It is possible that the construction works will reduce the distribution of these species.
(negative impact in the construction phase)

(8) Fauna

The activities to be provided under the schemes of the project are expected to have the following impacts upon the region's fauna:

1) As the region's soils are heavily degraded in some places, they are easily easy destroyed under the influence of weathering. It is also likely that if the site's soils is destroyed during the construction of some facilities, some rodents will be forced away.
(negative impact in the construction phase)

2) In the course of the construction activities especially during the breeding season of animals, noise from heavy vehicles' and technical facilities' and noxious fumes dispersed into the atmosphere may cause the temporary change in distribution of bird and animal species. And if such activities were to be repeated, it would lead to more adverse consequence in future.
(negative impact in the construction phase)

3) The site of B5 and B6 well is more sensitive to external condition change in comparison with the other sites. There are many springs, streams, swamps and a large water body called Oloon Nuur around this site. A lot of waterfowl visit this area. Such factors as a wider utilization of various machines and technical facilities will inevitably put pressures upon the diversity of animal species inhabiting this region in respect of their habitats and distribution patterns. However this area is not the main breeding site for the rare species of birds, Bar-headed Goose and Whooper Swan, which visit the area in wet season.
(a little negative impact in the construction phase)

4) Around A3 comparatively large number of species were recorded and large communities inhabit Khadaasan spring's terrace. But this site also is not used for breeding by any rare bird species. A variety of birds of prey visit this area for finding their food such as voles.
(a little negative impact in the construction phase)

(9) Social Impacts

1) Demographic factors

a) Some 30% of Altai City's population is viewed as the population's poor stratum and most of them are residents of Gers. The life conditions of the people residing in this ger region including the poor stratum of the population would not be affected adversely due to the groundwater development activities. Moreover, the implementation of the project would contribute to the improvement of water supply for the ger area and will be beneficial for the most vulnerable stratum of the city population as well as for the others.
(positive impact in the operation phase)

b) Some 3-4 households were recorded to be living close to A1 well.
(a little negative impact in the construction phase)

c) Employment (small impact in the construction phase)
if construction workers are locally employed, impact is positive.
if construction workers are employed from other places, impact is negative

2) Socio-cultural factors

a) The population of Altai City is almost homogenous in terms of its ethnic structure, because the overwhelming majority of its population are made up of Khalkha Mongolians. Historically, the indigenous residents of the city used to worship shamanism and only since the mid-16th century they turned into the Buddhist. It can be regarded that there would not be anything to hinder the implementation of the project with regard to the local populace's religious, ethnic rites, ceremonies and customs.
(no impact).

b) The religious ceremonies and functioning of Altai City's Dashpeljeelen monastery will not be affected by the implementation of this project.
(no impact)

c) No customs, religious beliefs and traditions are expected to be affected by the activities to be carried out within the frame work of the Study
(no impact)

10.5.4 Mitigation of Environmental Impacts

(1) Groundwater

1) The major way to prevent the decline of groundwater level and the degradation of groundwater quality is to avoid over pumping by monitoring the water level reguarly.
2) To monitor water level and the major parameters of water quality.
3) To formulate a plan for the proper use of groundwater based on respective hydrogeological materials and data.
4) To take measures to keep on in future carrying out on a permanent basis the studies in this field that are being carried out currently on short-term basis.
5) To undertake some studies into the disturbed regimes(quantity) of water sources concurrently with conducting regime studies in the natural conditions.

(2) Surface water, soil, fauna and flora

1) To take reclamation actions including the clearing of the sites around the drilled wells, such as eliminating the garbage, mud and clay piles left there, leveling the

soils.

2) To launch a campaign for the purpose of improving the knowledge of the locals about soil erosion and its control.

3) To protect sub-soils, vegetation, and rare plant species during construction of water supply facilities, the following steps shall be taken:

a) Specialists survey rare plant species and breeding sites of rare animal species in the affected area around the construction of a facility, they take a protection action for these rare species as well.
b) To preserve sub-soils from the construction area.
c) To construct the facility.
d) To return sub-soils in the affected area.
e) To monitor fauna and flora in the affected area.

(3) Hygiene

The water from B5 and B6 wells showed a little content of nitrogen compounds and coliform, which indicated that the water is contaminated by organic substances mainly from domestic animal waste and human activity. This is not an impact from this project. The mitigation methods are as follows:

1) To develop sanitary zonation scheme to protect the sources of water supply as:
   I - (0 to 100m) strictly prohibited zone.
   II - (100 to 300m) zone under protection.
   III - (300 to 1,000 m) monitoring zone.
   and prohibit setting up any sources of possible pollution in the I-zone.

2) To carry out bacteriological and chemical analyses (monitoring).

In order to reduce the rates of infectious diseases associated with water utilization, it is recommended to take measures for protecting water sources and water-carriers from contamination.

10.5.5 Conclusion

The proper use of water resource, keeping the good subsoil and vegetation, and the appropriate land use are tightly related to each other. Effective water use will not only reduce the total water consumption and also help keep the good water quality. And also this attempt will reduce the degradation of subsoil and vegetation. Keeping the good subsoil and vegetation will improve the groundwater quantity and reduce the scale of flood, which in return improve the subsoil and vegetation condition. Furthermore the appropriate land use will reduce the risk of degradation of the subsoil and vegetation.

The following precautions are necessary:

- the subsoil and vegetation should be kept aside from the construction work of water supply facilities for future restoration;
- the effective water use in order to reduce the total groundwater consumption.
- the appropriate land use in order to keep the good subsoil, vegetation and groundwater.

Table IV - 1 Annual Operation and Maintenance Cost

Unit : US dollars

Item	Unit	Year (2000-2015)															
		2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Daily Mean Demand	m3/day	1,011	1,037	1,063	1,089	1,114	1,140	1,176	1,212	1,248	1,284	1,320	1,356	1,392	1,428	1,464	1,500
Hourly Maximum Demand	m3/h	86.4	95.6	104.9	114.1	123.3	132.5	139.8	147.0	154.3	161.5	168.8	176.0	183.3	190.5	197.8	205.0
1. Electric Power Cost (US$0.126/KwH)	US$/Year	32,600	37,173	37,699	31,213	31,558	31,917	32,414	32,910	33,407	33,904	38,452	39,501	40,549	41,598	42,647	43,695
・Electric Consumption	KwH/Year	258,727	295,022	299,198	247,726	250,463	253,310	257,252	261,194	265,136	269,078	305,177	313,499	321,821	330,143	338,465	346,787
①Intake Pump (Existing)	KwH/Year	162,367	166,542	170,718													
②Intake Pump (Reconst. & New)	KwH/Year				119,246	121,983	124,830	128,772	132,714	136,656	140,598	144,540	148,482	152,424	156,366	160,308	164,250
③Distribution Pump (Existing)	KwH/Year	96,360	128,480	128,480	128,480	128,480	128,480	128,480	128,480	128,480	128,480						
④Distribution Pump (New)	KwH/Year											160,637	165,017	169,397	173,777	178,157	182,537
2. Chemical Cost (US$0.34/Kg)	US$/Year	916	939	963	987	1,009	1,033	1,065	1,098	1,131	1,163	1,196	1,228	1,261	1,294	1,326	1,359
・Chemical (Cl_2) Consumption	Kg/Year	2,693.81	2,763.09	2,832.36	2,901.64	2,968.25	3,037.53	3,133.45	3,229.37	3,325.30	3,421.22	3,517.14	3,613.06	3,708.98	3,804.91	3,900.83	3,996.75
3. Personnel Cost	US$/Year	10,598	10,598	11,771	11,771	13,456	15,141	15,141	15,141	15,141	15,532	13,806	13,806	13,806	13,806	13,806	13,806
4. Repairing Cost (1% of Const.-Cost)	Lot	0	0	1,812	4,137	6,410	7,876	7,876	7,876	10,645	15,667	21,629	22,188	21,948	22,692	23,301	23,301
Total Annual M & O Cost	US$/Year	44,113	48,710	52,245	48,108	52,433	55,967	56,496	57,026	60,324	66,266	75,083	76,724	77,564	79,390	81,080	82,161

Note : Exchange rate US$ 1.00 = Yen 117.5 = Tg 890

Table IV-2 Replacement Cost

Unit : US Doller

No	Work Item	Unit	Life Span	Year (2000-2015)																Total
				2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	
1	Intake facility (Exist. & New)					164,423	82,212	0	0	0	82,212	82,212	0	0	0	0	0	0	0	411,059
	·Well	Year	15			30,660	15,330				15,330	15,330								76,650
	·Pump house	Year	40			6,710	3,355				3,355	3,355								16,775
	·Intake pump	Year	15			116,531	58,266				58,266	58,266								291,329
	·Collection pipe	Year	25			10,522	5,261				5,261	5,261								26,305
2	Transmission facility	Year									194,687	194,687								389,374
	·New pipe-line (Φ200 x 2line	Year									194,687	194,687								389,374
3	Distribution facility	Year		0	81,170	68,124	145,056	146,650	0	0	0	225,286	596,157	55,956	41,967	74,375	60,919	0	0	1,595,660
	·Water level indicator	Year	15			68,124														68,124
	·Water wagon	Year	10		66,000															66,000
	·Water cart	Year	15		15,170															115,170
	·Water kiosk	Year	40				31,913	31,913					25,530							89,356
	·Reservoir												97,675							97,675
	·Pipe-line (Φ150~250)	Year	25				113,143	114,738				96,350	231,577	55,956	41,967	74,375	60,919			789,025
	·Pump, house	Year	40									21,250	21,250							42,500
	·Distribution pump facility	Year	15									107,686	107,686							215,372
	·Chlorination equipment	Year	10										66,562							66,562
	·Water level indicator	Year	15										45,877							45,877
4	Total of Replacement Cost	-	-		81,170	232,547	227,268	146,650	0	0	276,900	502,185	596,158	55,956	41,967	74,375	60,919	0	0	2,396,095
	Every 10 Years				66,000								66,562							132,562
	Every 15 Years				15,170	215,315	73,596				73,596	181,282	153,563							812,522
	Every 25 Years					10,522	118,404	114,738			199,948	296,298	231,577	55,956	41,967	74,375	60,919			1,204,704
	Every 40 Years					6,710	35,268	31,913			3,355	24,605	144,455							246,306

Note 1) Exchange Rate : US$ 1.00 = Yen 117.5 US$ 1.00= Tg 890

Table IV-3 (1/3) Economic Evaluation of Priority Project

(Unit : $)

No.	Year	Cost				Benefit			Balance
		Invest-ment	OM	Replace-ment	Total	Domestic	Industrial & institutional	Total	
1	2000	10,418	44,113	0	54,531	0	0	0	-54,531
2	2001	232,134	48,710	0	280,844	1,739	3,007	4,746	-276,098
3	2002	293,869	52,245	0	346,114	40,495	6,326	46,821	-299,293
4	2003	282,859	48,108	0	330,967	89,557	9,887	99,445	-231,522
5	2004	177,080	52,433	0	229,513	136,782	13,166	149,948	-79,565
6	2005	0	55,967	0	55,967	166,346	112,102	278,447	222,480
7	2006	0	55,967	0	55,967	166,346	112,102	278,447	222,480
8	2007	0	55,967	0	55,967	166,346	112,102	278,447	222,480
9	2008	0	55,967	0	55,967	166,346	112,102	278,447	222,480
10	2009	0	55,967	0	55,967	166,346	112,102	278,447	222,480
11	2010	0	55,967	0	55,967	166,346	112,102	278,447	222,480
12	2011	0	55,967	0	55,967	166,346	112,102	278,447	222,480
13	2012	0	55,967	0	55,967	166,346	112,102	278,447	222,480
14	2013	0	55,967	0	55,967	166,346	112,102	278,447	222,480
15	2014	0	55,967	0	55,967	166,346	112,102	278,447	222,480
16	2015	0	55,967	0	55,967	166,346	112,102	278,447	222,480
17	2016	0	55,967	0	55,967	166,346	112,102	278,447	222,480
18	2017	0	55,967	0	55,967	166,346	112,102	278,447	222,480
19	2018	0	55,967	0	55,967	166,346	112,102	278,447	222,480
20	2019	0	55,967	404,081	460,048	166,346	112,102	278,447	-181,601
21	2020	0	55,967	0	55,967	166,346	112,102	278,447	222,480
22	2021	0	55,967	0	55,967	166,346	112,102	278,447	222,480
23	2022	0	55,967	0	55,967	166,346	112,102	278,447	222,480
24	2023	0	55,967	0	55,967	166,346	112,102	278,447	222,480
25	2024	0	55,967	0	55,967	166,346	112,102	278,447	222,480
26	2025	0	55,967	0	55,967	166,346	112,102	278,447	222,480
27	2026	0	55,967	0	55,967	166,346	112,102	278,447	222,480
28	2027	0	55,967	0	55,967	166,346	112,102	278,447	222,480
29	2028	0	55,967	0	55,967	166,346	112,102	278,447	222,480
30	2029	0	55,967	0	55,967	166,346	112,102	278,447	222,480
	Total	996,360	1,644,784	404,081	3,045,225	4,427,220	2,834,926	7,262,146	4,216,921

Sensitivity Analysis

Case	EIRR (%)	B/C	B-C ($)
Standard	16.3%	1.38	532,082
Cost 10% up	14.3%	1.25	390,646
Benefit 10% down	14.1%	1.24	337,438
Cost 10% up and benefit 10% dow	12.3%	1.13	196,001

Table IV-3 (2/3) Economic Evaluation of Feasibility Study Component (Sensitivity Analysi

No.	Year	Cost 10% up			Benefit 10% down			Cost 10% up & benefit 10% down		
		Cost	Benefit	Balance	Cost	Benefit	Balance	Cost	Benefit	Balance
1	2000	59,984	0	-59,984	54,531	0	-54,531	59,984	0	-59,984
2	2001	308,928	4,746	-304,183	280,844	4,271	-276,573	308,928	4,271	-304,657
3	2002	380,725	46,821	-333,904	346,114	42,139	-303,975	380,725	42,139	-338,586
4	2003	364,064	99,445	-264,619	330,967	89,500	-241,467	364,064	89,500	-274,564
5	2004	252,464	149,948	-102,516	229,513	134,953	-94,560	252,464	134,953	-117,511
6	2005	61,564	278,447	216,884	55,967	250,603	194,636	61,564	250,603	189,039
7	2006	61,564	278,447	216,884	55,967	250,603	194,636	61,564	250,603	189,039
8	2007	61,564	278,447	216,884	55,967	250,603	194,636	61,564	250,603	189,039
9	2008	61,564	278,447	216,884	55,967	250,603	194,636	61,564	250,603	189,039
10	2009	61,564	278,447	216,884	55,967	250,603	194,636	61,564	250,603	189,039
11	2010	61,564	278,447	216,884	55,967	250,603	194,636	61,564	250,603	189,039
12	2011	61,564	278,447	216,884	55,967	250,603	194,636	61,564	250,603	189,039
13	2012	61,564	278,447	216,884	55,967	250,603	194,636	61,564	250,603	189,039
14	2013	61,564	278,447	216,884	55,967	250,603	194,636	61,564	250,603	189,039
15	2014	61,564	278,447	216,884	55,967	250,603	194,636	61,564	250,603	189,039
16	2015	61,564	278,447	216,884	55,967	250,603	194,636	61,564	250,603	189,039
17	2016	61,564	278,447	216,884	55,967	250,603	194,636	61,564	250,603	189,039
18	2017	61,564	278,447	216,884	55,967	250,603	194,636	61,564	250,603	189,039
19	2018	61,564	278,447	216,884	55,967	250,603	194,636	61,564	250,603	189,039
20	2019	506,053	278,447	-227,605	460,048	250,603	-209,445	506,053	250,603	-255,450
21	2020	61,564	278,447	216,884	55,967	250,603	194,636	61,564	250,603	189,039
22	2021	61,564	278,447	216,884	55,967	250,603	194,636	61,564	250,603	189,039
23	2022	61,564	278,447	216,884	55,967	250,603	194,636	61,564	250,603	189,039
24	2023	61,564	278,447	216,884	55,967	250,603	194,636	61,564	250,603	189,039
25	2024	61,564	278,447	216,884	55,967	250,603	194,636	61,564	250,603	189,039
26	2025	61,564	278,447	216,884	55,967	250,603	194,636	61,564	250,603	189,039
27	2026	61,564	278,447	216,884	55,967	250,603	194,636	61,564	250,603	189,039
28	2027	61,564	278,447	216,884	55,967	250,603	194,636	61,564	250,603	189,039
29	2028	61,564	278,447	216,884	55,967	250,603	194,636	61,564	250,603	189,039
30	2029	61,564	278,447	216,884	55,967	250,603	194,636	61,564	250,603	189,039
	Total	3,349,748	7,262,146	3,912,399	3,045,225	6,535,932	3,490,707	3,349,748	6,535,932	3,186,184

Table IV-3 (3/3) Economic Evaluation of Feasibility Study Component
(Net Present Value and Benefit - Cost Ratio)

(Costs and Benefits Discounted by 10% Discount Rate) (Unit : $)

No.	Year	Standard case		Cost 10% up		Benefit 10% down		Cost 10% up & Benefit 10% down	
		Cost	Benefit	Cost	Benefit	Cost	Benefit	Cost	Benefit
1	2000	54,531	0	59,984	0	54,531	0	59,984	0
2	2001	255,313	4,314	280,844	4,314	255,313	3,883	280,844	3,883
3	2002	286,045	38,695	314,649	38,695	286,045	34,826	314,649	34,826
4	2003	248,660	74,714	273,526	74,714	248,660	67,243	273,526	67,243
5	2004	156,760	102,416	172,437	102,416	156,760	92,175	172,437	92,175
6	2005	34,751	172,894	38,226	172,894	34,751	155,605	38,226	155,605
7	2006	31,592	157,176	34,751	157,176	31,592	141,459	34,751	141,459
8	2007	28,720	142,888	31,592	142,888	28,720	128,599	31,592	128,599
9	2008	26,109	129,898	28,720	129,898	26,109	116,908	28,720	116,908
10	2009	23,735	118,089	26,109	118,089	23,735	106,280	26,109	106,280
11	2010	21,578	107,354	23,735	107,354	21,578	96,618	23,735	96,618
12	2011	19,616	97,594	21,578	97,594	19,616	87,835	21,578	87,835
13	2012	17,833	88,722	19,616	88,722	17,833	79,850	19,616	79,850
14	2013	16,212	80,656	17,833	80,656	16,212	72,591	17,833	72,591
15	2014	14,738	73,324	16,212	73,324	14,738	65,992	16,212	65,992
16	2015	13,398	66,658	14,738	66,658	13,398	59,992	14,738	59,992
17	2016	12,180	60,598	13,398	60,598	12,180	54,538	13,398	54,538
18	2017	11,073	55,089	12,180	55,089	11,073	49,580	12,180	49,580
19	2018	10,066	50,081	11,073	50,081	10,066	45,073	11,073	45,073
20	2019	75,222	45,528	82,744	45,528	75,222	40,976	82,744	40,976
21	2020	8,319	41,389	9,151	41,389	8,319	37,250	9,151	37,250
22	2021	7,563	37,627	8,319	37,627	7,563	33,864	8,319	33,864
23	2022	6,875	34,206	7,563	34,206	6,875	30,786	7,563	30,786
24	2023	6,250	31,096	6,875	31,096	6,250	27,987	6,875	27,987
25	2024	5,682	28,270	6,250	28,270	5,682	25,443	6,250	25,443
26	2025	5,166	25,700	5,682	25,700	5,166	23,130	5,682	23,130
27	2026	4,696	23,363	5,166	23,363	4,696	21,027	5,166	21,027
28	2027	4,269	21,239	4,696	21,239	4,269	19,115	4,696	19,115
29	2028	3,881	19,308	4,269	19,308	3,881	17,378	4,269	17,378
30	2029	3,528	17,553	3,881	17,553	3,528	15,798	3,881	15,798
	Total	1,414,361	1,946,442	1,555,797	1,946,442	1,414,361	1,751,798	1,555,797	1,751,798

Table IV-4 Financial Internal Rate of Return of Priority Project

(Under the revised water tariff for OM cost recovery)

FIRR = 4.6% (Unit : $)

Year	Cost				Revenue			Balance
	Invest-ment	OM	Replace-ment	Total	Domestic	Industrial & instiuturional	Total	
2000	10,418	44,113	0	54,531	0	0	0	-54,531
2001	232,134	48,710	0	280,844	536	977	1,513	-279,331
2002	293,869	52,245	0	346,114	12,489	22,741	35,230	-310,884
2003	282,859	48,108	0	330,967	27,620	50,294	77,914	-253,053
2004	177,080	52,433	0	229,513	42,184	76,815	118,999	-110,514
2005	0	55,967	0	55,967	51,302	93,418	144,720	88,753
2006	0	55,967	0	55,967	51,302	93,418	144,720	88,753
2007	0	55,967	0	55,967	51,302	93,418	144,720	88,753
2008	0	55,967	0	55,967	51,302	93,418	144,720	88,753
2009	0	55,967	0	55,967	51,302	93,418	144,720	88,753
2010	0	55,967	0	55,967	51,302	93,418	144,720	88,753
2011	0	55,967	0	55,967	51,302	93,418	144,720	88,753
2012	0	55,967	0	55,967	51,302	93,418	144,720	88,753
2013	0	55,967	0	55,967	51,302	93,418	144,720	88,753
2014	0	55,967	0	55,967	51,302	93,418	144,720	88,753
2015	0	55,967	0	55,967	51,302	93,418	144,720	88,753
2016	0	55,967	0	55,967	51,302	93,418	144,720	88,753
2017	0	55,967	0	55,967	51,302	93,418	144,720	88,753
2018	0	55,967	0	55,967	51,302	93,418	144,720	88,753
2019	0	55,967	404,081	460,048	51,302	93,418	144,720	-315,328
2020	0	55,967	0	55,967	51,302	93,418	144,720	88,753
2021	0	55,967	0	55,967	51,302	93,418	144,720	88,753
2022	0	55,967	0	55,967	51,302	93,418	144,720	88,753
2023	0	55,967	0	55,967	51,302	93,418	144,720	88,753
2024	0	55,967	0	55,967	51,302	93,418	144,720	88,753
2025	0	55,967	0	55,967	51,302	93,418	144,720	88,753
2026	0	55,967	0	55,967	51,302	93,418	144,720	88,753
2027	0	55,967	0	55,967	51,302	93,418	144,720	88,753
2028	0	55,967	0	55,967	51,302	93,418	144,720	88,753
2029	0	55,967	0	55,967	51,302	93,418	144,720	88,753
Total	996,360	1,644,784	404,081	3,045,225	1,365,381	2,486,273	3,851,654	806,429

Table IV-5 Noise and Vibration Level from Drilling Machine at Well A1

Noise Level

Distance from drilling machine	Noise Level (dB(A))			
	1	2	3	mean
1 m (measured)	92	92	92	92.0
5 m (measured)	94	93	93	93.3
10 m (measured)	88	88	88	88.0
20 m (measured)	79	79	78	78.7
50 m (measured)	78	78	79	78.3
100 m (calculated)	65	67	68	66.7
200 m (calculated)	52	60	54	55.3

Vibration Level

Position of measurement	Vibration Level (dB)			
	1	2	3	mean
In the cab of a vehicle	113	112	110	111.7
In the cab of a drill	78	84	83	81.7
at a distance of 1 m from the drill	56	47	43	48.7
at a distance of 5 m from the drill	13	12	12	12.3

Table IV-6 Insects Found in the Project Sites

No	Scientific Name	Recorded Sites
	Orthoptera	
	Acrididae	
1	*Bryodema gebleri mongolicum*	A2, A3, A3', B2, B3, B4, B5, B
	Tettigonidae	
2	*Daracanthina onas*	B2, B3, B4, B5
	Mallophaga	
3	*Linognatus ovis*	
	Coleoptera	
	Carabidae	
4	*Amara fodinoe*	A2, A3, A3', B2, B3, B4, B6
5	*Harpalus ampilicollis*	A2, A3, A3', B2, B3, B4, B6
6	*Harpalus cervus*	A2, A3, A3', B2, B3, B4, B6
7	*Ophonus calecaltus*	A2, A3, A3', B2, B3, B4, B6
	Solphidae	
8	*Nicrophorasarg utor*	A3, A3', B5, B6
9	*Nicrophorasarg germanicus m*	A3, A3', B2, B3, B4
10	*Nicrophorasargsepultor*	A3, A3', B2, B3, B4
	Scarabaeidae	
11	*Gymnopleurus mopsus*	A1, B1
12	*Scarabeus sacer*	A3, A3'
13	*Polyphylla alba*	A3, A3', B2, B3, B4
14	*Brahmina agnella*	A3, A3', B2, B3, B4
15	*Chioneosota reitteri*	A3, A3', B5, B6
16	*Pentodon patruelis*	A3, A3', B4, B5, B6
17	*Potosia hungarica sibirica*	A3, A3', B2, B3, B4
	Dermestidae	
18	*Dermestes dimidiatus*	All wells
19	*Dermestes sibiricus*	All wells
	Eloteridae	
20	*Selatosomus latus*	A3, A3', B5, B6
21	*Agriotes meticulosus*	A3, A3', B5, B6
	Buptestidae	
22	*Sphenoptera potanini*	A3, A3', B2, B3, B4, B5, B6
	Coccinellidae	
23	*Coccinella transversogutta*	A1, B1
24	*Coccinella septempunctata*	A3, A3', B5, B6
25	*Adonia variegata*	A3, A3', B2, B3, B4
26	*Bulaea licahatshovi*	A1, A3, A3', B1
	Tenebrionidae	
27	*Epitrichia mongolica*	All wells
28	*Anatolica politaborealis*	All wells
29	*Anatolica potanini*	All wells
30	*Blaps fermoralis medusula*	All wells
31	*Blaps rugosa*	All wells
32	*Platyscelis rugofronis*	A3, A3'
33	*Crypticus quisquilus*	A3, A3'
	Meloidae	
34	*Epicauta megcephala*	A2, A3, A3', B2, B3, B4
35	*Meloe brevicollis*	A2, A3, A3', B2, B3, B4, B5
	Cerambycidae	
36	*Eodorcadion humerale*	A3, A3', B5, B6
	Chrysomelidae	
37	*Chaetocrema hortensis*	A1, B1
	Curculionidae	
38	*Conorrhynchus conitrostris*	All wells
39	*Stephanocleomus oxicisus*	All wells
	Lepodiptera	
	Nymphalidae	
40	*Vanessa uriteae*	A3, A3', B5, B6
	Hymenoptera	
	Formicidae	
41	*Tetramorium caespitum*	
42	*Cataglyphis aeneseens*	
	Aphaniptera	
43	*Oropsylla silantiewi*	A1, A3, A3', B5, B6
44	*Oropsylla asiatica*	A1, A3, A3', B5, B6
45	*Amphalius runatus*	A1, A3, A3', B5, B6
46	*Ctenophyllus hirticrus*	A1, A3, A3', B5, B6
47	*neopsylla mana*	A1, A3, A3', B5, B6
	Diptera	
	Tabonidae	
48	*Tabonus subuletorum*	A3, A3', B2, B3, B5, B6
49	*Haematopoda turkestanica*	A3, A3', B2, B3, B5, B6
50	*Atylotus quadritarius*	B5, B6
51	*Hybomitra montana morgani*	B5, B6
	Muscidae	
52	*Musca domestica*	
	Sarcophagidae	
53	*Wohlfahrtia magnifica*	

Table IV-7 Reptiles Found in Project Sites

No	English Name	Scientific Name	Status	Recorded Sites
1	Toad headed Agama	*Phrynocephalus versicolor*	Rare	A3, A3', B5, B6
2	Pallas' Coluber	*Elaphe dione*	Rare	B5, B6
3	Haly's or Central Asian Viper	*Aqkistrodon halys*	Rare	A3, A3'

Table IV-8 Birds Found in Project Site (1/2)

No	English Name	Scientific Name	Status	Recorded Sites
1	Gray Heron	*Ardea cinerea*	tr, r	B5, B6
2	Graylag Goose	*Anser anser*	tr, r	B5, B6
3	Bar-headed Goose	*Eulabeia indica*	tr, r	B5, B6
4	Whooper Swan	*Cygnus cygunus*	tr, r	B5, B6
5	Ruddy Shelduck	*Tadorna ferruginea*	n, c	B5, B6
6	Mallard	*Anas platyrhynchos*	tr, r	B5, B6
7	Green-winged Teal	*Anas crecca*	tr, r	B5, B6
8	Gadwall	*Anas strepera*	tr, r	B5, B6
9	Northern Pintail	*Anas acuta*	tr, c	B5, B6
10	Garganey	*Anas querquedula*	tr, r	B5, B6
11	Northern Shoveler	*Anas clypaeta*	tr, r	B5, B6
12	Pochard (Northern)	*Aytha ferina*	tr, r	B5, B6
13	Tuft Pochard (Tufted Dack	*Aytha fuligula*	tr, r	B5, B6
14	Common Goldeneye	*Bucephala clangula*	tr, r	B5, B6
15	Black Kite	*Milvus migrans*	n, c	All wells
16	Marsh Harrier	*Circus aeruginosus*	tr, r	B5, B6
17	Upland Buzzard	*Buteo hemilasius*	n, r	A3, A4
18	Golden Eagle	*Aquila chrysaetos*	n, r	A2, A3, B2, B3
19	Cinereous Vulture	*Aegypius monachus*	n, r	B2
20	Saker Falcon	*Falco cherrug*	n, r	A1, B1, B3
21	Merlin	*Falco columbarius*	n, r	A3, A3'
22	Lesser Kestrel	*Falco cherrug*		A3, A3', B5, B6
23	Common Kestrel	*Falco naumanni*		A3, A3', B5, B6, B2, B3
24	Common Coot	*Fulica atra*	tr, r	B5, B6
25	Little Ringed Plover	*Charadrius dubius*	n, r	B5, B6
26	Kentish Plover	*Charadrius alexandrinus*	n, r	B5, B6
27	Great Sand Plover	*Charadrius leschenaulti*	n, c	B5, B6
28	Oriental Plover	*Charadrius veredes*	n, r	B5, B6
29	Northern Lapwing	*Vanellus vanellus*	n, r (tr, c)	B5, B6
30	Green Sandpiper	*Tringa ochropus*	tr, r	B5, B6
31	Wood Sandpiper	*Tringa glareola*	n, r	B5, B6
32	Marsh Sandpiper	*Tringa stagnatilis*	tr, r	B5, B6
33	Common Redshank	*Tringa totanus*	n, r	B5, B6
34	Common Sandpiper	*Actitis hypoleucos*	tr, r	B5, B6
35	Little Stint	*Calidris minuta*	tr, r	B5, B6
36	Temminck's Stint	*Calidris temminckii*	tr, r	B5, B6
37	Hill Pigeon	*Columba rupestris*	n, s, r	A1, B1, B2, B3, B4
38	Oriental Turtle-Dove	*Streptopelia orientalis*	tr, Rr	A1, B1
39	Northern Eagle-Owl	*Bubo bubo*	n, s, r	A3, A3'
40	Little Owl	*Athene noctua*	n, s, r	A3, A3', B5, B6
41	Northern Swift	*Apus apus*	n, r (tr, c)	A2, B2, B3, B4, B5, B6
42	Hoopoe	*Upupa epops*	n, r	A3, A3', B5, B6

n: nesting migratory, (n):possible for nesting, s:settled, tr: transit migratory, c: common, r: rare, R: very rare

Table IV-8 Birds Found in Project Site (2/2)

No	English Name	Scientific Name	Status	Recorded Sites
43	Asian Short-toed Lark	*Calandrella chileensis*	n, r	B2, B3, B4, B5, B6
44	Mongolian Lark	*Melanocorypha mongolic*	n, s, r	B2, B3, B4, B5, B6
45	Horned Lark	*Eremophila alpestris*	n, s, c	All wells
46	Northern Skylark	*Alauda arvensis*	n, r	B2, B3, B4, B5, B6
47	Sand Martin	*Riparia riparia*	n, Rr	B5, B6
48	Barn Swallow	*Hirundo rustica*	n, r	A1, B1, B5, B6
49	Northern House Martin	*Delichon urbica*	n, r	B5, B6
50	Tawny Pipit	*Anthus campestris*	n, r	B2, B3, B4, B5, B6
51	Richard's Pipit	*Anthus richardii*	n, r	B5, B6
52	White Wagtail	*Motacilla alba*	n, c	A3, A3', B5, B6
53	Yellow Wagtail	*Motacilla flava*	tr, r	A1, A3', B1, B5, B6
54	Citrine Wagtail	*Motacilla citreola*	tr, r	B3, B5, B6
55	Brown Shrike	*Lanius cristatus*	tr, r	A1, B1
56	Isabelline Shrike	*Lanius isabellinus*	n, r	A1, B1
57	Stonechat (Stone Bushchat	*Saxicola torquata*	tr, r	A1, B1
58	Northern Wheatear	*Oenanthe oenanthe*	n, c	All wells
59	Pied Wheatear	*Oenanthe pleschanka*	n, r	A3, A3'
60	Desert Wheatear	*Oenanthe deserti*	(n), r	A3, A3'
61	Isabellinus Wheatear	*Oenanthe isabellina*	n, r	A3, A3'
62	Eurasian Redstart	*Phoenicurus phoenicurus*	tr, r	A1, A3, A3', B1
63	Black Redstart	*Phoenicurus ochruros*	n, r	A1, A3, A3', B1
64	Eversmann's Redstart	*Phoenicurus erythronotus*	n, r	A1, A3, A3', B1
65	Greater Whitethroat	*Sylvia communis*	n, r	A1, B1
66	Lesser Whitethroat	*Sylvia curruca*	n, r	A1, B1
67	Arctic Warbler	*Phylloscopus borealis*	tr, r	A1, B1
68	Greenish Warbler	*Phylloscopus trochiloides*	tr, r	A1, B1
69	Yellow-browed Warbler	*Phylloscopus inornatus*	tr, r	A1, B1
70	Dusky Leaf Warbler	*Phylloscopus fuscatus*	tr, r	A1, B1
71	Red-breasted Flycatcher	*Ficedula parva*	tr, r	A1, B1
72	Black-billed Magpie	*Pica pica*	n, s, c	B2, B3, B4, B5, B6
73	Red-billed Chough	*Pyrrhocorax pyrrhocorax*	n, s, c	A3, A3', B5, B6
74	Eurasian Rook	*Corbus frugilegus*	n, r	A1, B1
75	Eurasian Crow	*Corvus corone*	n, r	A1, A2, B1
76	Northern Raven	*Corvus corax*	n, s, r	All wells
77	House Sparrow	*Passer domesticus*	n, s, c	A1, B1
78	Tree Sparrow	*Passer montanus*	n, s, c	All wells
79	Rock Petronia	*Petronia petronia*	n, s, c	A3, A3'
80	Twite	*Acanthis flavirostris*	n, c	A3, A3'
81	Mongolian Trumpeter Fin	*Bucanetes mongolica*	(n), c	A3, A3'
82	Little Bunting	*Emberiza pusilla*	tr, r	B5, B6
83	Yellow-breasted Bunting	*Emveriza aureola*	tr, r	A1, B1

n: nesting migratory, (n):possible for nesting, s:settled, tr: transit migratory, c: common, r: rare, R: very rare

Table IV-9 Mammals Found in the Project Sites

No	English Name	Scientific Name	Status	Recorded Sites
1	Daurian Hedgehog	*Erenaceus auritus*	Rare	A3, A3', B5, B6
2	Daubenton's Water Bat	*Myotus daubentoni*	Rare	A1, A3, A3', B1
3	Whiskered Bat	*Myotus mystacinus*	Rare	A1, B1
4	Pallas' Pika	*Ochotona pallasi*	Rare	A3, A3'
5	Daurian Pika	*Ochotona daurica*	Rare	A1, B1
6	Tolai Hare	*Lepus tolai*	Numerous	A3, A3', B2, B3, B4, B5, B6
7	Siberian Marmot	*Marmota sibirica*	Rare	A3, A3'
8	Northern Mole-vole	*Ellobius talpinus*	Numerous	A3, A3', B5, B6
9	Brandt's Vole	*Lasiopodomys brandti*	Numerous	A2, A3, B3, B4, B6
10	Royle's Mountain Vole	*Alticola argentatus*	Numerous	B2, B5, B6
11	Siberian Jerboa	*Allactaga sibirica*	Numerous	B2, B3, B4, B5, B6
12	Gobi Jerboa	*Allactaga bullata*	Rare	A3, A3'
13	Red Fox	*Vulpes vulpes*	Rare	A3, A3'
14	Corsac Fox	*Vulpes corsac*	Rare	A3, A3', B2, B3, B4
15	Manul	*Felis manul*	Rare	A3, A3', B5, B6
16	Beech	*Martes foina*	Numerous	A3, A3'
17	Least Veasel	*Mustela nivalis*	Rare	B5, B6
18	Siberian Polecat	*Mustela evermanni*	Numerous	A3, A3', B4, B5, B6

Table IV-10 Rare Birds and Mammals in the Project Site

No	English Name	Scientific Name	Mongolian Law on Hunting		Red book of Mongolia	Red book of BBNHOH		Washington Convention (CITES)		Recorded Site
			very rare	rare		rare	uncertain	I	II	
1	Bar-headed Goose	*Eulabeia indica*		+	+					B5, B6
2	Whooper Swan	*Cygnus cygnus*			+					B5, B6
3	Black Kite	*Milvus migran*							+	all sites
4	Upland Buzzard	*Buteo hemilasius*							+	A3, A3', B2, B3, B4, B5
5	Golden Eagle	*Aquila chrysaetos*							+	A3, A3', B2, B3
6	Saker Falcon	*Falco cherrug*							+	A1, B1, B2, B3, B4
7	Merlin	*Falco columbarius*							+	A3, A3'
8	Lesser Kestrel	*Falco naumanni*				+			+	A3, A3', B5, B6
9	Common Kestrel	*Falco tinnunculus*							+	A3, A3', B2, B3, B5, B6
10	Northern Eagle-owl	*Bubo bubo*							+	A3, A3'
11	Little Owl	*Athene noctua*							+	A3, A3', B5, B6
12	Daurian Hedgehog	*Erenaceus auritus*			+					A3, A3', B5, B6
13	Manul	*Felis manul*					+		+	A3, A3', B2
14	Corsac Fox	*Vulpes corsac*					+			A3, A3', B2, B4, B5, B6
15	Beech	*Martes foina*		+						A3, A3'

Table IV-11 Plant Found in the Project Site

No	English Name	Scientific Name	Status	Recorded Sites
1	Covely achnatherum	*Achnaterumsplendens*		A1, A2, A3, A3', B1, B2, B5
2	Creasteel Weatgrass	*Agropyron cristatum*		A1, A3, B2, B4, B5, B6
3	Weatgrass	*Agropyron repens*		A2, A3, B5, B6
4	Mongolian Onion	*Allium mongolicum*		A2, A3, B2, B4, B5, B6
5	Many Root Onion	*Allium pollirrhizum*		A2, B2, B5, B6
6	Della Wormwood	*Artemisia anatifolia*		A1, A2, B1, B2, B3, B4, B5, B6
7	Sweet Wormwood	*Artemisia annua*		A1, B1, B2, B4
8	Largehead Wormwood	*Artemisia macrocephala*		A1, B1, B2, B4, B5, B6
9	Thinlobed Wormwood	*Artemisia santolinifolia*		A2, A3', B5, B6
10	Sieuers Wormwood	*Artemisia sievarsiena*		A2, A3', B2, B4
11	Wormwood	*Artemisia xantochroa*	very rare	A3, A3', B1
12	Erect Milkvetch	*Astragalus adsurgens*		A3, A3', B1
13	Milkvetch	*Astragalus galactites*		A1, A3, A3'
14	Siberian Saltbush	*Atriplex sibirica*		A1, A2, B2, B4
15	Smooth Bromegrass	*Bromus innermis*		A2, A3, B2, B4
16	Whitebark Peashrub	*Caragana leucophyla*		A3, A3'
17	Sedge	*Carex duriuscula*		A3, A3', B5, B6
18	Sedge	*Carex enervis*		A3, A3', B5, B6
19	Sedge	*Carex stenophylloides*		A3, A3', B5, B6
20	Aristate Goosefoot	*Chenopodium aristatum*		A1, B2, B4
21	Oakleaf Goosefoot	*Chenopodium glancum*		A1, A2, B2, B4
22	Prostate Goosefoot	*Chenopodium prostratum*		A1, A2, B2, B4
23	Awnless Cleistogenes	*Cleistogenes songorica*		A2, B1, B5, B6
24	Gmelin Globethiste	*Echinops gmelinii*		A1, A3, A3'
25	Mongolian Ephedra	*Ephedra equisetina*	very rare	B2
26	Chinese Ephedra	*Ephedra sinica*		B2
27	Len Fescus	*Festuca lenensis*		A1, A2, B4, B5, B6
28	Altai Heteropappus	*Heteropappus altaica*		A1, A2, B2, B4, B6
29	Link Shortsubulate Barley	*Hordeum brevisubulatum*		B2, B4
30	White Flower Tris	*Iris lacteae*		B2, B4
31	Savin Juniper	*Juncus salsuginosus*		B5, B6
32	Rush	*Juniperus sabina*	very rare	A1
33	Spinyleaf Crazyweed	*Oxytropis aciphylla*		A3, A3'
34	Filiformis Crazyweed	*Oxytropis filiformis*		A3, A3'
35	Racemose Bluegrass	*Poa loatryoides*		A2, A3, A3', B2
36	Depressed Plantian	*Plantago depressa*		A2, A3, B4, B5, B6
37	Laureleaf Poplar	*Populus laurifolia*		B1
38	Selverweed Linquifoli	*Potentilla anserina*		A3, A3', B5, B6
39	Bilfurcate Linquifoli	*Potentilla biffurca*		A3, A3', B5, B6
40	Trantu Willow	*Salix ledebouriana*		B1
41	Pearl Russian thistle	*Salsola passerina*		B2, B4
42	Common Russian thistle	*Salsola collina*		A1, A2, A3, A3', B4
43	Meadow Saussurea	*Sausurea amara*		A1, A2, A3, A3', B4
44	Saline Saussurea	*Sausurea salsa*		A1, A2, A3, A3', B4
45	Green Bristegrass	*Setaria viridis*		A1, B2, B4
46	Sandy Needlegrass	Stipa glareosa		A1, A2, A3, A3', B4
47	Gobian Needlegrass	Stipa gobica		B1, B2, B4
48	Krylov Needlegrass	Stipa krylovii		A3, B2, B4
49	Mazz Dandelian	Taraxacum dealbotum		A3, A3', A4
50	Shore poggrass	Triglochin maritium		B5, B6
51	Nempleaf Nettle	Urtica cannabina		A3, A3', B1
52	Vetch	Vicia costata		B5, B6

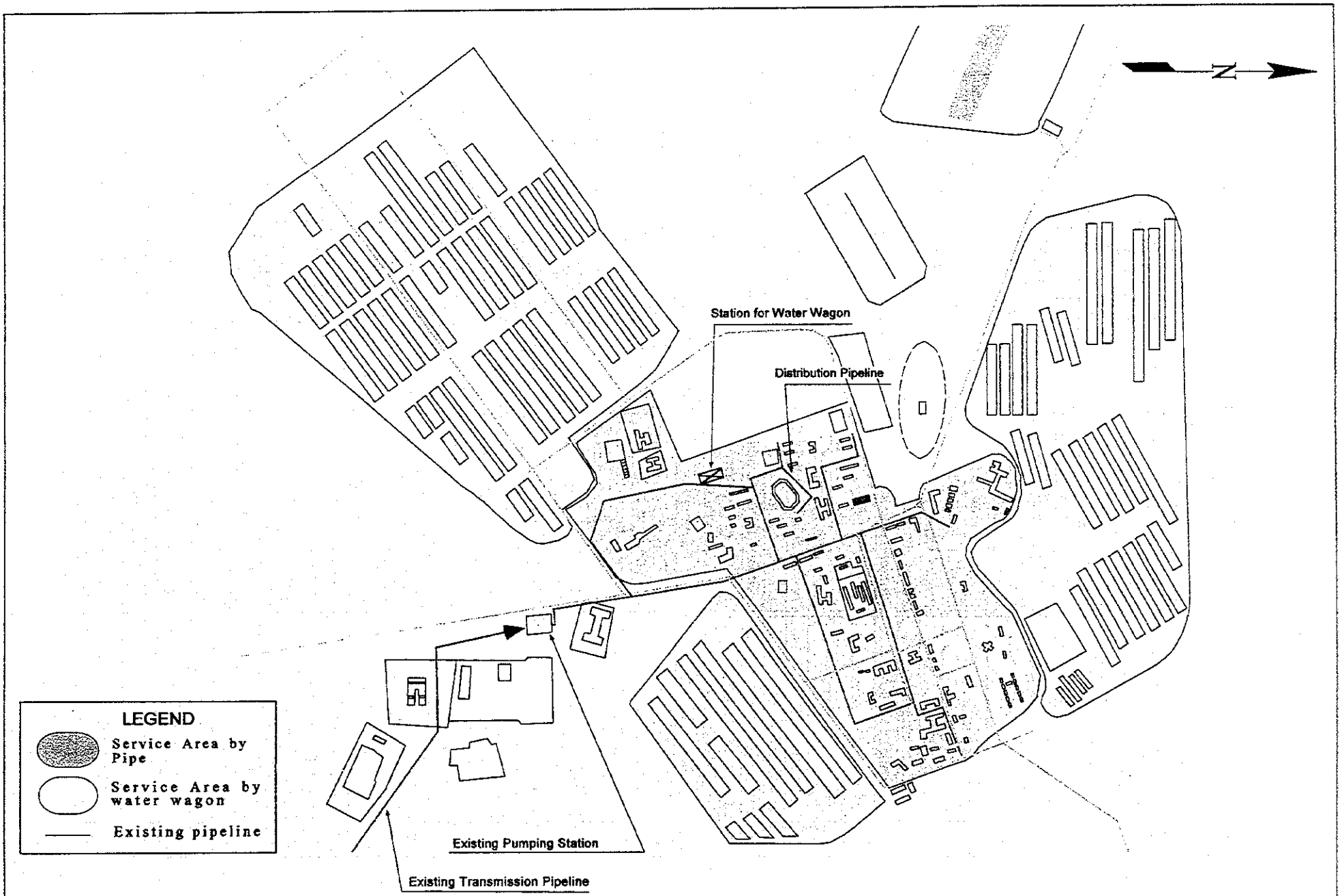

Figure IV-1 Existing Pipeline and Service Area

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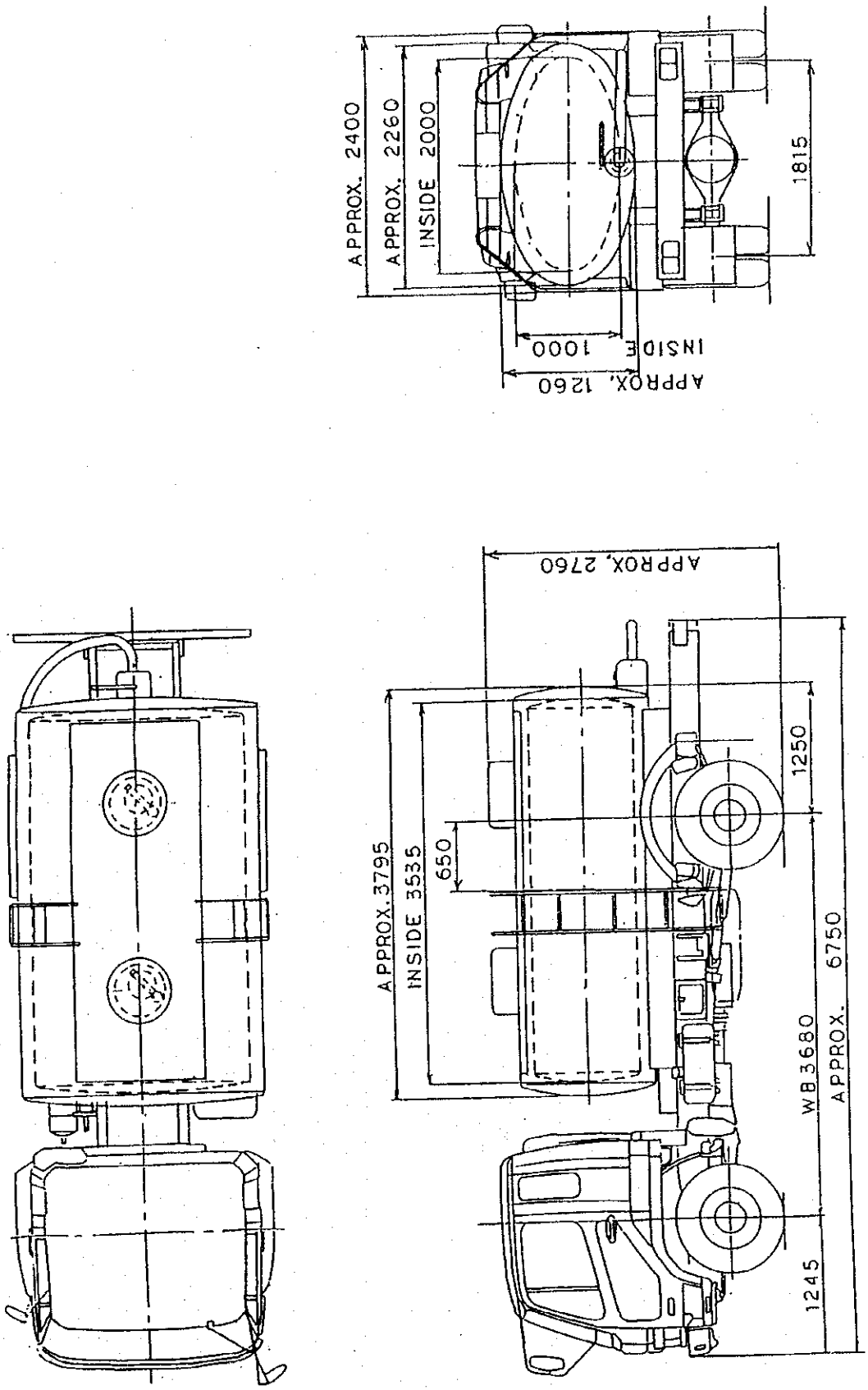

Figure IV-2 Proposed Specification of Water Wagon

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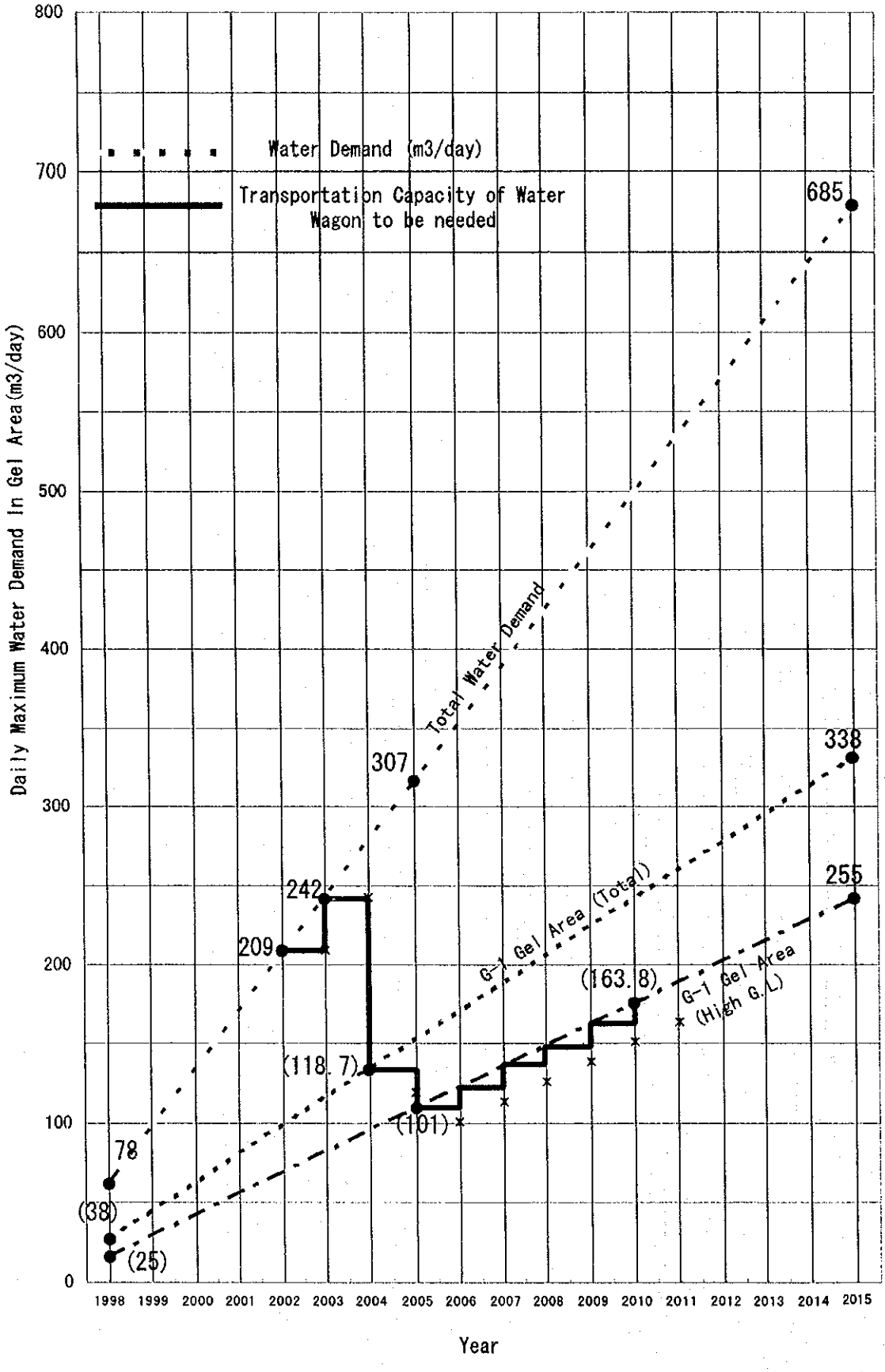

Figure IV-3 Transportation Capacity of Water Wagons to be needed

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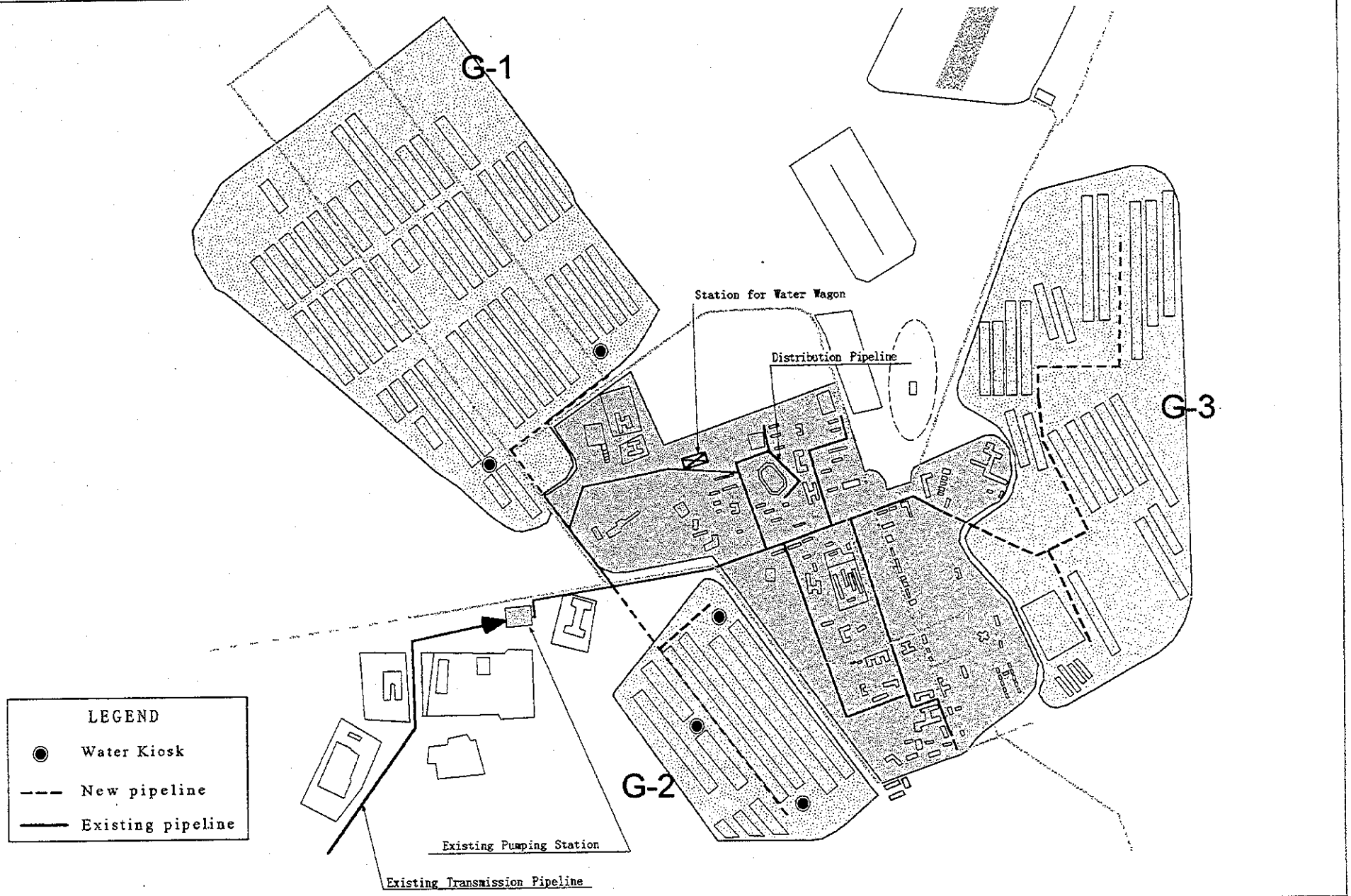

Figure IV-4 Proposed Water Distribution Network in future (by 2005)

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