7 ECOLOGY AND ENVIRONMENT

7.1 MONGOLIA

(1) Outline

No countries can be compared with Mongolia on the size, diversity, and the health of its natural ecosystems in the temperate zones of the Northern Hemisphere. Mongolia is located at the northern edge of Central Asian deserts and the southern edge of vast Siberian taiga. Its wide range of transitional ecosystems is reflected in the diversity of wild species. But these ecosystems are recently affected by some environmental factors, such as overgrazing and deforestation.
Mongolian Ministry of Nature and Environment revised the "Protected Area of Mongolia" in 1998 as shown in Figure 7.1.

(2) Fauna

Mongolia's fauna represents a mixture of species from the northern taiga of Siberia, the steppe, and the deserts of Central Asia. Fauna includes 136 species of mammals, 436 birds, 8 amphibians, 22 reptiles, 75 fish, and numerous invertebrates.

(3) Flora

Representative species of Siberia's coniferous taiga forest, Central Asia's steppe and desert, and the Altai and Sayan mountains all occur in Mongolia. More than 3000 species of vascular plants, 927 lichens, 437 mosses, 875 fungi, and numerous algae have been recorded. Mongolia's flora includes almost 150 endemic plants and nearly 100 relict species.

(4) Land Degradation

Much of Mongolia is pasture land. Grazing pressure is greatest near settlements and as a consequence these areas are most degraded. By all accounts the traditional methods of livestock management maintained most of Mongolia's pasture lands in relative good condition. In the last few years, however, there has been substantial increase in the number of herders. The effect of bringing many herders who are not familiar with the

traditional grazing systems induces the land degradation.

Hydrologically, degrading grasslands lead to increased nutrient and sediment runoff from the bared soils. Without grass and organic materials the snow and moisture retention character of the soil degrades and seed germination and plant growth become more difficult each succeeding year.

7.2 GOBI-ALTAI PROVINCE

Gobi-Altai province has a variety of ecosystems, has five of six natural zones of Mongolia, such as high mountain, mountain forest steppe, steppe, desert steppe and desert, but doesn't have taiga forest zone.

- High mountain zone: climate in the high mountain zone is extreme, with high winds, extreme cold, and a short growing season. Relatively few species are adapted to these harsh conditions. Located above tree line, the zone is characterized by tundra, alpine-sedge meadows, highland swamps, and lichen-covered boulder fields (Khan Tayshirn mountains).
- Mountain forest steppe zone: mixed coniferous forest is found on cooler, moister northern slopes, while steppe vegetation predominant on other slopes (around Khan Tayshirn and Altai mountains).
- Steppe zone: the steppe zone provides many of the nation's most important grazing lands for domestic live-stock. The steppe is vulnerable to impacts from overgrazing, agriculture, roads and other human activities (North part of Khan Tayshirn mountains and areas between Khan Tayshirn mountains and Altai mountains).
- Desert steppe zone: the zone includes many low grasses and semi-shrub areas with salt pans, and small ponds. The climate is arid with frequent droughts and annual precipitation of 100-125 mm, and frequent strong winds and dust storms strongly influence the areas vegetation (the most part of northern Gobi-Altai province).
- Desert zone: Vegetation is sparse here. Climate is extreme. Precipitation may fall only once every two to three years, and averages less than 100 mm annually. Temperatures climb as high as 40℃ in summer, and fall as low as -40℃ in winter the most part of southern Gobi-Altai province).

The Study area is situated in the desert steppe zone.

7.3 ALTAI CITY

(1) Fauna

The development of Altai City has reduced the distribution of the large mammals near the city however some animals are still observed in the survey area. The dominant wild animals in the study area are shown in Figure 7.2. Common mammal species are Brandt's Vole, Tolai Hare, Siberian Marmot, Red Fox and Corsac Fox, and common bird species are Northern Wheatear, Arctic Warblar, Tree sparrow, White Wagtail, Horned Lark, Northern Raven and Rock Pigeon. Around Khadaasan river a variety of birds of prey were seen. In wet season (spring and summer), some waterfowls visit temporary wet lands. Common insects are arid steppe locusts and grasshoppers.

(2) Flora

A great part of land near the Altai City is used as pasture land. Overgrazing near the city and the present chaotic sprawl of roads have caused damage to the soil and vegetation.

The vegetation cover near Altai City can be divided into two types as follows:

Arid desert vegetation

- On the hilly and elevated terrain with small mounds and knolls stretching south-eastward from the north-west of Altai with clayey brown soils are abundant hillock plants with segmented stems, Shiveet Needlegrass, Motley Grass, and wild Leek.
- On the elevated places with pebbly soils grow small hillock plants with segmented stems.
- On the lowlands and valleys are recorded Feather Grass communities.
- The average plant height is 10 to 15 cm, approximately 10-12 species are to be observed at an area of 100 m^2, and the vegetation coverage makes up15-20%.

Desert steppe vegetation

- One of the characteristics of this type of vegetation is "arid clusters" where segmented small plants are dominating.
- In the brown soils of lower and middle mountain slopes, knolls, inter-mountain hillocks and elevations around Altai City, some of the most widespread are typical plant species of the Mongolian desert steppe.
- Near Altai City, Gobian Needlegrass and Sandy Needleglass, Racemose Bluegrass, Pearl Russian Thistle, Common Russian Thistle, root onion species and Della Wormwood species are found.
- The vegetation coverage is 10-15%, and 5-10 species of plants are to be recorded per 100 m^2.

7.4 ENVIRONMENTAL LAWS AND REGULATIONS

7.4.1 Mongolian Environment Law

Mongolia has the following environmental laws.

(1) Mongolian Law on Land (date effective: April/1/1995)

Purpose of this law is to regulate the possession, use, and other related issues of land owned by citizens, economic entities, and organizations.

(2) Mongolian Law on Special Protected Areas (date effective: June/5/1995)

Purposed of this law is to regulate the procurement of land for state special protected area which has the following characteristics:

Natural zones
Unique geological formations
Rare and endangered plants and animals
Historic and cultural monuments
Natural beauty

Protected area is classified as follows:

A. Strictly Protected Area

B. National Conservation Parks
C. Nature Reserves
D. Monuments

Present protected areas are shown in Table 7.1 and figure 7.1.

(3) Mongolian Law on Environmental Protection (date effective: June/5/1995)
Purpose of this law are shown below.
To guarantee:

- the human right to live in a healthy and safe environment;
- an ecologically balanced social and economic development;
- the protection of the environment for present and future generations; and
- the proper use of natural resources, and the restoration of available resources.

This law is applied to interrelations between the States, citizens, economic entities and organizations.

(4) Mongolian Law on Air (date effective: June/5/1995)

Purpose of this law is to regulate the protection and proper use of the atmosphere in relation to the human rights to live in a healthy and safe environment, and to the provision of environmental balance.

(5) Mongolian Law on Hunting (MLH) (date effective: June/5/1995)

Purpose of this law is to regulate the protection and proper use of mammals, birds, and fish for hunting. MLH lists "Very Rare" animals as shown in Table 7.2. The MLH prohibits the hunting, trapping, and sale of any parts of these animals except for "scientific research " as authorized by the Ministry of Nature and the Environment (MNE). Government Resolution 152 Annex 1 lists "Rare" animals as shown in Table 7.3. Hunting of these animals in the country requires permission by MNE with fees established by the Hunting Law.

(6) Mongolian Law on Water (date effective: June/5/1995)
Purpose of this law is to regulate the protection, proper use, and restoration of water.

(7) Mongolian Law on Forests (date effective: June/5/1995)
Purpose of this law is to regulate the protection, proper use and restoration of forests.

(8) Mongolian Law on Natural Plants (MLNP) (date effective: June/5/1995)

Purpose of this law is to regulate the protection, proper use, and restoration of natural plants except forest and cultivated plants.

* This law defines "Very Rare" plants as "no natural restorative capacity, a very restricted distribution, no usable reserves, and are in danger of extinction". "Very Rare" plants listed in MLNP are shown in Table 7.4.

* "Rare" plants are defined as limited natural restorative capacity, a restricted distribution and reserves, and are potentially in danger of extinction. Governmental Resolution 153 lists "Rare" plants as shown in Table 7.5.

(9) Mongolian Law on Protection from Toxic Chemicals (date effective: June/5/1995)

Purpose of this law is to regulate the production, export, import, storage, trade, transport, use, and disposal of toxic chemicals.

(10) Mongolian Law on Hunting Reserve Use Payments, and on Hunting and Trapping

Authorization Fees (date effective: July/1/1995)
Purpose of this law is to regulate the fee requirements for hunting and trapping of mammals, birds, and fish by citizens, economic entities, and organizations. The authorized fees are carried over to the state budget.

(11) Mongolian Law on Water and Mineral Water Use Fees (date effective: July/1/1995)

Purpose of this law is to regulate the fee requirements for the use of water and mineral water by citizens, economic entities, and organizations. These fees are carried over to the state budget.

(12) Mongolia Law on Fees for Harvest of Forest Timber and Fuel Wood (date effective: July/1/1995)

Purpose of this law is to regulate the fee requirements for harvest of forest timber and fuel-wood by citizens, economic entities and organizations. These fees are carried over to the state budget.

(13) Mongolian Law on Natural Plant Use Fees (date effective: July/1/1995)

Purpose of this law is to regulate the fee requirements for the use of natural plants by citizens, economic entities and organizations. These fees are carried over to the state budget.

(14) Mongolian Law on Underground Resources (date effective: May/5/1996)
Purpose of this law is to regulate interrelations related to protection and proper use of underground resources for the benefits of present and future generations.

(15) Mongolian Law on Mineral Resources (date effective: September/30/1994)

Purpose of this law is the regulation of the exploration and exploitation, and protection of mining area.

(16) Mongolian Law on Protection from Forest and Steppe Fire (date effective: May/5/1996)

Purpose of this law is to prevent, combat, extinguish a fire and eliminate damage from fire.

(17) Mongolian Law on Environmental Impact Assessment (date effective: February/20/1998)

Purpose of this law is the environmental protection, prevention from ecological imbalance, management of natural resource use, environmental impact assessment of the projects and coordination of any interrelation connected to the regulation on project implementation.

(18) Mongolian Law on Hydrometeorology (date effective: November/13/1997)

Purpose of this law is to regulate the network of information of meteorological, hydrological and environmental monitoring.

(19) Land fees Law of Mongolia (date effective: July/1/1997)

Purpose of this law is to regulate the relations concerning land fee payment for state land that is possessed and used by citizens, economic entities and organizations. These fees are carried over to the state budget.

(20) Mongolian Law on Buffer zone of Strictly Protected Areas (date effective: October/23/1997)

Purpose of this law is the regulation of setting up of buffer zone on the Strictly Protected Areas and regulating activities on Buffer zone.

7.4.2 International Conventions and Treaties Related to Environment

Mongolia participates in the following conventions.

(1) Convention on International Trade in Endangered Species of Wild Fauna and Flora (acceded in January/5/1995). This prohibits the trade of animals in Mongolia listed in Table 7.6.
(2) Montreal Protocol on Substances that Deplete the Ozone Layer (ratified in March/7/1996).
(3) Vienna Convention for the Protection of The Ozone Layer (ratified in March/7/1996).
(4) Convention on Biological Diversity (acceded in September/30/1993).
(5) United Nations Convention to Combat Desertification in Those Countries Experiencing Serious Drought and/or Desertification, Particularly in Africa (signed in 1994, ratified in September/3/1996).
(6) UN Framework Convention on Climate Change (acceded in September/30/1993)
(7) Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and Their Disposal (ratified in April/15/1997).
(8) Convention on Wetlands of International Importance Specially as Waterfowl

Habitat (acceded in April/8/1998).

(9) Convention on the Prohibition of the Development, Production, Stockpiling and the Use of Chemical Weapons and on their Destruction (ratified in January/7/1995, entry into force in April/29/1997).

7.4.3 Executing Agency

Ministry of Nature and Environment (MNE) has the responsibility for the investigation, monitoring, conservation, and protection of the natural and social environment. The structure of MNE is shown in Figure 7.3.

7.4.4 Mongolian Environmental Impact Assessment

The Environmental Impact Assessment (EIA) is described by the following laws;

(1) Mongolian Law on Environmental Impact Assessment (date effective: February/20/1998): the purpose of this law is the environmental protection, prevention of ecological imbalance, natural resource use management, environmental impact assessment of the projects and coordination of any interrelations connected to the regulation on project implementation.
(2) Annex of the Mongolian Law on Environmental Impact Assessment: the Criteria for application of projects to Environmental Impact Assessment.
(3) Annex of decree No. 66 of 1998 of the Minister for Nature and Environment: the Manual for the Project screening of the Environmental Impact Assessment.
(4) Annex 1 of decree No. 66 of 1998 of the Minister for Nature and Environment: the Manual for Project Description.
(5) Annex 2 of decree No. 66 of 1998 of the Minister for Nature and Environment: the Mitigation Measures taken for environmental impacts.

EIA procedure is shown in Figure 7.4. First, proponents of projects shall submit a project description to MNE and local government. Then, MNE and the local government conduct a screening and determine the required level of EIA study for the project out of the following.

- No further study of EIA is required

- Item-wise study is required
- Full scale study of EIA is required

If it is required, a licensed environment impact assessment company conducts the EIA study for a project under the supervision of the government. The results of EIA study are made open to the public. Government makes a decision whether to implement the project or not on the basis of the results.

7.4.5 Mongolian Red Book and Red List of World Conservation Union (IUCN)

Rare animal species are listed in so called " Red (Data) Book " by researchers from both private sectors or governmental organizations and every country has its own Red Data Book. Mongolian Red Book was first published in 1987 and later in 1997. Rare animal species (mammal, bird, reptile, amphibian and fish) and plant species listed in these books are shown in Table 7.7 and Table 7.8, respectively. Red list of IUCN reported some animal species as rare animals in Mongolia (in Table 7.9), but it doesn't report any plant species as rare or endangered.

Table 7.1 Special Protected Area of Mongolia

No	Name	Area (ha)	Year	Decision of Protectiong (Resolution number)
A. Strictly Protected Areas 10,494,283 ha/57.67%				
1	Great Govi A and B (Two sites)	5,311,730	1975	84 of Presidium Peoples Great Hurals
2	Khokh Serkh	65,920	1977	76 of Presidium Peoples Great Hurals
3	Bogd Khan Uul	41,651	1974	248 of Presidium Peoples Great Hurals
4	Khasagt Khairkhan	27,448	1965	17 of Presidium Peoples Great Hurals
5	Khan Khntii	1,227,074	1992	11 of State Small Hural
6	Nomrog	311,205	1992	11 of State Small Hural
7	Dornod Mongol	570,374	1992	11 of State Small Hural
8	Mongol Dagurian	103,016	1992	11 of State Small Hural
9	Otgon Tenger	95,510	1992	11 of State Small Hural
10	Uvs Nuur Basin	712,545	1993	83 of State Great Hural
11	Govi Baga A and B (Two sites)	1,839,176	1996	43 of State Great Hural
12	Khordol Saridag	188,634	1997	47 of State Great Hural
B. National Parks 5,813,130 ha/31.95%				
1	Khovsgol	838,070	1992	11 of State Small Hural
2	Khorgo-Terkh Tsagaan Nuur	77,267	1995	26 of State Great Hural
3	Gobi Gurvansaikhan	211,737	1993	83 of State Great Hural
4	Gorkhi-Terelj	293,168	1993	83 of State Great Hural
5	Altai Taban Bogd	636,161	1996	43 of State Great Hural
6	Khangain Nuruu	888,455	1996	43 of State Great Hural
7	Khar Us Nuur	850,272	1997	47 of State Great Hural
8	Noyon Khangai	58,000	1998	28 of State Great Hural
C. Nature Reserves 1,809,310 ha/9.94%				
1	Nagalkhaan Uul	3,076	1995	26 of State Great Hural
2	Batkhaan Uul	21,850	1995	26 of State Great Hural
3	Lkachinvandad Uul	58,800	1995	26 of State Great Hural
4	Bulgan Gol	7,657	1995	26 of State Great Hural
5	Khustain Nuruu	49,940	1993	83 of State Great Hural
6	Ugtam Uul	46,160	1993	83 of State Great Hural
7	Sharga-Mankhan	390,071	1993	83 of State Great Hural
8	Zagiin Us	273,606	1996	43 of State Great Hural
9	Alag Khairkhan	36,400	1996	43 of State Great Hural
10	Burkhan Buudai Uul	52,110	1996	43 of State Great Hural
11	Ergeliin Zoo	60,910	1996	43 of State Great Hural
12	Ikh Nart	43,740	1996	43 of State Great Hural
13	Khognokhaan Uul	46,990	1997	47 of State Great Hural
14	Toson-Khulstai	430,000	1998	28 of State Great Hural
15	Khar Yamaat	46,000	1998	28 of State Great Hural
16	Yakh Nuur	242,000	1998	28 of State Great Hural
D. Natural and Historical Monuments 79,305 ha/0.44%				
1	Bulgan Uul	1,840	1995	26 of State Great Hural
2	Uran togoo-Tulga Uul	5,800	1995	26 of State Great Hural
3	Eej Khaikhan Uul	22,475	1995	26 of State Great Hural
4	Lhuisiin Naiman Nuur	11,500	1992	11 of State Small Hural
5	Ganga Nuur	32,860	1993	83 of State Great Hural
6	Suihent Uul	4,830	1996	43 of State Great Hural

Table 7.2 Animals Listed as "Very Rare" in Mongolian Law on Hunting

Class	Scientific Name		English Name
Mammalia	*Equus*	*przewalskii*	Przewalskii Horse
	Camelus	*bactrianus ferus*	Wild Camel
	Ursus	*arctos*	Gobi Bear
	Alces	*alces cameloides*	Moose
	Rangifer	*tarandus valentinae*	Reindeer
	Moschus	*moschiferus*	Musk Deer
	Castor	*fiber*	Beaver
	Lutra	*lutra*	Eurasian Otter
	Uncia	*uncia*	Snow Leopard
	Cuon	*alpinus*	Asiatic Wild Dog
	Saiga	*tatarica*	Saiga Antelope
Aves	*Chlamydotis*	*undulata*	Houbara Bustard
	Cygunus	*cygunus*	Whooper Swan
	Phasianus	*colchicus*	Ring-necked Pheasant
	Grus	*vipio*	Whitenaped Crane
	Grus	*monacha*	Hooded Crane
	Grus	*leucogeranus*	Siberian Crane
Pisces	*Acipenser*	*schrenki*	Amur Sturgeon
	Acipenser	*baeri*	Siberian Sturgeon

Table 7.3 Animals Listed as "Rare" in Gov. Res. 152 Annex 1

Class	Scientific Name		English Name
Mammalia	*Ovis*	*ammon*	Argali
	Capra	*sibirica*	Siberian Ibex
	Equus	*hemionus*	Asiatic Wild Ass
	Gazella	*subgutturosa*	Goitered Gazelle
	Cervus	*elaphus*	Red Deer
	Alces	*alces pfizenmayeri*	Elk
	Sus	*scrofa*	Wild Boar
	Lynx	*lynx*	Eurasian Lynx
	Martes	*foina*	Beech Marten
	Felis	*lybica*	Europian Wild Cat
	Vormela	*peregusna*	Margled Polecat
	Citellus	*alashanicus*	Groundsquirrel
Aves	*Tetraogallus*	*altaicus*	Altai Snowcock
	Anser	*albifrons*	Pied Goose
	Anser	*indicus*	Barheaded Goose
	Anser	*cygnoides*	Swan Goose
	Cygnus	*olor*	Mute Swan
	Cygnus	*bewickii*	Bewick's Swan
	Anas	*formosa*	Baikal Teal
	Aythya	*baeri*	Bear's Pochard
	Aix	*galericulata*	Mandarin Duck
	Oxyura	*leucocephala*	White-headed Duck
	Botaurus	*stellaris*	Eurasian Bittern
	Egretta	*albus*	Great White Egret
	Platalea	*leucorodia*	Eurasian Spoonbill
	Ciconia	*boyciana*	Oriental White Stork
	Ciconia	*nigra*	Black Stork
	Otis	*tarda*	Great Bustard
	Limnodromus	*semipalmatus*	Asiatic Dowitcher
	Himantopus	*himantopus*	Black-winged Stilt
	Streptopelia	*turtur*	European Turtle Dove
	Falco	*vespertinus*	Red-footed Falcon
	Falco	*amurensis*	Amur Falcon
	Pelecanus	*crispus*	Dalmatian Pelican
Pisces	*Ctenopharyngodo*	*idella*	Grass Carp
	Hypophthalmicthy	*molitrix*	Silver Carp
	Tinca	*Tinca*	Tench

Table 7.4 Very Rare Plants Listed in the Mongolian Law on Natural Plants (1/3)

Family	English name	Scientific Name	
Compositae	Iljin's arnica	*Arnica*	*iljinii*
Liliaceae	Siberian zygadenus	*Zygadenus*	*sibiricus*
Geraniaceae	Fragrant Biebersteinia	*Biebersteinia*	*odora*
Rutaceae	Feather-seed dictammy	*Dictamnus*	*dasycarpus*
Liliaceae	Red tofildia	*Tofildia*	*coccinea*
Liliaceae	Single flowered tulip	*Tulipa*	*uniflora*
Liliaceae	Desert cintanche	*Cintanche*	*deserticolla*
Cupressaceae	Creeping juniper	*Juniperus*	*sabina*
Chenopodiaceae	Aphyllous anabasis	*Anabasis*	*aphylla*
Chenopodiaceae	Lanose anabasis	*Anabasis*	*eripoda*
Valerianaceae	Saikhan valerian	*Valeriana*	*saichanensis*
Compositae	Saussurea	*Saussurea*	*involucrata*
Scrophulariaceae	Tibetan lancea	*Lancea*	*tibetica*
Rosaceae	White flowered dasiphora	*Dasiphora*	*lactiflora*
Nymphaeaceae	White water-lily	*Nymphaea*	*candida*
Chenopodiaceae	Brittle budara	*Iljinia*	*regelii*
Leguminoseae	Mongolian chesney	*Chesneya*	*mongolica*
Caprifoliaceae	Mongolian arrow-wood	*Viburnum*	*mongolicum*
Caprifoliaceae	Sargent's white rod	*Viburnum*	*sargentii*
Plumbaginaceae	Golden limonium	*Limonium*	*aureum*
Boraginaceae	Yellow arnebia	*Arnebia*	*guttata*
Caprifoliaceae	Manjurian elder	*Sambucus*	*manshurica*
Leguminosae	Tseden's vetch	*Vicia*	*tsydenii*
Polygonoceae	Rhubarb	*Rheum*	*uninerve*
Araceae	Sedgerush	*Acorus*	*calamus*
Primulaceae	Longleafed androsace	*Androsace*	*longifolia*
Gentianaceae	Macrophyllous gentian	*Gentiana*	*macrophylla*
Gentianaceae	Swelt gentian	*Gentiana*	*pulmonaria*
Typhaceae	Smaller cat's tail	*Typha*	*minima*
Malvaceae	Mauritanian mallow	*Malva*	*mauritiana*
Ranunculaceae	Syanian trollflower	*Trollius*	*sajanense*
Elaeagnaceae	Moorcroft's eleagnus	*Elaeagnus*	*moorcroftii*
Pinaceae	Siberian fir	*Abies*	*sibirica*
Ranunculaceae	Glaucous leatherflower	*Clematis*	*glauca*
Liliaceae	Wide beadruby	*Maianthemum*	*dilatatum*
Cruciferae	Small-flowered bitter-cress	*Cardamine*	*parviflora*
Gentianaceae	Banzgrach's swertia	*Swertia*	*banzaragczii*
Ephedraceae	Horsetailed ephedra	*Ephedra*	*equistina*
Ephedraceae	Fedchencko ephedra	*Ephedra*	*fedtschenkoae*
Compositae	Dahurian solidago	*Solidago*	*dahurica*
Compositae	Central Asian asterthemny	*Asterothamnus*	*centrali-asiaticus*
Leguminosae	Yellow sophora	*Sophora*	*flavescens*
Crassulaceae	Plume stonecrop	*Sedum*	*pallescens*
Compositae	Sand strawflower	*Helichrysum*	*arenarium*
Leguminosae	Mongolian ammopipthanthy	*Ammopiptanthus*	*mongolicus*
Liliaceae	Solomon's Seal	*Polygonatum*	*humile*
Labiatae	Desert sage	*Salvia*	*deserta*
Crassuraceae	Rose rhodiola	*Rhodiola*	*rosea*
Scheuchzeriaceae	Paludal Scheuchzeria	*Scheuchzeria*	*palustris*
Violaceae	Brachycerous Violet	*Viola*	*brachychera*
Orchidaceae	Two-leafed greater butterfly	*Plantanthera*	*bifolia*

Table 7.4 Very Rare Platnts Listed in the Mongolian Law on Natural Plants (2/3)

Family	English name	Scientific Name	
Liliaceae		*Anemarrhena*	*asphodeloides*
Caryophyllaceae	Przewalskii's Gymnocarpos	*Gymnocarpos*	*przewalskii*
Ericaceae	Bilberry	*Vaccinium*	*myrtillus*
Aspidiaceae	Wide dryopteria	*Dryopteris*	*dilatata*
Orchidaceae	Aphyllous epipogium	*Epipogium*	*aphyllum*
Leguminosae	Acicular oxytrope	*Oxytropis*	*acanthacea*
Leguminosae	Fragile-leaved oxytrope	*Oxytropis*	*fragilifolia*
Leguminosae	Grubov's oxytrope	*Oxytropis*	*grubovii*
Zygophyllaceae	Common pegania	*Peganum*	*harmala*
Orchidaceae	Grand lady's-slipper	*Cypirpedium*	*macranthum*
Orchidaceae	Yellow lady's-slipper	*Cypirpedium*	*calceolus*
Nymphaeaceae	Small candock	*Nuphar*	*pumilum*
Leguminosae	Monophylous gueldenstaedtia	*Gueldenstaedtia*	*monophyla*
Liliaceae	Crisped lily	*Lilium*	*martagon*
Liliaceae	Candlestick lily	*Lilium*	*pensylvanicum*
Rosaceae	Kokand Rose	*Rosa*	*kokanica*
Rosaceae	Friable Rose	*Rosa*	*laxa*
Liliaceae	Macrandrous onion	*Allium*	*macrostemon*
Liliaceae	Wild garlic onion	*Allium*	*obliquum*
Rosaceae	Alpian sanguisorbia	*Sanguisorba*	*alpina*
Alismataceae	Floating arrow head	*Sagittaria*	*natans*
Saxifragaceae	Yellow marsh saxifrage	*Saxifraga*	*hirculus*
Saxifragaceae	Naked miterwort	*Mitella*	*nuda*
Compositae	Emarginate chrysanthemia	*Chrysanthemum*	*sinuatum*
Compositae	Gobi brachanthemia	*Brachanthermum*	*gobicum*
Compositae	Mongolian brachanthemia	*Brachanthermum*	*mongolorum*
Labiatae	The Mountain phlomy	*Phlomis*	*oreophila*
Gramineae	Platyphyllous rice	*Zizania*	*latifolia*
Orchidaceae	Clovy calypso	*Calypso*	*bulbosa*
Asclepiadaceae	Siberian vince toxic	*Vincetoxicum*	*sibiricumm*
Ericaceae	Golden rhododendron	*Rhododendron*	*aureum*
Ericaceae	Adam's rhododendron	*Rhododendron*	*adamsii*
Ericaceae	Dahurian rhododendron	*Rhododendron*	*dahuricum*
Ericaceae	Ledebour rhododendron	*Rhododendron*	*ledebourii*
Ericaceae	Microphyllous rhododendron	*Rhodedendron*	*pravifolium*
Rosaceae	Sorbiphyllous sorbaria	*Sorbaria*	*sorbifolia*
Ranunculaceae	Ganbold's columbian	*Aquilegia*	*ganboldii*
Bignoniaceae	Potanin's incarvillea	*Incarvillea*	*potaninii*
Salicaceae	Swamp cottonwood	*Populus*	*diversifolia*
Droseraceae	Round-leaved sundew	*Drosera*	*rotundifolia*
Droseraceae	English sundew	*Drosera*	*anglica*
Umbelliferae		*Ferula*	*ferulaeodes*
Leguminosae	Gobi pea shrub	*Caragana*	*gobica*
Leguminosae	Brachypodous pea shrub	*Caragana*	*brachypoda*
Leguminosae	Tibetan pea shrub	*Caragana*	*tibetica*
	Algea	*Nematonostoc*	*flagelliforme*
Compositae	White-leaved olgaea	*Olgaea*	*leucophylla*
Rosaceae	Mongolian potininia	*Potaninia*	*mongolica*
Compositae	Beatiful knapweed	*Centaurea*	*pulchella*
		Rhaponticum	*carthamnoides*
Liliaceae	Keiski's lily-of-the-valley	*Convallaria*	*keiskei*

Table 7.4 Very Rare Plants Listed in the Mongolian Law on Nature Plants (3/3)

Family	English name	Scientific Name	
Campanulaceae		*Codonopsis*	*clematidea*
Leguminosae		*Halimodendron*	*halodendron*
Ranunculaceae	Kuznetsov's monkshood	*Aconitum*	*kusnezoffi*
Zygophyllaceae	Potanin's zygophyllia	*Zygophyllum*	*potaninii*
Scrophulariaceae	Altai lousewort	*Pedicularis*	*altaica*
Scrophulariaceae	Wormwood-leafed lousewort	*Pedicularis*	*abrotanifolia*
Cruciferae	Mongolian adonis	*Adonis*	*mongolica*
Solanaceae	White-flowered physochlaina	*Physochlaina*	*albiflora*
Ericaceae	Bog cranberry	*Oxycoccus*	*microcarpus*
Orchidaceae	Galeated orchis	*Orchis*	*militaris*
Orchidaceae	Fuchs' orchis	*Orchis*	*fuchsii*
Salicaceae	Cucullated neottianthe	*Neottianthe*	*cucullata*
Orchidaceae	Kamchatka neottia	*Neottia*	*camtschatea*
Paeoniaceae	White-flowered peony	*Paeonia*	*lactiflora*
Liliaceae	Whorled paris	*Paris*	*verticillata*
Leguminosae	Barunkhurain licorice	*Glycyrrhiza*	*squamulosa*
Compositae	Mongolian jurinea	*Jurinea*	*mongolica*
Liliaceae	Heensi gagea	*Gagea*	*heensis*
Compositae	Mongolian tugarinovy	*Tugarinovia*	*mongolica*
Compositae	Quarred sagebrush	*Artemisia*	*lithophilia*
Compositae	Finefilamented wormwood	*Artemisia*	*tomentella*
Compositae	Yellow wormwood	*Artemisia*	*xanthochroa*
	Lichene	*Aspecilia*	*esculenta*
Leguminosae	Friticose tick trefail	*Hedysarum*	*fruticosum*
Leguminosae	Tsengel's tick trefail	*Hedysarum*	*sanilense*
Botrychiaceae	Sword-leafed botrychium	*Botrychium*	*lanceolatum*
Orchidaceae	Trifid coralroot	*Corrallorhiza*	*trifida*
Lycopodium	Clavoted club-moss	*Lycopodium*	*clabatum*
Lycopodium	Alpine club-moss	*Lycopodium*	*alpinum*
Rhamnaceae	Micropyllous buckthorn	*Rhamnus*	*parvifolia*
Rhamnaceae	Ussurian buckthorn	*Rhamnus*	*ussuriensia*

Table 7.5 Rare Plants Listed in Gov. Res. 153 (1/3)

Family	Scientific Name	
Caryophyllaceae	*Acanthophyllum*	*pungens*
Compositae	*Achillea*	*acuminata*
Compositae	*Achillea*	*ledebourii*
Gramineae	*Achnatherum*	*inebrians*
Compositae	*Achyrophorus*	*maculatus*
Ranunculaceae	*Aconitum*	*anthoroideum*
Ranunculaceae	*Aconitum*	*komarovii*
Campanulaceae	*Adenophora*	*changaica*
Ranunculaceae	*Adonis*	*sibirica*
Caryophyllaceae	*Agrostemma*	*githago*
Rosaceae	*Alchemilla*	*changaica*
Rosaceae	*Alchemilla*	*cyrtopleura*
Rosaceae	*Alchemilla*	*krylovii*
Rosaceae	*Alchemilla*	*hebescens*
Rosaceae	*Alchemilla*	*pavlovii*
Liliaceae	*Allium*	*altaicum*
Liliaceae	*Allium*	*galanthum*
Liliaceae	*Allium*	*galanthum*
Liliaceae	*Allium*	*maximoviczii*
Saxifragaceae	*Amygdalus*	*mongolica*
Chenopodiaceae	*Anabasis*	*elatior*
Gramineae	*Arundinella*	*hirta*
Liliaeceae	*Asparagus*	*oligoclonos*
Rubiaceae	*Asperula*	*humifusa*
Rubiaceae	*Asperula*	*saxicola*
Compositae	*Aster*	*sanczirii*
Compositae	*Asterothamnus*	*molliusculus*
Leguminosae	*Astragalus*	*altaicus*
Leguminosae	*Astragalus*	*baitagensis*
Leguminosae	*Astragalus*	*changaicus*
Leguminosae	*Astragalus*	*granitovii*
Leguminosae	*Astragalus*	*gregorii*
Leguminosae	*Astragalus*	*kurtschumensis*
Leguminosae	*Astragalus*	*physocarpus*
Leguminosae	*Astragalus*	*scabrisetiformis*
Leguminosae	*Astragalus*	*squarrosulus*
Leguminosae	*Astragalus*	*vulpinus*
Ranunculaceae	*Atragene*	*ochotensis*
Polygonaceae	*Atraphaxis*	*danicus*
Polygonaceae	*Atraphaxis*	*dshinensis*
Polygonaceae	*Atraphaxis*	*spinosa*
Polygonaceae	*Atraphaxis*	*compacta*
Umbelliferae	*Aulackspermum*	*anomalum*
Ranunculaceae	*Batrachium*	*kauffmannii*
Ranunculaceae	*Batrachium*	*mongolicum*
Compositae	*Brachanthemum*	*mongolicum*
Cruciferae	*Braya*	*siliquosa*
Cruciferae	*Bunias*	*cochlearioides*
	Bunium	*capillifolium*
Butomaceae	*Butomus*	*junceus*
Gramineae	*Calamagrostis*	*inexpansa*
Gramineae	*Calamagrostis*	*turczaninovii*
Polygonaceae	*Calligonum*	*gobicum*
Polygonaceae	*Calligonum*	*junceum*
Callitrichaceae	*Callitriche*	*hermaphroditica*
	Calutzkya	*macrocapra*
Convolvulaceae	*Calystegia*	*hederacea*
Convolvulaceae	*Calystegia*	*subvolubilis*
Cruciferae	*Camelina*	*microcarpa*
Leguminoceae	*Caragana*	*spinosa*
Cruciferae	*Cardamine*	*leucantha*
Cruciferae	*Cardamine*	*macrophylla*
Cruciferae	*Cardamine*	*trifida*

Family	Scientific Name	
Compositae	*Carduus*	*nutans*
Cyperaceae	*Carex*	*alba*
Cyperaceae	*Carex*	*laliacea*
Cyperaceae	*Carex*	*leporina*
Cyperaceae	*Carex*	*parva*
Cyperaceae	*Carex*	*selengensis*
Cruciferae	*Carpoceras*	*ceratocarpum*
Umbelliferae	*Cenolophium*	*denudatum*
Compositae	*Centaurea*	*adpressa*
Compositae	*Centaurea*	*calva*
Genetianaceae	*Centaurium*	*pulchellum*
	Cetraria	*potaninii*
Paraveraceae	*Chelidonium*	*majus*
Chenopodiaceae	*Chenopodium*	*chenopodioides*
Chenopodiaceae	*Chenopodium*	*iljinii*
Cruciferae	*Chorispora*	*bungeana*
Compositae	*Chrysanthemum*	*chalchingolicum*
Compositae	*Chrysosplenium*	*nudicaule*
Compositae	*Cichorium*	*intybus*
Ranunculaceae	*Cimicifuga*	*dahurica*
Compositae	*Cirsium*	*pendulum*
Ranunculaceae	*Clematis*	*aethusifolia*
Capparaceae	*Cleome*	*gobica*
Chenopodiaceae	*Climacoptera*	*subcrassa*
Primulaceae	*Cortusa*	*brotheri*
Compositae	*Cousinia*	*affinis*
Compositae	*Crepis*	*czuensis*
Gramineae	*Crypsis*	*schoenoides*
Cynomoriaceae	*Cynomorium*	*soongaricum*
Caryophyllaceae	*Dianthus*	*hoeltzeri*
Caryophyllaceae	*Dianthus*	*soongoricus*
Thymelaeaceae	*Diarthron*	*limifolium*
Cruciferae	*Draba*	*altaica*
Cruciferae	*Draba*	*multiceps*
Cruciferae	*Draba*	*sibirica*
Compositae	*Echinops*	*nanus*
Gramineae	*Elymus*	*excelsus*
Gramineae	*Elymus*	*fedtschenkoi*
Gramineae	*Elymus*	*pamilicus*
Gramineae	*Elymus*	*praecaespitosus*
Onagraceae	*Epilobium*	*davuricum*
Onagraceae	*Epilobium*	*hirsutum*
Equisetaceae	*Equisetum*	*ramosissimum*
Equisetaceae	*Equisetum*	*variegatum*
Gramineae	*Eragrostis*	*cilianensis*
Caryophyllaceae	*Eremogonia*	*androsacea*
Caryophyllaceae	*Eremogonia*	*juncea*
Gramineae	*Eremopyrum*	*distans*
Umbelliferae	*Eryngium*	*planum*
	Euphoridia	*alpina*
Gramineae	*Festuca*	*komatovii*
Gramineae	*Festuca*	*litvinovii*
Gramineae	*Festuca*	*venusta*
Frankeniaceae	*Frankenia*	*pulverulenta*
Compositae	*Galatella*	*macrosciadia*
Gentianaceae	*Gentiana*	*algida*
Gentianaceae	*Gentiana*	*riparia*
Compositae	*Gnaphalium*	*supinum*
Cruciferae	*Goldbachia*	*ikonnikovii*
Cruciferae	*Goldbachia*	*laevigata*
Plumbaginaceae	*Goniolimon*	*callicomum*
Caryophyllaceae	*Gypsophila*	*cephalotes*
Chenopodiaceae	*Halocnemum*	*strobilaceum*

Table 7.5 Rare Plants Listed in Gov. Res. 153 (2/3)

Family	Scientific Name	
Leguminosae	*Hedysarum*	*dahuricum*
Caryophyllaceae	*Herniaria*	*glabra*
Compositae	*Hieracium*	*echioides*
Gramineae	*Hordeum*	*bogdanii*
Hypericaceae	*Hypericum*	*gebleri*
Iridaceae	*Iris*	*halophila*
Cruciferae	*Isatis*	*tinctoria*
	Juncellus	*pannoynicus*
Juncaceae	*Juncus*	*articulatus*
Cupressaceae	*Juniperus*	*dahurica*
Cupressaceae	*Juniperus*	*pseudosadina*
Compositae	*Jurinea*	*chaetocarpa*
Chenopodiaceae	*Kalidium*	*caspicum*
Cyperaceae	*Kobresia*	*robusta*
Compositae	*Krylovia*	*eremophila*
Compositae	*Lactuca*	*undulata*
Labiatae	*Lagochilus*	*bungei*
Leguminosae	*Lathyrus*	*quinquenervius*
Labiatae	*Leonurus*	*panzerioides*
Compositae	*Ligularia*	*soongarica*
Liliaceae	*Lilium*	*buschianum*
Liliaceae	*Lilium*	*potaninii*
Plumbaginaceae	*Limonium*	*gobicum*
Plumbaginaceae	*Limonium*	*grubovii*
Scrophulariaceae	*Linaria*	*hepatica*
Linaceae	*Linum*	*pallescens*
Linaceae	*Linum*	*usitatisimum*
Labiatae	*Lophanthus*	*krylovii*
Solanaceae	*Lycium*	*potaninii*
Lycopodiaceae	*Lycopodium*	*annotinum*
Orchidaceae	*Lysiella*	*nevskii*
Compositae	*Matricaria*	*recutita*
Cruciferae	*Megacarpaea*	*megarocarpa*
Caryophyllaceae	*Melandrium*	*mongolicum*
Leguminosae	*Melilotus*	*albus*
Leguminosae	*Melilotus*	*wolgicus*
Cruciferae	*Meniocus*	*iinifolius*
Gramineae	*Melica*	*nutans*
Cruciferae	*Microstigma*	*junatovii*
Lythraceae	*Middeneorfia*	*borysthentica*
Caryophyllaceae	*Minuartia*	*arctica*
Caryophyllaceae	*Minuartia*	*regeliana*
Caryophyllaceae	*Minuartia*	*stricta*
Caryophyllaceae	*Moehringia*	*umbrosa*
Pyrolaceae	*Moneses*	*uniflora*
Najadaceae	*Najas*	*marina*
Labiatae	*Nepeta*	*densiflora*
Labiatae	*Nepeta*	*pannonica*
Nymphaeaceae	*Nuphar*	*lutea*
Nymphaeaceae	*Nymphaea*	*tetragona*
Oxalidaceae	*Oxalis*	*acetosella*
Umbelliferae	*Oenanthe*	*javanica*
Compositae	*Olgaea*	*lomonossovii*
Boraginaceae	*Onosma*	*transrhymnense*
Leguminosae	*Oxytropis*	*diantha*
Leguminosae	*Oxytropis*	*falcata*
Leguminosae	*Oxytropis*	*gorbunovii*
Leguminosae	*Oxytropis*	*komarovii*
Leguminosae	*Oxytropis*	*krylovii*
Leguminosae	*Oxytropis*	*ladyginii*
Leguminosae	*Oxytropis*	*mongolica*
Leguminosae	*Oxytropis*	*saposhnikovii*
Leguminosae	*Oxytropis*	*sordida*

Family	Scientific Name	
Leguminosae	*Oxytropis*	*sutaica*
Leguminosae	*Oxytropis*	*tenuis*
Paeoniaceae	*Paeonea*	*anomala*
Papaveraceae	*Papaver*	*saichanense*
Papaveraceae	*Papaver*	*changaica*
Scrophulariaceae	*Pedicularis*	*dasystachys*
Scrophulariaceae	*Pedicularis*	*fissa*
Scrophulariaceae	*Pedicularis*	*proboscidea*
Chenopodiaceae	*Petrosimonia*	*litwinowii*
Chenopodiaceae	*Petrosimonia*	*sibirica*
Umbelliferae	*Peucedanum*	*terebinthaceum*
Gramineae	*Phleum*	*alpinum*
Labiatae	*Phlomis*	*pratensis*
Gramineae	*Phragmites*	*communis*
Lentibulariaceae	*Pinguicula*	*alpina*
Pinaceae	*Pinus*	*sibirica*
Gramineae	*Piptatherum*	*songaricum*
Plantaginaceae	*Plantago*	*komarovii*
Gramineae	*Poa*	*kenteica*
Gramineae	*Poa*	*reverdattoi*
Gramineae	*Poa*	*supina*
	Poacynum	*hendersonii*
Polygonaceae	*Polygonum*	*dumetorum*
Potamogetonace	*Potamogeton*	*lucens*
Potamogetonace	*Potamogeton*	*natans*
Potamogetonace	*Potamogeton*	*obtusifolius*
Potamogetonace	*Potamogeton*	*praelongus*
Rosaceae	*Potentilla*	*arenosa*
Rosaceae	*Potentilla*	*chrysantha*
Rosaceae	*Potentilla*	*ikonnikovii*
Rosaceae	*Potentilla*	*imbricata*
Rosaceae	*Potentilla*	*norvegica*
Rosaceae	*Potentilla*	*regeliana*
Gramineae	*Puccinellia*	*przewalskii*
Cruciferae	*Pugionium*	*pterocarpum*
Compositae	*Pulicaria*	*prostrata*
Compositae	*Pyrethrum*	*alatavicum*
Compositae	*Pyrethrum*	*changaicum*
Compositae	*Pyrethrum*	*pulchrum*
	Rhizoplaca	*baranovii*
Crassulaceae	*Rhodiola*	*algida*
Saxifragaceae	*Ribes*	*fragrans*
Saxifragaceae	*Ribes*	*graveolens*
Saxifragaceae	*Ribes*	*heterotrichum*
Saxifragaceae	*Ribes*	*hispidulum*
Boraginaceae	*Rochelia*	*leiocarpa*
Rosaceae	*Rosa*	*albertii*
Rosaceae	*Rosa*	*beggeriana*
Rosaceae	*Rosa*	*platyacantha*
Polygonaceae	*Rumex*	*pseudonatronatus*
Chenopodiaceae	*Salsola*	*foliosa*
Chenopodiaceae	*Salsola*	*rosacea*
Compositae	*Saussurea*	*catharinae*
Compositae	*Saussurea*	*foliosa*
Compositae	*Saussurea*	*glacialis*
Compositae	*Saussurea*	*drogostaiskii*
Compositae	*Saussurea*	*klementzii*
Compositae	*Saussurea*	*latifolia*
Compositae	*Saussurea*	*acuminata*
Gramineae	*Schismus*	*arabicus*
Gramineae	*Schizachne*	*callosa*
Gramineae	*Scolochloa*	*festucacea*
Cyperaceae	*Scirpus*	*radicans*

Table 7.5 Rare Plants Listed in Gov. Res. 153 (3/3)

Family	Scientific Name	
Compositae	*Scorzonera*	*grubobii*
Compositae	*Scorzonera*	*parviflora*
Labiatae	*Scutellaria*	*paulsenii*
Labiatae	*Scutellaria*	*supina*
Labiatae	*Scutellaria*	*viscidula*
Euphorbiaceae	*Securinega*	*suffruticosa*
Compositae	*Senecio*	*argunensis*
Compositae	*Senecio*	*flammeus*
Gramineae	*Setaria*	*glauca*
Caryophyllaceae	*Silene*	*mongolica*
Cruciferae	*Sisymbrium*	*loeselii*
Cruciferae	*Sisymbrium*	*subspinescens*
Cruciferae	*Smelovskia*	*bifurcata*
Solanaceae	*Solanum*	*depilatum*
Leguminosae	*Sophora*	*alopecuroides*
Sparganiaceae	*Sparganium*	*glomeratum*
Caryophyllaceae	*Stellaria*	*dichotoma*
Caryophyllaceae	*Stellaria*	*media*
Caryophyllaceae	*Stellaria*	*pulvinata*
Caryophyllaceae	*Stellaria*	*radians*
Umbellifferae	*Stenocoelium*	*athamantoides*
Gramineae	*Stipa*	*consanguinea*
Gramineae	*Stipa*	*rubens*
Cruciferae	*Sirigosella*	*africana*
Chenopodiaceae	*Suaeda*	*linifolia*
Compositae	*Synurus*	*deltoides*
Tamaricaceae	*Tamarix*	*hispida*
Compositae	*Tanacetum*	*tanacetoides*
Compositae	*Taraxacum*	*armeriifolium*
Compositae	*Taraxacum*	*glabrum*
Compositae	*Taraxacum*	*armerifolium*
Cruciferae	*Tetracme*	*quadricornis*
Leguminosae	*Thermopsis*	*grubovii*
Leguminosae	*Thermopsis*	*hirsutissima*
Leguminosae	*Thermopsis*	*longicarpa*
Leguminosae	*Thermosis*	*mongolica*
Labiatae	*Thymus*	*komarovii*
Labiatae	*Thymus*	*mongolicus*
Labiatae	*Thymus*	*pavlovii*
Labiatae	*Thymus*	*roseus*
Crassulaceae	*Tillaea*	*aquatica*
Cruciferae	*Torularia*	*grubovii*
Boravinaceae	*Tretocarya*	*pratensis*
Leguminosae	*Trifolium*	*repens*
Ranunculaceae	*Trollius*	*altaicus*
Ranunculaceae	*Trollius*	*lilacinus*
Valerianaceae	*Valeriana*	*capitata*
Valerianaceae	*Valeriana*	*oficinalic*
Scrophulariaceae	*Veronica*	*perpusilla*
Scraphulariaceae	*Veronica*	*porphyriana*
Leguminosae	*Vicia*	*geminiflora*
Leguminosae	*Vicia*	*japonica*
Leguminosae	*Vicia*	*semenovii*
Asclepiadaceae	*Vincetoxicum*	*lanceolatum*
Violaceae	*Viola*	*acuminata*
Violaceae	*Viola*	*brachysepala*
Violaceae	*Viola*	*collina*
Violaceae	*Viola*	*patrinii*
Polypodiaceae	*Woodsia*	*alpina*
Labiatae	*Ziziphora*	*clinopodioides*
Zygophyllaceae	*Zygophyllum*	*gobicum*
Zygophyllaceae	*Zygophyllum*	*kaschgaricum*
Zygophyllaceae	*Zygophyllum*	*latifolium*
Zygophyllaceae	*Zygophyllum*	*micronatum*
Zygophyllaceae	*Zygophyllum*	*neglectum*
Zygophyllaceae	*Zygophyllum*	*stanum*

Table 7.6 Animals in Mongolia Listed in CITES

Class	Scientific Name		English Name	Status
Reptilia	*Eryx*	*tataricus*	Tatar Sand Boa	II
Aves	*Pelecanus*	*crispus*	Dalmation Pelican	I
	Platalea	*leucorodia*	Eurasian Spoonbill	II
	Ciconia	*boyciana*	Oriental White Stork	I
	Ciconia	*nigra*	Black Stork	II
	Pernis	*ptilorhynchos*	Eurasian Honey Buzzard	II
	Milvus	*migrans*	Black Kite	II
	Circus	*cyaneus*	Northern Harrier	II
	Circus	*melanoleucos*	Pied Harrier	II
	Accipiter	*gentilis*	Northern Goshawk	II
	Accipiter	*gularis*	Japanese Sparrow Hawk	II
	Accipiter	*nisus*	Eurasian Sparrow Hawk	II
	Asio	*otus*	Long-eared Owl	II
	Asio	*flammeus*	Short-eared Owl	II
	Aegolius	*funereus*	Boreal Owl	II
	Buteo	*lagopus*	Rough-legged Buzzard	II
	Buteo	*rufinus*	Long-legged Buzzard	II
	Buteo	*hemilasius*	Upland Buzzard	II
	Aquila	*clanga*	Greater Spotted Eagle	II
	Aquila	*chrysaetos*	Golden Eagle	II
	Aquila	*heliaca*	Imperial Eagle	I
	Circaetus	*gallicus*	Short-toed Eagle	II
	Hieraaetus	*pennatus*	Booted Eagle	II
	Falco	*naumanni*	Lesser Kestrel	II
	Falco	*tinnunculus*	Eurasian Kestrel	II
	Falco	*columbarius*	Merlin Hawk	II
	Falco	*amurensis*	Amur Falcon	II
	Falco	*vespertinus*	Red-footed Falcon	II
	Falco	*subbuteo*	Eurasian Hobby	II
	Falco	*cherrug*	Saker Falcon	II
	Falco	*pelegrinoides*	Barbary Falcon	II
	Grus	*japonensis*	Red-crowned Crane	I
	Grus	*leucogeranus*	Siberian Crane	I
	Otis	*tarda*	Great Bustard	II
	Larus	*relictus*	Relict Gull	I
	Bubo	*bubo*	Eagle Owl	II
	Surnia	*ulula*	Northern Hawk Owl	II
	Glaucidium	*passerinum*	Eurasian Pygmy Owl	II
	Athene	*noctua*	Little Owl	II
	Strix	*uralensis*	Ural Owl	II
	Strix	*nebulosa*	Great Gray Owl	II
Mammalia	*Cuon*	*alpinus*	Asiatic Wild Dog	II
	Lutra	*lutra*	Eurasian Otter	I
	Lynx	*lynx*	Eurasian Lynx	II
	Felis	*manul*	Manul (Pallas' Cat)	II
	Felis	*libica*	Europian Wild Cat	II
	Uncia	*uncia*	Snow Leopard	I
	Ursus	*arctos pruinosus*	Gobi Bear	I
	Canis	*lupus*	Gray Wolf	II
	Equus	*hemionus*	Asiatic Wild Ass	I
	Equus	*przewalskii*	Przewalski's Wild Horse	I
	Moschus	*moschiferus*	Musk Deer	II
	Saiga	*tatarica*	Saiga Antelope	II
	Ovis	*ammon*	Argali	II

Note: I: Listed in appendices I of CITES, II: Listed in appendices II of CITES

Table 7.7 Animals Listed in Mongolian Red Data Book (1/2)

	Scientific Name		Status	
			1987	1997
Mammals	*Erinaceus*	*dauricus*		L
	Talpa	*altaica*		L
	Vespertilio	*superans*		L
	Citellus	*alaschanicus*		L
	Castor	*fiber birulai*	C	L
	Dryomys	*nitedula*	C	L
	Meriones	*tamariscinus*		L
	Cardiocranius	*paradoxus*	C	L
	Salpingotus	*kozlovi*	C	L
	Salpingotus	*crassicauda*	C	L
	Euchoreutes	*naso*	C	L
	Felis	*lybica*	C	L
	Uncia	*uncia*	C	L
	Ursus	*gobiensis(pruinosus*	A	L
	Cuon	*alpinus*	A	L
	Vormela	*peregusna*	C	L
	Lutra	*lutra*	A	L
	Equus	*przewalskii*	A	L
	Equus	*hemionus hemionus*	C	L
	Camelus	*bactrianus ferus*	A	L
	Sus	*scrofa*	C	L
	Rangifer	*tarandus valentinae*	C	L
	Alces	*alces pfizenmayeri*	C	L
	Alces	*alces cameloides*	C	L
	Saiga	*tatarica*	A	L
	Saiga	*tatarica mongolica*	A	L
	Moschus	*moschiferus*		L
	Capra	*sibilica*		L
	Ovis	*ammon*	C	L
	Gazella	*subgutturosa*	C	L
Birds	*Larus*	*ichthyyaetus*		L
	Pandion	*haliaetus*	C	L
	Haliaeetus	*albicilla*	C	L
	Gyps	*himalayensis*	C	L
	Phasianus	*colchicus*	C	L
	Tetragallus	*altaicus*		L
	Grus	*vipio*	A	L
	Grus	*monacha*	A	L
	Grus	*leucogeranus*	A	L
	Chlamydostis	*undulata*	A	L
	Otis	*tarda tinnaeus*	C	L
	Saxicola	*insignis*		L
	Remiz	*pendlinus*		L
	Paradoxornix	*heudei*	A	L

A: Endangered, B: Threatened, C: Rare, L: Listed

Table 7.7 Animals Listed in Mongolian Red Data Book (2/2)

	Scientific Name		Status	
			1987	1997
Birds	*Podoces*	*hendersoni*		L
	Egretta	*alba*		L
	Aytha	*baeri*		L
	Aix	*galericulata*		L
	Anas	*formosa*		L
	Anser	*indicus*	C	L
	Anser	*cygnoides*	C	L
	Oxyura	*leucocephala*		L
	Limnodromus	*semipalmatus*		L
	Larus	*relictus*	A	L
	Pelecanus	*crispus*	C	L
	Ciconia	*nigra*	C	L
	Ciconia	*boyciana*		L
	Platalea	*leucorodia*	C	L
	Cygnus	*cygnus*	C	L
	Cygnus	*olor*	C	L
	Numenius	*minutus*	C	
Reptiles	*Cyrtopidion*	*elongatus*	L	L
	Phrynocephalus	*helioscopus*		L
	Eremias	*arguta patanini*	L	L
	Eryx	*tartaricus*	L	L
	Coluber	*spinalis*	L	L
Amphibians	*Salamandrella*	*keyserlingii*	L	L
	Bufo	*danatensis*		L
	Hyla	*japonica*		L
	Rana	*chensinensis*	L	L
Fish	*Acipenser*	*baeri baicalensis*	L	L
	Acipenser	*schrencki*		L
	Tinca	*tinca*		L
	Mesocottus	*haitej*		L
	Coregonus	*autumalis migratori*		L
	Lampetra	*japonica*	L	L
	Hucho	*taimen*		L

A: Endangered, B: Threatened, C: Rare, L: Listed

Table 7.8 Plants Listed in Mongolian Red Data Book (1/4)

	Scientific Name		Status	
			1987	1997
Vascular plants	*Abies*	*sibirica*	A	L
	Acorus	*calamus*	A	L
	Adonis	*mongolica*	A	L
	Adonis	*sibirica*	C	L
	Allium	*altaicum*	B	L
	Allium	*condensatum*	B	
	Allium	*galanthum*	B	
	Allium	*macrostemon*	A	L
	Allium	*obliquum*	B	L
	Ammopiptanthus	*mongolicus*	C	L
	Amygdalus	*mongolica*	C	L
	Anemarrhena	*asphodeloides*	C	L
	Androsace	*longifolia*	A	L
	Artemisia	*lithophila*		L
	Astragalus	*dshinensis*		L
	Botrychium	*lanceolatum*		L
	Brachanthemum	*gobicum*	C	L
	Brachanthemum	*mongolorum*	A	L
	Calypso	*bulbosa*	C	L
	Caragana	*gobica*		L
	Caragana	*branchypoda*		L
	Caragana	*spinosa*	B	
	Carex	*parva*		L
	Carex	*selengensis*		L
	Caryopteris	*mongolica*	C	L
	Chrysandthemu	*sinuatum*		L
	Cistanche	*deserticolla*		L
	Convallaria	*keiskei*		L
	Corrallorhiza	*trifida*	C	L
	Cynomorium	*songaricum*	B	L
	Cypripedium	*macranthon*	C	L
	Cypripedium	*calceolus*	C	L
	Dictamnus	*dasycarpus*	C	L
	Drosera	*rotundifolia*		L
	Drosera	*anglica*		L
	Elaeagnus	*moorcroftii*	A	L
	Ephedra	*equisetina*	C	L
	Ephedra	*glauca*	C	
	Epipogon	*aphyllum*	C	L
	Euonymus	*maackii*	C	
	Ferula	*ferulaeodes*		L
	Festuca	*komarovii*		L
	Gentiana	*algida*	B	L

A: Endangered, B: Threatened, C: Rare, L: Listed

Table 7.8 Plants Listed in Mongolian Red Data Book (2/4)

	Scientific Name		Status	
			1987	1997
Vascular plants	*Goodyera*	*repens*	C	
	Gueldenstaedtia	*monophylla*	C	L
	Gymnadenia	*conopsea*	C	
	Gymnocarpos	*przewalskii*	A	L
	Haloxylon	*ammondendron*	B	
	Halimodendron	*halodendron*	B	L
	Hedysarum	*sangilense*		L
	Hemerocallis	*lilio-asphodelus*	B	
	Hippophae	*rhamnoides*	B	
	Hypericum	*attenuatum*	C	
	Iljinia	*regelii*	C	L
	Incarvillea	*potaninii*	C	L
	Iris	*dichotoma*	C	
	Juniperus	*dahurica*	A	
	Juniperus	*pseudosabina*		L
	Juniperus	*sabina*		L
	Jurinea	*mongolica*		L
	Kobresia	*robusta*		L
	Krylovia	*eremophila*		L
	Larix	*dahurica*	C	
	Lancea	*tibetica*	A	L
	Lilium	*dahuricum*	B	L
	Lycopodium	*clavatum*		L
	Lycopodium	*alpinum*		L
	Melica	*nutans*		L
	Mitella	*nuda*		L
	Neottianthe	*cucullata*	C	L
	Neottia	*camtshatea*	C	L
	Nymphaea	*candida*	C	L
	Nymphaea	*tertragona*		L
	Nuphar	*pumilum*	C	L
	Olgaea	*leucophylla*		L
	Olgaea	*lomonosowii*		L
	Orchis	*militaris*		L
	Orchis	*fuchsii*	C	L
	Oxycoccus	*microcarpus*	C	
	Oxytropis	*acanthacea*		L
	Oxytropis	*fragilifolia*		L
	Oxytropis	*grubovii*		L
	Oxytropis	*mongolica*		L
	Paeonia	*albiflora*	C	
	Paeonia	*pictum*	C	

A: Endangered, B: Threatened, C: Rare, L: Listed

Table 7.8 Plants Listed in Mongolian Red Data Book (3/4)

	Scientific Name		Status	
			1987	1997
Vascular plant	*Paeonia*	*anomala*	B	L
	Paeonia	*lactiflora*		L
	Peganum	*harmala*	C	L
	Phragmites	*communis*	B	
	Physochlaina	*albiflora*		L
	Pinus	*pumila*		L
	Plantanthera	*bifolia*	C	L
	Poacynum	*pictum*	C	
	Populus	*diversifolia*	A	L
	Populus	*pilosa*	C	
	Potaninia	*mongolica*	C	L
	Pugionium	*pterocarpum*	C	
	Pyrethrum	*changaicum*	C	
	Rhamnus	*ussuriensis*	C	
	Rhaponticum	*carthamnoides*	A	
	Rhodiola	*quadrifida*	B	
	Rhodiola	*rosea*	B	L
	Rhododendron	*aureum*	C	L
	Rhododendron	*adamsii*		L
	Rhododendron	*dauricum*		L
	Rhododendron	*ledebourii*		L
	Rhododendron	*parvifolium*		L
	Saxifraga	*hirculus*	B	L
	Sambucus	*manshurica*		L
	Saussurea	*dorogostaiskii*	A	L
	Saussurea	*involucrata*	A	L
	Sophora	*alopecuroides*	B	
	Sophora	*flavescens*	A	L
	Sorbaria	*sorbifolia*	C	L
	Stellaria	*dichotoma*		L
	Stipa	*pennata*	A	
	Synurus	*deltoides*	C	
	Tamarix	*L*	B	
	Tugarinovia	*mongolica*		L
	Tulipa	*uniflora*	B	L
	Vaccinium	*myrtillus*	A	L
	Valeriana	*officinalis*	B	L
	Viburnum	*mongolicum*	C	L
	Viburnum	*sargentii*	C	L
	Vicia	*tsydenii*		L
	Zygadenus	*sibiricus*	C	L

A: Endangered, B: Threatened, C: Rare, L: Listed

Table 7.8 Plants Listed in Mongolian Red Data Book (4/4)

	Scientific Name		Status	
			1987	1997
Lichens	*Asahinea*	*scholander*		L
	Aspicilia	*esculenta*		L
	Aspicilia	*changaica*		L
	Cetraria	*komarovii*		L
	Cetraria	*potaninii*		L
	Cetraria	*steppae*		L
	Cetraria	*alvarensis*		L
	Cladonia	*kanewskii*		L
	Rhizoplaca	*baranowii*		L
	Squamarina	*pamirica*		L
	Usnea	*longissima*		L
	Lobaria	*retigera*		L
Algae	*Batrachospermu*	*moniliforme*		L
	Cadophpora	*kozlowii*		L
	Dynallella	*viridis*		L
	Nematonostoc	*flagelliforme*		L
	Oocystis	*mongolica*		L
	Tolypothrix	*mongolica*		L
Moss	*Aongstroemia*	*julacea*		L
	Pterygoneurum	*kozlovii*		L
	Trematogon	*brevicollis*		L
	Oreas	*martiana*		L
Fungi	*Endoptychum*	*agaricoides*		L
	Lepista	*caespitosa*		L
	Tricholoma	*mongolicum*		L
	Leucopaxillus	*giganteus*		L
	Inonotus	*obliquus*		L
	Leccinum	*aurantiacum*		L

A: Endangered, B: Threatened, C: Rare, L: Listed

Table 7.9 Threatened Animals in Mongolia Reported by IUCN (1996)

Class	Order	Family	Scientific Name		English Name	Status
Mammalia	Carnivora	Canidae	*Cuon*	*alpinus*	Asiatic Wild Dog*	Vu
		Feridae	*Unica*	*Unica*	Snow Leopard	En
		Ursidae	*Ursus*	*thibetanus*	Asiatic Black Bear	Vu
		Mustelidae	*Gulo*	*gulo*	Wolverine	Vu
	Artiodactyla	Camelidae	*Camelus*	*bactrianus (ferus)*	Wild Baxtrian Camel	Vu
		Moschidae	*Moschus*	*moschiferus*	Siberian Musk Deer	Vu
	Perissodaxtyla	Equidae	*Equus*	*przewalskii*	Przewalski's Horse	Ew
			Equus	*hemionus*		Vu
	Artiodactyla	Bovidae	*Ovis*	*amon*	Argali	Vu
			Saiga	*tatarica*	Saiga	Vu
	Rodentia	Dipodidae	*Cardiocranius*	*paradoxus*		Vu
			Euchoreutes	*naso*		En
			Salpingotus	*crassicauda*		Vu
Aves	Pelecaniformes	Pelecanidae	*Pelecanus*	*crispus*	Dalmatian Pelican	Vu
	Anseriformes	Anatidae	*Answer*	*cygnoides*	Swan Goose	Vu
			Aythya	*nyroca*	Ferruginous Duck	Vu
			Oxyura	*leucocephala*	White-headed Duck	Vu
	Falconiformes	Accipitridae	*Haliaeetus*	*leucoryphus*	Pallas's Sea-Eagle	Vu
		Falconidae	*Falco*	*naumanni*	Lesser Kestrel	Vu
	Gruiformes	Gruidae	*Grus*	*japonensis*	Red-crowned Crane	Vu
			Grus	*leucogeranus*	Siberian Crane	En
			Grus	*vipio*	White-naped Crane	Vu
		Otididae	*Otis*	*tarda*	Great Bustard	Vu
	Passeriform	Turdidae	*Saxicola*	*insignis*	White-throated Bushchat	Vu
		Muscicapidae	*Megalurus*	*albolimbatus*	Fly River Grassbird	Vu
			Megalurus	*pryeri*	Marsh Grassbird	Vu
Insecta	Lepidoptera	Papilionidae	*Parnassius*	*apollo*	Apollo	Vu
		Lasiocampidae	*Phyllodesma*	*ilicifolia*	Small Lappet Moth	Vu
	Hymenoptera	Formicidae	*Harapgoxenus*	*zaisanicus*		Vu

Ew: Extinct in the Wild, En: Endangered, Vu: Vulnerable

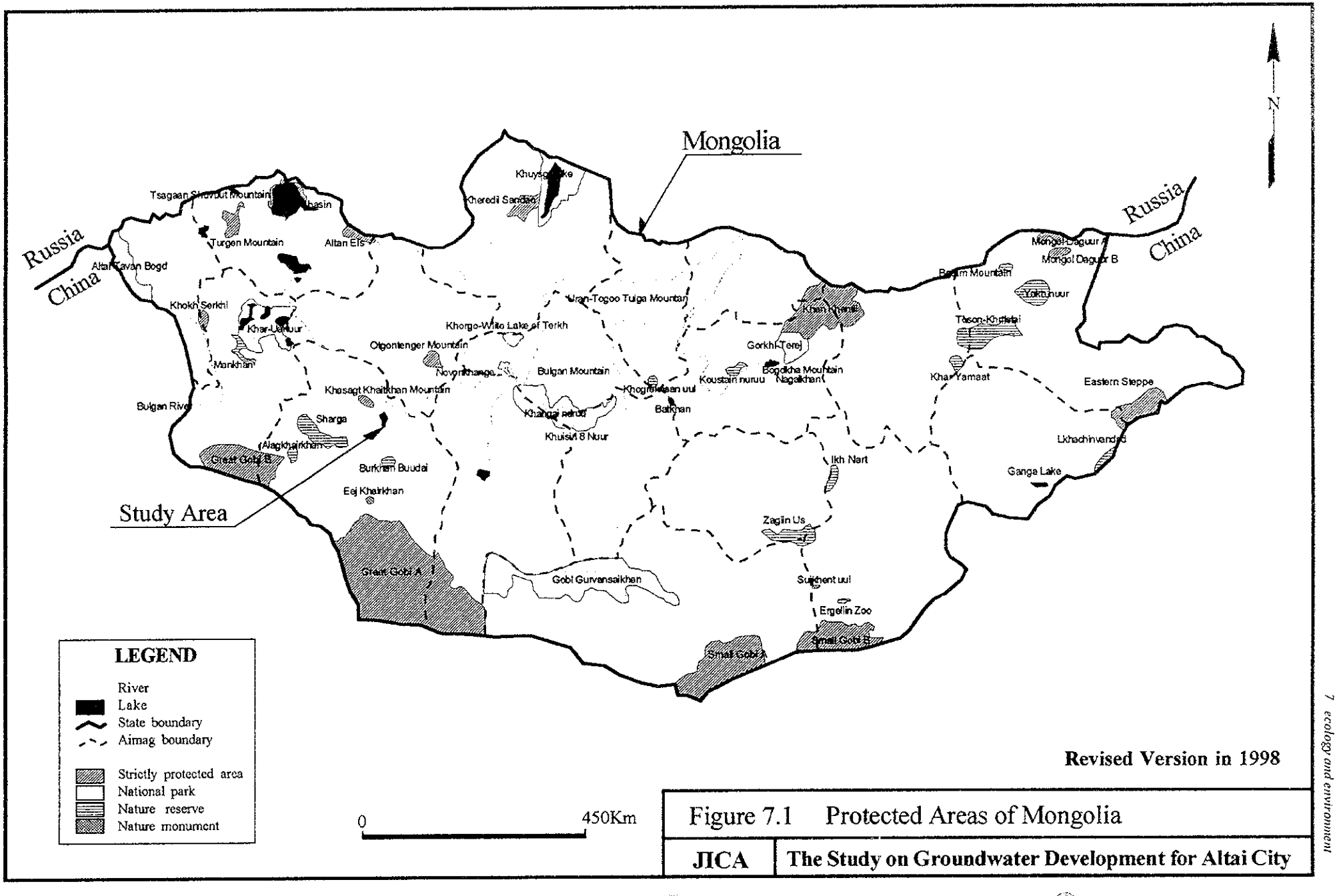

Figure 7.1 Protected Areas of Mongolia

JICA	The Study on Groundwater Development for Altai City

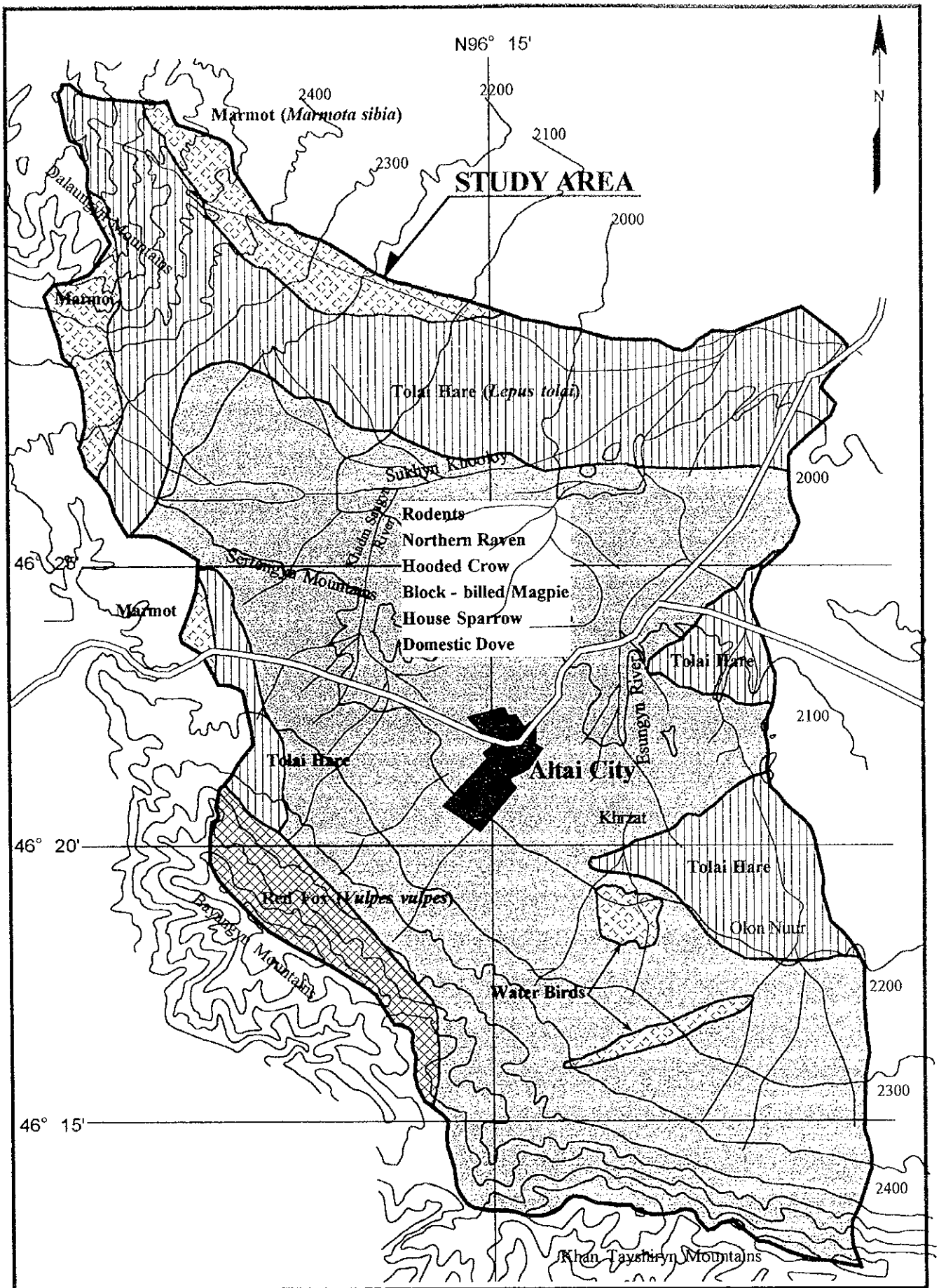

Figure 7.2 Distribution Map of Animals in the Study Area

JICA	The Study on Groundwater Development for Altai City

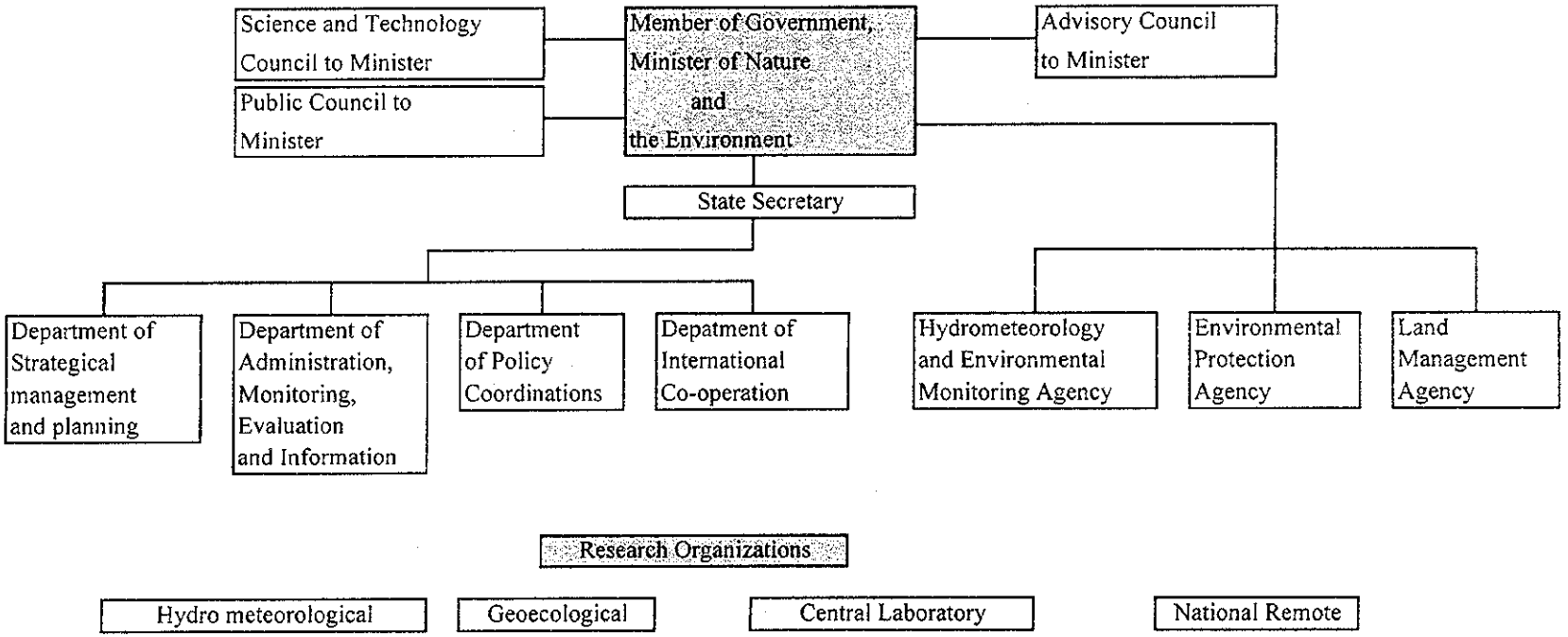

Figure 7.3 Structure of Ministry of Nature and the Environment of Mongolia

JICA	The Study on Groundwater Development for Altai Cty

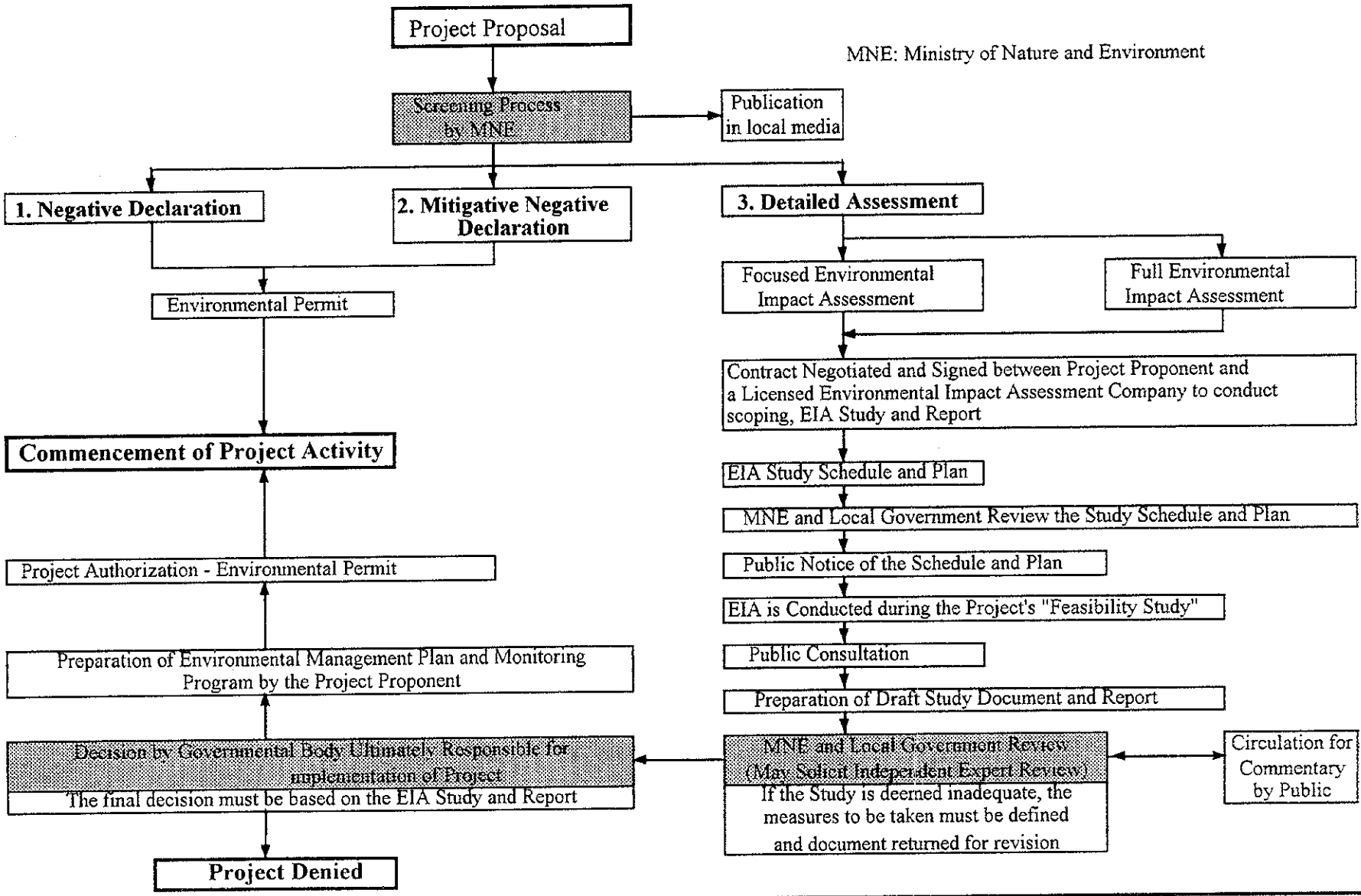

Figure 7.4 Mongolian Environmental Impact Assessment Procedure

JICA | The Study on Groundwater Development for Altai Cty

8 WATER QUALITY

8.1 REVIEW OF PREVIOUS DATA

Water quality of drinking water in Gobi Province has been monitored by Physiochemical and Bacteriological laboratories of Social Health Center in Gobi Altai Province in the past.

The recent results of analysis for drinking water of Village in Gobi Altai Province are shown in Table 8.1. Water quality of the water supply system in Altai City is shown in Table 8.2. Some heavy metal parameters for the drinking water in Altai City was also studied (Table 8.3). The following things can be pointed out from the review of those data:

1) The magnesium ion concentration of drinking water in some Villages (Khaliun, Bayan, Jargalan, Erdene, Tugrug, Khekhmorut, and Tsogt) and Altai City exceeds the Mongolian standard for drinking water (30 mg Mg/l);
2) The chloride ion concentration of drinking water in two Villages of Bayan and Khekhmorut, exceeds the Mongolian standard for drinking water (350 mg Cl/l).
3) Total bacteria number tends to increase in Altai City as the years go on.
4) All heavy metallic parameters shown in Table 8.3 fulfill the Mongolian standard for drinking water.

8.2 OBJECTIVES OF THE ANALYSIS

The Study Team conducted water quality analysis in 1997 and 1998. A part of the actual analysis was subcontracted to a local firm and the rest was carried out by some counterparts under the supervision of a member of the Study Team in Altai City.

The objectives of the water quality analysis are:

1) to investigate the groundwater characteristics and mechanism;
2) to clarify the condition of water supply system;
3) to clarify the condition of contamination of sewerage system; and
4) to clarify the condition of contamination of river.

8.3 SAMPLING

The sampling was done in 1997 and 1998 separately at rivers, wells, and water supply facilities. The total number of samples taken in this study is 1250. The sampling sites are summarized in the following table and the locations are shown in Figure 8.1 (1) – (3).

Summary of Sampling in 1997:

Site	Site Names and Remarks	
Existing Well	Total Number of sites	8
	SW-1, SW-2, SW-3, SW-4, SW-5, SW-6, SW-7, SW-8 * SW-6 is the production well of APSD	
Water Supply System	Total Number of sites	14
	Reservoir at the pumping station: (DR-1 and DR-2)	
	Tap water: Hospital (DT-1), Government Office (DT-2), Hotel (DT-3), High School (DT-4), Apartment (DT-5)	
	Water wagons: (DW-1 and DW-2) at the station for water wagons.	
	Water stored in Ger : (DG-1, DG-2, DG-3, DG-4, DG-5)	
Sewerage System	Total Number of sites	3
	at the new wastewater treatment plant (WWTP) (S-1)at the influent, (S-2) at the middle, (S-3)at the effluent * The old WWTP has no flow	
River	Total Number of sites	4
	Khadaasan (R-1), Mandaliin Aryn Am (R-2), Esuitiin Sair (R-3), and Hanginaagiin Hooloi (R-4) * The location of sampling are those where river cross sectional surveys were conducted in 1997. Some sampling were not carried out because of no stream.	

The result of the analysis in 1997 revealed relatively high concentration of heavy minerals in waters of both well and water supply systems. Therefore the Study Team decided to carry out sampling at some of these sites to confirm this results. The detail will be discussed in the following section.

Summary of Sampling in 1998:

Site	Site Names and Remarks	
Existing Well (Reanalysis)	Total number of sites	4
	SW-5, SW-6, SW-7, SW-8 * Water sampling was planned at four existing wells (SW-5, SW-6, SW-7, and SW-8) in order to reanalyze heavy metal parameters (lead, cadmium and arsenic) but SW-5 well had been filled with stones, and SW-7 well was frozen. Therefore sampling could not be carried out for these two wells. The other wells (SW-1, SW-2, SW-3 and SW-4) were in very low water level and sampling could not be carried out for these four wells.	
Water Supply System (Reanalysis)	Total number of sites	9
	DR-1, DR-2, DT-1, DT-2, DT-3, DT-4, DT-5, DW-1, and DW-2 * in order to reanalyze heavy metal parameters (lead, cadmium and arsenic).	
New Test Well	Total number of sites	10
	A1, A2, A3, A4, B1, B2, B3, B4, B5, and B6 * The samplings were done when the pumping test of a new well was done.	

8.4 PARAMETERS AND METHODS OF ANALYSIS

Forty eight (48) chemical parameters were analyzed with several different methods. The Parameters for the analysis are shown in Table 8.4.

The following parameters were measured in Altai City:

pH, temperature, odor, taste, color, turbidity, conductivity, hardness, dry residue, COD ($KMnO_4$, alkali)*, nitrite*, nitrate*, ammonium*, orthophosphate*, bicarbonate*, carbonate*, chloride*, sulfate*, potassium*, calcium*, magnesium*, copper*, iron*, manganese*, chromium (VI)*, cyanide*, fluoride*, silica*, alminum*, total coliforms, general bacteria, residual chlorine*, SS, Alkalinity, Acidity

* shows that these analyses were carried out with speedy water analyzer (WAL-F, Kyoritsu Chemical-Check Lab., Corp.).

The following parameters were measured in Ulaanbaatar:

chloride, sulfate, sodium**, potassium** *** #, calcium***, copper***, iron***, manganese***, zinc***, lead*** # & %, chromium*** #, cadmium*** # & %, arsenic*** # &, mercury*** # &, molybdenum &, beryllium &, sulfur***, chlorine(element)***, nickel***, selenium***, bromine***, strontium***, BOD, COD.

** shows that the analysis is done with flame emission spectrometric methods,

*** shows that the analysis is carried out with energy dispersive total reflection X-ray fluorescence (ED-TRXRF) technique

shows that the analysis for some samples is done in Japan,

& shows that the analysis for some samples is done with colorimetry

% shows that the analysis for some samples is done with atomic absorption spectrometric methods.

The results of the analysis are shown in tables attached in the Annex. of chapter 8 in DATA Book for specific figures.

8.5 VERIFICATION ON ANALYSIS RESULTS IN 1997

(1) Major Ions

Electric neutrality, dry residue and electrical conductivity are altogether compared with major ions' concentrations obtained from various methods shown in the Annex VIII-3 (1/4 and 2/4). The following conclusion is obtained by the examination of the comparison results.

1) Measured dry residue have large errors in 1997.

2) For chloride measurement the ED-TRXRF and titration methods are more reliable than turbidity method (WAL-F, Kyoritsu Chemical-Check Lab., Corp.) under the condition of high chloride concentration.

3) Sulfate concentration are calculated from the linear relationship between sulfate concentration measured with the titration method and sulfur element concentration obtained from ED-TRXRF. These calculated sulfate concentrations are more reliable than those obtained from turbidimetric method (WAL-F, Kyoritsu Chemical-Check Lab., Corp.).

4) The data on potassium concentration obtained from the ED-TRXRF is more reliable than that obtained from turbidimetric method (WAL-F, Kyoritsu Chemical-Check Lab., Corp.) under the condition of high potassium concentration.

5) The data on calcium concentration obtained from the titration method is consistent with that obtained from the ED-TRXRF methods.

(2) Other Metal Components

Iron was measured with two methods, colorimetry (WAL-F) and ED-TRXRF technique. The results from ED-TRXRF technique show the very high value of iron concentration in Annex VI-3 ((3/4) and (4/4)). But water samples didn't clearly have color and taste problems. Samples of B5 and B6 were also analyzed in Japan and the concentrations obtained in Japan were below 0.05 mg/l for both samples. Iron concentrations obtained from ED-TRXRF were 2 mg/l for both B5 and B6 samples. Probably spectra of other elements affected that of iron in the ED-TRXRF method, so the results from colorimetry (WAL-F) were chosen.

Copper and manganese were measured with two methods, colorimetry (WAL-F) and ED-TRXRF technique. These results are compared in Annex VI-3 ((3/4) and (4/4)). ED-TRXRF technique is generally more reliable than the colorimetry.

However ED-TRXRF technique is not a good method to measure lead, cadmium, arsenic and mercury in the range of the drinking water quality standard where concentration of those metals is considerably low. This made it difficult to determine the accurate concentration of those heavy metal parameters. Therefore some of the samples were analyzed again with a different method in 1998. In this reexamination, it was confirmed that the results from the colorimetric method used for arsenic and Graphite furnace atomic absorption spectrometric method used for lead and cadmium are reliable. This is supported by a separate analysis done in Japan.

(3) Microbiological Analysis

Two different methods were used for coliform and general bacteria detection, standard method and test paper method. The standard method takes time and effort while the test paper method is quick and easy. However the test paper method didn't work well in this study. This is probably because preservation condition during the transportation was bad and the test papers had already been expired. Therefore only the results from standard method are shown in this report.

8.6 CHARACTERISTICS OF WATER QUALITY

8.6.1 Existing Wells and New Test Wells

The results of the analysis are summarized in Table 8.5 for existing wells (including calculated values of magnesium and hardness from the charge balance of major ions) and Table 8.6 for new test wells. The reanalyzed data of heavy metal (lead, cadmium, arsenic and total chromium) for SW-6 and SW-8 is also shown in Table 8.7. These values are compared with Mongolian Standard and the findings are as follows.

All the existing wells except SW-6 are not good for drinking because the hardness, magnesium and sulfate concentration are very high.

All the new test wells except B5 and B6 are not good for drinking, because the hardness, magnesium and sulfate concentration are very high.

(1) Color

Samples for SW-7 exceed the revised WHO guideline (15 mg/l Pt scale) and some samples for SW-1, SW-4, SW-5, SW-6, SW-7, and SW-8 exceed the revised WHO guideline for existing wells.
Samples for A1, A2, B3, B4 new test wells exceed the revised WHO guidelines.

(2) Hardness

All the samples for existing wells except SW-6 exceed the Mongolian standard value (350 mg $CaCO_3$/l). All the samples for SW-1 and SW-7 exceed 1000mg $CaCO_3$/l.
Samples for new test wells except B5 and B6 exceed the Mongolian standard value. Especially samples for A1, A2, A4 and B3 exceed 1000mg $CaCO_3$/l.

(3) Dry residue

Samples for SW-1, SW-3, SW-4, SW-7, A1, A2, A3, A4, B1, B2, B3, and B4 exceed the Mongolian standard value (1000 mg/l).

(4) Sulfate

Samples for SW-1, SW-3, SW-4, SW-7, A2, B2, B3 and B4 exceed the Mongolia

standard value (500mg SO_4^{2-}/l). Especially samples for SW-1, A2, B2 and B3 exceed 1000 mg SO_4^{2-}/l.

(5) Calcium

Samples for SW-1, SW-3, A2 and B3 exceed the Mongolian standard value (100mg Ca/l).

(6) Magnesium

Samples for all the existing wells exceed the Mongolian standard value (30 mg Mg/l). Furthermore samples for SW-1, SW-3, SW-4, and SW-7 exceed 100 mg Mg/l. All samples for the new test wells exceed the Mongolian standard value. Samples for new test wells except A3, B5, B6 exceed 100 mg Mg/l.

(7) Strontium

Samples for SW-1, SW-3 and SW-4 exceed the Mongolian standard value (2 mg Sr/l). Samples for A2, B2, B3 and B4 exceed the Mongolian standard value.

(8) Iron

Samples for SW-4 and A2 exceed the Mongolian standard value (0.3 mg Fe/l).

(9) Manganese

Samples for SW-5, SW-6, and SW-8 exceed the Mongolian standard value (0.1 mg Mn/l). One sample for SW-1 and SW-7 exceed the Mongolian standard value. One sample for SW-1 and SW-7 exceed the Mongolian standard value. Samples for A2 and B3 exceed the Mongolian standard value.

(10) Cyanide

Some samples for SW-1and SW-5 exceed the Mongolian standard value (0.1 mg CN/l). Samples for B2 and B4 new test wells exceed the Mongolian standard value.

(11) Total Coliforms

Samples for existing wells except SW-6 exceed the guideline (less than 3 in 1l). One sample for SW-6 fulfils this guideline. Samples for all the new test well exceed the guideline.

8.6.2 Water Supply System

The results of water quality analysis for 1997 are summarized in Tables 8.8 - 8.11. The calculated values of magnesium ion, hardness and dry residue from the charge balance of major ions are shown in Table 8.8. The magnesium concentration for DR-1 and DW-1 analyzed in Japan are also shown in Table 8.9. The reanalyzed data for 1998 for lead, cadmium, arsenic and total chromium are shown in Table 8.11. It was confirmed that the reanalysis values for the heavy metals all fulfil the Mongolian standard values.

(1) Magnesium

Every sample exceeds the Mongolian standard value (30 mg Mg/l).

(2) Iron and Manganese

The majority of samples fulfill the Mongolian standard values (0.3 mg Fe/l, and 0.1 mg Mn/l).

(3) Total Coliforms

For the majority of samples total coliforms exceed the guideline value (less than 3 in 1 liter). The distribution of coliform count for DR, DT, DW and DG is shown in Table 8.10. The comparison between tap water (DT) and the water stored in Gers (DG) shows that the water quality of the tap water is microbiologically better than that of stored water in Gers.

(4) General Bacteria

For the majority of samples general bacteria exceed the Mongolian standard value (100/ml).

8.6.3 Rivers

Water quality for rivers are shown in Table 8.12. Khadaasan river (R-1)'s water seems to be concentrated by up and has high concentration of sulfate, chloride, calcium, magnesium and strontium. All these rivers are microbiologically contaminated.

8.6.4 Sewerage System

Water quality for the sewerage system is shown in Table 8.13 and 8.14. Comparison of water quality of the effluent (S-3) with the maximum quality limit for reusing the treated wastewater for pasture indicate:

a) Ammonia exceeds this limit (10 mg N/l),
b) SS exceeds this limit (30 mg/l), and
c) BOD is within or is slightly over this limit (20 mg/l).

8.7 EVALUATION OF DRINKING WATER QUALITY

Water Quality is evaluated according to the Mongolian standard and WHO guidelines. The results are shown in Table 8.15 for existing wells and water supply system, and new test wells.

(1) Existing Wells and New Test Wells

Kharzat production well (SW-6) is the best of all analyzed existing wells for a domestic water source, though magnesium concentration exceeds the Mongolian standard and total coliform number is high.
B5 and B6 of the new test wells are better than any other new test wells for a domestic water source, though its magnesium concentration exceeds the Mongolian standard for drinking water and total coliform is very high.
Considering all the analysis results, it can be concluded that SW-6 (Kharzat production well) is the best choice as water supply source among all the existing wells and new test wells. B5 and B6 can also be used in the future. B5 is better than B6, because the magnesium concentration in B5's water is lower than that in B6.

(2) Water Supply System

All the parameters except for the magnesium concentration and microbiological parameters (total coliform and general bacteria) of the water supply system are acceptable. Water stored in Ger (DG) is microbiologically more contaminated than

other samples of the water supply system.
The existence of coliform will not be a big problem because it can be easily removed by chlorination.

Table 8.1 Water Quality for Drinking Water in Gobi Altai Province

Sum name	year	season	odor	taste	temp °C	trans-parency cm	color	pH	hardnes meq/l	Ca mg Ca/	Mg mg Mg/l	NH_4 mg N/l	NO_2 mg N/l	NO_2 mg N/l	chloride mg Cl/l	Fe mg Fe/l	PO_4 mg PO_4/l	F mg F/l	SO_4 mg SO_4/l	acidity meq/l	alkalinity meq/l	residual chlorine mg Cl_2/l	bacterium number/ml	coliform number/l
Kharzat	1985	av. of 4 time	1	2	6.0	>30	5	6.8	4.4	39	40	0.06	0.01	0.90	21	0.00				0.30	3.6		38	3
(Altai City)	1986	av. of 4 time	1	2	6.0	>30	5	8.0	4.5	30	35	0.01	0.01	1.00	28	0.00				0.20	4.0		35	3
	1987	av. of 4 time	1	2	7.6	>30	5	7.5	4.7	31	35	0.01	0.01	1.50	28	0.00				0.30	3.8		7	3
	1988	av. of 4 time	1	2	8.2	>30	5	7.2	4.6	32	36	0.10	0.03	1.30	27	0.30				0.30	4.0		31	3
	1989	av. of 4 time	1	2	8.5	>30	5	7.2	4.8	34	37	0.10	0.03	1.10	28	0.30		0.46		0.30	3.9		18	3
	1990	av. of 4 time	1	2	9.0	>30	5	7.2	5.0	36	38	0.09	0.03	1.00	28	0.30		0.44		0.30	4.0		47	3
	1991	av. of 4 time	1	2	9.0	>30	5	8.0	4.9	32	39	0.10	0.05	0.05	155	0.30	0.030	0.70		0.30	4.1	0.35	99	3
	1992	av. of 4 time	1	2	9.0	>30	5	8.0	4.8	34	39	0.10	0.05	0.30	181	0.23	0.050	0.52		0.25	4.3	0.40	105	3
	1993	av. of 4 time	1	2	8.5	>30	5	8.0	4.9	34	40	0.09	0.03	0.30	59	0.17	0.150	0.56		0.25	4.0	0.38	134	3
	1994	av. of 4 time	1	2	8.7	>30	5	8.0	4.8	32	39	0.15	0.07	0.03	27	0.40	0.098	0.46		0.23	4.1	0.50	318	5
	1995	av. of 4 time	1	2	8.6	>30	5	8.0	4.8	32	37	0.15	0.09	0.10	29	0.10	0.085	0.64		0.28	3.8	0.35	117	3.5
Sharga	1993	av. of 4 time	1	1		>30	5	7.0	4.2	46	23	0.20	0.01	1.00	25	0.00				0.03	4.0			
	1994	av. of 4 time	1	1	4.0	>30	5	7.0	4.0	40	24	0.01	0.01	1.00	25	0.00				0.30	4.0			
	1995	av. of 4 time	2	2				6.0	4.0	50	15	0.23	0.05		58	0.10				0.20	2.9			
Khaliun	1993	av. of 4 time	1	1	6.0		5	7.4	5.4	56	31	0.10	0.03	1.50	21	0.00				0.30	3.8			
	1994	av. of 4 time	1	1	10.0		5	7.0	5.2	52	31	0.10	0.04	1.00	37	0.30				0.30	4.6			
	1995	av. of 4 time	2	2		>30	5	7.0	5.3	58	29	0.20	0.11	0.75	60	0.08					3.7			
Taishir	1993	av. of 4 time	1	1	7.0		5	7.0	2.8	38	11	0.01	0.01	1.00	28	0.00				0.30	4.0		52	9
	1994	av. of 4 time	1	1	4.0		5	7.0	2.0	28	72	0.01	0.01	1.00	24	0.00				0.30	4.0			
	1995	av. of 4 time	1	1			5	7.0	2.6	28	15	0.01	0.01	1.50	25	0.00				0.30	3.8			
Delger	1993	av. of 4 time	1	1	5.0	28	5	6.8	3.6	38	20	0.00	0.03		37	0.50				0.30	2.7			
	1994	av. of 4 time	1	1	3.0	>30	5	6.8	4.6	46	28	0.10	0.01	1.50	49	0.50				0.20	3.0			
	1995	av. of 4 time	1	1		>30	5		3.9	40	19	0.10	0.01	1.00	26	0.30				0.30	3.5		91	3
Bungat	1994	II	2	2		>30	5	6.0	3.9	52	16	0.20	0.15		36					0.10	2.7			
Tseel	1994	II	1	1		>30	5		8.1	95	24	0.10	0.01	1.00	60	0.30				0.20	4.3			
Bayan	1994	II	2	2		>30	5	4.0	8.2	88	46	0.10	0.03	0.14	462	0.20				0.20	3.9			
Chandmana	1994	II	4	1		>30		7.0	3.3	46	16		0.05		26	0.10				0.30	4.2			
Jargalan	1994	II	2	2	3.0	>30	5	4.0	5.2	44	36	0.23	0.10	0.04	60	0.15				0.20	4.0			
Erdene	1994	II	2	2		>30	5	6.5	6.1	50	43	0.20	0.05		18	0.10				0.30	3.8			
Tugrug	1994	II	2	2		>30		7.0	8.2	88	46	0.20	0.25		52	0.10				0.40	2.9			
Khekhmorut	1994	II	2	2		>30	5	8.0	6.5	79	31	0.20	1.50	0.10	354	0.10				0.30	3.1			
Bigar	1994	II	1	1		>30		7.0	3.2	36	17	0.20	0.10		19	0.10	0.005	0.60		0.10	2.7			
Tsogt	1994	II	2	2		>30	5	7.0	8.2	76	53				55					0.20	4.6			
Tonkhil	1994	II	2	2			5	6.1	5.6	71	28	0.10	0.01	0.80	23	0.30				0.20	4.0			
Darvi	1994	II	2	2		>30	5	7.0	2.7	30	14				18					1.50	0.3			
Altai	1994	II	2	2		>30	5	5.0	4.5	58	19	0.15	0.44	0.03	17	0.07	0.025	0.50		0.30	3.0			
Standard for drinkng water			≦2	≦2		>30	≦20	6.5-8.5		≦100	≦30			≦10	≦350	≦0.3	≦3.5	0.7-1.5	≦500					≦3

Table 8.2 Water Quality for Drinking Water in Kharzat (Altai City) and Zavkhan River

Sampling Point	year	odor	taste	transparency cm	color	pH	hardness meq/l	Ca mg Ca/l	Mg mg Mg/l	NH4 mg N/l	NO_2 mg N/l	NO_3 mg N/l	chloride mg Cl/l	Fe mg Fe/l	PO_4 mg P/l	F mg F/l	acidity meq/l	alkalinity meq/l	residual chlorine mg Cl2/l
Reservoir (before chlorination)	1993	2	2	>30	5	7.6	4.9	32	36	0.02	0.04	0.35	47	0.10	0.035	0.50	0.20	3.8	0.00
	1994																		
	1995	2	2	>30	5	7.0	4.8	32	39	0.80	0.28	0.04	23	0.20	0.140	0.60	0.20	3.8	0.00
	1996	2	2	>30	5	7.5	4.9	50	41	0.30	0.20	0.01	23	0.20	0.060	1.10	0.30	3.7	0.00
Reservoir (after chlorination)	1993	2	2	>30	5	7.8	5.0	35	38	0.20	0.04	0.16	60	0.20	0.080	0.40	0.30	4.0	0.60
	1994	2	2	>30	5	7.0	4.7	32	32	0.10	0.02	0.04	21	0.18	0.130	0.40	0.30	4.0	0.68
	1995	2	2	>30	5	7.0	4.8	32	39	0.12	0.13	0.03	23	0.18	0.080	0.45	0.30	4.0	0.35
	1996	2	2	>30	5	8.0	4.8	39	40	0.20	0.10	0.20	23	0.10	0.200	1.00	0.30	4.0	0.00
Tap Water	1993	2	2	>30	5	7.0	5.2				0.05	0.04	23	0.20			0.30	4.0	0.30
	1994	2	2	>30	5	7.0	4.7	31	37		0.03	0.05	23	0.20		0.40	0.30		0.30
	1995																		
	1996	2	2	>30	5	8.0	4.8	36						0.20	0.040		0.30	3.8	0.00
Water Wagon	1993	2	2	>30	5	7.0	5.4	40	42		0.08	0.04	23	0.21	0.030	0.70	0.30	4.0	0.25
	1994	2	2	>30	5	7.0	4.8			0.12	0.04	0.05	23	0.20	0.100	0.80	0.30		0.27
	1995	2	2	>30	5		4.7	30	39					0.20		0.80	0.30	4.0	0.29
	1996	2	2	>30	5	8.0	4.8	36	31					0.28			0.30	4.0	
Zavkhan River																			
(Guulin)	1991	2	2	>30	5	7.5	2.1	26	10				14	0.10	0.120		0.20	2.8	
(Guulin)	1996	2	2	>30	5	7.5	1.8	30	6				8	0.10	0.130		0.20	2.8	
(Taishir)	1996	2	2	>30	5	7.5	2.4	36	7				16	0.10	0.300		0.20	3.0	
Standard for drinking water		≦2	≦2	>30	≦20	6.5-8.5		≦100	≦30			≦10	≦350	≦0.3	≦3.5	0.7-1.5			

Table 8.3 Heavy Metal Parameters in Drinking Water of Altai City in 1991

Heavy Metal	Sampling Number	Unit	Average Concentration	Mongolian Standard for drinking water
Copper	3	micro-g CU/l	5.38	≦1000
Silver	3	micro-g Ag/l	0.85	≦50
Zinc	3	micro-g Zn/l	42.96	≦5000
Cadmium	3	micro-g Cd/l	0.86	≦10
Lead	3	micro-g Pb/l	5.84	≦30
Vanadium	3	micro-g V/l	4.90	—
Chromium	3	micro-g Cr/l	12.36	≦50
Molybdenum	3	micro-g Mo/l	3.64	≦250
Manganese	3	micro-g Mn/l	3.62	≦100
Iron	3	micro-g Fe/l	275.70	≦300
Cobalt	3	micro-g Co/l	0.40	—
Nickel	3	micro-g Ni/l	7.90	—
Aluminum	3	micro-g Al/l	50.66	≦500
Cesium	3	micro-g Cs/l	0.70	—

Table 8.4 Items for Water Quality Analysis

Parameter	Wells	Water Supply Facilities	Rivers	Sewerage	Analized in
1 pH	O	O	O	O	ALT
2 Temparature	O	O	O	O	ALT
3 Odor	O	O	O		ALT
4 Taste	O	O			ALT
5 Colour	O	O			ALT
6 Turbidity	O	O	O	O	ALT
7 Conductivity	O	O	O		ALT
8 Hardness	O	O	O	O	ALT
9 Dry Residual	O	O	O	O	ALT
10 COD	O	O	O	O	BOTH
11 Nitrite Ion	O	O	O	O	ALT
12 Nitrate Ion	O	O	O	O	ALT
13 Ammonium Ion	O		O	O	ALT
14 Orthphosphate	O			O	ALT
15 Biocarbonate Ion	O				ALT
16 Carbonate Ion	O				ALT
17 Chloride Ion	O	O	O	O	ALT
18 Sulfate Ion	O				BOTH
19 Sodium Ion	O				UBL
20 Potassium Ion	O				BOTH
21 Calcium Ion	O	O	O	O	BOTH
22 Magnesium Ion	O	O	O	O	ALT
23 Copper	O	O	O	O	BOTH
24 Iron	O	O	O	O	BOTH
25 Manganese	O	O	O	O	BOTH
26 Zinc	O	O	O	O	UBL
27 Lead	O	O	O	O	UBL
28 Chromium(VI)	O	O	O	O	BOTH
29 Cadmium	O	O	O	O	UBL
30 Arsenic	O	O	O	O	UBL
31 Cyanide	O	O	O	O	ALT
32 Mercury	O			O	UBL
33 Fluoride	O	O	O	O	ALT
34 Silica	O				ALT
35 Molybdenum	O				UBL
36 Beryllium	O				UBL
37 Aluminum	O				ALT
38 Total Coliforms	O	O	O	O	ALT
39 General Bacteria		O			ALT
40 Residual Chlorine	O	O			ALT
41 BOD				O	UBL
42 SS				O	ALT
43 Acidity	O	O	O	O	ALT
44 Alkaklinity	O	O	O	O	ALT
45 Nickel	O	O	O	O	UBL
46 Selenium	O	O	O	O	UBL
47 Bromeine	O	O	O	O	UBL
48 Strontium	O	O	O	O	UBL

Note : O means parameters analyzed

ALT: Altai City, UBL: Ulaanbaatar City, BOTH: Altai and Ulaanbaatar City

Table 8.4 Items for Water Quality Analysis

Parameter	Wells	Water Supply Facilities	Rivers	Sewerage	Analized in
1 pH	○	○	○	○	ALT
2 Temparature	○	○	○	○	ALT
3 Odor	○	○	○		ALT
4 Taste	○	○			ALT
5 Colour	○	○			ALT
6 Turbidity	○	○	○	○	ALT
7 Conductivity	○	○	○		ALT
8 Hardness	○	○	○	○	ALT
9 Dry Residual	○	○	○	○	ALT
10 COD	○	○	○	○	BOTH
11 Nitrite Ion	○	○	○	○	ALT
12 Nitrate Ion	○	○	○	○	ALT
13 Ammonium Ion	○		○	○	ALT
14 Orthphosphate	○			○	ALT
15 Biocarbonate Ion	○				ALT
16 Carbonate Ion	○				ALT
17 Chloride Ion	○	○	○	○	ALT
18 Sulfate Ion	○				BOTH
19 Sodium Ion	○				UBL
20 Potassium Ion	○				BOTH
21 Calcium Ion	○	○	○	○	BOTH
22 Magnesium Ion	○	○	○	○	ALT
23 Copper	○	○	○	○	BOTH
24 Iron	○	○	○	○	BOTH
25 Manganese	○	○	○	○	BOTH
26 Zinc	○	○	○	○	UBL
27 Lead	○	○	○	○	UBL
28 Chromium(VI)	○	○	○	○	BOTH
29 Cadmium	○	○	○	○	UBL
30 Arsenic	○	○	○	○	UBL
31 Cyanide	○	○	○	○	ALT
32 Mercury	○			○	UBL
33 Fluoride	○	○	○	○	ALT
34 Silica	○				ALT
35 Molybdenum	○				UBL
36 Beryllium	○				UBL
37 Aluminum	○				ALT
38 Total Coliforms	○	○	○	○	ALT
39 General Bacteria		○			ALT
40 Residual Chlorine	○	○			ALT
41 BOD				○	UBL
42 SS				○	ALT
43 Acidity	○	○	○	○	ALT
44 Alkaklinity	○	○	○	○	ALT
45 Nickel	○	○	○	○	UBL
46 Selenium	○	○	○	○	UBL
47 Bromeine	○	○	○	○	UBL
48 Strontium	○	○	○	○	UBL

Note : ○ means parameters analyzed

ALT: Altai City, UBL: Ulaanbaatar City, BOTH: Altai and Ulaanbaatar City

Table 8.5 Water Quality for Existing Wells

Item			well water								Mongolian
No.	Item	Unit	SW-1	SW-2	SW-3	SW-4	SW-5	SW-6	SW-7	SW-8	Standard
1	pH		7.4-7.9	7.4-8.1	7.7-7.9	8-8.1	7.6-8.4	8.3-8.6	8.1-8.5	7.6-7.9	6.5-8.5
2	Temperature	°C	4.5-7.0	(-2)-6	(-5.5)-7	(-4.5)-5	3.5-4	(-3)-2.5	(-3.5)-3.5	4-8	
3	Odor	dilution factor	-	<1	<1	<1	<1	<1	1	<1	≦2
4	Taste	dilution factor	-	-	-						≦2
5	Color	mg/l Pt scale	4-20	2-6	2-10	6-20	4-20	10-20	20	5-20	≦15$
6	Turbidity	kaolin (JIS)	1-5	1-2	<1	3-15	0.5-10	3-5	3-15	0.5-5	
7	Conductivity	mS/m(at 25°C)	276-436	100-186.7	238-360	288-450	143-224	46-91.3	71.7-524	83-134.7	
8	Hardness	$mgCaCO_3/l$	1375-2500	370-575	690-1625	890-3375	178-550	200-300	793-1150	220-1850	≦350
8	Hardness###	$mgCaCO_3/l$	1400-1770	400-540	1800-970	690-1140	300-510	116-210	1110-1790	340-410	≦350
9	Dry Residue###	mg/l	1796-2257	574-746	1047-1338	1025-1402	498-685	270-396	1296-1981	495-563	≦1000
10	COD($KMn0_4$, alkali)	mg O_2/l	6	4.8	6.2	1.5	5.1-7	2-4	2-6.7	4-8	
11	Nitrite	mg NO_2/l	0.06-0.24	0.01-0.5	0.01-0.25	0-0.34	0.02-0.05	0.05-0.3	0.01-0.17	0.03-2	
12	Nitrate	mg NO_3/l	5.5-9.6	5.4-9.8	4.1-9.6	3.9-28	0.5-1	2-5.6	4-6	0.21-0.6	≦44.3
13	Ammonium	mg NH_4/l	0.43-0.6	0.2-0.4	0.24-0.35	0.24-0.38	<0.2-1.2	0.24-0.45	0.28-0.45	1.2-1.6	
14	Orthophosphate	mg PO_4/l	0.14-0.3	0.05-0.15	0.03-0.1	0.07-0.1	0.04-0.5	<0.05	0.18-0.38	0.12-0.41	≦3.5
15	Bicarbonate	mg HCO_3/l	305-427	220-281	244-281	311-354	0-70	207-214	403-1007	397-470	
16	Carbonate	mg CO_3/l	0.27-0.66	0.16-0.89	0.35-0.52	0.89-1.08	0.18-0.96	1.04-2.14	2.33-3.20	0.4-0.86	
17	Chloride*	mg Cl/l	14-28	10-36	58-138	139-140	18-25	6-19	57-236	17-35	≦350
18	Sulfate#	mg SO_4/l	1170-1430	280-380	540-670	401-730	270-380	57-140	520-720	80-130	≦500
19	Sodium***	mg Na/l	49.0-49.3	47	54.0-54.6	52-52.3	54.2-54.8	56-56.2	53.1-53.6	52-52.2	
20	Potassium*	mg K/l	13.2-16	3.7-6	7	9-12.2	3.1-8.6	2.5-5	19.4-31	6.7-17	
21	Calcium	mg Ca/l	100-236	45-67	136-260	28-60	19-26	22-27	27-42	25-80	≦100
22	Magnesium	mg Mg/l	188-540	62-96	108-234	146-774	27-116	33-56	174-251	36-356	≦30
22	Magnesium##	mg Mg/l	250-282	68-97	177-188	141-257	61-110	133-138	240-405	34-77	≦30
23	Copper*	mg Cu/l	0.04-0.12	0.05-0.13	0.05-0.07	<0.05	<0.04-0.11	0.03-0.15	0.05-0.08	0.02-0.24	≦1
24	Iron	mg Fe/l	0.09-0.30	0.04-0.2	0.06-0.14	0.05-0.35	0.06-0.14	0.06-0.10	0.03-0.10	0.02-0.11	≦0.3
25	Manganese*	mg Mn/l	0.07-0.13	<0.1	<0.08	0.08	0.54-0.61	0.19-0.43	0.04-0.14	0.73-0.84	≦0.1
26	Zinc*	mg Zn/l	0.21-0.48	0.16-0.58	0.14-0.37	0.32-0.9	0.06-0.28	0.33-0.6	0.23-0.48	0.7-1.25	≦5
27	Lead**	mg Pb/l	0.02	0.01	0.02	0.01	0.02	0.01	0.01	0.02	≦0.03
28	Chromium(VI)	mg Cr(VI)/l	0.01	0.01-0.05	<0.02	<0.01-0.02	0.01-0.04	0.03	0.01-0.02	<0.01	
	Chromium**	mg Cr/l	0.03	0.05	0.05	0.02	0.04	0.02	0.03	0.02	≦0.05
29	Cadmium**	mg Cd/l	0.02	0.02	0.01	0.01	0.02	0.01	0.01	0.02	≦0.01
30	Arsenic*	mg As/l	<0.1								≦0.05
	Arsenic**	mg As/l	0.02	0.01	0.03	0.01	0.02	0.01	0.02	0.01	
31	Cyanide	mg CN/l	<0.01-0.5	0.01-0.04	<0.01-0.1	<0.01-0.1	0.09-2.5	0.02-0.05	0.01-0.05	0.06	≦0.1
33	Fluoride	mg F/l	0.04	0.01-0.04	0.05	<0.01-0.02	0.06-0.3	0.01-0.4	0.01-0.7	0.01-0.62	0.7-1.5
34	Silica	mg SiO_2/l	2.3-14	5.2-14	3.5-12	5.2-13	1.1-1.3	5.4-9	5.2-11	2.7-15	
35	Molybdenum**	mg Mo/l	0.02-0.03	0.03	0.05	0.03	0.04	0.02	0.03	0.03	≦0.25
36	Beryllium**	mg Be/l	nd	nd	0.003	0.026	0.003	nd	nd	0.0042	≦0.0002 $$
37	Aluminum	mg Al/l	0.01-0.1	0.01	<0.01-0.08	0.02-0.03	0.02-0.1	0.01-0.03	0.01-0.11	0.01-0.02	≦0.5
38	Total Coliforms	No. in 1l	2380	180-960	180-2380	23-2380	94-2380	9-23	23-960	10-960	(<3 in 1l)
43	Acidity	mg $CaCO_3/l$	90-125	45-100	55-125	50-130	0-57.5	92.5-95	70-205	90-160	
44	Alkalinity	mg $CaCO_3/l$	250-350	210-230	200-230	255-290	115-240	170-175	330-825	325-385	
	Nickel*	mg Ni/l	<0.07	<0.04-0.08	<0.07	<0.05-0.07	<0.07	0.02-0.07	0.02-0.12	0.03-0.08	
	Selenium*	mg Se/l	<0.08	<0.07	<0.06	<0.06	<0.1	<0.03	<0.055	<0.04	≦0.001 $$$
	Strontium*	mg Sr/l	3.68-4.17	0.92-1.1	5.27-5.17	2.8-3	0.4-0.51	0.5-0.89	0.43-0.57	0.53-0.69	≦2
	Bromine*	mg Br/l	0.37-0.46	0.08-0.48	0.31-0.69	0.68-0.7	0.14-1.51	0.05-0.45	0.56-1.81	0.12-0.42	

nd not detected
* ED-TRXRF
** Colorimetry in Ulaanbaatar
*** Flame emission spectrometric method
\# Calculated from the correlation between results from gravimetric method and from ED-TRXRF method
\## Calculated from charge balance
\### Calculated value
$ WHO guideline
$$ 0.004 (mg/l) as maximum contaminant level (MCL) for the Primary Regulation of USA
$$$ 0.05 (mg/l) as maximum contaminant level (MCL) for the Primary Regulation of USA

Table 8.5 Water Quality for Existing Wells

Item			well water								Mongolian
No.	Item	Unit	SW-1	SW-2	SW-3	SW-4	SW-5	SW-6	SW-7	SW-8	Standard
1	pH		7.4-7.9	7.4-8.1	7.7-7.9	8-8.1	7.6-8.4	8.3-8.6	8.1-8.5	7.6-7.9	6.5-8.5
2	Temperature	℃	4.5-7.0	(-2)-6	(-5.5)-7	(-4.5)-5	3.5-4	(-3)-2.5	(-3.5)-3.5	4-8	
3	Odor	dilution factor	-	<1	<1	<1	<1	<1	1	<1	≦2
4	Taste	dilution factor	-	-	-						≦2
5	Color	mg/l Pt scale	4-20	2-6	2-10	6-20	4-20	10-20	20	5-20	≦15$
6	Turbidity	kaolin (JIS)	1-5	1-2	<1	3-15	0.5-10	3-5	3-15	0.5-5	
7	Conductivity	mS/m(at 25℃)	276-436	100-186.7	238-360	288-450	143-224	46-91.3	71.7-524	83-134.7	
8	Hardness	mg$CaCO_3$/l	1375-2500	370-575	690-1625	690-3375	178-550	200-300	783-1150	220-1850	≦350
8	Hardness###	mg$CaCO_3$/l	1400-1770	400-540	1800-970	690-1140	300-510	116-210	1110-1790	340-410	≦350
9	Dry Residue###	mg/l	1798-2257	574-746	1047-1338	1025-1402	498-685	270-396	1296-1981	495-563	≦1000
10	COD($KMnO_4$, alkali)	mg O_2/l	6	4.8	6.2	1.5	5.1-7	2-4	2-6.7	4-8	
11	Nitrite	mg NO_2/l	0.06-0.24	0.01-0.5	0.01-0.25	0-0.34	0.02-0.05	0.05-0.3	0.01-0.17	0.03-2	
12	Nitrate	mg NO_3/l	5.5-9.6	5.4-9.8	4.1-9.6	3.9-28	0.5-1	2-5.6	4-6	0.21-0.6	≦44.3
13	Ammonium	mg NH_4/l	0.43-0.6	0.2-0.4	0.24-0.35	0.24-0.38	<0.2-1.2	0.24-0.45	0.28-0.45	1.2-1.6	
14	Orthophosphate	mg PO_4/l	0.14-0.3	0.05-0.15	0.03-0.1	0.07-0.1	0.04-0.5	<0.05	0.18-0.38	0.12-0.41	≦3.5
15	Bicarbonate	mg HCO_3/l	305-427	220-281	244-281	311-354	0-70	207-214	403-1007	397-470	
16	Carbonate	mg CO_3/l	0.27-0.66	0.16-0.89	0.35-0.52	0.89-1.08	0.18-0.96	1.04-2.14	2.33-3.20	0.4-0.86	
17	Chloride*	mg Cl/l	14-28	10-36	58-138	139-140	18-25	6-19	57-236	17-35	≦350
18	Sulfate#	mg SO_4/l	1170-1430	280-380	540-670	401-730	270-380	57-140	520-720	80-130	≦500
19	Sodium***	mg Na/l	49.0-49.3	47	54.0-54.6	52-52.3	54.2-54.8	56-56.2	53.1-53.6	52-52.2	
20	Potassium*	mg K/l	13.2-16	3.7-6	7	9-12.2	3.1-8.6	2.5-5	19.4-31	6.7-17	
21	Calcium	mg Ca/l	100-236	45-67	36-260	28-60	19-26	22-27	27-42	25-80	≦100
22	Magnesium	mg Mg/l	188-540	62-98	138-234	146-774	27-116	33-56	174-251	38-396	≦30
22	Magnesium##	mg Mg/l	250-282	68-97	77-188	146-257	61-110	13-38	249-405	34-77	≦30
23	Copper*	mg Cu/l	0.04-0.12	0.05-0.13	0.05-0.07	<0.05	<0.04-0.11	0.03-0.15	0.05-0.08	0.02-0.24	≦1
24	Iron	mg Fe/l	0.09-0.30	0.04-0.2	0.06-0.14	0.05-0.35	0.06-0.14	0.06-0.10	0.03-0.10	0.02-0.11	≦0.3
25	Manganese*	mg Mn/l	0.07-0.13	<0.1	<0.08	0.08	0.54-0.61	0.19-0.43	0.04-0.14	0.73-0.84	≦0.1
26	Zinc*	mg Zn/l	0.21-0.48	0.16-0.58	0.14-0.37	0.32-0.9	0.06-0.28	0.33-0.6	0.23-0.48	0.7-1.25	≦5
27	Lead**	mg Pb/l	0.02	0.01	0.02	0.01	0.02	0.01	0.01	0.02	≦0.03
28	Chromium(VI)	mg Cr(VI)/l	0.01	0.01-0.05	<0.02	<0.01-0.02	0.01-0.04	0.03	0.01-0.02	<0.01	
	Chromium**	mg Cr/l	0.03	0.05	0.05	0.02	0.04	0.02	0.03	0.02	≦0.05
29	Cadmium**	mg Cd/l	0.02	0.02	0.01	0.01	0.02	0.01	0.01	0.02	≦0.01
30	Arsenic*	mg As/l	<0.1								≦0.05
	Arsenic**	mg As/l	0.02	0.01	0.03	0.01	0.02	0.01	0.02	0.01	
31	Cyanide	mg CN/l	<0.01-0.5	0.01-0.04	<0.01-0.1	<0.01-0.1	0.09-2.5	0.02-0.05	0.01-0.05	0.06	≦0.1
33	Fluoride	mg F/l	0.04	0.01-0.04	0.05	<0.01-0.02	0.06-0.3	0.01-0.4	0.01-0.7	0.01-0.62	0.7-1.5
34	Silica	mg SiO_2/l	2.3-14	5.2-14	3.5-12	5.2-13	1.1-1.3	5.4-9	5.2-11	2.7-15	
35	Molybdenum**	mg Mo/l	0.02-0.03	0.03	0.05	0.03	0.04	0.02	0.03	0.03	≦0.25
36	Beryllium**	mg Be/l	nd	nd	0.003	0.026	0.003	nd	nd	0.0042	≦0.0002 $$
37	Aluminum	mg Al/l	0.01-0.1	0.01	<0.01-0.08	0.02-0.03	0.02-0.1	0.01-0.03	0.01-0.11	0.01-0.02	≦0.5
38	Total Coliforms	No. in 1l	2380	180-960	180-2380	23-2380	94-2380	9-23	23-960	10-960	(<3 in 1l)
43	Acidity	mg $CaCO_3$/l	90-125	45-100	55-125	50-130	0-57.5	92.5-95	70-205	90-160	
44	Alkalinity	mg $CaCO_3$/l	250-350	210-230	200-230	255-290	115-240	170-175	330-825	325-385	
	Nickel*	mg Ni/l	<0.07	<0.04-0.08	<0.07	<0.05-0.07	<0.07	0.02-0.07	0.02-0.12	0.03-0.08	
	Selenium*	mg Se/l	<0.08	<0.07	<0.06	<0.06	<0.1	<0.03	<0.055	<0.04	≦0.001 $$$
	Strontium*	mg Sr/l	3.68-4.17	0.92-1.1	5.27-6.17	2.8-3	0.4-0.51	0.5-0.89	0.43-0.57	0.53-0.69	≦2
	Bromine*	mg Br/l	0.37-0.46	0.08-0.48	0.31-0.69	0.68-0.7	0.14-1.51	0.05-0.45	0.56-1.81	0.12-0.42	

nd not detected
* ED-TRXRF
** Colorimetry in Ulaanbaatar
*** Flame emission spectrometric method
\# Calculated from the correlation between results from gravimetric method and from ED-TRXRF method
\## Calculated from charge balance
\### Calculated value
$ WHO guideline
$$ 0.004 (mg/l) as maximum contaminant level (MCL) for the Primary Regulation of USA
$$$ 0.05 (mg/l) as maximum contaminant level (MCL) for the Primary Regulation of USA

Table 8.6 Analysis for Water Quality of New Test Well in Altai City

	Parameter	Unit	Mongolian	A1	A2	A3	A4	B1	B2	B3	B4	B5	B6
	Sampling date		Standard	8th Sep	6th Aug	13th Oct.	5th Oct.	17th Sep	15th Aug	6th July	2nd July	19th July	24th Sep.
1	pH			7.7	7.2	7.2	6.5	8.1	7.8	7.56	7.8	8	8.36
2	Temparature	Deg. C		4.2	9.1	2.2	1.8	4.2	7.2	7.8	4	3.5	2.2
3	Odor		2	1	4	1	1	1	1	2	2	1	1
4	Taste		2	2	2	1	1	2	2	2	2	1	1
5	Color	Pt-unit	15#	20	50	2	2	2	2	50	50	2	1.5
6	Turbidity	NTU	5#	0.5	1.5	1	0.5	0.5	1.5	1	1	1.5	0.5
7	Conductivity	ms/m		213	470	164.3	350	159.2	214	156.7	(58)	44.3	59.9
8	Dry Residue	mg/l	1000	200	600	200	200	200	400	400	400	400	800
9	COD			-	-	-	-	-	-	-	-	-	-
10	Nitrite Ion	mg/l		0.03	0.003	0.006	0.008	0.05	0.007	0.003	0.005	0.002	0.005
11	Nitrate Ion	mg/l	44.3	0.3	10	8	0.1	0.8	0.1	1.5	6	4	0.1
12	Ammonium Ion	mg/l		1.5	0.7	0.6	0.3	1	0.7	0.2	0.15	0.3	1.2
13	Orthophosphate	mg/l	3.5	0.05	0	0.3	0.06	0.6	0.75	0.2	0.05	0.2	0.25
14	Cyanide	mg/l	0.1	0.008	0.01	0.01	0.02	nd	0.1	0.04	0.1	nd	nd
15	Biocarbonate Ion	mg/l		134	420	232	265	135	200	135	160	147	200
16	Carbonate Ion	mg/l		0.3	0.3	0.2	0.0	0.9	0.6	0.2	0.5	0.7	0.2
17	Hardness	mg $CaCO_3$/l	350	100	300	200	200	200	300	200	200	225	257.5
18	Chloride Ion*	mg/l	350	200	300	240	300	235	300	300	300	110	95
19	Sulfate Ion*	mg/l	500	316	300	336	331	303	300	300	300	42.5	59
20	Sodium Ion**	mg/l		68.9	69	83.1	75.3	69.1	71.2	68.3	57.3	59.5	55.9
21	Potassium Ion**	mg/l		6	2.8	6.5	7	4.5	6.8	7	6	1.7	4
22	Calcium Ion	mg/l	100	20	80	24	80	60	40	80	80	12	6
23	Magnesium Ion	mg/l	30	30	30	30	30	30	30	30	30	30	30
24	Copper***	mg/l	1	0.02	0.01	0.01	0.01	0.1	0.2	0.002	0.001	0.1	nd
25	Iron	mg/l	0.3	0.3	0.3	0.1	0.25	0.05	0.2	0.03	0.15	0.05	0.2
26	Manganese***	mg/l	0.1	nd	0.1	nd	nd	nd	nd	0.1	nd	nd	nd
27	Zinc***	mg/l	5	0.37	0.59	0.32	0.73	0.18	0.63	1.45	0.32	0.13	nd
28	Lead****	mg/l	0.03	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
29	Chromium(VI)	mg/l		0.04	0.03	0.02	0.04	0.03	0.01	0.04	0.004	0.01	0.03
30	Cadmium****	mg/l	0.01	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
31	Arsenic**	mg/l	0.05	0.012	0.035	0.01	0.012	0.02	0.015	0.01	0.01	0.015	0.021
32	Mercury			-	-	-	-	-	-	-	-	-	-
33	Fluoride	mg/l	0.7-1.5	1.7	1.5	0.8	1.5	0.7	1.5	0.75	1.5	1.5	0.8
34	Silica	mg/l		2.9	3	2.2	2.5	2	3	2.9	3	2.7	0.5
35	Molybdenum**	mg/l	0.25	0.035	0.024	0.03	0.038	0.029	0.03	0.02	0.04	0.03	0.02
36	Beryllium**	mg/l	0.0002 $	<0.005	<0.003	<0.003	<0.004	<0.005	<0.004	<0.003	<0.003	<0.003	<0.004
37	Aluminum	mg/l	0.5	nd	0.03	0.01	0.01	0.02	nd	0.01	nd	0.25	nd
38	Total Coliforms	no/l	3	50	50	50	50	50	50	50	50	50	50
39	General Bacteria			-	-	-	-	-	-	-	-	-	-
40	Residual Chlorine	mg/l		nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
41	BOD			-	-	-	-	-	-	-	-	-	-
42	SS			-	-	-	-	-	-	-	-	-	-
43	Acidity	mg $CaCO_3$/l		275	250	225	240	175	155	960	27	210	225
44	Alkalinity	mg $CaCO_3$/l		100	325	175	200	100	150	100	120	110	150
	Nickel*	mg Ni/l		1.3	0.17	0.13	0.08	nd	0.08	0.15	nd	nd	nd
	Selenium*	mg Se/l		nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
	Strontium*	mg Sr/l		0.7	11.1	0.6	nd	1	2.1	11.8	5.9	0.5	nd
	Bromine*	mg Br/l		0.3	2	nd	0.2	nd	0.6	2.1	0.9	0.1	0.3

nd: not detected
#: WHO guideline
*: Central Laboratory of Drinking Water and Food Products
**: Institute Chemistry and Chemical Technology of Mongolian Academy of Science
***: Nuclear Physic Research Center
****: Central Laboratory of Geology
$ 0.004 (mg/l) as maximum contaminant level (MCL) for the Primary Regulation of USA

Table 8.6 Analysis for Water Quality of New Test Well in Altai City

	Parameter	Unit	Mongolian	A1	A2	A3	A4	B1	B2	B3	B4	B5	B6
	Sampling date		Standard	8th Sep	6th Aug	13th Oct.	5th Oct.	17th Sep	15th Aug	6th July	2nd July	19th July	24th Sep.
1	pH			7.7	7.2	7.2	6.5	8.1	7.8	7.56	7.8	8	8.36
2	Temparature	Deg. C		4.2	9.1	2.2	1.8	4.2	7.2	7.8	4	3.5	2.2
3	Odor		2	1	4	1	1	1	1	2	2	1	1
4	Taste		2	2	2	1	1	2	2	2	2	1	1
5	Color	Pt-unit	15#	20	50	2	2	2	2	50	50	2	1.5
6	Turbidity	NTU	5#	0.5	1.5	1	0.5	0.5	1.5	1	1	1.5	0.5
7	Conductivity	ms/m		213	470	164.3	350	159.2	214	156.7	(58)	44.3	59.9
8	Dry Residue	mg/l	1000	2000	7600	1200	2400	1400	2100	2800	2400	400	800
9	COD			-	-	-	-	-	-	-	-	-	-
10	Nitrite Ion	mg/l		0.03	0.003	0.006	0.008	0.05	0.007	0.003	0.005	0.002	0.005
11	Nitrate Ion	mg/l	44.3	0.3	10	8	0.1	0.8	0.1	1.5	6	4	0.1
12	Ammonium Ion	mg/l		1.5	0.7	0.6	0.3	1	0.7	0.2	0.15	0.3	1.2
13	Orthophosphate	mg/l	3.5	0.05	0	0.3	0.06	0.6	0.75	0.2	0.05	0.2	0.25
14	Cyanide	mg/l	0.1	0.008	0.01	0.01	0.02	nd	0.15	0.04	1	nd	nd
15	Biocarbonate Ion	mg/l		134	420	232	265	135	200	135	160	147	200
16	Carbonate Ion	mg/l		0.3	0.3	0.2	0.0	0.9	0.6	0.2	0.5	0.7	0.2
17	Hardness	mg $CaCO_3$/l	350	1000	3725	362.5	1875	875	845	1950	900	225	257.5
18	Chloride Ion*	mg/l	350	200	2200	240	475	235	1000	1750	1500	110	95
19	Sulfate Ion*	mg/l	500	316	2818	336	331	303	1150	3062	913	42.5	59
20	Sodium Ion**	mg/l		68.9	69	83.1	75.3	69.1	71.2	68.3	57.3	59.5	55.9
21	Potassium Ion**	mg/l		6	2.8	6.5	7	4.5	6.8	7	6	1.7	4
22	Calcium Ion	mg/l	100	20	272	24	80	60	40	385	100	12	6
23	Magnesium Ion	mg/l	30	228	730	73	402	174	179	237	156	47	58
24	Copper***	mg/l	1	0.02	0.01	0.01	0.01	0.1	0.2	0.002	0.001	0.1	nd
25	Iron	mg/l	0.3	0.3	51	0.1	0.25	0.05	0.2	0.03	0.15	0.05	0.2
26	Manganese***	mg/l	0.1	nd	0.36	nd	nd	nd	nd	0.51	nd	nd	nd
27	Zinc***	mg/l	5	0.37	0.59	0.32	0.73	0.18	0.63	1.45	0.32	0.13	nd
28	Lead****	mg/l	0.03	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
29	Chromium(VI)	mg/l		0.04	0.03	0.02	0.04	0.03	0.01	0.04	0.004	0.01	0.03
30	Cadmium****	mg/l	0.01	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
31	Arsenic**	mg/l	0.05	0.012	0.035	0.01	0.012	0.02	0.015	0.01	0.01	0.015	0.021
32	Mercury			-	-	-	-	-	-	-	-	-	-
33	Fluoride	mg/l	0.7-1.5	1.7	1.7	0.8	1.7	0.7	1.8	0.75	1.8	1.8	0.8
34	Silica	mg/l		2.9	3	2.2	2.5	2	3	2.9	3	2.7	0.5
35	Molybdenum**	mg/l	0.25	0.035	0.024	0.03	0.038	0.029	0.03	0.02	0.04	0.03	0.02
36	Beryllium**	mg/l	0.0002 $	<0.005	<0.003	<0.003	<0.004	<0.005	<0.004	<0.003	<0.003	<0.003	<0.004
37	Aluminum	mg/l	0.5	nd	0.03	0.01	0.01	0.02	nd	0.01	nd	0.25	nd
38	Total Coliforms	no/l	3	92	23	27	10	27	27	960	90	21	10
39	General Bacteria			-	-	-	-	-	-	-	-	-	-
40	Residual Chlorine	mg/l		nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
41	BOD			-	-	-	-	-	-	-	-	-	-
42	SS			-	-	-	-	-	-	-	-	-	-
43	Acidity	mg $CaCO_3$/l		275	250	225	240	175	155	960	27	210	225
44	Alkalinity	mg $CaCO_3$/l		100	325	175	200	100	150	100	120	110	150
	Nickel*	mg Ni/l		1.3	0.17	0.13	0.08	nd	0.08	0.15	nd	nd	nd
	Selenium*	mg Se/l		nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
	Strontium*	mg Sr/l		0.7	11.1	0.6	nd	1	2.1	11.8	5.9	0.5	nd
	Bromine*	mg Br/l		0.3	2	nd	0.2	nd	0.6	2.1	0.9	0.1	0.3

nd: not detected
#: WHO guideline
*: Central Laboratory of Drinking Water and Food Products
**: Institute Chemistry and Chemical Technology of Mongolian Academy of Science
***: Nuclear Physic Research Center
****: Central Laboratory of Geology
$ 0.004 (mg/l) as maximum contaminant level (MCL) for the Primary Regulation of USA

Table 8.7 Reanalyses of Heavy Metals in Well Water of Altai City

Item	Laboratory	Unit	Mongolian Standard	Samples (Sampling:May 30th 1998)	
				SW-6 Kharzat well	SW-8 school well
Lead	#	mg/l	0.03	0.0006	0.0004
	##	mg/l		<0.005	-
Cadmium	#	mg/l	0.01	0.0024	not detected
	##	mg/l		<0.001	-
Arsenic	###	mg/l	0.05	0.009	0.025
	##	mg/l		<0.005	-
Total Chromium	##	mg/l	0.05	<0.004	-

#: Central Laboratory of Environmental Monitoring (Atomic Absorption Spectroscopy (Graphite Furnace))
##: Shizukan Kensa Center (Japan: Analysis Method of Drinking Water in Japan)
###: Institute Chemistry and Chemical Technology of Mongolian Academy of Science (Colorimetry)

Table 8.8 Average Concentrations of Major Ions and Average Physical Parameters for the Water Supply System

Item No.	Item	Unit	Average	Mongolian Standard	WHO	
					(health)	(complain)
7	Conductivity	mS/m(at 25℃)	63.5			
8	Hardness#	mg$CaCO_3$/l	199	≦350		
9	Dry Residue#	mg/l	344	≦1000		≦1000
12	Nitrate	mg NO_3/l	5.4	≦44.3	≦50	
15	Bicarbonate	mg HCO_3/l	247			
16	Carbonate	mg CO_3/l	1.65			
17	Chloride*	mg Cl/l	29	≦350		≦250
18	Sulfate**	mg SO_4/l	68	≦500		≦250
19	Sodium***	mg Na/l	56			
20	Potassium****	mg K/l	3.3			
21	Calcium	mg Ca/l	28	≦100		
22	Magnesium##	mg Mg/l	31	≦30		

* Titration method
** Gravimetric method
*** Flame emission spectrometric method (using data from SW-6)
**** ED-TRXRF method
# Calculated from calcium and magnesium concentration
Calculated from the charge balance

Table 8.9 Water Quality for Water Supply Facilities

Item No.	Item	Unit	Reservoir water		Tap water					Water wagon		Stored water in ger					Mongolian Standard
			DR-1	DR-2	DT-1	DT-2	DT-3	DT-4	DT-5	DW-1	DW-2	DG-1	DG-2	DG-3	DG-4	DG-5	
1	pH		8.2-8.3	8.2-8.3	8.1-8.3	8.2-8.4	7.9-8.2	8.0-8.1	8.2	8.2-9.1	8.3-8.5	8.2	8.0-8.3	7.8-8.3	8.3	8.3	6.5-8.5
2	Temperature	℃	3.0-5.2	4.0-5.2	12.0-20.0	5.0-20.0	7.0-18.0	9.0-10.0	5.7-14.5	5.0-9.0	7.0-9.0	8.0-19.0	9.4-19.4	11.6-19.7	9.8-19.7	16.0-19.4	
3	Odor	dilution factor	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	1	1	1	1	≦2
4	Taste	dilution factor	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	1	1	1	<1	≦2
5	Color	mg/l Pt scale	<1-4	<1-4	<1-2	<1-6	<1-2	<1-20	<1-2	2.0-5.0	<1-4	2.0-4.0	2.0-4.0	<1-5	<1-20	<1-2	≦15$
6	Turbidity	kaolin (JIS)	<1-2	<1	<1	<1	<1	<1-5	<1-6	<1	<1	<1-2	<1-2	<1-1	<1-3	<1	
7	Conductivity	mS/m(at 25℃)	58-89	54-93	54-68	57-93	54-82	54-68	56-86	58-94	58-85	55-86	56-73	58-69	54-75	53-64	
8	Hardness	mg $CaCO_3$/l	265-310	240-300	220-288	188-250	220-300	210-450	230-450	240-313	238-300	230-250	225-300	230-375	285-320	220-275	≦350
10	COD($KMnO_4$, alkali)	mg O_2/l	<1-2	<1	1.0-2.0	1.0-2.0	<1-3.0	<1-2	<1-1.5	<1-2.2	<1-2	<1-3	<1-3	<1-2	1.0-3.5	<1-2.8	
11	Nitrite	mg NO_2/l	<0.01	<0.01	0.01-0.03	<0.01-0.13	0.01	<0.01	<0.01-0.02	<0.01	0.01	<0.01-0.02	<0.01	<0.01-0.5	<0.01-0.25	<0.01	
12	Nitrate	mg NO_3/l	4.0-7.4	3.1-8.6	0.4-7.0	4.6-7.0	4.7-8.0	0.4-9.0	4.1-8.2	4.2-9.2	3.0-5.0	4.0-8.0	4.0-8.2	4.1-9.4	4.9-7.0	2.0-9.0	≦44.3
15	Bicarbonate	mg HCO_3/l	217-244	232-250	214-275	232-250	220-244	220-262	177-275	244-366	214-266	238-275	214-256	226-305	220-275	214-275	
16	Carbonate	mg CO_3/l	0.86-1.22	1.00-1.25	1.00-1.73	0.97-2.50	0.77-1.39	0.69-0.97	1.12-1.38	1.09-11.57	1.35-2.68	0.87-1.50	0.89-2.03	0.77-1.79	1.73-1.99	1.70-2.18	
21	Calcium	mg Ca/l	24-30	21-30	23-30	22-26	25-29	26-38	22-27	20-40	26-70	24-44	11-28	23-52	25-32	24-27	≦100
22	Magnesium	mg Mg/l	49-70	45-55	35-53	25-47	37-55	36-87	39-95	46-58	38-46	34-46	43-59	41-59	52-62	38-42	≦30
22	Magnesium#	mg Mg/l	37							35							≦30
22	Magnesium##	mg Mg/l						31									≦30
23	Copper*	mg Cu/l	0.04-0.14	0.04-0.13	0.06-0.2	0.05-0.4	<0.04-0.05	0.05-0.09	<0.03	<0.04-0.16	<0.06	<0.05-0.08	<0.03-0.05	0.04-0.05	0.03-0.06	<0.05-0.31	≦1
24	Iron	mg Fe/l	0.09-0.12	0.10-0.15	0.08-0.10	0.10-0.12	0.06-0.25	0.05-0.10	0.04-0.10	0.06-0.13	0.03-0.91	0.03-0.2	0.05-0.21	0.04-0.30	0.01-0.3	0.02-0.10	≦0.3
25	Manganese*	mg Mn/l	<0.06	0.1-0.42	<0.07	<0.05	<0.04	<0.02-0.04	<0.06	<0.04	<0.02	<0.06	<0.04-0.06	<0.05	<0.06	<0.02-0.04	≦0.1
26	Zinc*	mg Zn/l	0.11-0.48	0.14-0.27	0.21-0.28	0.2-1.28	0.29-0.43	0.21-0.7	0.1-0.37	0.25-0.43	0.11-0.21	0.17-0.35	0.06-0.26	0.12-0.57	0.23-0.41	0.07-0.26	≦5
27	Lead**	mg Pb/l		0.05		0.04				-	-		0.041				≦0.03
28	Chromium(VI)	mg Cr(VI)/l	0.01-0.04	0.02-0.03	0.02-0.03	0.01-0.02	0.02-0.05	0.02-0.03	0.02-0.03	0.02-0.03	0.01-0.02	0.02-0.04	0.02-0.03	0.01-0.02	0.02	0.01-0.04	
	Chromium**	mg Cr/l		0.10		0.01				-	-	-	-	-	-	-	≦0.05
29	Cadmium**	mg Cd/l		0.03-0.04		0.028-0.03				-	-		0.026				≦0.01
30	Arsenic**	mg As/l		0.03		0.03-0.035		<0.06	<0.02	-	-		0.024				≦0.05
31	Cyanide	mg CN/l	0.04-0.06	0.03-0.05	0.03-0.05	0.03-0.05	0.03-0.05	0.03-0.06	0.03-0.05	0.03-0.05	0.03-0.06	0.02-0.75	0.03-0.05	0.03-0.05	0.04-0.06	0.02-0.05	≦0.1
33	Fluoride	mg F/l	0.05-0.2	<0.05	0.05-0.54	<0.05-0.52	<0.05-0.82	<0.05-0.88	<0.05-0.62	<0.05	<0.05	<0.05-0.74	<0.05-0.7	<0.05-0.69	<0.05-0.61	<0.05	0.7-1.5
38	Total Coliforms	No. in 1l	7-39	4.0-21	3.0-7.0	<3-4	3	<3-4	3.0-4.0	7.0-14	11	3.0-11	4.0-28	11-460	3.0-21.0	3.0-43	(<3 in 1l)
39	General Bacteria	No. in 1 ml	143-1000	102-700	42-500	250-580	30	300-350	22-150	200-720	300	102-300	240-1000	100-950	345-780	143-850	
40	Residual Chlorine	mg ClO/l	0.02-0.7	0.02-0.1	<0.1	<0.1	<0.1	<0.02-0.1	<0.1	0.03-0.1	<0.02-0.1	<0.02-0.1	<0.02-0.2	<0.02-0.2	<0.02-0.2	<0.02-0.2	
43	Acidity	mg $CaCO_3$/l	35-65	35-50	35-100	28-85	43-78	63-85	35-100	30-80	35-80	30-65	50-60	40-65	50-60	30-60	
44	Alkalinity	mg $CaCO_3$/l	178-200	190-205	175-225	190-205	180-200	180-215	145-225	200-300	175-220	195-225	175-210	185-250	180-225	175-225	
	Nickel*	mg Ni/l	<0.06	<0.05	<0.09	0.03-0.05	<0.04	<0.05	<0.03	<0.02-0.03	<0.05	<0.05	<0.04	<0.05	<0.04	<0.02-0.03	
	Selenium*	mg Se/l	<0.03	<0.06	<0.05	<0.03	<0.03	<0.04	<0.02	<0.04	<0.07	<0.07	<0.05	<0.04	<0.05	<0.04	0.001 $$
	Strontium*	mg Sr/l	0.54-0.61	0.53-0.59	0.52-0.58	0.52-0.55	0.62-0.63	0.42-0.56	0.51-0.52	0.58-0.60	0.53-0.64	0.58-0.61	0.19-0.63	0.27-0.58	0.45-0.59	0.42-0.63	≦2
	Bromine*	mg Br/l	0.12-0.15	0.14-0.23	0.14-0.34	0.09-0.14	0.14-0.3	0.1-0.17	0.11-0.17	0.11-0.25	0.12	0.13-0.3	0.12-0.14	0.13-0.15	0.07-0.12	0.07-0.28	

* ED-TRXRF
** Colorimetry in Ulaanbaatar
# Analyzed in Japan: the test method for tap water
Calculated from the charge balance
$ WHO guideline
$$ 0.05 (mg/l) as maximum contaminant level (MCL) for the Primary Regulation of USA

Table 8.10 Classification of Samples by Total Coliforms' Number

Sampling Site	Total Sample Number	Total Number of Coliforms in 1 litter			
		0 – <3	3 – <10	10 – <100	100 –
		Sample Number			
Reservoir	8	0	6	2	0
Water Wagon	4	0	1	3	0
Tap Water	11	3	8	0	0
Ger	20	0	10	9	1
SW-1	3	0	0	0	3
SW-2	3	0	0	0	3
SW-3	3	0	0	0	3
SW-4	3	0	0	1	2
SW-5	2	0	0	1	1
SW-6	3	0	2	1	0
SW-7	3	0	0	0	3
SW-8	3	0	0	1	2

Table 8.11 Reanalyses of Heavy Metals in Drinking Water of Altai City

Item	Laboratory	Unit	Mongolian Standard	Samples (Sampling:May 30th 1998)				
				DT-1 hospital	DT-2 government house	DT-3 apartment near hotel	DT-4 high school	DT-5 apartment (Ms. Tunga)
Lead	#	mg/l	0.03	0.0001	0.0004	not detected	not detected	not detected
	##	mg/l		<0.005	-	<0.005	-	-
Cadmium	#	mg/l	0.01	not detected	not detected	not detected	not detected	not detected
	##	mg/l		<0.001	-	<0.001	-	-
Arsenic	###	mg/l	0.05	0.03	0.01	not detected	0.01	0.02
	##	mg/l		<0.005	-	<0.005	-	-
Total Chromium	##	mg/l	0.05	<0.004	-	<0.004	-	-

Item	Laboratory	Unit	Mongolian Standard	Samples (Sampling:May 30th 1998)			
				DR-1 reservoir	DR-2 reservoir	DW-1 water wagon	DW-2 water wagon
Lead	#	mg/l	0.03	0.0002	not detected	0.0001	not detected
	##	mg/l		<0.005	-	-	<0.005
Cadmium	#	mg/l	0.01	not detected	not detected	not detected	not detected
	##	mg/l		<0.001	-	-	<0.001
Arsenic	###	mg/l	0.05	0.015	0.02	0.03	0.02
	##	mg/l		<0.005	-	-	<0.005
Total Chromium	##	mg/l	0.05	<0.004	-	-	<0.004

#: Central Laboratory of Environmental Monitoring (Atomic Absorption Spectroscopy (Graphite Furnace))
##: Shizukan Kensa Center (Japan: Analysis Methods of Drinking Water in Japan)
###: Institute Chemistry and Chemical Technology of Mongolian Academy of Science (Colorimetry)

Table 8.12 Water Quality of Rivers

Item No.	Item	Unit	R-1			R-3	R-4		
			27-Jun-97	18-Jul-97	24-Jul-97	27-Jun-97	27-Jun-97	18-Jul-97	24-Jul-97
1	pH		8.4	8.9	8.7	8.6	9.3	8.7	8.1
2	Temperature	℃	14	15	22	12.5	2	10	8.5
3	Odor	dilution factor	-		<1	-	-		1
5	Color	mg/l Pt scale	20	20	5	10		5	6
6	Turbidity	kaolin (JIS)	10	5	<1	<1	10	1	1
7	Conductivity	mS/m(at 25℃)	1999	1830	1746	528	128	102	141
8	Hardness	mg$CaCO_3$/l	300	6875	8195	445	450	410	425
10	COD	mg O_2/l	-	-	-	4	-	-	-
11	Nitrite	mg NO_2/l	0.01	0.02	<0.01	0.01	<0.01	0.01	<0.01
12	Nitrate	mg NO_3/l	0.2	0.5	0.7	0.3	0.2	5.6	9.6
13	Ammonium	mg NH_4/l			0.4		0.34		0.23
15	Bicarbonate	mg HCO_3/l	345	329	238	1098		403	458
16	Carbonate	mg CO_3/l	3.45	10.41	4.73	13.82		6.38	1.82
17	Chloride*	mg Cl/l	10100	5420	4770	1120	303	160	152
18	Sulfate*	mg SO_4/l	5350-10700	2865-5730	2660-5320	1110-2220	206-412	158-316	143-286
20	Potassium*	mg K/l	29	17	17	20	17	7.3	8.6
21	Calcium*	mg Ca/l	548	312	305	58	48	49	48
22	Magnesium	mg Mg/l	72	1650	1789	95	92	85	67
23	Copper*	mg Cu/l	<0.15	<0.13	<0.12	<0.09	0.06	0.05	<0.05
24	Iron	mg Fe/l	0.19	0.13	0.09	0.06	0.05	0.42	0.07
25	Manganese*	mg Mn/l	<0.31	<0.17	<0.14	<0.08	0.1	<0.05	<0.07
26	Zinc	mg Zn/l	<0.23	0.43	<0.13	0.12	0.15	0.17	0.18
28	Chromium(VI)	mg Cr(VI)/l	0.01	0.03	0.02	0.01		0.01	0.001
31	Cyanide	mg CN/l	0.06	0.5	0.8	0.09	0.8	0.05	0.01
33	Fluolide	mg F/l	0.22	<0.05	0.05	0.19		0.05	0.04
38	Total Coliforms	No. in 1l	960	2380	2380	>2380		960	>2380
43	Acidity	mg $CaCO_3$/l	40	95	80	750		160	78
44	Alkalinity	mg $CaCO_3$/l	283	270	195	900		330	375
	Nickel*	mg Ni/l	<0.14	<0.11	<0.13		<0.05	<0.03	<0.06
	Seleni8m*	mg Se/l	<0.3	<0.2	<0.17		<0.04	<0.03	<0.04
	Strontium*	mg St/l	27.8	19.2	16.7		1.25	0.93	0.87
	Bromine*	mg Br/l	5.85	3.3	3		0.53	0.21	0.21

* ED-TRXRF

Table 8.13 Water Quality of Sewerage System

Item No.	Item	Unit	S-1			S-2			S-3			Maxmum Quality limit (in Oman)#
			26-Jun-97	18-Jul-97	24-Jul-97	26-Jun-97	18-Jul-97	24-Jul-97	26-Jun-97	18-Jul-97	24-Jul-97	
1	pH		8.4	8.4	8.6	8.3	8.1	9	8.9	8.7	9.3	
2	Temperature	℃	5.5	7	7	9	11	15	15	12.5	16	
3	Odor	dilution factor			16			4			4	
5	Color	mg/l Pt scale	60	60	50	20	20	100	20	40	140	
6	Turbidity	kaolin (JIS)	30	10	40	5	10	80	20	10	80	
7	Conductivity	mS/m(at 25℃)	130	109	155	102	80	114	100	84	108	270
8	Hardness	mg$CaCO_3$/l	170	270	475	163	270	350	175	270	425	
9	Dry Residue	mg/l	1486		2800	4120		3200	412		2000	2000
10	COD ($K_2Cr_2O_7$)	mg O_2/l	161.4	102.7	163	112.2	113.8	115	138	139.9	144	200
11	Nitrite	mg NO_2/l	0.02	0.01	0.01	0.38	0.35	0.3	0.07	0.3	0.28	
12	Nitrate	mg NO_3/l	0.07	0.2	<0.1	2.6	3.8	2.8	0.08	2.4	2.1	50
13	Ammonium	mg NH_4/l										10
14	Orthophosphate	mg $P0_4$/l			1.55			1.8			1.7	
17	Chloride*	mg Cl/l	261	265	195	228	160	197	212	173	195	650
20	Potassium*	mg K/l	18	16	11.3	20	8.1	12.5	20	7.6	9.1	
21	Calcium	mg Ca/l	28	33	48	34	27	37	37	30	40	
	Calcium*	mg Ca/l	40	41	39	43	33	36	43	30	40	
22	Magnesium	mg Mg/l	24	45	85	18.6	49	62	19.8	47	78	
23	Copper*	mg Cu/l	<0.05	0.11	0.17	0.05	0.05	<0.05	0.04	0.04	0.08	1
24	Iron	mg Fe/l	0.25	0.36	0.15	0.29	0.25	0.21	0.34	0.26	0.17	5
25	Manganese*	mg Mn/l	0.08	<0.07	0.04	0.09	0.07	<0.08	0.09	<0.03	<0.06	
26	Zinc*	mg Zn/l	0.13	0.19	0.54	0.14	0.1	0.23	0.17	0.12	0.27	5
28	Chromium(VI)	mg Cr(VI)/l	0.01	0.03	0.03	0.01	<0.01	0.03	0.03	<0.01	0.01	total 0.05
31	Cyanide	mg CN/l	0.08	0.28	0.06	0.07	0.07	0.05	0.09	0.09	0.05	0.1
33	Fluolide	mg F/l	0.2		0.04	0.16		0.03	0.18		0.03	2
38	Total Coliforms	No. in 1l	100000	1000000	1000000	100000	1000000	1000000	10000	100000	100000	Fecal 1000
39	General Bacteria	No. in 1 ml	600000			200000			60000			
41	BOD	mg O_2/l	20	20.5	21	21.4	22.8	23.5	20.5	22.3	2.5	20
42	SS	mg SS/l	708	247	211	572	283	444	424	255	171	30
43	Acidity	mg $CaCO_3$/l	140	180		170	75		210	105		
44	Alkalinity	mg $CaCO_3$/l	270	400		355	250		330	325		
	Nickel*	mg Ni/l	<0.03	<0.04	<0.06	<0.04	<0.03	0.04	<0.04	<0.04	<0.05	
	Selenium*	mg Se/l	<0.04	<0.03	<0.05	<0.03	<0.03	<0.05	<0.03	<0.02	<0.05	
	Strontium*	mg St/l	0.83	0.7	0.79	0.82	0.52	0.64	0.94	0.53	0.71	
	Bromine*	mg Br/l	0.3	0.12	0.27	0.12	0.12	0.22	0.15	0.07	0.28	

*ED-TRXRF
Donald R. Rowe and Isam Mohammed Abdel-Magid, Handbook of Wastewater Reclamation and Reuse (1995), CRC Press Inc.

Table 8.14 Analysis Results for Sewerage System (Phase 4)

Item	28-Jul-97				
No.	Item	Unit	S-1	S-2	S-3
10	COD($KMnO_4$ Alkali)	mg O_2/l	80	60	25
13	Ammonium	mg NH_4/l	100	45	18
Item	30-Jul-97				
No.	Item	Unit	S-1	S-2	S-3
10	COD($KMnO_4$ Alkali)	mg O_2/l	27	17	21
13	Ammonium	mg NH_4/l	70	45	40

Table 8.15 Evaluation of Water Quality for Water of Wells and Water Supply Facilities

Item	Existing Wells								New Test Wells										Water Supply System			
	SW-1	SW-2	SW-3	SW-4	SW-5	SW-6	SW-7	SW-8	A1	A2	A3	A4	B1	B2	B3	B4	B5	B6	DR	DT	DW	DG
Color*	B	A	A	B	B	B	C	B	C	D	A	A	A	A	D	D	A	A	A	A	A	A
Hardness	D	C	D	D	C	A	D	B	D	D	B	D	D	D	D	D	A	A	A			
Dry Residue	C	A	C	C	A	A	C	A	D	D	C	D	C	D	D	D	A	A	A			
Chloride	A	A	A	A	A	A	A	A	A	D	A	C	A	D	D	D	A	A	A			
Sulfate	D	A	C	C	A	A	C	A	A	D	A	A	A	D	D	C	A	A	A			
Calcium	C	A	B	A	A	A	A	A	A	D	A	A	A	A	D	B	A	A	A			
Magnesium	D	D	D	D	D	B	D	D	D	D	D	D	D	D	D	D	C	C	C	C	C	C
Strontium	C	A	D	C	A	A	A	A	A	D	A	A	A	B	D	D	A	A	A	A	A	A
Iron	A	A	A	B	A	A	A	A	B	D	A	A	A	A	A	A	A	A	A	A	A	A
Manganese	B	A	A	A	D	D	B	D	A	D	A	A	A	A	D	A	A	A	A	A	A	A
Lead	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	?
Chromium	A	?	?	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Cadmium	?	?	?	?	?	A	?	A	A	A	A	A	A	A	A	A	A	A	A	A	A	?
Arsenic	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Total coliform**	D	D	D	D	D	C	D	D	D	D	D	D	D	D	D	D	D	D	C	B	C	D

* WHO guidelines

** Guidelines

A: good, below the standard

B: fair, around the standard

C: bad, exceed the standard

D: very bad, more than bouble the standard

?: inconclusive