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UZEN ENVIRONMENTAL ASSESSMENT OF REHABILITATION STRATEGIES

UZEN OIL FIELD PROJECT

BY

AGRA

UZEN ENVIRONMENTAL ASSESSMENT OF REHABILITATION STRATEGIES

UZEN OIL FIELD PROJECT

Prepared For:

THE GOVERNMENT OF KAZAKHSTAN

Prepared By:

AGRA Earth & Environmental Limited

CALGARY, ALBERTA

September 1994

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27 September 1994
CE01465

Mr. Vladimir Litvak
Infrastrusture Energy and Environment Division
Country Department III
Europe and Central Asia
International Bank for Reconstruction and Development
1818 H Street, NW
Washington, DC 20433

Dear Vladimir:

RE: SUBMISSION OF FINAL ENVIRONMENTAL ASSESSMENT
OF REHABILITATION STRATEGIES
UZEN OIL FIELD, WESTERN KAZAKHSTAN

We are pleased to submit two (2) copies of the final report. We have addressed the draft report deficiencies as identified by your organization in the following sections:

- Part 9.0 - Environmental Protection and Mitigation Measures
- Part 12.0 - Environmental Management Plan
- Part 14.0 - Strengthening Local Environmental Management Capabilities and Institutions

We have also addressed comments from the Kazakh Ministry of Ecology. Specifically, Mr. Anatoly Lychov, Deputy Head of the Environmental Review Department, and Ms. Nina Inozemtseva, Head of the Environmental Department of the former Ministry of Fuel and Energy, presented comments on the draft report.

Mr. Lychov expressed concern that the environmental assessment was submitted without an accompanying technical document that detailed the engineering aspects of the project. In light of this comment, we recommend in the future that the engineering design basis be submitted simultaneously with the environmental assessment.

Ms. Nina Inozemtseva expressed concern that the total area of polluted soil within the Uzen oil field was not assessed. We feel that this is beyond the scope of the project at this time, and is a component of future detailed due diligence programs. Ms. Inozemtseva also indicated that we should have shown the total increase in toxic elements in the atmosphere, water and soil since the field began producing. Again, we feel this is beyond the scope of this environmental assessment.

We have enjoyed working on this very challenging project. It has been a tremendous opportunity for us to enhance both our corporate and personal experiences. We thank you for the opportunity, and look forward to working with you on future assignments.

Yours truly,

AGRA Earth and Environmental Limited

Leslie A. Zilm
Project Manager

Enclosure

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PART 1 - INTRODUCTION

1.1 BACKGROUND

The World Bank is undertaking rehabilitation of the Uzen oil field in Western Kazakhstan (Figure 1.1). This project is part of the World Bank's initiative to promote the economic sustainability of developing nations. The Uzen oil field was chosen because of the substantial size of the reservoir and the potential to increase the economic life of the field from five years with total recoveries capped at 25% of the original-oil-in-place, to 20 years with total recoveries capped at 35%.

To achieve this level of recovery, significant changes in operating practices, extensive rehabilitation of wells and in-field flow lines, and changes to the existing waterflood program will be necessary. The World Bank proposes to implement these changes in a phased manner, with Phase 1 consisting of the rehabilitation of 2 of the total of 16 blocks comprising the field (Figure 1.2).

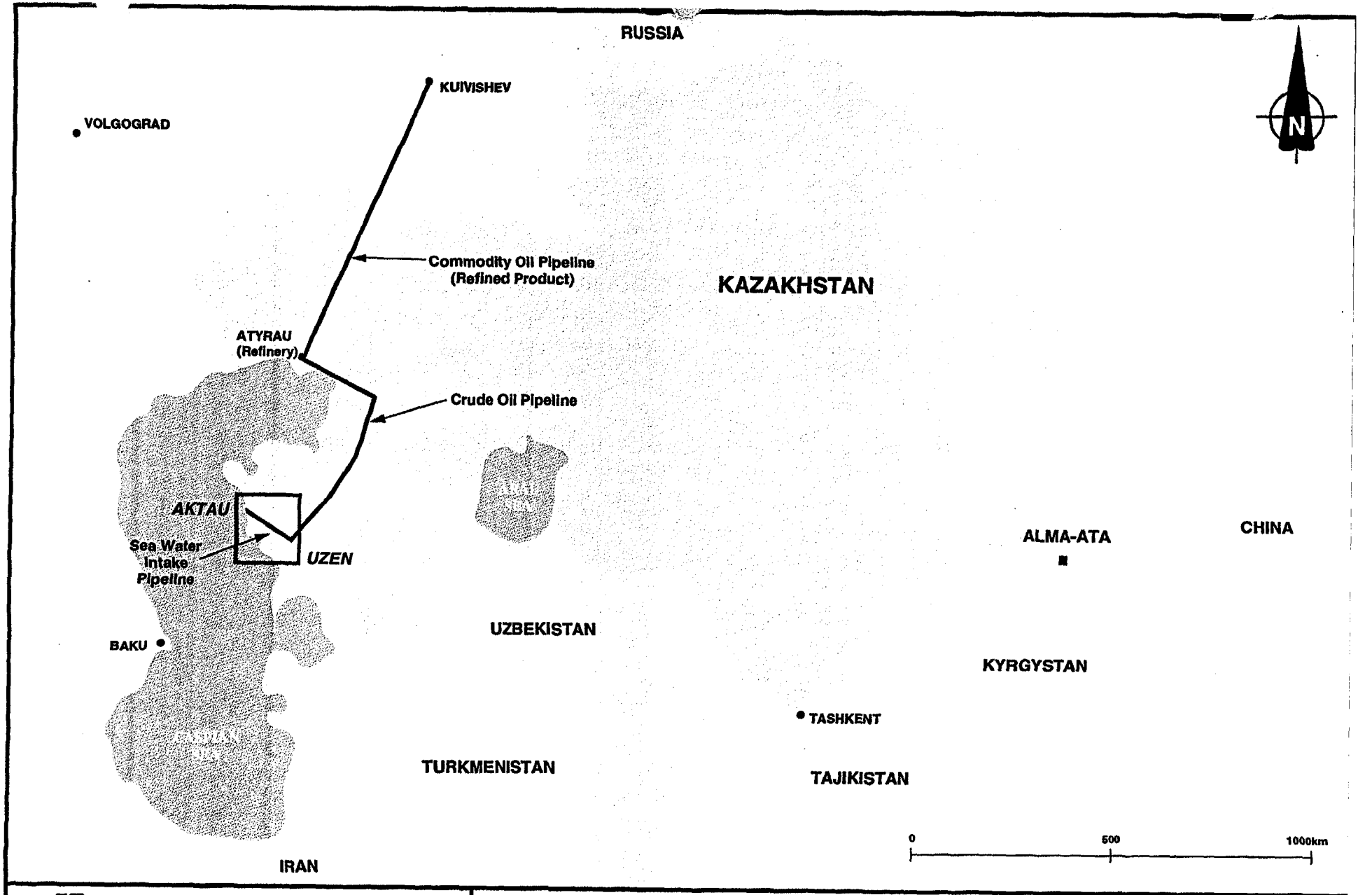
1.2 OBJECTIVES OF THE ENVIRONMENTAL ASSESSMENT (EA)

The overall objective of an environmental assessment (EA) under World Bank Directive 4.01 is to improve decision making to ensure that the project options under consideration are environmentally sound and sustainable. EAs identify ways of improving projects environmentally, by preventing, minimizing, mitigating or compensating for adverse impacts. The specific objectives of the Uzen EA are to:

- assess the existing environmental conditions and prioritize environmental issues related to the proposed rehabilitation strategy for the Uzen oil field;
- determine overall environmental impacts of the project and develop environmental mitigation, monitoring and an emergency response plan;
- assess existing training components and suggest improvements, where necessary, for emergency response, spill cleanup, environmental monitoring and fire fighting;
- review the capabilities of national and local environmental regulatory and monitoring agencies, and discuss the needs for strengthening;
- develop a pilot program for remediation of environmental damages; and
- identify the social impact of the proposed investment program and the proposed World Bank financed project.

The scope of this environmental assessment is directed at the general design features for surface facilities and below ground rehabilitation strategies proposed by the World Bank to increase the productivity of the Uzen oil field. The assessment is completed for:

- facilities within the Uzen oil field;
- the existing water intake facilities at Aktau;



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LOCATION OF THE UZEN FIELD IN KAZAKHSTAN

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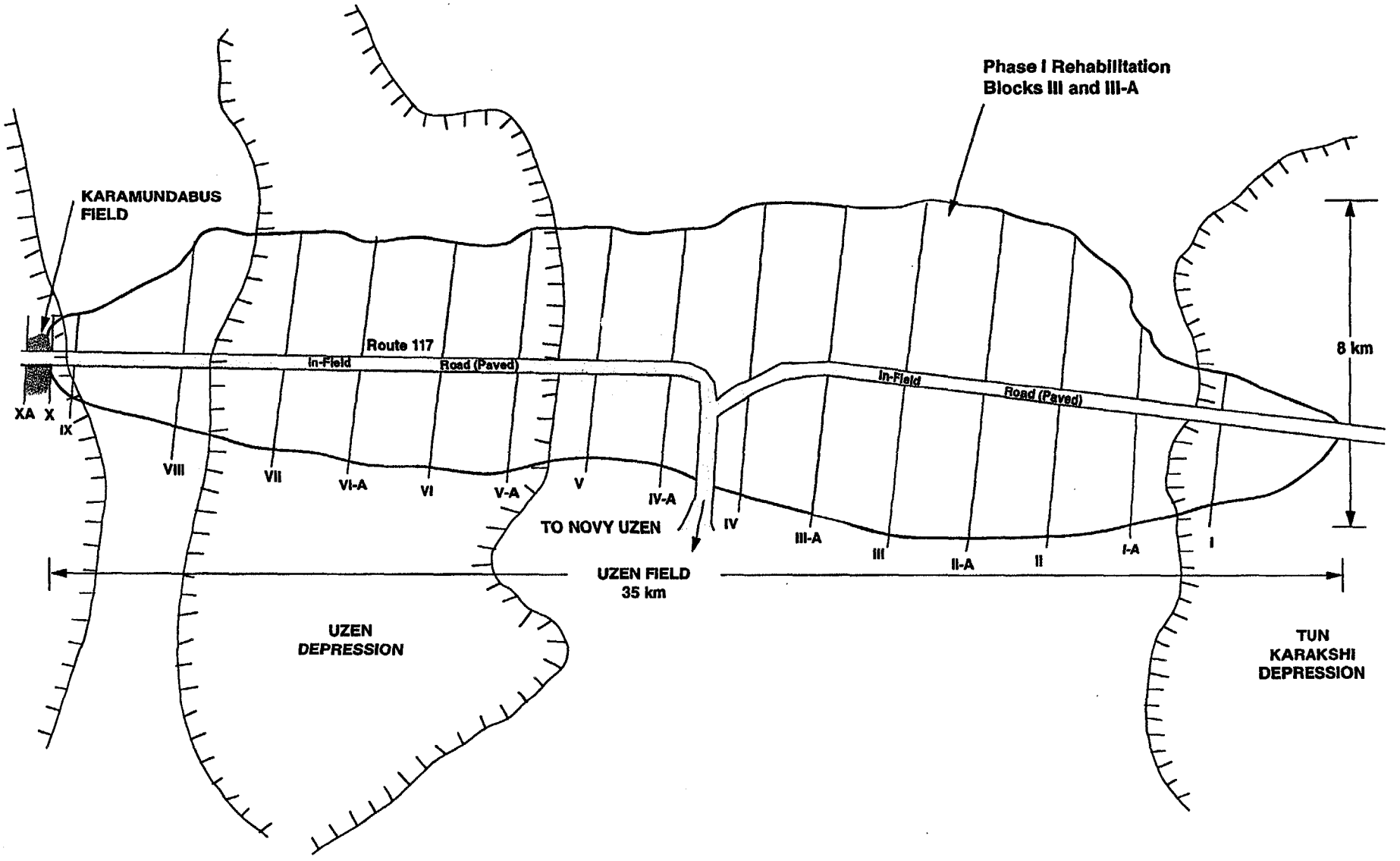
FIGURE 1.1



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UZEN OILFIELD BLOCK LAYOUT

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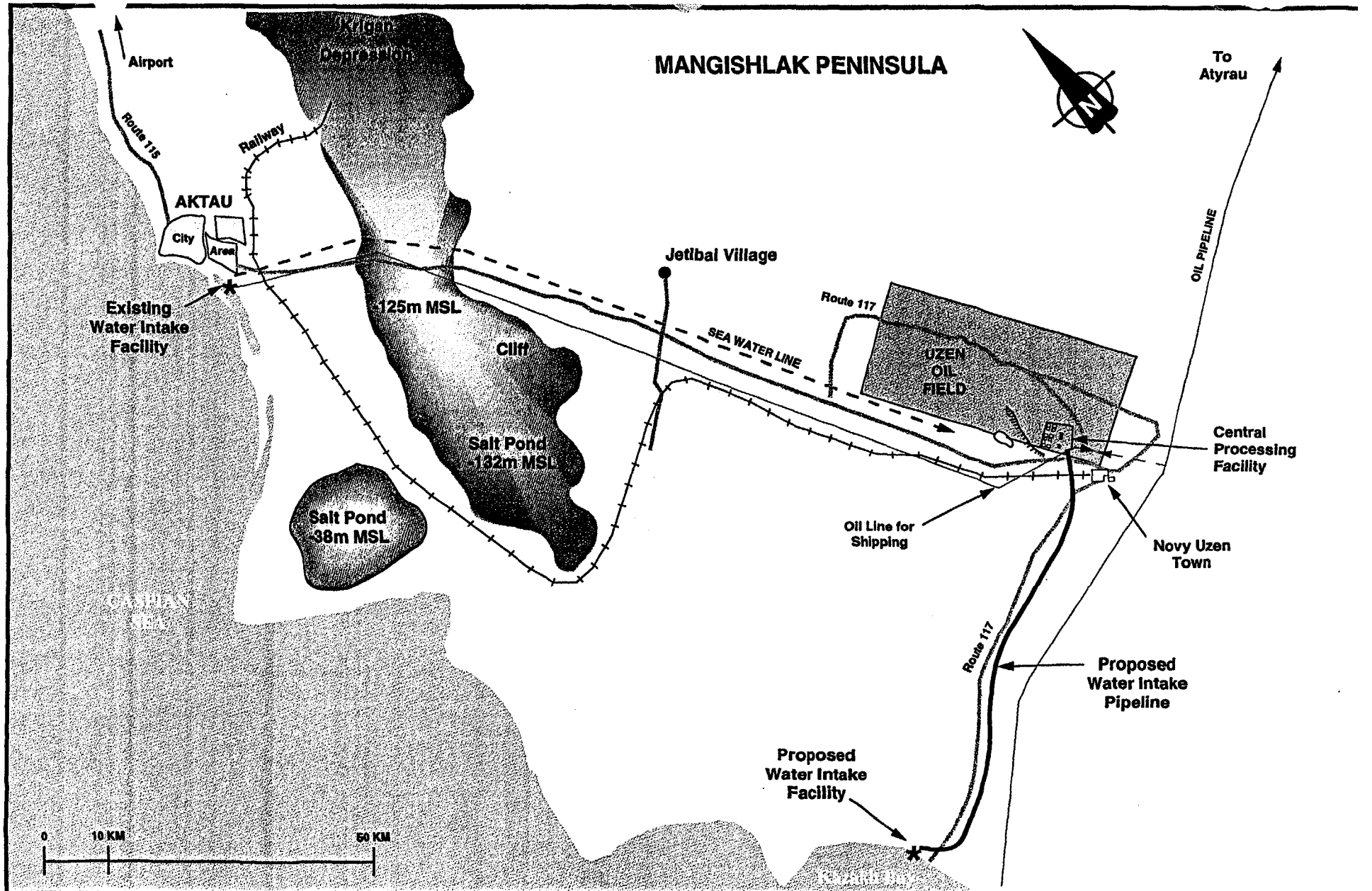
FIGURE 1.2

- the sea water transport line from Aktau;
- the proposed alternate sea water intake site at Kazakh Bay;
- the proposed alternate sea water supply line from Kazakh Bay to Uzen; and
- any adjacent areas directly impacted by Uzen operations.

The regional scope of the project is illustrated in Figure 1.3. The assessment considers implications of the rehabilitation project in terms of changes to the existing infrastructure and operations from conception to the predicted life of the field (20 years). It does not, however, consider peripheral activities such as the establishment of administrative centers or camps. Appendix A lists all individuals and organizations who assisted in the preparation of the environmental assessment.



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REGIONAL LOCATION MAP

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FIGURE 1.3

PART 2 - PROJECT DESCRIPTION

2.1 EXISTING FACILITY INFRASTRUCTURE AND STATUS

The Uzen oil field was discovered in 1959 and field development began in 1965. The field is one of the largest oil fields under the Mangystaumunaigas (MMG) Production Association, and is operated by the Uzenneft Production Unit (Uzenneft NGDU). The Uzen oil field is a multiple reservoir field. It is reported to be the largest in terms of original-oil-in-place in the CIS. Estimates dictate the size of the reservoir to be 1.2 billion m^3, or 7.3 billion barrels. Cumulative production to date has been approximately 286 million m^3 (1.8 billion barrels), or about 25% of the estimated total reserves. Ultimate recoverable reserves are estimated at 35% of the original-oil-in-place, with remaining recoverable reserves of approximately 130 million m^3 (0.8 billion barrels).

The Uzen oil field is 35 km long from east to west and 8 km wide from north to south. To date there have been approximately 5000 wells drilled, of which there are currently 2150 active production wells and 960 active injection wells. The field is divided into 16 blocks separated by rows of water injection wells located at approximately 2 km intervals (Figure 1.2). Average daily fluid production/well is about 20 m^3, at a watercut of 72%.

The existing oil processing facilities for the field consist of:

- 251 satellites;
- 192 test separators;
- 70 group gathering stations;
- a central processing facility;
- 70 km of transfer pipeline that transports produced fluid from the gathering stations to the central processing facility;
- 2900 km of in-field gathering lines;
- a water injection system, including a 150 km sea water supply line;
- 26 water injection stations; and
- 4 sea water pump stations.

Since 1990 there has been a sharp decline in the overall field production. In 1993, production from the field was reported at 4.1 million tonnes. The decline in production is attributed largely to the degraded condition of the production facilities. The majority of the oil field facilities are seriously damaged for three main reasons:

- oil processing and transport problems in part related to the high pour point of the oil (30°C) and the high content of impurities (asphaltenes and paraffin);
- the field was reportedly developed without due consideration for design, operation and maintenance; and

- the economic downturn after the demise of the Former Soviet Union resulted in an inability to maintain facilities.

Specifically, the following are the major technical issues:

- significant corrosion problems for the entire production facilities, including oil production and water injection systems;
- large oil losses from spills and breaks during oil processing and transportation;
- substantial environmental degradation due to spills of sea water, produced water and oil, as well as erosion and terrain disturbance;
- an inefficient system design in terms of energy conservation;
- inaccurate or absent instrumentation and monitoring systems for facilities;
- very poor maintenance practices;
- inability to obtain spare parts from Russian manufacturers;
- outdated operational data procurement practices; and
- very low quality of oil after processing at the central processing facility (internationally unacceptable).

2.2 PROPOSED REHABILITATION STRATEGIES

Rehabilitation of the Uzen oil field consists of three main components: aboveground rehabilitation, underground rehabilitation and training. This document considers the duration of the entire rehabilitation project to be 20 years. This time frame allows for implementation of the rehabilitation project, as well as operations of the rehabilitated field. A broad strategy for the rehabilitation of the field has been developed. Under this strategy, the field's surface infrastructure will be completely replaced. The key features of this strategy are:

- elimination of centralized fluid processing and replacement of the central processing facility by up to 6 field processing facilities fed by 48 gathering stations;
- modification of the existing processing facility for treatment of produced water;
- replacement of satellites and gathering stations with test and group separators, and associated flow measuring and control equipment;
- replacement of flowline systems between production wells and gathering stations;
- replacement of oil/water transfer lines and gas lines between gathering stations to the existing processing plant;
- replacement of water injection stations with water injection pumps and upgrading associated flow monitoring and control equipment;
- replacement of water distribution lines between the existing processing plant and water injection stations;
- replacement of high pressure water injection line systems between water injection stations and injection wells with associated flow measuring and control equipment;
- maximization of the use of recycled produced water;
- treatment of recycled and make-up sea water;
- rehabilitation of virtually all currently active producer and injector wells, including major workovers of 267 production wells and 121 injection wells;

- drilling of up to 970 replacement injectors and 360 new producers, and conversion of 247 producers to injectors as part of the project to modify the water-flooding pattern;
- replacement of the current sea water intake system from Aktau to by constructing a new 70 km pipeline from Kazakh Bay to the field; and
- technical assistance and training.

This project will adopt a phased approach, initially concentrating on Blocks 3 and 3A. The following technical description (Table 2.1) outlines the specific rehabilitation strategies for Blocks 3 and 3A, and ancillary facilities (central processing facility and sea water intake line). These blocks will serve as a model for the remainder of the field. The Environmental Impact Section (Section 9.0), although based on this technical description, is projected for the entire field.

Table 2.1

Rehabilitation Strategies for Blocks 3 and 3A and Ancillary Facilities

Facility	Present Status	Proposed Modification
Flowline Systems (transport of produced oil from active production wells to gathering stations)	The flowlines are in an advanced state of corrosion, resulting in frequent failure and oil spills.	Complete replacement of the flowlines will be made. Flowlines will be 88.9 mm (3 in.), buried and coated on the outside with PE. The pipe proposed to be used is steel pipe, ASTM-A-106 Grade B or APL-5L with 3 mm corrosion allowance. Flowlines will be constructed to withstand 6897 kPaG operating pressure. Flowlines to be equipped with check valves and block valves at tie-in points to the gathering station. Flowlines to be laid under existing obstacles. Hydrotesting of flowlines will be completed. A corrosion inhibitor package will be provided at each well site.
Satellites and group gathering stations	Many test separators at satellites and group separators at gathering stations are not presently operational due to corrosion problems. Test separators lack gas scrubbers. Production fluid measurements at group gathering stations are very inaccurate due to deficient monitoring systems. Not presently possible to determine accurate watercut data for reservoir management.	Test separators will be three-phase separators equipped with a gas scrubber. The test separators will be transferred to gathering stations so that process vessels will be concentrated in the same place. New test separators and group separators will be installed in gathering stations, complete with sophisticated measuring and control equipment. Alarms will be installed to ensure safe and efficient operations of equipment and facilities. The number of gathering stations will be reduced to approximately 10 stations to facilitate efficient operation and maintenance of the stations.
Oil/water transfer lines (transfer of produced fluid from the group gathering stations to the central processing facility)	Oil/water transfer lines are in an advanced state of corrosion.	Same specifications proposed for transfer pipelines as for flowlines.
Gas transfer lines (transfer gas from the gathering stations to the gas processing facility)	Gas transfer lines in advanced state of corrosion.	Gas lines buried and coated on the outside with PE. Pipe proposed is steel pipe ASTM-A-106 Grade B or APL-5L with 1 mm corrosion allowance.

Table 2.1 (continued)

Rehabilitation Strategies for Blocks 3 and 3A and Ancillary Facilities

Facility	Present Status	Proposed Modification
Central processing facility	Lack of treatment of produced water prior to sending for waterflooding has resulted in severe corrosion of entire water injection system. Corrosion products have accumulated within formations and reduced the injectivity of the wells.	A gas blanket system will be implemented to prevent water from contacting air. This system will be used on the existing 20 000 m^3 storage tanks. A produced water treatment plant will be constructed to neutralize pH (pH 7 to 8), remove suspended solids (less than 2 mg/l) and remove oxygen (less than 0.02 mg/l).
Water distribution lines (produced water from central processing facility to water injection stations)	Advanced corrosion of the majority of water distribution lines.	Same specifications proposed for water distribution pipelines as for flowlines.
Water injection stations	Existing water injection stations have 15 water injection pumps. Most pumps require replacement as they are worn out.	Four new water injection stations will be constructed and 16 new pumps installed to facilitate injection of water at the required 48 000 m^3/day. A corrosion inhibitor package will be provided at all water injection pumps (including existing and new pumps).
High pressure water injection line systems	High pressure water injection lines are in an advanced state of corrosion.	Same specifications proposed for high pressure water injection pipelines as for flowlines. Updated injection monitoring and control equipment will be installed to accurately measure and control water injection rate for each well.
Sea water intake pipeline	Advanced stage of corrosion on portions of the existing 150 km sea water intake line due to corrosion from Untreated sea water. Approximately 1 km of existing sea water intake line replaced per year. Original wall thickness decreased from 10 mm to 3 mm along various sections of the pipeline.	Construction of new 813 mm, 70 km sea water intake line from Uzen to Kazakh Bay. New pipeline to be designed per ANSI B31.4, internally and externally coated. Installation of two new electric-powered pump stations. Treatment of sea water to remove oxygen and suspended sediments, adjust pH, and add corrosion inhibitor.

Table 2.1 (continued)

Rehabilitation Strategies for Blocks 3 and 3A and Ancillary Facilities

Facility	Present Status	Proposed Modification
Sea water intake facility	Lack of treatment of Caspian Sea water has resulted in extensive corrosion of pipelines and downhole equipment. Formation of barium sulphate scale plugs downhole equipment and flowlines.	Installation of new water treatment facilities. Process may involve coagulation (flocculation) of suspended sediments, filtering, vacuum de-aeration, and/or oxygen scavenger chemicals (sodium sulphite). API Recommended Practice RP 38 will be referenced to determine chemical(s) best suited for bacteria control. Typical chemicals that may be used are chlorine, various amines, Quaternary ammonium, imidazolines, chlorinated phenols, aldehydes and peroxygens.
Production wells and water flooding program	There are currently 5000 wells in the field, of which approximately 3000 are producers and 1500 are injectors. Non-active wells due to equipment failure number 1200 for producers and 400 for injectors.	For Blocks 3 and 3A there will be major workovers of 551 production wells and 229 injection wells. As well, there will be conversions of 33 injectors to producers and 32 producers to injectors. Ten new workover rigs will be purchased to rehabilitate the field. Main components of the workover will include: replacement of downhole and surface tools, cleaning of paraffin and scale from the wells, cement-squeezing existing perforation intervals, re-perforation of selected interval with high power gun and stimulation with wax solvent and acid (and/or mini frac). Conversion of producer to injector and injector to producer will be completed to modify the water flood pattern.

PART 3 - REGULATORY OVERVIEW

3.1 INTRODUCTION

Kazakhstan has set regulations and standards governing environmental quality and protection of natural resources which are part of the Kazakhstan Law on Environmental Protection (1991). The petroleum industry is still regulated by many norms established under the former Soviet environmental regulatory system. The process of obtaining environmental approval and licences is set out in the Regulations on State Ecological Examination (1991). An agreement has been reached with the Ministry of Ecology and Bioresources on the standards that will be applied for approval of this environmental assessment. A listing of SNIPs and GOSTs pertinent to the environmental legislation of Kazakhstan is presented in Appendix B.

3.2 ENVIRONMENTAL LAWS OF THE REPUBLIC OF KAZAKHSTAN

3.2.1 Law on Environmental Protection Kazakh SSR (1991)

This is the main environmental protection law in Kazakhstan. The law establishes state ownership of the natural resources, including land, mineral resources, forests, water, fauna, flora and other natural resources. The law sets out a legislated environmental assessment process for proposed development projects. This process is to ensure that economic development occurs in an environmentally responsible manner, with the opportunity for public participation.

The law includes provisions for the following:

- administrative control of the law is exercised by the State Committee for Ecology and Nature Management (the Ministry of Ecology and Bioresources at present);
- establishment of environmental quality standards;
- statement of main objectives of state ecological examination;
- environmental requirements of proposed developments for all stages, including design, construction and operation;
- environmental requirements regarding using radioactive materials and chemicals;
- protection of sensitive areas and endangered species;
- mechanisms for control and supervision of environmental protection;
- provision for environmental education;
- mechanism for settlement of disputes; and
- provision for international cooperation in the field of environmental protection.

3.2.2 Law on Land Code in Kazakh SSR (1990)

The main objective of this law is to regulate land use activities in the public interest for the best use of the land. Land use activities must take into consideration conservation of resources, preservation of soil fertility, prevention of environmental damage (i.e., erosion, contamination, etc.) and protection of the rights of citizens, enterprises, institutions and organizations. Provisions for granting of pipeline right-of-ways and land for meter stations, compressor or pump stations, and other structures are also included.

3.2.3 Law on Protection, Reproduction and Utilization of Fauna (1993)

The aim of this law is to ensure efficient protection, reproduction and utilization of fauna (wildlife); and education in the spirit of prudent and humane treatment of wildlife. Provisions are made for protection of wildlife, preservation of species variety and protection of wildlife habitat. Regulations on trapping, hunting and fishing; violations; control mechanisms; settlement of disputes; and international cooperation are stated.

3.2.4 Law on Forest Cost in Republic of Kazakhstan (1993)

The purpose of this law is the regulation and management of forest land to protect and maintain forest productivity. Provisions for administration, management, land zonation, protection, research and financing are included.

3.2.5 Law on Water Code of the Republic of Kazakhstan (1993)

The aim of the water legislation is to regulate water for domestic industrial use, and environmental requirements. Regulations on pollution, contamination and conservation are stipulated. Conditions of state registration and planning of water consumption, settlement of disputes, and violations are included.

3.2.6 Law on Code of the Republic of Kazakhstan on Mineral Resources and their Processing (1992)

The objective of this legislation is to ensure the efficient use and conservation of mineral resources in the public interest. Regulations cover types of use, obligations of users, state administrative bodies, taxation, application procedures, processing and safety.

3.3 OPERATING STANDARDS AND NORMS OF OIL AND GAS ENTERPRISES

Many of the standards and norms established under the former Soviet environmental regulatory system are still valid for the petroleum industry. The following is a list of key standards for quality of air, surface water, groundwater and soil, as well as regulations on design and safety of facilities.

- Nature Preservation. Atmosphere. Rules of Setting Permissible Discharge of Harmful Substances by Industry Enterprises, GOST 17.2.3.02-78. Moscow.
- Instructions on Procedure of Consideration, Approval and Examination of Air Protection Measures and Granting of Permissions for Discharge of Contaminants into Atmosphere According to Designs (OND 1-84), 1984. Goskomgidromet.
- Procedure of Transfer of Exploded Oil and Gas Oil Fields for Industrial Development, Moscow, 1988.
- Sanitary Rules for Oil Industry. Minzdrav SSSR. M., 1986.
- Decision of Cabinet of Ministers of the Republic of Kazakhstan on February 13, 1993, "On Rise and Development of Raw Hydrocarbon Recovery in Kazakh part of Caspian Sea".
- Decision of Cabinet of Ministers of Republic of Kazakhstan on February 2, 1994, No. 128 "On Approval of Certification Procedure for Mineral Resources Users".
- Drinking Water. Hygienic Requirements and Control of Quality. GOST 2874-82, Moscow.
- Standard of Council for Economic Aid (CMEA), CMEA 4285-84. Ground Waters, General Requirements for Sampling, 1985.
- Nature Preservation. Hydrosphere. General Requirements for Ground Water Protection. GOST 17.1.3.06-82 (St CMEA 3079-84), Moscow.
- Nature Preservation. Hydrosphere. General Requirements for Protection of Surface and Ground Waters from Pollution with Oil and Oil Products during Transport along Pipeline. GOST 17.1.310-83 (St CMEA 3545-82), Moscow.
- Nature Preservation. Hydrosphere. General Rules of Water Protection from Pollution in Drilling and Oil Production on Land. GOST 17.1.3.12-86, Moscow.
- List of Maximum Permissible Concentrations (MPC) and Operating Reference Safe Levels of Impacts of Pollutants on Community Air. Ministry for Ecology and Biologic Resources of Republic of Kazakhstan. Almaty, 1992.
- Methods of Calculation of Harmful Substances Concentrations in Atmospheric Air, Contained in Enterprises Discharge (OD-86), L., Goskomgidromet, 1987.
- Methodical Instructions on Calculation of Total Discharge of Harmful Substances into Atmosphere for Oil Processing and Petrochemical Enterprises RD-17-89. M., 1989.
- Instructions on Composition, Procedure for Elaboration, Agreement and Approval of Designing Estimates for Enterprises, Buildings and Structures Construction. SNIP 1.02.01-85. Gosstroy, 1985.
- Temporary Instructions on Procedure for Carrying Out Environmental Impact Evaluation of Planned Activities in Republic of Kazakhstan. PND 03.02.01-93. Almaty, 1993.

3.4 PROCEDURE FOR ECOLOGICAL EXAMINATION AND ISSUING OF LICENCES

The procedure for environmental evaluation or state ecological examination of the oil and gas industry is legislated by the Code of the Republic of Kazakhstan on Mineral Resources and Raw Materials Processing (1992). The state ecological examination follows from the previous law on Environmental Protection in Kazakh SSR (1991).

The state departments with control over the development of hydrocarbon resources, environmental protection, safety, public health and administration are:

- Ministry of Ecology and Bioresources;
- Ministry of Geology and Mineral Resources Preservation;
- State Committee for Supervision of Safe Execution of Work in Industry; and
- Ministry of Public Health.

More details of the responsibility and function of each ministry are presented in Appendix C.

3.4.1 State Ecological Examination Process

This process is similar to the international concept of an environmental impact assessment, which is a mechanism to ensure that proposed hydrocarbon developments are assessed according to potential impacts, mitigative measures and residual impacts. Hence, a decision can be made on whether or not the project meets established environmental criteria.

The environmental impact evaluation begins at the earliest planning stage and continues to the feasibility report and detailed design state. This allows the selection of the most suitable mitigative measures to prevent or minimize adverse effects on the environment and socio-economic conditions in the area.

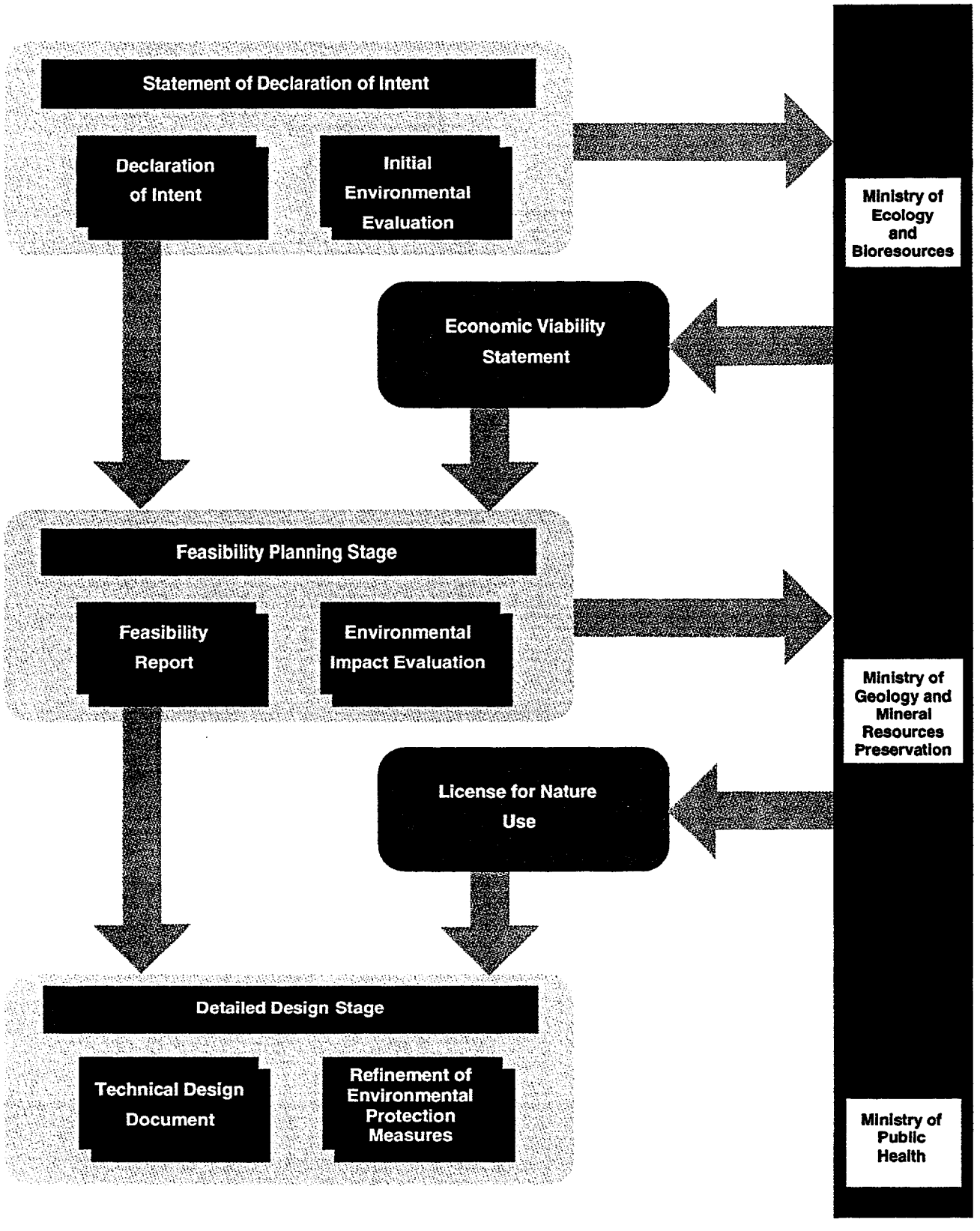
As a rule, three stages of evaluation (Figure 3.1) of the proposed development are distinguished:

- statement of declaration of intent;
- feasibility planning stage; and
- detailed design stage.

At each stage environmental matters are taken into account and appropriate issues and measures are identified.

An environmental screening shall be undertaken for all kinds of planned developments. The completeness of the environmental evaluation, scope of materials used and level of detail will depend on the anticipated intensity of impact of the proposed development. Large projects which may have potential impacts must be subject to an environmental impact evaluation. For smaller projects, early discussions with the state ecological examination committee are essential to determine the nature and extent of the environmental evaluation.

On review of the proposed project description, the examination committee will issue a terms of reference or temporary instructions to guide the proponent in preparing the environmental evaluation.



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ECOLOGICAL EXAMINATION AND LICENSING PROCESS KAZAKHSTAN

FIGURE 3.1

The environmental evaluation is assessed by the examination committee in terms of how closely the propoent adhered to the temporary instructions, as well as to the:

- State Law on Environmental Protection; and
- Statute on State Environmental Evaluation.

The results of the environmental impact evaluation are prepared as a document which corresponds to the three planning stages mentioned previously, and are an integral part of the predesign and design materials. The environmental impact evaluation stages are:

- initial environmental evaluation;
- environmental impact evaluation; and
- refinement of environmental protection measures (including residual impacts and monitoring programs).

Approval from the examination committee to proceed is required at two stages: after submission of the Declaration of Intent and after submission of the Feasibility Report.

3.4.2 Licensing Process

If the state ecological examination committee, with input from the other ministries, considers that the proposed development project meets acceptable environmental criteria, then a Licence for Nature Use is issued. This licence specifies the terms and conditions under which the proposed development can proceed. The general provisions and procedure for coordinating and granting of licences is presented in Appendix C.

3.5 STANDARDS FOR APPROVAL OF THE PROPOSED UZEN OIL FIELD REHABILITATION PROJECT

At the inception of the project, discussions were held between Dr. M. Khabibullov of AGRA Earth & Environmental (AGRA E&E), Mr. Vladimir Litvak of the World Bank, and representatives of the Kazakh Ministry of Ecology and Bioresources to discuss the standards on which this environmental assessment would be approved. All parties verbally agreed that this environmental evaluation would be considered, in the first stage of the ecological examination process, as part of the Declaration of Intent; i.e., an initial environmental evaluation. This initial environmental evaluation would be characterized by a high level of local content, which would be provided by "KazEcology", the Ministry's experts on environmental protection.

4.1 CONTINENTAL ENVIRONS

4.1.1 Climatology

The data used to characterize the Uzen and Novy Uzen areas (Mangystau Region) were obtained from the Tushibek meteorological station and the Reference Book on the Climate of the USSR, Volume 18 (SNiP 2.01.01.82).

4.1.1.1 Seasonal Weather Patterns

The Mangystau Region is designated as Region IV under the Construction Climate Zoning System and as Region VIII (i.e., very arid and hot) under the Agroclimatic Zoning System.

The climate of the Mangystau Region is influenced by the Arctic, Iranian and Turanian air masses. The warm season is characterized by hot tropical air masses from the Middle East and Iranian deserts. The summers are uniformly hot and begin, generally, during the first week of April and last until the end of October. The hottest month of the year (July) has an average temperature of 26.3°C, with daytime temperatures normally ranging from 26 to 28°C. Daytime temperatures can be as high as 40 to 43°C during some years, and the average maximum temperature for the area is 32.5°C, with an absolute maximum temperature of 43°C (Table 4.1). Daily temperature fluctuations during the summer normally vary from 16 to 17°C, but may vary as much as 25 to 30°C.

The winter season is short and relatively warm, with an average temperature (in January) of -4.4°C and monthly averages for January ranging from -2.5 to -5°C. The average minimum temperature during January is -7.7°C, but during the winter season night-time temperatures can decrease to -12 to -16°C. During severe winters, temperatures as low as -28°C have been recorded (Table 4.1). On average, 200 frost-free days occur annually (Table 4.2).

4.1.1.2 Wind Patterns and Velocities

Prevailing winds are generally from the east and southeast in the winter, and from the west and north in the summer. The annual average wind velocity is 4.8 m/s (Table 4.3). Generally, average monthly wind velocities exceed 5 m/s, with possible exceptions occurring in the fall and early winter when average wind velocities may decrease to 4.2 m/s. On average, about 22 days/year have winds exceeding 15 m/s, while winds with a velocity of 8 to 15 m/s occur approximately about 189 days/year (Table 4.4). A maximum wind velocity of 34 m/s was recorded in the region during the month of February. The relatively high frequency of strong winds results in dust storms occurring about 7 to 8 days/month during the summer and in snow storms occurring about 4 days/month during the winter.

Table 4.1

Air Temperature Data

Data	Jan	Feb	Mar	Apr	May	Jun	July	Aug	Sept	Oct	Nov	Dec	Year
Average Monthly and Annual Air Temperature (°C)	-4.4	-3.2	2.3	11.7	19.2	23.5	26.3	25.3	18.9	10.5	3.7	1.3	11.0
Average Maximum Air Temperature (°C)	-0.5	1.2	7.5	17.8	25.4	29.7	32.5	31.6	25.1	16.0	8.3	2.1	16.4
Average Minimum Air Temperature (°C)	-7.7	-6.5	-1.6	6.6	13.6	18.0	20.9	19.8	13.6	5.9	0.3	-4.1	6.6
Absolute Maximum of Air Temperature (°C)	14	20	25	35	38	41	43	41	38	30	23	15	43
and Year of Occurrence	1966	1958	1971	1972	1985	1966	1983	1976	1971	1957	1974	1980	1983
Absolute Minimum of Air Temperature (°C)	-25	-28	-19	-7	-1	5	10	-6	-2	-12	-18	-20	-28
and Year of Occurrence	1964	1969	1963	1957	1960	1967/70	1957	1980	1973	1967	1957	1959	1969

Table 4.2

Dates of Last and First Frosts, and Duration of Frost-Free Period

Date of Last Frost			Date of First Frost		
Average Days	Earliest Date	Latest Date	Average Days	Earliest Date	Latest Date
6.19	Mar. 14/77	Apr. 26/68	24.10	Sept. 27/73	Nov. 20/71

Duration of Frost-Free Period		
Average	Minimum (Year)	Maximum (Year)
200 days	165 days (1964)	229 days (1967)

Table 4.3

Average Monthly and Annual Wind Velocity (m/s)

Jan	Feb	Mar	Apr	May	Jun	July	Aug	Sept	Oct	Nov	Dec	Year
4.5	5.1	5.2	5.2	5.1	4.7	5.0	4.7	4.5	4.2	4.4	4.4	4.8

Table 4.4

Average Number of Days per Month with Wind Velocity Equal to or Exceeding Preset Value

Preset Velocity	Jan	Feb	Mar	Apr	May	Jun	July	Aug	Sept	Oct	Nov	Dec	Total Days
8 m/s	14.6	15.3	18.4	17.4	17.0	15.5	17.5	15.7	14.2	14.3	14.5	14.1	188.5
15 m/s	2.5	2.7	3.2	1.7	1.2	0.7	1.3	2.0	2.0	1.0	1.7	2.2	22.2
20 m/s	0.2	0.4	0.5	0.5	0.1		0.1	0.1		0.1	0.1	0.2	2.3
30 m/s		0.1						0.1					0.2

Table 4.5

Monthly and Annual Precipitation (mm)

Jan	Feb	Mar	Apr	May	Jun	July	Aug	Sept	Oct	Nov	Dec	Annual Total
11	13	19	22	16	15	17	6	12	15	20	14	180

4.1.1.3 Precipitation and Humidity

The Mangystau Region is arid, with an annual precipitation of about 180 mm. Maximum precipitation (about 22 mm) occurs in April and minimum precipitation (about 6 mm) occurs in August (Table 4.5).

Generally, snow cover only occurs about 32 days/year and may be present only during every other year around the end of December or beginning of January. Maximum and minimum depths of snow cover have been reported to be 20 cm and 1 cm, respectively, with an average depth of 6 cm. The soil normally freezes to a depth of 70 to 100 cm.

Average monthly relative humidity is about 68% in the spring (March) and decreases to 40% in the autumn (August). Relative humidity increases in the winter, with a maximum value of 78% recorded in December (Table 4.6). Relatively humidities of less than 30% may occur for as many as 120 to 130 days/year, while relative humidities of greater than 80% may only occur for periods of 60 to 70 days/year.

4.1.1.4 Air Quality

The air quality of the Mangystau Region is heavily influenced by the oil- and gas-producing industry, with emissions from oil wells, flare pits, oil refining and storage facilities, gas processing plants, and related facilities acting as the main sources of atmospheric pollutants. There are no permanent air quality monitoring stations in the region, and the information on air quality has been produced as a number of individual studies. Meteorological conditions, especially wind velocity, influence air quality to a great extent.

The most hazardous substances in the air are the compounds of sulphur, because of their acid-forming potential, effects on plants and human respiration, and potential for long-range atmospheric transport. Sulphur deposition, measured as sulphate, has been reported to range from 0.07 to 1.02 t/km^2/year in the Uzen oil fields and from 0.54 to 1.64 t/km^2/year in the Jetebai oil fields.

Average sulphur dioxide concentrations in the area of the Uzen gas processing facility were 38.4 mg/m^3/day in 1991 and 185.6 mg/m^3/day in 1992. Concentrations within the Town of Uzen are somewhat lower and have been reported to range from 0.259 to 109.6 mg/m^3/day. According to the "General Sanitary-Hygienic Requirements for Occupational Air" (GOST 12.1005-88), the maximum permissible value for sulphur dioxide in occupational air is 10 mg/m^3/day.

Hydrocarbons are also another major air pollutant. Ambient atmospheric hydrocarbon concentrations in the Uzen oil field have been reported to be 2.5 times the maximum permissible concentration of 3 mg/m^3. Mean values for hydrocarbon contamination were reported to be 3.7 times the average permissible concentration (not provided). The concentrations of benzene in the air are reported to be 60 to 70 times permissible values.

Table 4.6

Relative Humidity

Data	Jan	Feb	Mar	Apr	May	Jun	July	Aug	Sept	Oct	Nov	Dec	Annual Average
Monthly Relative Humidity Averages (%)	75	74	68	54	44	43	42	40	45	59	71	78	58

4.1.2 Geology

4.1.2.1 Geomorphology

The study area lies within the South Manghyshlak Plateau geomorphic region. Elevation ranges from 300 m ASL in the Manghyshlak hills to 60 m in the south part of the Kerderly Kayasan Plateau. Dominant features of the region include several large depressions, of which Kashkarta, Kasagie, Kaundy, Zhazgundy and Kazynzharak are the largest. The Karigan, Uzen and Tun Karakshi Depressions are considered moderately sized. In general, the east and southeast sides of the largest depressions are high and the west slopes are low. They are flat-bottomed, with sides up to 80 to 200 m high.

4.1.2.2 Bedrock and Surficial Materials

A brief description of regional stratigraphy is as follows.

The most ancient deposits are the Permian and Triassic deposits collectively known as the "Karatauz Complex". They form the Karatauchik, West and Edge Karatau Ridges, and crop out in the Tungashin anticline. Jurassic deposits are only evident in the Manghyshlak Mountains.

The Lower Cretaceous rocks outcrop in the Manghyshlak Mountains, as do the Upper Cretaceous. The Upper Cretaceous rocks also outcrop in the Tebedzhik and Hangababa tracts, in the base of the Ustyurt and South Manghyshlak ?? and in the Uzen and Karigan Depressions.

The Paleogene deposits make up the Synclinal Zones (Nakyrgan, Sauskan-Bostankum, Tyuesui, etc.) within the Manghyshlak dislocations system. The Tyub-Karigan, South Manghyshlak and Ustyurt Plateaus are comprised of Neogene rocks. The Neogene rocks have largely been removed from the Manghyshlak Mountains by erosion and only isolated remnants remain.

The Miocene period is represented by the Torotoman, Sarmatian and Neothic stages, the most widespread of which are the Sarmatian deposits (Lower, Middle and Upper Sarmat).

Marine Quaternary deposits make up the entire surface of the Buzaki Peninsula. They are comprised of sediments representing four stages: Bukiman, Khazarian, Khvalynian and New Caspian. The Bakiman and Khazarian stage deposits are of limited distribution.

Khvalyrian stage deposits are found in a continuous strip adjacent to the Caspian Sea. The strip has a maximum width of 40 to 50 km near Karigan and narrows to 0.5 to 1 km on the Tyub-Karigan Peninsula. These deposits are divided into Lower and Upper Khvalynian. Lower Khvalynian deposits represent the extent of Caspian Sea flooding. The deposits of this stage form the highest benches comprising fine- and medium-grained sands. The Upper Khvalynian deposits in the western part of the region form two benches at a height of 3 to 6 m on the Caspian shore and are comprised of sand and pebbles.

The New Caspian stage deposits form a narrow strip along the Caspian shore and are widespread in the Karigan, Ashdisor and Karasol Depressions.

The New Caspian stage deposits form a narrow strip along the Caspian shore and are widespread in the Karigan, Ashchisor and Karasol Depressions.

Continental Quaternary deposits are more widespread than the marine Quaternary deposits and cover large areas of the region. The Middle Quaternary deposits comprising aeolian and slopewash deposits are widespread.

A number of sand dunes oriented in a southwest direction are comprised of middle-clustering sediments. The largest of these are the Sausken, Baskuduk, Bostaukun, Sergirkun, Tyshkarkun and Tyresu. The dunes range in height from 10 to 15 m along ridges to 1 to 3 m in depressions.

Upper Quaternary deposits are represented by diluvial, diluvial-slopewash, eluvial-diluvial and areolar geratic types. Recent deposits are represented by slopewash, lake and aeolian formations.

4.1.3 Hydrogeology

Water-bearing strata exist at a variety of depths in the Novy Uzen Region in deposits laid down during the Jurassic, Cretaceous, Tertiary and Quaternary periods of geological history. Each of the particular water-bearing deposits (or strata within deposits) of the region will be discussed separately in the following sections. Information concerning the groundwater of this region was obtained from existing hydrogeological surveys.

Most of the groundwater in this region is saline (i.e., salinity greater than 0.5 g/L). However, two water-bearing formations (the Baskuduk and Sauken sand masses) are reliable sources of drinking water for the inhabitants of this area.

4.1.3.1 Upper Holocene - Upper Quaternary Deposits

These deposits occupy large areas above the north limb of the Beke-Baskuduk Anticline and in the southwest corner of the Uzen Depression. Water is withdrawn from these deposits by Wells #137 to #139 and by two pits (#57 and #59) in the Uzen Depression. Fine-grained to coarse-grained sands serve as the conduit for groundwater. Particle size of the sands increases from west to east, and toward the south to the edges of the aeolian mass. The groundwater in the Upper Quaternary deposits has a free surface at a depth of from 3 to 11.5 m. Piezometric pressures in these deposits are not great and measure 6 to 6.5 in wells and 3.6 to 3.8 in pits. Production of water from these deposits is typical of that observed for Well #9, which is completed in fine-grained sands and produces 0.8 L/s at depths of 2.65 m. Production rates from wells completed in coarse-grained sands and poorly cemented sandstones is somewhat higher and varies from 0.4 to 0.15 L/s at a depth of about 0.2 m. Salinity of the groundwaters from this area ranges from 3 to 15 g/L. Generally, higher values are observed in the western area and central parts of the deposit. Major ions are sodium and chloride. Water composition in pits is somewhat different and varies in salinity from 4.3 to 8.9 g/L. Major ions in these waters are sodium, chloride and sulphate. Changes in the

composition of the groundwater are caused not only by the change in lithologic composition of the water-bearing strata, but also by the conditions of the formation. In the western area, the Upper Pliocene-Quaternary sands adjoin the Sarmain and Karyganian strata which drain highly mineralized waters. Their close proximity to the surface favours intense evaporation, thus causing higher mineral content. The flow of the water in the Sarmain and Karyganian strata is mainly to the south. The strata in the southeast corner of the Uzen region is of limited value due to its high salinity and low production. The piezometric pressure of the Sarmain and Karyganian strata varies from 12 to 33 at depths ranging from 1.5 to 18 m.

In the Barkhan zone, minimum groundwater depths range from 1.0 to 5.5 m, with maximum depths ranging from 13.8 to 18.0 m within the Barkhan sands. In the north, the well production rate increases from 0.1 to 1.0 L/s at depths of 2.5 to 4.7 m, respectively. Salinity of the water increases toward the edge of the Barkhan sands. Increased salinity at the edge of the sand mass is caused by the decrease in depth, intensive evaporation and stagnation conditions. The water-bearing stratum is closest to the surface along the north edge of the Barkhan sand mass. The major ions of the waters of the Barkhan zone are calcium, magnesium and bicarbonate over most of the area, but change to calcium, sodium, sulphate and chloride in the northern and eastern areas.

The Baskuduk sand mass has an estimated storage capacity of about 32 970 000 m^3, with an exchange capacity of over 24 L/s. The hydraulic slope is 0.0016 and the pore velocity is about 4 m/day. The area of the Baskuduk sand mass is 3 255 000 m^2, and has an average thickness of 21 m.

Another sand mass in this area is the Sausken mass, which contains water at depths ranging from 1 to 24.4 m. Pump tests from piezometers in aeolian sands vary from 0.0 to 0.4 L/s at depths of 0.1 and 1.0 m, respectively. Typical production rates from this area range from 0.1 to 0.4 L/s.

Fresh groundwater (generally considered to have a salinity ranging from 0.2 to 0.5 g/L) occurs in the central and northeast parts of the Sausken sand mass. Toward the north of this sand mass, the salinity increases to over 10 g/L. The major ions in the groundwaters with a salinity of up to 1 g/L are sodium, magnesium, bicarbonate and sulphate. Chloride ions may also be prevalent in this water.

The total area of the Baskuduk and Sauken sand masses, which produce water with a salinity up to 3 g/L, is 165 km^2. Capacity of this area is estimated to be 210 536 450 m^3, or about 1.3 million m^3/km. Restricted use of half of the water-bearing formation allows the production of 0.4 to 66 L/s from a 1 km^2 area. Given the generally saline nature of groundwaters in the Novy Uzen Region, the Baskuduk and Sauken sand masses represent a reliable source of drinking water to the population of the area.

4.1.3.2 Sarmatian Stratum in the Miocene Deposits

The Sarmatian stratum of the Miocene deposit in the southern part of the Novy Uzen area contains water-bearing limestones with a thickness of 5 to 15 m. Groundwater surfaces in this area occur at depths of 70 to 80 m. The thickness of the water-bearing limestone formation does not exceed 15 m, and well production rates are generally fractions of a litre/second. Salinity ranges from 7.8 to 10 g/L. Major ions of the waters are sodium, chloride and sulphate. Due to the salinity of this stratum, the water is only used for process water supply and livestock watering.

4.1.3.3 Pliocene and Eocene Deposits

The Pliocene and Eocene deposits consist of two to three formations of poorly cemented sands and sandstones ranging from 5 to 15 m in thickness. Pressure within the deposit is sufficient to bring water to the surface once a well is completed. Salinity of the water varies from 6.2 to 46.54 g/L, with sodium and chloride being the dominant ions. The deepest strata of this deposit produce a sharp increase in salinity and increased concentrations of hydrogen sulphide. Typical well production from the Karigan Depression was recorded as 1700 m^3/day. The temperature of the groundwater at the wellhead is 36°C.

4.1.3.4 Senonian and Danian Strata in Upper Cretaceous Deposits

The Senonian and Danian water-bearing strata of the Upper Cretaceous are in the area of the Chakyrgan syncline, which is composed of fractured white chalk, limestone and marl. Water-bearing strata are about 50 m thick and up to 30 m below ground level. Salinity ranges from 1.7 to 3.5 g/L, with major ions being sodium, calcium, sulphate and chloride. Well production rates range from 0.04 to 0.92 L/s at depths of 42.5 and 35.4 m, respectively. These strata are of no practical use because of the low production rates.

4.1.3.5 Senonian and Turanian Strata of the Upper Cretaceous Deposits

These water-bearing formations are widespread in the Novy Uzen Region and are composed of fine- to medium-grained silica-glauconitic sands and sandstones on limestone. These strata have sufficient pressure to force water to the surface once a well is completed. Pressure at the well head increases with increased well depth from 31.8 to 690.5 m. Well pump tests ranged from 0.21 to 0.97 L/s at depths of 31.7 to 47.6 m, respectively. Specific production rates range from 0.0006 to 0.0002 L/s. Salinity of the water ranges from 3 to over 10 g/L, with major ions of sodium, chloride and sulphate. Salinity decreases in the northwest portion of this water-bearing formation due to the encroachment of less saline water from the Karatau Ridge. The waters of this formation are of sufficient quality and quantity for process water only.

4.1.3.6 Middle and Upper Albanian Strata of the Lower Cretaceous

This formation forms up to seven separate water-bearing strata in the region, with the exception of those formations in the Beke-Baskuduk and Ogyu anticline. Wells have been completed in these formations to depths of 5 m to between 70 and 80 m. The water-bearing strata are composed of fine-grained, clayey and poorly cemented silica-glauconite sandstones. Static piezometric levels in completed wells vary from 32.25 to 141 m, depending on the elevation of the well head. Pump tests have established discharge rates of 1.6 to 3.95 L/s at depths of 7.8 to 10.15 m, respectively. Most of the wells in the Jetebai and Uzen Regions were drilled for oil and investigated for water at the same time. Maximum discharges reached 10 L/s at depths of 15.07 m. The water has a hydrogen sulphide odour and its temperature at a depth of 500 m is 30°C. Salinity ranges from 5 to 10 g/L. Total hardness is 10 mg-eqv/L. Major ions in the water are sodium, magnesium, bicarbonate and sulphate. At wells 135 to 138 at the elevation of Uzen, the waters contain iodine in concentrations ranging from 2.8 to 26.5 mg/L and bromide ranging from 26.5 to 140 mg/L. The iodine and bromide contents are related to the presence of oil in the formation. The waters of these formations are suitable for process water supplies only. The estimated volume of water within the Albian stratum is 19 million m^3.

4.1.3.7 Neokomian Stratum of the Lower Cretaceous

This stratum forms an outcrop in the Ogyu anticline region. The water-bearing formation is formed by sands and slightly cemented sandstones at a depth ranging from 0.5 to 3.4 m. Production rates of completed wells range from 0.07 to 0.35 L/s at depths of 1.0 and 0.31 m, respectively. Salinity of the waters varies from 3.1 to 4.7 g/L, with major ions of sodium, chloride and sulphate. In the western portion of this formation, where waters have a salinity of up to 3 g/L, the major ion is bicarbonate. Waters with a salinity below 4 g/L are generally acidic (i.e., pH 6.0 to 6.5). The water in this formation is of sufficient quality in some areas to be used for drinking or livestock watering.

4.1.3.8 Middle Jurassic Deposits

Water-bearing strata within this formation are composed of sands, sandstones, carbonaceous shale and limestones. Stable piezometric levels are attained at a depth of approximately 220 m. Maximum depth of the water-bearing formation is about 2500 m. Well production rates are generally less than 1 L/s. Salinity of the waters ranges from 70.7 to 157 g/L, with a total hardness of 748 mg-eqv/L. Water temperature is 90°C.

4.1.3.9 Upper Pliocene-Quaternary Deposits

Several water-bearing strata occur sporadically in the southern part of the Baskuduk sands. Well production rates vary from 0.04 to 0.1 L/s at a depth of 0.84 m. Salinity of the water varies from 0.3 to 4.3 g/L, with calcium, sodium, bicarbonate and chloride as the major ions. Total hardness ranges from 5.4 to 19.8 mg-eqv/L. Generally, these water supplies can be used for drinking.

4.1.3.10 Sarmatian Stratum of Miocene Deposits

Water-bearing portions of the Sarmatian stratum occur sporadically in the Miocene deposits of the region. The thickness of the water-bearing strata varies from 0.6 to 3.2 m at depths ranging from 2.7 to 28.4 m. Depth of the Sarmatian stratum increases toward the southwest. Salinity of the waters varies from 0.5 to 5.65 g/L. Major ions in water with salinities of up to 1 g/L are sulphate and bicarbonate. Waters with salinities of 5 to 6 g/L have sulphate and chloride as major ions.

4.1.3.11 Kongorian Deposits

Water-bearing strata occur sporadically in the Kongorian deposits, which exist as narrow strips with a width of up to 300 m spread along the Uzen Depression in the east limb of the Beke-Baskuduk anticline. Salinity of these waters varies from 9.0 to 12.4 g/L, with major ions of sodium, calcium, chloride and sulphate.

4.1.3.12 Paleocene and Lower Eocene Deposits

Water-bearing strata occur sporadically in Paleocene and Lower Eocene deposits north of the Murzair sor. Well production rates are about 0.1 L/s and salinity generally exceeds 3 g/L.

4.1.3.13 Middle and Upper Eocene Deposits

Water-bearing strata occur sporadically in the Middle and Upper Eocene deposits. The deposits border the Baskuduk and Sausken sand masses as a wide strip along the north sand mass margin. The Middle and Upper Eocene deposits also spread along the southern margin of the Sausken sand mass and along the Uzen Depression. Salinity of these waters ranges from 0.7 to 5.6 g/L and they occur at depths of 2.7 to 22.5 m. Production rates have been recorded from 0.8 to 2.3 L/s at depths of 4 m.

4.1.3.14 Senonian and Danian Strata of the Upper Cretaceous Deposits

Water-bearing Senonian and Danian strata occur sporadically in the Upper Cretaceous deposits of the Chakyrgan syncline. Production rates from these strata are less than 1 L/s, with salinity ranging from 3 to 5 g/L. Major ions are sodium, calcium, sulphate and chloride.

4.1.3.15 Keokomian Stratum of the Lower Cretaceous

Water-bearing formations occur sporadically in the sandstones of the Keokomian stratum of the lower cretaceous in the Karocyaz-Taskas upland. Salinity ranges from 2.4 to 2.8 g/L, with a static piezometric level at 3.6 to 5.7 m.

4.1.3.16 Salt Deposits

Water-bearing strata of salt deposits are spread along the south of the Uzen hollow and along the north of the Baskuduk sand mass. These waters generally have a salinity of 200 g/L, with major ions of sodium and chloride.

4.1.3.17 New Caspian Deposits

Water-bearing strata of the New Caspian deposits occur in the Karigan and Ashchisor Depressions and along the Caspian seashore. These groundwaters range in depth from 1.2 to 8 m, with a static piezometric pressure at 0.5 to 1.5 m. Salinity of the waters ranges from 0.3 to 7.6 g/L.

4.1.4 Soils

The Uzen oil field lies within the northern subzone of the Manghyshlak bioclimatic region. This northern subzone is characterized by halophyte-wormwood stepped desert with brown soils.

The main soil types within the Manghyshlak Region are as follows:

- brown saline;
- brown alkaline-saline;
- brown eroded;
- brown undeveloped;
- meadow brown alkaline-saline;
- meadow brown saline;
- grey-brown saline;
- grey-brown alkaline-saline;
- grey-brown crust-saline (highly gypsiferous);
- grey-brown undeveloped;
- grey-brown eroded;
- desert alkali;
- meadow alkali;
- takyrs;
- meadow saline;
- sea saline;
- sor saline; and
- mound-ridge stabilized and half-stabilized Barkhan sands (unstabilized).

Brown Alkaline-Saline Soils

The brown alkaline-saline soils are widespread and mainly occur in complex with alkali soils. Vegetation associated with these soils is represented by the biyurgen-wormwood association, with kneyreuk, itrigek, ebelek and mortuk.

The humus horizon is 20 to 25 cm thick, with a low humus content (0.8 to 1.01%) and a low gypsum content (0.18%). The cation exchange capacity is also low (7 to 11 meq/100 g).

The alkaline horizon has a prismatic or columnar structure. The calcareous horizon is more compact. These soils are strongly alkaline, with a reaction of pH 8.1 to 8.3. They are highly calcareous, with a carbonate content of 10 to 15%. They are also highly saline, particularly at depth.

At a depth of 30 to 50 cm, the soils contain up to 1.5% salts; the gypsum content increases up to 16.4% (sometimes up to 26%) from a depth of 50 to 100 cm. These soils are used for pasture and hay lands.

Grey-Brown Alkaline-Saline Soils

Grey-brown alkaline-saline soils are the most widespread on the Manghyshlak Plateau. The vegetation is represented by wormwood-keykeuk-biyurgen and wormwood-boyalysh associations, sometimes with the addition of ephemeral-mortuk.

These soils are derived from saline sand deposits, with inclusions of gravel underlaid by limestone. They occur in association with crustal-saline (highly gypsum ferrous) soils, alkali soils, takyrs and eroded soils.

The soils are highly calcareous, with 10 to 15% carbonates, on average, throughout the soil profile. Maximum carbonate levels are 35%. They have an alkaline reaction (pH 7.7 to 8.5), with pH decreasing to 7.0 in the lower horizons.

These soils also contain a high content of water-soluble salts at depths of 10 to 20 cm. The gypsum horizon occurs from 30 to 50 cm. It sometimes has considerable thickness, but more often the soil below 50 cm is characterized by a layer of mainly limestone, also with considerable gypsum inclusions.

These soils are deficient in humus and nutrients—particularly nitrogen and phosphorus. They are not suitable for agriculture because of the shallow gypsum ferrous horizon, thin profile, salinity and shallow limestone bedrock. They provide medium quality autumn-winter pastures.

Meadow Brown Alkaline-Saline Soils

These soils are widespread in the intermontane valley, and are formed on stratified materials. Mineralized groundwater is found within 3 to 5 m of the surface. Vegetation is represented by a wormwood itsigek-zhantak association, with azhnek and drig.

Sharply defined inclusions of soluble salts at 20 to 30 cm and alkaline upper horizons are typical for these soils. They are used primarily for pasturelands, with some haylands.

Alkali Soils
These soils are widespread. Vegetation is typically sparse and is represented by biyurgen, tasbiyurgen and wormwood. These soils are highly alkaline (pH 8.4) and highly calcareous (10.7 to 15% carbonates). They are also sodic, with sodium comprising 30 to 50% of the exchangeable bases.

Meadow Alkali Soils
These soils occupy only small areas and are found in intermontane depressions with azhnek-halophyte vegetation. Highly mineralized groundwater is found within 3 to 4 m of the surface. They are not suitable for agriculture.

Takyrs
Takyrs occupy karst sink holes of different sizes (from 0.1 to 10 m^2) and are scattered over the region. These depressions serve as collection points for snow melt and rainwater. Soils within these depressions are low in humus and nutrients. They are also sodic, with sodium comprising 25 to 45% of exchangeable bases.

Saline Soils
Saline soils are widespread in the region and occupy low seashore benches and depressions. The salts are derived from mineralized groundwater and sediments of marine origin.

Sands
Unstabilized and stabilized sands are found in the Buzhchi Peninsula to the north and in the Krynzhank Hollow to the east. Small sand mussels occur in coastal areas and in the Karigan Depression. These sand deposits represent aeolian deposits of Quaternary age.

Sors
These are formed in poorly drained depressions in areas of groundwater discharge. They are characterized by saline silty muds and have a permanently swampy surface.

4.1.5 Vegetation

The main plant species found in the Manghyshlak Region are listed in Table 4.7. The soils and climate of the Manghyshlak Region have combined to produce mainly desert and, occasionally, arid steppe vegetation zones. The productivity of pasture areas of the Region ranges from 1.0 to 3.0 c/ha.

Steppe species such as Indian, Caucasian and Shovit's feather grasses, and Siberian and desert *Agropyron* grow on mountain ridges and are important components of the vegetative cover in the region. Plants such as tasbiyurgen, chandelier biyurgen, *Atraphaxis* spp., caragana, bindweed, etc. form occasional cover on pebbly and stony areas.

Table 4.7

Major Plant Species of the Manghyshlak Region

Common Name	Scientific Name
Maidenhair Feather Grass	*Stipa orientalis*
Indian Feather Grass	*S. sareptian*
Caucasian Feather Grass	*S. caucasica*
Black Saxaul	*Holoxylon aphyllum*
Rigid Halophyte	*Salsola rigida*
Carinate Halophyte	*S. carinata*
Paulsen Halophyte	*S. paulentii*
Sand Astragalus	*Astragalus ammorphilus*
Astragalus Halophytic	*A. salsugineus*
False of Common Camel's Thorn	*Alhagi pseudoalhagi*
White Wormwood	*Artemisia pseucodes*
Common Wormwood	*A. absinthium*
Turanian Wormwood	*A. turanika*
Mugwort	*A. vulgare*
Sandy Wormwood	*A. arenaria*
Salt-Loving Wormwood	*A. halophila*
Sally Cockspur (Biyurgen)	*Anabasis aphylla*
High Cockspur (Itsigek)	*A. elatior*
Ceratocarpus Ascomycetons (Ebelek)	*Ceratocarpus utriculosus*
Prostrate Summercypress (Izen)	*Kochia prostrata*
Leafless Zhizgun	*Calligonum aphyllum*
Chandelier Biyurgen	N/A
Beard Grass	*Andropogon ischaemum*
East Mortuk	*Eremopyrum orientale*
Bulbiferous Meadow Grass	*Poa bulbosa*
Siberian Couch-Grass	*Agropyron fragile*
Atraphaxis	*Atraphaxis teritifolia*
Small-Leaf Seablite	*Suaeda microphylla*
Teresken	*Eurotia ceratoides*
Caragana	*Caragana frutex*
Sandy Goosefoot	*Atriplex dimorphostegia*

N/A = Not Available

Wormwood and wormwood associations represent the predominant vegetation types in desert areas. Gurganian wormwood and perennial cereal-beard grass are typical of the wormwood associations. As well, caragana, teresken, izen (prostrate summercypress), bulbiferous meadow grass, mortuk and alyssum are widespread in the wormwood, feather-grass and erkek communities.

Azhrekan, reed, chian associations, dzhigida and tamarisk are found near springs and in intermontane valleys. Sarsazan, seablite, solonchak goosefoot, kermek, etc. are typical of saline soils.

4.1.5.1 Major Plant Communities

The Manghyshlak Region is divided into the following three regions, based on prevalent vegetation community, soils and geomorphology:

- Manghyshlak low-mountain region;
- Tyshkarkun ropy-plain region; and
- Aktau-Karigan spur-ropy region.

Manghyshlak Low-Mountain Region
The Manghyshlak low-mountain region covers the low ridges (150 to 550 m in elevation) of the North and South Aktau, West and East Karatau, Karatauchik, Kaushe, Emdy, Kaskyrzhol mountains, etc. These mountains stretch for 200 km along the northern edge of the Manghyshlak Region, at widths varying from 30 to 50 km. In addition to the low ridges, the primary surface features of the mountains include intermontane valleys, spurs and says.

The region is characterized by brown undeveloped and rubble soils. Most of the vegetative cover is formed by white wormwood-kuyreuk associations with caragana and white wormwood-biyurgen associations. The white wormwood-biyurgen associations are combined with meadow-eremic groups in valleys, meadow groups (e.g., chiy, azrhek, reed) along springs and halophyte groups growing in the intermontane valleys. The productivity of the region ranges from 1.5 to 2.5 c/ha.

Tyshkarkun Ropy-Plain Region
The Tyshkarkun ropy-plain region occupies a peninsula on the western edge of the Mangyhshlak low-mountain region. The peninsula is 60 to 70 km in length and 30 to 40 km in width. The region is basically devoid of waterbodies, except for some minor springs at the base of the limestone cliffs near the Caspian shoreline.

The region is characterized by brown alkaline and saline soils. The vegetative cover is formed by cereal-wormwood (Sareptian feather grass, meadow grass, white wormgrass, itsigek, mortuk, astragalus, etc.) and caragana-white wormwood erkek-white wormwood associations. These associations are replaced by tasbiyurgen and white wormwood-biyurgen associations in the open country, and by halophytes along the coastal strip.

Aktau-Karigan Spur-Ropy Region
The Aktau-Karigan spur-ropy region is located along the southern edges of the Mangyhshlak low-mountain region and the Tyshkarkun ropy-plain region. The Aktau-Karigan Region has complex relief. Elevations range from 50 m ASL for spurs down to 132 m BSL for the Karigan Depression. The region is characterized by brown alkaline and saline soils.

The majority of the vegetative cover of the Aktau-Karigan spur-ropy region is formed by itsigek-white wormwood and white wormwood-biyurgen (Sally cockspur) associations (productivity of 2 to 3 c/ha). Tasbiyurgen and white wormwood-tasbiyurgen associations (productivity of 1.5 to 2.5 c/ha) form the vegetative cover on shallow soils of steep slopes of spurs. Various halophytes (e.g., sarsazan, seablite) are found in the valleys between spurs, in says, around salt depressions and along the shoreline of the Caspian Sea.

4.1.5.2 Rare and Endangered Species

Russian Hawthorn *(Crotaegusambigua sp.)*
Russian hawthorn grows in a few depressions and ravine bottoms of the Mangyhshlak Plateau. The species has horticultural value and is used for landscaping purposes. As a result, it has been recommended that small groves and individual trees in the Ustyurt Karatau Mountains and the Mangyhshlak Plateau be protected as sources of seed.

Madder Cretaceous *(Rubia cretecea)*
Madder cretaceous is an endemic plant of West Kazakhstan (Caspian Sea, Mudgozhar, Embin and North Ustyurt) floral regions. It grows exclusively on chalk outcrops along the slopes and ravines of chalk mountains, from Ustyurt to the Mudgozhar Mountains.

Soft Pistil (no latin name provided)
Soft pistil grows in the North Ustyurt and Mangyhshlak floral regions but has limited distribution. It is also uncommon in Middle Asia. As a result, measures are required to protect populations of the plant in the wild and to cultivate it artificially.

4.1.6 Mammals

There are at least 36 species of mammals identified within the Mangystau Region and Uzen oil field area (Table 4.8). The distribution of these species in the region is dictated by a combination of topography, soils and vegetation complexes, and the lack of water sources. The mammals inhabit 11 faunal complexes, based on the distribution of the different species in relation to the various biotypes. Most of the wildlife in the Uzen oil field area is concentrated near the cliffs of depressional areas, where there is minimal disturbance and good escape cover.

Table 4.8

Mammals of the Uzen Oil Field Area

Common Name	Scientific Name
Long-Spine Hedgehog	*Hemiechinus hypomelas*
Eared Hedgehog	N/A
White-Belly Streloukh	*Ctonycterie hemprichi*
Perevyazka	*Vormela peregusna*
Kihi	*Mtllivora capensis*
Cheetah	*Acinonyx jubatus*
Sand Cat	*Felis margarita*
Palla's Cat	*F. manul*
Caracal	*F. carakal*
Wild Cat	*F. libyca*
Goitred Gazelle	*Gazella subgutturosa*
Ustyurt Mouflon or Turkmen Mountain Ram	*Ovis ammon cicloseros*
Saiga	*Saiga tatarica*
Mottled Putorak	*Diplomesodon pulchellum*
Hare Toly	*Lepus capensis*
Tolai Hare	*L. tolai*
Bobunsky's Bat	*Vespertilio nathusii*
Ground Squirrel	*Citellus maximus*
Desert Dormise	*Selevinia betpakdalensis*
Great Jerboa	*Allactaga major*
Severtsov's Jerboa	*A. severtzovi*
Small Jerboa	*A. elatior*
Jerboa-Jumper	*A. sibrica*
Hair-Legged Jerboa	*Dipus sagitta*
Emurchanchik	*Stilodipus telim*
Great Gerbille	*Rhombomys opimus*
Tamarisk Gerbille	*Meriones tamariscinus*
Midday Gerbille	*M. meridianus*
Libyan Jird	*M. libycus*
Common Vole	*Microtus socialis*
Jackal	*Canis aureus*
Wolf	*C. lupus*
Fox	*Vulpes vulpes*
Corsac Fox	*V. corsac*
Steppe Polecat	*Mustela eversmanni*
Weasel	*M. nivalis*

N/A = Not Available

4.1.6.1 Ungulates

Primary ungulates within the Mangystau Region are the Ustyurt mouflon, goitred gazelle and saiga. The Ustyurt mouflon is primarily an inhabitant of the West Ustyurt chinoks. Goitred gazelles primarily inhabit stabilized sand dunes, areas of rubble and clay desert, and areas vegetated by shrubs (saxaul, zhizgun, etc.). These areas are typical of low elevation, or arid mountains such as the Mangyhshlak Karatau. Saiga *(Saiga tatarica)* are also found in the region.

4.1.6.2 Carnivores

Cats typical of the Mangyhshlak Region include the sand cat, caracal, Palla's cat, wild cat and cheetah. Tracks of a wild cat were observed near Fetisovo during a spring 1994 survey of the Uzen oil field area.

The corsac fox and the steppe polecat are found in the steppe areas of the region. Wolves, jackals, foxes and weasels are widespread across the region. Fox tracks were observed at the Uzen and Tun Karakshi Depressions, and at the Kazakh Bay coast during the field survey. As well, jackal tracks and droppings were observed at the cliffs of the Uzen Depression and along the Kazakh Bay coast.

4.1.6.3 Rodents

Rodents are the most widespread of the desert mammals found in the region. Ground squirrels, common voles and dwarf hamsters are abundant and found in high densities. Gerbils are also widespread.

4.1.6.4 Other Mammals

The desert cat and insect-eating mammals, such as the long-spined hedgehog and the eared hedgehog, also occur in the Mangyhshlak Region. They are primarily found in desert areas with topographic relief (e.g., isolated hills and hollows, chinoks, dry river beds). Most of the specimens are observed near human dwellings and utility buildings. In the Mangyhshlak Region the order Lagomorpha is represented by the hare-toly or sand hare *(Lepus capensis)* and the Tolai hare. Tracks and droppings of the Tolai hare were observed at the Uzen and Tun Karakshi Depressions, and at the Kazakh Bay coast during the field survey.

Evidence of the Libyan jird was found during the spring field survey. It was not clear what order this species belongs to. However, their colonies are widespread. From 1000 to 2000 holes were observed at the foot of the northeast cliffs of the Uzen Depression during the field survey.

4.1.6.5 Rare and Endangered Species

Eleven of the 36 mammal species listed in Table 4.8 appear in the 1991 Red Book of the Kazakh SSR. Rare species include the long-spine hedgehog, white-belly streloukh, perevyazka and kihi. The kihi is a rare Kazakhstan mammal that reaches its northern limit in the Mangyhshlak Region. It is a poorly studied species and requires protection.

The Ustyurt mouflon and goitred gazelle are listed in the second category of the Red Book. The goitred gazelle population has shown slight declines, while the Ustyurt mouflon population has declined rapidly. The Ustyurt Preservation was established primarily to protect the rare Ustyurt mouflon.

Endangered species in the family Felidae are represented by the Palla's cat, sand cat and caracal. The cheetah is a rare and endangered species whose occurrence in the Mangyhshlak Region has not been confirmed for 25 to 30 years.

4.1.6.6 Critical Habitats

Details on the biological requirements of the Ustyurt mouflon are limited. The species is found near the southwest margins of the Ustyurt Preservation. They primarily inhabit crags located from the West Ustyurt on the south to the Sozhik on the north. They have a particular preference for craggy outcroppings bordering plateaus. Mouflons use caves, caverns and areas sheltered by overhangs for resting and protection from predators. The females also use these areas for lambing. The most recent (1987) estimate of the mouflon population in the Mangyhshlak Region was between 2500 and 3200 animals.

Goitred gazelles have critical wintering requirements. These requirements consist of areas for watering, minimal snow cover and thermal protection (e.g., rugged terrain or saxaul bushes).

4.1.7 Birds

4.1.7.1 Common Birds

A list of the species of birds found in the Uzen oil field area is provided in Table 4.9. At least 57 species of birds, belonging to at least 10 orders, have been identified. The orders represented in the area include: Podicipediformes, Anseriformes, Gruiformes, Charadriiformes, Falconiformes, Strigiformes, Columbiformes, Caprimulgiformes, Galliformes and Passeriformes. Most of the available information deals with the orders Passeriformes and Falconiformes.

Table 4.9

Birds of the Uzen Oil Field Area

Common Name	Scientific Name
Great Crested Grebe	*Podiceps cristatus*
Shelduck	*Tadorna tadorna*
Dabbling Ducks	*Anas sp.*
Coot	*Fulica atra*
Moorhen	*Gallinula chloropus*
Little Ringed Plover	*Charadrius dubius*
Black-Headed Gull	*Larus ridibundus*
Common Tern	*Strena hirundo*
Dunlin	*N/A*
Stone Curlew	*N/A*
Pallid Harrier	*Circus macrourus*
Long-Legged Buzzard	*Buteo rufinus*
Steppe Eagle	*Aqualia rapax*
Golden Eagle	*A. chysaetos*
Imperial Eagle	*A. heliaca*
Houbara	*N/A*
Serpent Eagle	*Circaetus gllicus*
Saker Falcon	*Falco cherrug*
Kestrel	*F. tinnunculus*
Jack	*Chlamidotis ungulata*
Neophron	*Neophron percnopterum*
Eagle Owl	*Bubo bubo*
Horned Owl	*N/A*
Chukar	*Alectoris kakelik*
See-See Partridge	*Ammoperdix griseogulari*
Roller	*Coracias garrulus*
Hoopoe	*Upapa epops*
Collared Dove	*Streptopelia decaoto*
Feral Pigeon	*Columba livia*
Black-Bellied Sandgrouse	*Pterocles orientalis*
Common Wido	*Caprimulgidae enropaeus*
Shore Lark	*Eremophila alpestris*
Crested Lark	*Galerida cristata*
Skylark	*Alauda arvensis*
Small Lark	*Calandrella cinerea*
Lesser Short-Toed Lark	*C. rufescens*
Short-Toed Lark	N/A
Swallow	*Hirundo rustica*
White Wagtail	*Motacilla alba*
Wheatear	*Oenanthe oenanthe*
Pied Wheatear	*O. pleschanka*

Table 4.9 (cont'd)

Birds of the Uzen Oil Field Area

Common Name	Scientific Name
Isabelline Wheatear	*O. isabellina*
Rock Sparrow	*Petronia petronia*
House Sparrow	*Passer domesticus*
Brambling	N/A
Chipping Sparrow	N/A
Crossbill	N/A
Starling	*Sturnus vulgaris*
Jackdaw	*Corvus monedula*
Hooded Crow	*C. cornix*
Rook	*C. frugilegus*
Raven	*C. corax*
Black-Bellied Ryabok	N/A
Astan Wrybill	N/A
Large-Beaked Wrybill	N/A
Asian Sadzha	N/A
Macrobill	N/A

N/A = Not Available

Table 4.10

Results of a Bird Survey of the Uzen Oil Field Area (March 27 to April 1, 1994)

General Location	Biotype	Length of Survey Route (km)	No. of Species Observed	No. of Individuals Observed	No. of Individuals/km Route
Northeast cliffs of Uzen Depression	Rocks; conglomerations of stones and clay; detritus slopes	3	6	44	14.7
Uzen to Fetisovo	Clay desert; wormwoods and salt worts	100	6	38	0.4
Coast of Kazakh Bay near West Fetisovo	Sand beach	1	9	71	71
Coast of Kazakh Bay near West Fetisovo	Clay desert; wormwoods and salt worts; rock cliffs	5	4	10	2
West side of Tun Karakshi Depression	Clay hills and ravines; limestone cliffs	4	3	7	1.75
East side of Tun Karakshi Depression	Clay desert; wormwoods and salt worts	5	5	16	3.2
East cliffs of Tun Karakshi Depression	Rocks; conglomerations of stones and clay; limestone ravines	1	3	7	7

An avifauna survey of various biotypes of the Uzen oil field area was conducted between March 27 and April 1, 1994. The results of the survey are shown in Table 4.10. All surveys were conducted on foot, with the exception of the Uzen to Fetisovo survey. The largest number of species—and the greatest number of individuals/kilometre of survey route—were observed along the sand beaches of Kazakh Bay near Fetisovo. Of the terrestrial biotypes surveyed, the rocks, conglomerations of stones and clays, and detritus slopes of the northeast cliffs of the Uzen Depression had the highest number of individuals/kilometre of survey route. The results of the survey for the clay desert with wormwoods and saltworts, located between Uzen and Fetisovo, may not be representative. The survey of the biotype was conducted by vehicle which increased the probability that birds along the route were not detected.

Passeriformes (Song Birds)

Birds belonging to the order Passeriformes are the most abundant of the avifauna found in the Mangyhshlak Region. The order is comprised of many species with various characteristics. They nest in a variety of locations. The majority of species belonging to Passeriformes are sociable and form flocks of single species or several species outside of the breeding period. Massive flocks may be formed in the fall. Birds of this order rely on a wide variety of food types, and those that eat pest insects provide a benefit to humans.

During the breeding period most of the species nest as separate pairs. Many species hatch two, and sometimes three, clutches of eggs annually. Some species, such as crossbills and ravens that nest during the cooler periods of winter and spring, may be particularly sensitive to disturbance during their nesting periods.

A review of the avifauna of the Mangyhshlak Region indicated that the lesser short-toed lark is the most abundant species of the order Passeriformes in the area. The species nest throughout the area in suitable habitats. However, only one lesser short-toed lark was observed in one of the seven biotypes surveyed in the Uzen oil field area during the spring of 1994. The most abundant passerines observed during the survey were rock sparrows (31 individuals in three biotypes), starlings (20 individuals in one biotype) and shore larks (16 individuals in three biotypes).

The crested lark is a resident species of the Mangyhshlak Region that is known to winter in the area as well as nest there. The species nest on the ground under shrubs. They breed from late March to early April.

Falconiformes (Diurnal Birds of Prey)

Birds belonging to the order Falconiformes are more widespread throughout the Mangyhshlak Region than the passerines, although they are not numerous and a few are rare. The diurnal birds of prey have a large source of food in the Uzen oil field area as a result of the abundance of rodents. However, a lack of nesting sites limits the numbers of these birds.

Both resident and migratory diurnal birds of prey are represented in the Mangyhshlak Region. They inhabit desert mountains, sandy deserts, crevices in rock faces and saxaul bushes.

They nest in saxaul bushes, on rocks and sometimes on the ground. Single nests of the Saker falcon and the long-legged buzzard were observed in the crevices and outcrops, respectively, of cliffs on the northeast outskirts of the Uzen Depression. Diurnal birds of prey feed on insects, and small and medium-sized animals and birds.

Other Species

Hoopoes are widely distributed in the Mangyhshlak Region. They are found primarily in dry areas with sparse vegetative cover. The houbara, dunlin, Asian sadzha and macrobill are the most common inhabitants of clay deserts. Stone curlews, larks and dorhawks inhabit the moister lower slopes of steppes.

4.1.7.2 Rare and Endangered Species

Rare and endangered avian species found in the Mangyhshlak Region primarily belong to the order Falconiformes. Within the boundaries of the Uzen oil field, the Saker falcon is the only endangered bird species. These birds nest on cliffs along the northeast outskirts of the Uzen Depression. The Saker falcon is listed under the second category in the Red Book. Their numbers have declined, primarily as a result of the capturing of birds for falconry purposes. Nestlings are illegally removed from the nests and sold.

The houbara is listed under the first category in the Red Book and is in danger of extirpation. In 1989, only 216 houbaras were observed during a survey along 12 000 km of road in the Ustyurt and Mangyhshlak.

The serpent eagle is listed under the second category in the Red Book. Serpent eagles are low in abundance and their populations have shown a steady decline. Only four birds were observed during a 12 000 km survey of the Mangyhshlak and Kazakhstan part of the Ustyurt in 1989.

The imperial eagle is a migratory species. They are listed under the third category in the Red Book as a species whose number has declined. The factors affecting their decline have not been identified. Specific habitat and nesting sites have not been identified.

The golden eagle is a resident of the area. The species is listed under the second category in the Red Book. Golden eagles are rare and have experienced decreases in abundance due to the removal of nestlings by hunters, killing of birds and habitat destruction. Attempts to breed golden eagles in captivity have failed.

The eagle owl is a resident species of the Mangystau Region that is listed under the second category in the Red Book. The steppe eagle and the black-bellied sand grouse are also listed in the Red Books of Kazakhstan and the former USSR as rare and endangered species.

4.1.7.3 Critical Habitats

Critical bird habitat within the Mangystau Region varies for each species. The houbara inhabit saline, clay deserts throughout the Mangystau Region. The imperial eagle migrates to the area in March to breed. They nest in shrubs, trees and power transmission line towers. The fledglings are sometimes mistaken for young eagle owls and removed from the nests for hunting purposes.

The neophron inhabit rocky areas of low elevation desert mountains and rocky crevices. They arrive from March to April and lay their eggs towards the end of April. Saker falcons are observed in the Mangyhshlak Region as both residents and migrants. They are not an abundant species. Saker falcons live in mountainous areas and nest in the shelter of rocks and cliffs. The serpent eagle is a seasonal visitor that builds its nest near the ground in saxaul bushes or on rocks. Golden eagles inhabit treed deserts. The horned owl is primarily a resident of the Mangyhshlak Region, but also occurs as a migrant. The species inhabits desert landscapes. Horned owl are affected by nest destruction, and may be killed accidentally in traps or as a result of collisions with power transmission lines. As discussed previously, the abundance of diurnal birds of prey in the Uzen oil field area is apparently limited by a lack of nesting sites. Since rocky cliffs provide important nesting habitat for many of the species, these areas should be preserved in order to protect bird populations.

4.1.8 Fisheries

Fisheries resources are generally absent in the Mangyhshlak Region due to the lack of permanent waterbodies.

4.1.9 Reptiles

Available information on the reptiles that inhabit the Uzen oil field area is limited to the results of a field survey conducted from March 27 to April 1, 1994. There were few sitings of reptiles during the survey as a result of cold weather. On one warm day a few individuals of a lizard species were observed and were thought to belong to the genus *Eremias* (sand lizards). Carapaces belonging to turtles *(Testudo horsfieldi)* were found at the Uzen and Tun Karakshi Depressions. The moulted skin of a snake (either *Coluber* sp. or *Elaphe* sp.) was also found in a cave within a rocky escarpment along the Kazakh Bay coast at Fetisovo.

4.1.10 Land Use

Information for land use was derived from the current regional yearbook of Kazakhstan (1992). Statistical data concerning land used for hunting, fishing and forestry resources are unavailable due to the absence of information.

4.1.10.1 Agricultural Land Uses

The Mangystau Region contains 17 053 600 ha of land, of which 11 487 500 ha (67%) are classified as agricultural lands. Within the Yeraliyev District, 5 501 239 ha of land are allocated for agriculture. This includes 26 864 ha of land within the jurisdiction of the Town of Novy Uzen which is used for pastures.

4.1.10.2 Population Centres

There are 14 centres of population within the Mangystau Region. These population centres or Town Lands occupy about 17 100 ha of the Mangystau Region. Major population centers are Atyrau (137 000 people) and Aktau (169 000 people).

4.1.10.3 Protected Lands

Two categories of protected lands under the jurisdiction of the Mingiest Area are Reservations and National Nature Parks. A single reservation (i.e., the Ustyurt Reservation) occupies 223 500 ha of land. There are no National Nature Parks in the Mingiest Area.

The Ustyurt Reservation was developed in 1984 in the western part of the Kazakhstan Republic in the Yeraliyev District. The reservation occupies a narrow section of the western portion of the Ustyurt Plateau and an extensive area of the Kenderlisor Depression. The absolute height of the terrain ranges from 50 to 300 m above sea level. The largest part of the Ustyurt Plateau presents a transition from the northern salt-wormwood deserts to the southern wormwood-ephemeral deserts of the extensive Turan lowland. That portion of the Ustyurt Reservation located on the western edge of the Ustyurt Plateau is at the junction of the Ustyurt and Mangyhshlak Districts of the southern desert subzone. Wind-sculptured relief, flat clay areas, dry hollows and river beds of ancient and seasonally ephemeral water flow are widely scattered in this area.

The Kenderlisor Depression, the bottom of which is 50 m below sea level, is surrounded by steep cliffs or sloping terrain with many fissures, caves and flat residual outcroppings. The sides of the depression can, in some cases, be several hundred metres high (measured from the bottom of the depression). Precipitation in this area rarely produces surface runoff. A small lake is contained in the depression due to its internal drainage, but the water is highly saline because of the intense evaporation. A stream (the Karazhar) flows into the north end of the Kenderlisor depression and is fed by melting snow in the spring and by discharges from surface wells during the remainder of the season. Other streams on the reservation are also fed by discharge of underground waters either from wells or seasonal surface drainages of melting snow. The combination of different water qualities produces dissolved solids in the waters which range from 3000 to 15 000 mg/L.

Although not studied extensively, the flora and fauna of the reservation have been generally described. One of the main reasons for the establishment of the reservation was preservation of a rare animal (the Ustyurt mouflon, a subspecies of the Asian mouflon). Two

other ungulates are also endemic to the territory of the reservation. They are the goitred gazelle (present throughout the year) and the saiga antelope (present only during the winter). The cheetah is the main carnivore of the wildlife population and was last observed in the territory of the reservation on May 9, 1965. Currently, plans are being made for the restoration of both cheetahs and the Siberian weasel (no longer present in the area) to areas of their natural habitat within the reserve.

4.1.11 Archaeology

Archaeological sites are rare in the western part of the Mingiest Region. In ancient times caravan routes traversed the Ustyurt Plateau in this region. A modern-day remnant of one of these routes is the Khoresmshakhov Road, which connects Khiva with the lower portions of the Emba and Volga Rivers to the Caspian Sea. The ancient town of Shakh-i-Vezir—and perhaps many other unknown towns—were once connected by the old caravan routes, as evident by the widespread occurrence of ancient cemeteries and mausoleums. However, many of the archaeological sites in this area have yet to be investigated. A plan for the investigation of these archaeological sites is in preparation at the Institute of Archaeology and History of Kazakhstan NAN RK.

4.2 COASTAL AND MARINE ENVIRONS

Kazakh Bay is located within the Mingiest Region along the east-central coast of the Caspian Sea. The unique fauna and flora of this coastal area have the potential to be negatively impacted by oil and gas field development further inland. The information used in this section was derived from the material contained in "Complex Investigations of the Caspian Sea" (MGU, 1975-1976 (4.5), NAN of the Kazakhstan Republic).

4.2.1 Physical and Geographic Conditions of the Caspian Sea

The Caspian Sea is the world's largest internal-drainage basin and is located at the boundary of Europe and Asia. Because of the absence of a surface water connection between it and any ocean, the Caspian Sea is technically a lake. However, it has all the characteristics of a marine environment.

The long-axis of the Caspian Sea is oriented in a north-south direction between latitudes 47°7" and 36°33" north. In terms of its east-west orientation, the Caspian Sea is located between longitudes 45°43" and 54°20" east. The long-axis (length) of the sea is approximately 1200 km and the average width is 310 km. Coastline length is about 10 000 km, of which 1500 km are within the Kazakhstan Republic. At an elevation of 27.5 m above sea level, the Caspian Sea has a surface area of 386 400 km^2 and a drainage area of 3.1 million km^2.

Bottom deposits of the Caspian Sea are characterized by terrestrial-shell salt sands on the offshore shelf areas with aleurite and slimy deposits containing high calcium carbonate concentrations covering the deep areas of the sea. Bedrock outcrops of the Neogene age

occur in some areas of the bottom and rich oil and gas deposits are also present in the sub-bathymetric structures.

The Caspian Sea is usually divided into three basins on the basis of the bottom contours (i.e., northern, middle and southern). The middle basin of the sea is relatively isolated from the remaining basins, with a surface area of about 138 000 km^2. The maximum depth in this part of the sea is 788 m at the western coast in the Derbent Cavity. In contrast to the steep western slope of this middle basin, the eastern slope is gently sloping. The bottom area of the middle basin is a slightly inclined plain, with water depths ranging from 400 to 600 m. The average depth of the Caspian Sea in the middle basin (including the Derbent Cavity) is 190 m. In terms of its subbathymetric geological structure, the bottom of the middle basin is heterogeneous. Its eastern portion is a depression of the Tura Platform.

The middle basin of the Caspian Sea is separated from the southern basin by the Apsheron Edge (at a maximum depth of 180 m) which is a geological, subsurface extension of the Main Caucasus Mountain Range. In geological terms, the Apsheron Edge is a structure formed as a result of the plunging of the Great Caucasus foldings and connects with the folded structures of Konetdag. The surface area of the southern basin is about 168 400 km^2. The deepest portion of the southern basin is 1025 m and is located east of the Kura River delta. The subbathymetric geology of the southern basin is characterized by a suboceanic crust. A basalt layer of up to 15 km lies under a 25 km sedimentary layer.

The northern basin of the Caspian Sea is separated from the middle basin by the Mangyhshlak Crest, which is an elevated topographic structure connecting the connate Karpinsky Swell on the western coast of the sea with the Mangyhshlak Mountains on the eastern coast. The northern basin is at the edge of the Caspian Sea syneclise of the East European Plain.

4.2.1.1 Surface Water Elevations and Fluctuations

Recent investigations of the Caspian Sea surface water level fluctuations have been conducted by Russian and Kazakh scientists. Based on the increased filling of salty depressions in the Dead Kultuk and Kaidak areas and the decrease of surface runoff into the Kazakh Gulf in the future (by 50%), a 6 to 7 cm/year decrease in surface water elevation is expected. This change is estimated to result in a decrease from the current elevation of 27.5 m above sea level to 26 m by the year 2010 and to 25 m sometime between the years 2025 and 2030. After this, the surface water elevation may stabilize or continue to decrease. However, accurate forecasts are impossible to make because of unforeseen climatic changes in the drainage area.

4.2.1.2 Ice Cover

Ice cover normally appears in the northern part of the Caspian Sea in November. In severe winters, the entire surface area of the northern part of the sea is ice-covered. During mild winters, however, ice cover is usually restricted to the shallow water areas (i.e., 2 to 3 m in depth).

4.2.1.3 Currents

Wind-generated water currents are evident in the coastal areas of the middle and southern Caspian Sea. Easterly coastal currents are known from the east coast, and southeasterly and southerly currents dominate along the western coast of the middle Caspian Sea. Current velocities are about 20 to 40 cm/s, with maximum velocities of from 50 to 80 cm/s. Other types of currents (e.g., lapse and inertial) also play a significant role in the regional water circulation.

4.2.1.4 Salinity

Salinity in the northern Caspian Sea varies rapidly from 0.1% at the mouths of the Volga and Ural Rivers to between 10 and 11% at the boundary of the middle Caspian Sea. Fluctuations of salinity in the middle and southern Caspian Sea are not great. Salinity in the surface layer varies from 12.6 to 13%, and increases from north to south and west to east.

4.2.1.5 Water Temperature

Water temperature of the Caspian Sea varies according to the latitude. Changes in water temperature are not large (about 10°C) in the winter when temperatures at the edge of ice in the north may be 0 to 0.5°C and temperatures in the southern Caspian Sea may be 10 to 11°C. Generally, the temperature along the western coast is 1 to 2°C higher than the water along the eastern coast. Temperatures of off-shore, open areas are generally higher than those along the coastal areas. These differences in temperature can range from 2 to 3°C in the middle Caspian Sea and from 3 to 4°C in the southern portion of the sea.

4.2.2 Biological Resources of the Caspian Sea

The number of species of animals and plants inhabiting the Caspian Sea is relatively small compared to the geographic size of the area. Taxonomic studies have established the presence of 854 species of animals and more than 500 species of plants in the Caspian Sea. A large percentage of the fauna and flora are endemic to the area, which is a characteristic of faunal antiquity and geographic isolation.

4.2.2.1 Bacteria

Sediment bacteria concentrations in the Caspian Sea have been estimated to reach 897 million/gram (wet weight). Organic pollutants from Aktau, Fort Shevchenko and other coastal population centres have stimulated the growth of microbial populations in Caspian Sea sediments.

4.2.2.2 Phytoplankton

There are more than 200 phytoplankton species in the Caspian Sea, including 73 species of diatoms, 55 species of blue-green algae, 44 species of green algae, over 28 species of dinoflagellates and over 17 species of mastigophora.

4.2.2.3 Zooplankton

Approximately 100 species of zooplankton inhabit the Caspian Sea. Of this number, about 45% are rotifers, 29% are cladocerans and 22% are copepodes, with the remainder from other groups.

4.2.2.4 Phytobenthos

Photosynthetic organisms which inhabit the shallow bottom areas of the Caspian Sea include 33 species of blue-green algae, 46 species of green algae, 29 species of red algae and 8 species of brown algae.

4.2.2.5 Zoobenthos

The number of species of animals inhabiting the bottom of the Caspian Sea is not large. Generally, the zoobenthic organisms occupy bottom areas within 50 m of the surface with the greatest biomass inhabiting the bottom areas within 15 to 20 m of the surface. The eastern coast of the Caspian Sea contains abundant molluscs, as well as gammarids and snails. The abundant snail fauna is linked to the abundance of macrophytes and the absence of bottom-feeding fish in this region of the sea. The greatest concentrations of benthic fauna occur in the middle Caspian Sea. Estimates of the biomass of shelled-forms (molluscs) range as high as 8 925 000 tonnes.

4.2.2.6 Ichthyofauna

There are 75 species and 17 subspecies of fish in the Caspian Sea. This include 47 species of brackish-water fish, 13 species of freshwater fish and 6 species which are considered marine fish. The number of endemic fish species is very high and is largest among the gob and herring families.

4.2.2.7 Mammals

The Caspian Seal is the only representative of aquatic mammals to inhabit the Caspian Sea.

4.2.3 Biology of the Kazakh Gulf Coast

Coastal aquatic macrophytes in this area include various submergent grass-like plants (e.g., *Zostra, Ruppia* and *Potamogeton*) and emergent plants (e.g., *Phragmites, Typha, Scirpus*). Vegetation of the saline shoreline consists of plants such as sarcarp and saltwort as well as others. Large concentrations of migratory birds use the coastal areas of the Caspian Sea during certain seasons. Birds from the tropics and subtropics as well as the coastal areas of the Mediterranean Sea use the coastal areas of the Caspian Sea for nesting. These birds include the heron, flamingo, ibis, Dalmatin and European pelicans, and red duck. Other species from the north which utilize the Caspian Sea include various species of geese, ducks, swans, gulls, divers and dotterels.

The insect fauna of this region are not well known. The coastal areas are inhabited by grasshoppers, locusts, bugs, beetles, butterflies, moths and true flies. Mayflies, dragonflies, mosquitoes, mides, and other aquatic and semi-aquatic insects also appear to have a major ecological role in the area.

PART 5 - BASELINE SOCIO-ECONOMIC CONDITIONS

5.1 METHODS

This section describes the socio-economic baseline conditions of the region within which the Uzen oil field rehabilitation project will be implemented. In addition, it describes the implications of the rehabilitation for local and regional populations, with particular emphasis on local residents—primarily the residents of Novy Uzen and surrounding communities.

The assessment focuses on key issues identified through a preliminary consultation program. This program was undertaken in March and April of 1994 and included meetings with various regional administrative officials and representatives of local communities. Through these meetings key stakeholders and major socio-economic issues were identified, and qualitative information was gathered. Records of these consultations are contained in Appendix D. Some of the generic baseline data were also provided by geographic scientists, including Alexander Ivanovich Danchin and Vyacheslav Leonidovich Baburin (University of Moscow).

The intent of the socio-economic impact review is to assess the forces of change as they impact the region's people. Some of the impacts will be positive in nature while others may have negative consequences, as has been the case with some previous oil and gas development activity in the area. It is believed that the utilization of environmentally sound and advanced construction and operation technologies, combined with socially sensitive planning and management practices, can greatly enhance local benefits and reduce the potential for harmful impacts.

5.2 OVERVIEW OF BASELINE DATA

5.2.1 Mangystau Region

The Mangystau Region was first established on March 20, 1973. Then, by Decree of the Presidium of the Supreme Soviet of the Kazakh Soviet Socialist Republic on June 2, 1988, the region was abolished and integrated into the Gurievskaya Region. Its former status was re-established two years ago.

5.2.1.1 Population

The region is approximately 165 000 km^2 and has a relatively small population of 330 000. Average population density is about 2 persons/km^2. The urban population is dominant and constitutes 89% of the total, or 295 000 people. The region is made up of three towns (with the territories governed by the Town Soviets), 12 town-type settlements and 3 country regions. Its administrative center is the Town of Aktau (Shevchenko), with a population of 169 000.

A large percentage of the population is concentrated around the oil fields, along the railroad and on the Caspian Sea coast.

Urban Population

Development of town-like settlements occurred for different reasons. The oldest one is Fort-Shevchenko, which emerged in the first half of the 19th century. At present, it has a relatively small population of 3700. The towns of Aktau and Novy Uzen emerged later, in 1963 to 1968, with the development of oil production. These two towns are now the largest in the region, with populations of 169 000 and 42 000, respectively.

Generally, town-type settlements with populations of 2000 to 5000 (Tenghe, Uzen, Munaishy) to 10 000 to 12 000 (Jetebai, Sarykamys) are located around areas of natural resource development. The second kind of town-type settlement combines administrative-management and industrial functions. The towns of Eraliev, Beinou and Shepte, with populations ranging from 10 500 to 12 600, fall into this category.

Rural Population

Apart from the three territories governed by the Town Soviets of Aktau, Novy Uzen and Fort-Shevchenko, three separate rural regions have been identified: Beinouski (Northeast), Mangystauski (Center) and Eralievski (South).

The rural population of the Mangystauski Region is the largest with 16 400 people, followed by Beinouski Region with 8800 and Eralievski Region with 4100. Most of the rural population is concentrated in the western part of the region or in the immediate vicinity of the railroad. The highest population density (10 to 20 persons/km^2) occurs north of the settlement of Manghyshlak and near the village of Ushtogan. In other areas population is sparse, with density not exceeding 1 person/km^2.

National Composition

The Mangystau Region is very characteristic of Western Kazakhstan. The Kazakhs are the dominant nationality. According to the last population census, they represent 75% (average) of the people in the region as a whole and almost 100% of the people in the countryside. The "Kazakh community" in Manghyshlak Region is strong, with only 50% of the Kazakhs able to speak Russian.

Russians are the second most dominant nationality in the region. Most of the Russians live in the towns, particularly the administrative centre of Aktau. They make up the bulk of working personnel at various enterprises. Ukrainians represent a much smaller portion of the population. They began migrating to these areas as early as the end of the 19th century.

The specific features and activities characteristic of the area have influenced the population structure of the region. Development of new oil deposits in the mid-1960s caused migration of petroleum specialists from North Caucasus, Azarbaijan and Tatarica. This contributed to the increase in the number of Azarbaijanians, Tatars, Lezghins and Chechens in the regional population.

Development in the region is constrained by a lack of working personnel. The migration of manpower out of the region has exacerbated this deficiency. Like many regions that focus on resource development and extraction, the majority of jobs require hard physical labour and are occupied by men. As a result, the women in the region have difficulty finding jobs, particularly in settlements near the oil fields.

5.2.1.2 Regional Economy

Mangystau is an industrial region. Commercial production in the region contributes just over 2% to the total volume of production in Kazakhstan.

Oil and Gas Industry

Industry specialization of the region was predetermined by large deposits of oil and gas. Petroleum production is the leading branch of industry and accounts for 63.5% of commercial production and 85% of the industry's basic funds. All heavy industry in the region began after 1960 with the production of industrial oil from the rich oil deposits.

At present, about 70% of republican oil production (with gas condensate) and about 30% of natural gas are produced in this region (Table 5.1). In 1993, there were two state oil and gas production enterprises: the Production Association "Manghyshlakneft" of the "Kazakhstanneftegaz" Corporation and "Karazhanbastermneft" of the Oil and Gas Production Department.

Table 5.1

Mangystau Region - Oil and Gas Production Enterprises

Enterprise	Output in Rubles (000)	Labour Force	Residual Cost of Capital Fund in Rubles (000)
Mangyhshlakneft	960 751	5107	920 029
Karazhanbastermneft	146 684	929	163 205

In 1992, the total volume of crude oil production was 14.2 million tonnes. Natural gas production was 2713.2 billion m^3. Existing pipelines carry oil to Atyrau, the Samara Region and Azarbaijan. The pipeline which connects the region's deposits to the main pipelines passes through Uzen-Kulsary-Makat and Atyrau to Samara, and through Orsk to Ishimbai. The oil fields of the Caspian Sea coast (Kalamkas-Aktau, Cape Rakushechnyi-Jetebai and others) are also connected to it.

Casing-head gas and gas condensate are refined at the plant in Novy Uzen. The Uzen-Beinou pipeline carries natural gas to the Central Asia-Center main pipeline.

There were intentions, in the early 1980s, to develop an industrial complex in the region based on the oil and gas deposits in the area. To this end, the foundation for a plastics and gas refinement plant was laid. In addition to these industries, the complex was also to include an oil refinery in Aktau (synthesis of large-capacity polymeric materials—polyethylene and polypropylene) and a fodder yeast production facility to utilize local deposits of natural gas and by-products from the gas refinement plant. However, the complex has not been completed.

At present, the region lacks significant value-added industries which link resource extraction to the final stages of raw materials refinement. One exception is the plastics plant in Aktau, which was commissioned in the mid-1980s. This plant operates on ethane fraction from the Kazakh gas refinement plant (Novy Uzen) and specializes in the production of polystyrene, styrene and ethyl-benzene. Its output is relatively small, constituting about 250 000 tonnes of product, or 431 million rubles (in 1992 prices) annually. The Aktau plastics plant is the only polystyrene producer in the republic. Most of the polystyrene is exported outside Kazakhstan for further refinement.

Food Industry

The fishing industry is also important in Kazakhstan. However, the industry faces a number of problems which remain to be solved. Along with the Atyrauskaya Region, Mangystau is considered to be a leading region in netting species of valuable fish such as sturgeon, pike, perch, Caspian roach, carp, herring, gray mullet and sprat.

The "Manghyshlakrybholodflot" fishing base, which includes a fish-processing combine and ship repairing plant, apart from the float itself, produces about 15 000 tonnes of fish and fish products, 4500 tins of canned foods, and about 3000 tonnes of fish meal. However, the plant is in need of radical reconstruction. The construction of a modern fish complex with freezing plants and processing capacities, in addition to existing facilities, could give impetus to development in Fort-Shevchenko (Bautino), where there are available labour resources. This type of development could significantly increase the role of the Mangystau Region. Currently, all industrial fishing occurs only in the Caspian Sea.

Other food industries in the region are not significant. The Aktau meat-packing plant and Novy Uzen milk plant satisfy primarily the internal needs of the region.

Mineral Extraction

Despite the availability of significant raw mineral reserves for the production of construction materials, this industry is still insufficiently developed. Almost all construction materials, with the exception of limestone, are imported. However, internal resources of road-building materials are used.

Light Industry

Light industry is generally represented by clothing manufacturing. This industry accounts for approximately 1.4% of the region's marketable production. Mechanical engineering and metal working are very poorly developed in the region. They amount to less than 1% of industrial production.

Restricted access enterprises such as mining/chemical combine and fast-reactor nuclear power stations are significant in the region. The nuclear power station is equipped with a sea water desalination plant. The desalted water satisfies both domestic and industrial needs.

The main industrial centres are Aktau, Novy Uzen, Fort-Shevchenko and Jetebai.

Agriculture

The region contains highly developed agricultural territories. Farming lands occupy 77.5% of the total area of the region, or 12.8 million hectares. Pasture lands are of prevailing importance.

Farming is only possible where irrigation exists. Small fields and gardens are located near springs and artesian wells. On average, about 1000 ha of farm land are cultivated per year. Fodder crops account for 70% of the total cultivated land and vegetable farms for 30%. The area experiences extremely difficult growing conditions as a result of summer temperatures. Gross vegetable harvests vary from 8 000 to 14 000 centners. However, this volume is not enough to satisfy the needs of even one regional centre, thus all necessary vegetable products have to be imported to the region.

Due to the predominance of pasture land in the region, cattle breeding is an important agricultural activity. Some pastures in the north, east and along the Mangystau Mountains are used year-round.

The type of vegetation predetermines the composition of the livestock population. Sheep herding and breeding is the most common and accounts for over 50% of livestock activity. Camels account for 25% of the livestock population and horses over 21%. Large-hoofed cattle represent only 3% of the total (Table 5.2). However, the importance of local cattle breeding in the total republic cattle population is not significant.

Cattle productivity is low. It satisfies only 30 to 35% of the needs of the local population. State purchases of meat are approximately 5000 tonnes and milk about 1 tonne.

The rehabilitation project of the Uzen oil field targets an area surrounded by the Kyzyl Uzen state farm. The farm was first established in 1984 for camel milk production. Later the farm became involved in breeding two-humped camels, which are now rare. The farm has three parts, with centers in the settlements of Borzhakty, Jetebai and Aktau. Butakoz is the farm's headquarters. The state farm land stretches from Aktau in the north to Aksu in the south. There are about 1000 residents in this range.

Table 5.2

Livestock Population in the Kazakhstan and Mangystau Regions (,000 heads)

Livestock	Kazakhstan	Mangystau
Cattle	160.7	3.7
Sheep and goats	36 407.9	673.9
Horses	1 533.2	34.0
Camels	139.2	35.5

The farm possesses about 3700 camels (baktrians—two-humped camels and dromedaries), 2000 sheep, 500 horses and 100 pigs. Private stock in the area consists of about 1500 sheep, goats, 120 horses and 270 camels. The farm already runs a milk store in Uzen and plans to open a sausage shop. Plans to privatize the farm are expected to begin in July.

There is under-utilized capacity in the local labour force, especially among women. Many young men work in Uzen, while their families (parents) live in the village where jobs are in high demand. Thirty percent of farm income comes from supplying milk to the towns of Novy Uzen, Eralievo and Jetebai. About 100 tonnes of meat is produced annually, of which 30% in used for barter. Camel skin is also produced and was previously sent to Yugoslavia for processing. Half of the area's inhabitants came in 1986 and 1987 from Turkmanistan (Krasnovodsk oblast) and Uzebekistan (Kara-Kalpak oblast). Some of them are also are engaged in carpet weaving.

Transportation

The railroad system in the region was developed in the second half of the 1960s. Generally, railroad construction was associated with the development of oil fields. The construction of the fourth railway connected the Central Asian republics of the USSR with Russia. The railroad system in the Mangystau Region covers about 700 km. The most important systems are: the Chardzhou-Makat main railroad, which is one of the routes to Russia's railway system and the modern states of Central Asia; and, deviating from it to the southwest, the Beinou-Aktau-Novy Uzen railroad.

The highway system is poorly developed and utilized primarily for local purposes. Coastal highways connect the main port of the region, Fort-Shevchenko, with Astrakhan, Baku and Makhachkala. In some years blocks of ice can be encountered on highways along the coast.

It is worth noting that industrial infrastructure—such as transportation systems, communications technology, and the power, heat and water supplies in the Mangystau Region are insufficiently developed. The region's social infrastructure—including civil-

community services, commerce, catering, cultural-educational and medical institutes—are also underdeveloped.

Infrastructure

There is a small first-aid medical center and a school with 163 students at Butakoz. A kindergarten for 90 children was also built. Potable water comes through a pipeline from Novy Uzen. There is a demand for telephones, other communication technologies and electricity.

5.2.2 The Town of Novy Uzen

The town of Novy Uzen is located in the centre of the Manghyshlak Peninsula, approximately 150 km southeast of the regional centre of Aktau. It is the last regional stop of the Beinou-Aktau-Novy Uzen main railroad and the Fort Shevchenko-Aktau-Novy Uzen highway. These factors have created an advantageous transportation and geographic situation for the town.

5.2.2.1 Population

Novy Uzen had a high profile and established itself very quickly as a town because of its advantageous location in terms of transportation linkages. It was given town status in 1968. The town Uzen grew rapidly and by 1985 the population had doubled. The current population is about 20 000 people and growth has slowed to about 0.5 to 0.8%/year. Population tends to be concentrated around natural resource deposits.

5.2.2.2 Regional Economy

Novy Uzen is governed by regional authorities. The Town Soviet includes the town itself and two town-type settlements: Uzen and Tenghe. The structure of the administrative-territorial unit is determined by the pattern of natural resource development in the region.

Oil and Gas Industry

One of the major manufacturing enterprises in the town is the "Manghyshlakneft" (presently Mangystaumunaigas) Production Association of the "Kazakhstanneftegaz" (Kazakhatanmunaigas) Corporation. The Corporation is represented the NGDU Uzenneft Oil and Gas Extracting Department and the Kazakh gas refinement plant that produces liquefied gas (over 80 000 tonnes) and ethyl fraction for the Aktau plastics plant. There are 5100 persons employed in industrial production at this enterprise.

The "Manghyshlakneftegazatroi" Trust is also located in Novy Uzen. It is related to the oil and gas extracting industry and secures the needs of the "Manghyshlakneft" Production Association. Approximately 230 industrial production personnel are employed at the Trust.

Food Industry

Bread-making and milk plants also contribute to the local economy of Novy Uzen. The Novy Uzen bread-making plant, which is part of the "Kazakhhleboproduct" Consortium, supplies flour to the Town Soviet territory, as well as a significant part of the region. The plant employs 106 industrial production personnel. Novy Uzen's milk plant is very important because it is the only significant milk enterprise in the region. It has a capacity of 11 000 tonnes, and provides a significant number of the region's residents with milk products. About 118 industrial production personnel are employed at the milk plant.

Light Industry

There are also a number of light industry enterprises in the town which provide some of the female population with jobs. These include the Uzen Clothing Manufacturer of the "Kazlegprom" Consortium, which was built recently and employs about 287 personnel. They manufacture shirts for students and men. Another industry is the Novy Uzen Firm of Public Services of the "Kazbytsoyuz" Association. The Firm manufactures cloth and shoes, and performs repair work. It employs 243 personnel.

Infrastructure

The service sector has experienced several periods of development. In 1968, there was one primary and three secondary schools, a sport school, several nursery schools, two cinemas, several clubs and a Palace of Culture. The public health sector, however, lagged significantly behind the average regional level.

The modern situation in Novy Uzen differs significantly from that of 20 years ago. Due to a high natural increase in the population, the demand for schools and preschool institutions also increased. At present there are six secondary schools, in addition to the musical and sport schools in the area. Higher level education and training is available at the professional-technical school or at branches of Atyrau technical and medical schools.

The town also has six libraries, the Palace of Youth and Pupils, and a stadium. Considerable attention has also been given to public health. Today Novy Uzen has five hospital complexes, including two that are specialized, and two poly-clinics.

PART 6 - PUBLIC CONSULTATION PROGRAM

The socio-economic assessment undertaken focused on key issues identified through a preliminary consultation program. This program was undertaken in March 1994 and included meetings with various regional administrative officials and representatives of local communities.

Through these meetings key stakeholders and major socio-economic issues were identified and qualitative information was gathered.

The goals of the public consultation program were as follows:

- inform stakeholders about the project;
- initiate a consultation process;
- identify issues of concern to be addressed in the study;
- recognize the stake that various organizations have in the project;
- understand organization functions and possibly their role in the project implementation; and
- recognize the needs and problems of an organization and communities.

6.1 KEY ISSUES

A summary of the key issues and concerns discussed during the consultation process is provided below. A complete record of the consultations undertaken is attached in Appendix E.

6.1.1 Economic Development

One of the major issues noted in the consultation process was the current rapid decline in oil production in the Uzen oil field as a result of the deterioration of production facilities and worsening operational practices.

One of the most attractive aspects of the project for national and local organizations is the opportunity to learn and implement world-standard practices.

The Kazakh's most common concern is the "withdrawal" of land for the benefit of "outside" interests and the destruction of the livestock grazing land with no substantial local benefit or compensation. The sources with whom the assessment team consulted reported that the rural communities are badly in need of infrastructure. There is growing local/outside effort to convince local and state administrations to use the proceeds of oil and gas development to address rural problems.

The transfer of management skills and technologies to the local, regional and national population is a key issue. Some individuals felt that the present decline in production and labour productivity is largely a result of poor management and control.

Local enterprises should be used to implement project mitigation plans wherever possible.

6.1.2 Employment

There is a drain of qualified personnel out of the area. Qualified personnel are being attracted to trade and commerce activities which offer higher wages and easier work conditions. Personnel also leave the region in search of more stable economic and social conditions.

There is a decline in labour productivity. It has been suggested that improved social conditions and work environments as well as higher wage levels may enhance employee productivity.

Information suggests that there remains an under-utilized, experienced and well-educated local labour force in the area from which the project can draw.

6.1.3 Government

The issues of primary concern named by government environmental control organizations include oil spills and radioactive contamination which are caused by mismanagement, obsolete technologies, and worn-out equipment and production facilities.

Local Kazakh specialists and control organizations, who are familiar with the Kazakhstan regulatory requirements, must be involved in the project.

This type of project is perhaps the best way to aid the Kazakhstan government in its efforts to develop, formulate and implement environmental policy.

6.1.4 Communication/Information Issues

Due to the complicated interrelations between potential stakeholder organizations, there is a need to establish a consultation process between involved parties, possibly in the form of a "consultative committee".

The public, particularly local and regional citizens, should be kept informed about the project through local newspapers, etc. Public input should be encouraged and opportunities to express concerns should be created.

6.1.5 Environment

Concerns expressed by the Ministry of Ecology and Bioresources include the current environmental situation, the intensification of oil production and the protection of subsurface resources.

Environmental standards and regulations are generally not given a high priority. Currently, pollution control is not considered in the economic evaluation of projects.

Water is badly needed for domestic use and irrigation of farm lands. The quality of water coming from the Volga River through the pipeline is currently unacceptable. The possibility of small-scale desalination devices was discussed.

Most of the field is covered in radioactive anomalies. The problems that need to be addressed in this regard include liquefaction, processing, burial and deactivation.

Environmentally sound practices need to be developed for disposal of drilling fluids. Scrap dumps are currently not fenced or labelled.

The impact of the construction of communication infrastructure on the migration routes of the saiga and jeiran was discussed.

The Caspian Sea is a valuable feeding area for fish, particularly sturgeon, therefore water intakes should be more than 3 m deep. The environmental assessment should be sent to the head regional fisheries inspection (Ural-Caspian Fishery Inspection).

Concern was also expressed by the Mangystau Hunting and Fishing Inspectorate. They felt that the increase in private automobiles and guns, purchased as a result of the increase in local incomes, may lead to an increase in poaching on nearby protected natural habitats.

6.2 KEY STAKEHOLDERS

A list of the key stakeholders involved in the consultation process is outlined in Appendix F.

PART 7 - FACILITY SITE ASSESSMENT

7.1 UZEN OIL FIELD

7.1.1 Field Assessment Methodologies

Current conditions in the oil field were evaluated via interviews with key personnel and guided tours, as well as a detailed assessment of randomly selected well sites. During the guided tours, the field team was able to observe several activities and facilities associated with oil production, including:

- well drilling;
- group gathering stations;
- central processing facility (CPF);
- injection water station;
- refuse dump; and
- waste pits.

In most cases, an individual knowledgeable of these activities and facilities was present to provide an overview as well as answer questions. The oil field evaluation took place from March 26 to April 8, 1994.

A major component of the oil field evaluation was a detailed assessment of current biophysical conditions within the immediate vicinity (75 m) of the wellheads. This work was completed from April 1 to 5 and included observations made using a checklist approach, as well as collection of soil samples for laboratory testing. A total of 20 well sites were evaluated, of which 10 were in Blocks 3 or 3A and the remainder were from randomly selected blocks in the rest of the field. At each location, surface conditions within 50 m of the wellhead were noted, with emphasis on the severity of surface disturbance due to such factors as oil/produced water spills, mechanical damage (e.g., traffic), erosion and refuse (housekeeping). The severity of disturbance was based on the size of area affected, according to the following classification:

- low = $<2\ m^2$
- medium = $2\text{-}25\ m^2$
- high = $>25\ m^2$

The predisturbance "natural" site conditions were assessed by selecting a location at least 50 m from the wellhead where minimal surface disturbance was evident. A soil pit was excavated to a depth of 1 m (where possible) and information collected on soil development, including:

- horizonation;

- colour;
- texture;
- coarse fragment content; and
- effective rooting depth.

Vegetation in this area of minimal disturbance was also assessed by estimating the percentage ground cover of each species present. With the exception of soil colour, all of the information collected was based on casual estimates and observations only. Soil colour was determined by comparing the soil horizons with the Munsell Soil Colour Charts (Macbeth 1992).

During the first week of the oil field evaluation, the field team included a wildlife specialist whose task was to collect data on wildlife use within the field. This included identification of species observed at the time of the survey, as well as evidence of other wildlife use (e.g., scats).

7.1.2 Sampling and Analytical Methodologies

At selected sites, soil samples were collected for laboratory analysis. Most of the samples were collected to provide a general characterization of the surface (0 to 15 cm) and subsurface (60 to 100 cm) soils undisturbed by oil field activities. These samples were obtained from the soil pits excavated for soil development characterization. A total of 10 samples (five surface and five subsurface) were collected and analyzed for texture, salinity properties (pH, electrical conductivity and soluble cations), and plant-available nutrients (phosphorus and potassium). Selected samples were analyzed for total carbon content, with the intent of determining organic matter content. However, the extremely high carbonate content of the soils rendered the organic matter determination unreliable.

A limited amount of soil sampling was also conducted for characterization of spills within the oil field. This included four samples from well sites in Blocks 3 and 3A, two of which were from the surface (0 to 15 cm) where soil contamination was evident and the other two from the surface soil layer in an adjacent undisturbed area. Another two samples were obtained from an area where oil spills have occurred regularly for at least 20 years. The samples were taken from the surface (0 to 15 cm) oil-stained layer and from the layer directly below (15 to 30 cm). The six samples collected from these spill areas were analyzed for total petroleum hydrocarbons (TPH) and a suite of constituents, including heavy metals. Finally, one sample was collected from a rust-stained area adjacent to an injector and analyzed for salinity properties.

7.1.3 Field Assessment Results

7.1.3.1 Overview of the Oil Field

Figure 7.1 (map pocket) presents a pictorial overview of the Uzen oil field. The figure was developed from a false-colour infrared SPOT satellite image dated 1986. Two features that were readily apparent while travelling through the oil field were the high density of wells (especially towards the middle of the field) and the general disorderly appearance of individual well sites and associated facilities. Apart from the main paved road that connects all of the production blocks and access roads to major facilities (e.g., central processing facility, group gathering stations), there were relatively few direct access roads to individual well sites. As a result, vehicle trails appeared to criss-cross throughout the oil field, creating much more surface disturbance than necessary. Photo 7.1 is a typical view in Production Block 3 where several wells were visible within a few hectares, and surface disturbance (vehicle tracks, mounded soil) was extensive. Open excavations, areas of rough grading and scattered debris were also common sights within the field that contributed to the disorderly appearance. Examples of these can be seen in Photos 7.2 and 7.3.

Of greater concern from an environmental perspective were the numerous major spills of production fluids (oil and water) throughout the field, either as a result of spillage around the wellhead or pipeline failures. Based on an aerial survey in 1989, the NGDU estimated 3 million tonnes of oil-contaminated soil within the Uzen oil field. Photos 7.4 and 7.5 are examples of spills from major pipeline failures. Numerous examples of spills around the wellhead are evident in the photos accompanying the well site assessment field data sheets (Appendix B).

Irrespective of the extensive disturbance and numerous potential hazards, livestock grazing in the area was commonplace (Photo 7.6). Although most of the grazing was observed to take place immediately adjacent to the oil field, there were no obstacles (e.g., fences) to exclude livestock and, on one occasion, a sheepherder was observed directing his flock through an area of intensive well site activity. One possible explanation for grazing in the oil field is that spills of produced water serve as an important source of drinking water for the livestock.

Observations specific to individual activities or facilities within the oil field follow. It must be recognized that the observations are based on preliminary inspections, therefore they represent conditions at one point in time and may not be representative of average conditions.

7.1.3.2 Well Drilling

Several conventional rotary drill rigs were active in the field at the time of the survey. In one location, the operation included a two-compartment sump (which appeared to be quite effective) for containment and recycling of fluids (Photo 7.7). In another location, however, several pools of fluid were observed approximately 75 m downstream of the sump and,

judging by the pattern of streamflow in the area, the origin of these fluids appeared to be the sump. The drilling mud at one operation consisted of bentonite, coal, polymer and caustic soda. The standard procedure in the oil field is that after the well is completed, sump fluids are siphoned off for use at the next drilling operation and the sump is then backfilled to cover the drill cuttings.

7.1.3.3 Group Gathering Stations

Several group gathering stations were observed during the oil field evaluation. In general, the stations were in a relatively clean state with a minimum amount of debris and very little evidence of spilled fluids (Photo 7.8). Vessels and pumps were usually clearly labelled and, in some instances, pipelines appeared to be colour-coded. In a few instances, moving equipment (such as motors and hydraulic rams) were operating without protective shields in place while oil field personnel were performing maintenance on the equipment. As well, maintenance personnel, as with almost all other oil field workers observed, frequently lacked basic personal protective clothing such as hard hats and safety glasses.

7.1.3.4 Central Processing Facility

A tour of the central processing facility included a view of conditions inside various buildings as well as the grounds. Environmental conditions inside the buildings appeared reasonable in that equipment was generally clean and there were numerous signs posted regarding safe operating and emergency procedures. A few workers in a relatively noisy building (pumping facility) wore no safety equipment (hard hats, safety glasses or hearing protection). Outside the buildings, the surrounding grounds had a very run-down appearance. Various debris (metal, gravel, rubble, etc.) was scattered throughout. The facility had been fenced but the fence had fallen into disrepair in several locations, and livestock (sheep) were roaming through the facility.

The final stop on the tour was at one of the commodity oil storage tanks (20 000 m^3) which was in the process of being cleaned. The tank bottoms were being landfilled nearby, a process which takes place approximately once every five years. All of the tanks in the vicinity, which included six of 10 000 m^3 capacity and four of 20 000 m^3, had a containment berm surrounding them which appeared to be of adequate size to contain a complete tank failure.

7.1.3.5 Injection Water Station

The main facility (in Production Area 3 of the oil field) for temporary storage and distribution of injection water was inspected briefly. The facility consisted of two semi-submerged holding tanks (20 000 m^3 capacity) and a pumping station. The tanks were used to store make-up water from the pipeline used to transport Caspian Sea water from Aktau.

Generally, conditions in and around the station were comparable to those at the central processing facility, where scattered debris and open excavations contributed to a disorderly

and unsafe appearance. Once again, the pump station contained several posters on safety and emergency procedures, but workers lacked personal safety equipment.

7.1.3.6 Refuse Dump

A relatively large area, covering several hectares and located near the entrance to the oil field from Novy Uzen, serves as a refuse dump for disposal of oil field equipment. Scrap metal and broken concrete appeared to be the main components which were scattered on the surface, with no apparent attempts to landfill this debris (Photo 7.9). There appeared to be no control of access into the area and, at the time of the survey, two children were observed playing in the dump.

7.1.3.7 Waste Pits

There were two major waste pits in the oil field which had been used for storage and/or disposal of production fluids (oil and produced water). The smaller of these covers an area of approximately 70 ha and is located adjacent to the central processing facility (Photo 7.10). The average depth of the pit is estimated at 3 to 4 m. The pit originated as an emergency oil retention pond in the early 1970s during a period when the commodity oil could not be sold. Berms were constructed to create temporary cells and the oil pumped into them. For a period of approximately 10 to 15 years it was common practice to dump processed water into the pit. Eventually the pit overflowed into a natural depression and created a much larger waste pit covering approximately 3600 ha (Photo 7.11). Information was not available on the average depth of oil in the pit.

Inspection of the smaller 70 ha waste pit revealed attempts to recover the oil. Six boom and skimmer units were noted that apparently belonged to a firm from Moscow. Close inspection of the larger 3600 ha waste pit determined that it was not possible to recover the oil due to poor access conditions. There was no mention of similar attempts to recover oil from this pit.

7.1.3.8 Well Site Assessment

A summary of biophysical features of the 20 well sites evaluated during the detailed assessment is given in Table 7.1. The detailed field data sheets, including sketches and photos of the well sites, are contained in Appendix B.

Emphasis was placed on producing wells during the evaluation, since these represent the majority of wells in the field and also have the greatest potential for environmental damage. Of the 16 producer wells examined, 10 were active at the time of the evaluation and six were not. The remaining four well sites were injector wells. No attempt was made to determine if injector wells were converted producer wells, or if they had been completed for injection only.

Table 7.1

Well Site Evaluation - Summary of Well Site Locations and Biophysical Features

	No. of Well Sites
Well Site Type/Status	
Active Producer	10
Inactive Producer	6
Active Injector	4
Oil Field Production Area	
3 or 3A	10
Other	10
Distance (m) to Nearest Wellhead	
< 10	1
11 - 50	3
51 - 75	3
76 - 200	11
> 200	2
Topographic Position	
Upland Plain	15
Depressional	4
Midslope	1
Surface Expression	
Level (< 1% slope)	9
Slightly Inclined (1 - 3% slope)	10
Inclined (10% slope)	1
Surface Soil Texture	
Silty Clay	1
Clay	1
Silty Clay Loam	2
Clay Loam	15
Sandy Loam	1
Percentage Vegetation within 50 m of Wellhead	
< 1	8
1 - 10	8
11 - 20	2
21 - 50	2
Percentage Vegetation in Adjacent Undisturbed Area	
< 1	1
1 - 10	0
11 - 20	3
21 - 50	11
51 - 75	5

Emphasis was also placed on Production Areas 3 and 3A. Half of the well sites, of which eight were producers, were located in one of these blocks. The remaining well sites were chosen at random from other production areas in the field.

At each location, the distance to the nearest wellhead (from the wellhead of the evaluated well site evaluated) was estimated. As indicated in Table 7.1, almost all of the wells were within 200 m of another well, and in approximately 30% of the cases (7 of 20 wells), a neighbouring well occurred within 75 m. In some cases, extensive surface disturbance at a well site may be attributed to the high density of wells in the vicinity.

Most of the wells evaluated (15), including all of those in Blocks 3 and 3A, were located on the upland plain portion of the Uzen oil field. Four of the wells were located in the depressional areas, including the Uzen and Tun Karakshi Depressions, as well as one site evaluated in the low-lying Karamundabus field. Finally, one well was situated in a mid-slope position between the upland plain and the Tun Karakshi Depression.

With the exception of the one well site in the midslope position (with an overall slope of 10%), the remaining well sites were nearly level (slopes less than 3%).

By far the most common (75%) soil texture near the surface (0 to 50 cm) was a clay loam, which had approximately equal proportions of sand, silt and clay in the soil matrix. Coarse fragments seldom exceeded 5% by volume and 2 cm in size in the surface layer, but were often in the 15 to 25% by volume range and up to 15 cm in size in the lower depths (50 to 100 cm). At four well sites bedrock was encountered within the upper 100 cm, with the minimum at a depth of 75 cm. Most often the bedrock was a sandstone, except in one location where a limestone was encountered. For this reason, it was usually assumed that the soil parent material was a sandstone at well sites where the bedrock was not encountered within the upper 100 cm, unless there was evidence of limestone near the surface at open excavations in the vicinity.

Groundwater was never encountered within 100 cm of the surface, nor was there evidence of near-surface groundwater anywhere in the oil field.

There was generally very little vegetation within 50 m of the wellhead. At 16 of the 20 well sites vegetation cover was less than 10%, and at half of these sites it was less than 1%. Beyond this area of disturbance, however, vegetation cover was much higher, with 16 of the sites in the 20 to 75% cover range. In the few instances where the vegetation cover was low (<20%) within 50 m of the wellhead, damage from vehicle traffic or installation of surface facilities (e.g., pipelines, power lines, etc.) usually accounted for the low cover. Two species, namely *Artemisia* spp. and *Salsola* spp., provided almost all of the vegetation cover, except for a few areas (three well sites) where a slightly higher moisture regime allowed the establishment of a grass tentatively identified as *Stipa* species.

A summary of the severity of disturbance within the immediate vicinity of the wellhead and the rating of housekeeping is given in Table 7.2. Oil spills around the wellhead were common

and only two of the producer well sites evaluated had a low (< 2 m^2) level of disturbance due to spilled oil. The other two well sites with low disturbance were injectors. In many cases, the spilled oil had been spread away from the wellhead and mixed with the surface soil over an area of 500 m^2 or more. It is unknown whether this was an attempt to degrade the oil onsite or to merely move the oil away from the wellhead to facilitate down-hole maintenance.

Spills of produced water or brine (injection water) were uncommon. It should be recognized, however, that these spills could have easily gone undetected due to the rapid infiltration and evaporation rates in the area. On two occasions, while driving through the field, injection wells were observed to be leaking water.

The greatest amount of damage at the well sites was attributed to mechanical disturbance, usually from vehicular traffic. All well sites had at least a moderate degree of disturbance and most (17 of 20) had high mechanical disturbance. The fact that many of the well sites had no obvious access road likely was a major contributor to this damage. Installation of associated facilities such as pipelines and power lines also played a role.

Erosion by water seldom causes significant disturbance. The very low rainfall and rapid soil infiltration rates limited the potential for water erosion, as did the near-level surface expression in most of the field. The only well site where this provided a high level of disturbance was the one on the mid-slope (10% slope angle) in Production Block 1. This same well site had a moderate amount of wind erosion evident, presumably due to its position on the lee side of the slope leading into the Tun Karakshi Depression.

7.1.4 Analytical Results

7.1.4.1 Undisturbed Soils

A summary of selected physical and chemical properties of soils collected from relatively undisturbed areas within the oil field is presented in Table 7.3. Results are shown for surface (0 to 15 cm) samples as well as subsurface (60 to 100 cm) samples at each location.

Soil textures were mostly clay loams, where the sand content ranged from 20 to 45% while the clay content fell within the 28 to 40% range. Exceptions included one sample which was classified as a clay due to its slightly higher clay content (42%), and two coarser-textured samples—one silt loam and one loam. In both cases, the coarser-textured samples occurred in the subsurface. In general, soils in the field have textures that were favourable for plant establishment and growth, and tended to resist erosion from wind or water.

Soil saturation percentages generally fell in the 40 to 50% range for all sites in Block 3 or 3A, but were slightly lower for the samples from the one site sampled in Block 9. All samples had values that were favourable for plant growth.

Table 7.2

Well Site Evaluation - Summary of Disturbance Type and Severity within 50 m of the Wellhead

Disturbance Type	No. of Well Sites		
Severity*:	Low	Medium	High
Oil Spill	4	7	9
Produced Water Spill	19	0	1
Brine (injection water) Spill	18	2	0
Mechanical/Physical	0	3	17
Erosion: Water	18	1	1
Wind	19	1	0
Other	16	3	1
	Good	Fair	Poor
Housekeeping	8	9	3

* Low: $< 4\ m^2$
Medium: $4 - 25\ m^2$
High: $> 25\ m^2$

Table 7.3

Analytical Results of Soils Collected from Undisturbed Areas in the Uzen Oil Field

Location (well site)	Production Block	Soil Depth (cm)	Texture (%)			Saturation (%)	pH	EC[1] (mS/cm)	Soluble Cations (meq/L)				SAR[2]	Plant-Available Nutrients (µg/g)		Total Carbon (%)
			Sand	Silt	Clay				Ca	Mg	K	Na		P	K	
234	3A	0-15	33	25	42	52.6	8.0	5.1	27	6	1	16	4	4.8	378	—
	3A	60-100	—	—	—	50.4	7.6	35.4	78	38	1	270	35	4.2	83	—
3613	3A	0-15	31	34	35	46.4	7.9	12.3	56	16	1	75	11	4.6	302	7.4
	3A	60-100	30	60	10	46.5	8.2	38.3	90	10	1	330	47	5.9	110	9.6
3615	3A	0-15	35	30	35	43.0	7.9	3.9	27	7	1	12	3	13	344	—
	3A	60-100	30	40	30	42.3	7.6	38.2	110	48	2	330	37	5.2	206	—
4082	3	0-15	32	31	37	46.8	8.0	5.7	25	5	1	32	8	11	387	7.7
	3	60-100	50	34	16	49.0	7.8	26.3	685	48	<1	180	24	12	83	13.3
5156	9	0-15	—	—	—	33.1	8.4	1.9	4	2	1	11	6	8.3	489	—
	9	60-100	—	—	—	29.8	7.9	4.9	24	4	<1	19	5	9.2	82	—

[1] EC = Electrical Conductivity
[2] SAR = Sodium Adsorption Ratio

All samples had an alkaline reaction ranging from pH 7.6 to 8.4, with no consistent difference between the surface and subsurface samples. Soils in this pH range are more alkaline than optimal for most plants but generally are not severely restrictive to growth. Electrical conductivities were generally very high, especially in the subsurface samples from Blocks 3 and 3A. Typically, only highly salt-tolerant plants can survive in soils with EC >8 to 10 mS/cm, clearly indicating the unsuitability of the subsurface soils for plant growth.
The one site sampled in Block 9 had a much lower salt content in both soil layers (EC <5 mS/cm). This likely accounts for the good grass growth at this location (see Appendix B), the only well site evaluated where grass was abundant.

Based on the analysis of soluble cations, calcium and especially sodium, sulphates and/or carbonates were the main salts in the soil and were most abundant in the subsurface. The relatively high sodium content was reflected in the very high sodium adsorption ratio (SAR) found in the subsurface samples from all sites in Blocks 3 and 3A. Generally, soils with an SAR >8 to 12 tend to restrict plant growth due to high sodium salt toxicity and/or unfavourable soil structure in the form of tight impervious soil layers (hardpans). It should be noted that the latter condition was never observed in the field.

Plant-available concentrations of phosphorous ranged from 4.2 to 13 $\mu g/g$ with no apparent difference in either soil layer. Values in this range generally indicate low to moderate supply in soils managed for annual crop production. Plant-available potassium content ranged from 82 to 489 $\mu g/g$ and was consistently higher in the surface soil. Values in this range suggest that a moderate to high quantity of this nutrient is available for plant growth.

The total carbon content of the four samples analyzed ranged from 7.4 to 13.3%. Based on the very light colour of the soils, almost all of this carbon was inorganic, likely in the form of calcium carbonate. Values in this range indicate a slightly calcareous soil that could limit plant growth in some situations, but the limitation is seldom severe.

7.1.4.2 Oil- and Brine-Contaminated Soils

Analytical results of seven samples collected for characterization of oil-contaminated soils are presented in Table 7.4. Included are the results of three samples taken where there was visible evidence of oil staining. Three samples were also collected, for comparison purposes, near the respective oil-contaminated soils. In one case (OS-2), the sample was collected directly below (15 to 30 cm) the oil-stained soil (OS-1 was from the surface, 0 to 15 cm). The other two samples were collected from the surface in a nearby undisturbed area.

Table 7.4

Analytical Results of Oil-Contaminated Soils

Sample Location[1] (Well Site)	Metal Content (μg/g)												Total Petroleum Hydrocarbon (%)
	Cr	Ni	V	Cu	Co	Pb	Zn	Mo	Mn	Cd	Be	Ba	
OS-1	9	4	12	190	4	<5	255	<1	150	<3	0.5	630	2.40
OS-2	22	9	23	15	6	7	36	1.5	315	<3	1.3	470	0.05
4021-1	52	25	58	97	13	9	110	1.5	640	<3	2.4	710	2.80
4021-2	77	37	73	33	15	13	83	2.2	530	<3	1.1	540	0.43
4083-1	100	31	53	13	11	20	42	2.0	460	<3	1.1	590	4.65
4083-2	83	38	69	25	15	14	75	2.1	540	<3	1.1	520	0.41

[1] Site Description:

- OS-1 Surface (0-15 cm) stained soil from an area where oil has been spilled for many years.
- OS-2 Subsurface (15-30 cm) below OS-1 where no visible oil staining was evident.
- 4021-1 Surface (0-15 cm) stained soil near wellhead at Well Site 4021.
- 4021-2 Surface (0-15 cm) soil from undisturbed area of Well Site 4021.
- 4083-1 Surface (0-15 cm) stained soil near wellhead at Well Site 4083.
- 4083-2 Surface (0-15 cm) stained soil from undisturbed area of Well Site 4083.

As expected, the most noteworthy difference in the analytical results between the contaminated soils and their respective control samples was the level of total petroleum hydrocarbon. Values ranged from 2.4 to 4.65% for the contaminated samples, compared to less than 0.5% for the controls. Most plants begin to show a reduction in performance as oil content rises above 0.5%. Concentrations of the metals generally show very little difference between the contaminated soil and the control sample. None of the values exceeded North American criteria levels where remediation of the site would be required for agricultural land use.

One sample of surface soil collected near an injector well (Well Site 2663) was analyzed for salinity properties. A rust-coloured surface provided evidence of a spill. The soil had an alkaline reaction (pH 7.8) and a relatively high electrical conductivity of 12.7 mS/cm. Although this value indicated a high salt content that could restrict plant growth, it was not substantially higher than at least one of the surface soils analyzed from Block 3A (Well Site 3613, Table 7.3). Its sodium adsorption ratio (15) was also comparable. It can be concluded therefore, that the spill at this site has probably not significantly degraded the soil in terms of its ability to support plant growth.

7.2 EXISTING WATER INTAKE PIPELINE

7.2.1 Field Assessment Methodologies

The existing injection water intake pipeline from Aktau to the injection water station in the oil field was examined during a half-day tour on April 7. Casual observations were made intermittently along the route, with more detailed inspection at two locations, namely:

- intake facility at Aktau; and
- bottom of Karigan Depression.

The Chief Engineer of Technological Fluids for the NGDU accompanied the field team.

7.2.2 Sampling and Analytical Methodologies

Three soil samples were taken for analysis at the bottom of the Karigan Depression. Samples were taken from the surface, in an open trench (from a depth of approximately 1 m), and from a green clay material at the bottom of the trench. The samples were analyzed for texture as well as salinity properties.

7.2.3 Field Assessment Results

7.2.3.1 Overview of the Pipeline Route

Injection water for the oil field has been supplied (at a current rate of approximately 80 000 m^3/day) via a pipeline from the Caspian Sea since construction of the first line in 1968. The original pipeline was eventually abandoned and replaced by pipelines completed in 1974, 1981 and 1983. Pipeline diameters for various segments ranged from 720 to 1020 mm.

The route begins with the intake facility on the industrial canal at Aktau and travels approximately 150 km to the oil field, terminating at two tanks (20 000 m^3 each) in Production Block 3. The most significant topographical change along the route was the crossing of the Karigan Depression, where elevations change from approximately 120 m above sea level on either side to 130 m below sea level in the depression. Apart from the steep slopes leading down into the depression, the route is nearly level.

Several sections of the pipelines have been replaced in recent years where severe corrosion has caused frequent failures. For example, there were four major failures in 1993, two of which occurred on the line constructed in 1974 and two on the one constructed in 1983. Failures most often occur in the depressions crossed along the route (where pipe pressures increase), especially the lowest point in the Karigan Depression. Another factor contributing to pipe failure is the trench material of fractured sandstone or limestone which damages the protective wrap applied to the pipe to prevent corrosion. There was no information available on the use of protective padding (e.g., sand) during construction to minimize this damage. In an attempt to reduce pipe corrosion, sections that have been replaced in recent years have been placed above ground.

The most noteworthy feature of the pipeline was the mound of backfill material 1 to 2 m high over the trench wherever the pipe was buried below ground. The mound was virtually devoid of vegetation and consisted of a mixture of surface fines as well as fractured rock from the trench. Photo 7.12 illustrates the condition at a location near the oil field where the water pipeline was one of several pipelines constructed in the same manner within an approximate 200 m wide corridor. Another consequence of this method of pipeline construction is that the disturbed surface soils are subject to erosion, especially wind erosion, as is evident in Photo 7.13, a view of the corridor in the Karigan Depression.

7.2.3.2 Intake Facility at Aktau

The intake facility was situated adjacent to a canal constructed for industrial use in Aktau. Major equipment at the intake facility included a small reservoir, three intake pipelines (two main and one auxiliary), pumps (eight atm. pressure), and a unit for adding an oxygen scavenger (orthophosphoric acid) to the water. The reservoir was fenced and separated from the canal by a coarse screen (Photo 7.14). Several small fish were observed in the reservoir and, apparently, the NGDU has been fined frequently for allowing fish to enter into the intake

lines. A new water intake is under construction which will include finer-textured screens to prevent fish passage.

7.2.3.3 Karigan Depression

The pipeline was inspected at a location which was approximately the lowest point along the route, at the bottom of the Karigan Depression. At this point the pipe had been replaced within the last year. There was an excavated trench adjacent to the pipe, although the decision had been made to leave the pipe above ground to reduce corrosion damage.

The most noteworthy difference in the pipeline corridor at this location was the appearance of surface salts (Photo 7.15) and relatively scarce surface vegetation. The long, steep slopes descending into the depression had only minor rill erosion (Photo 7.16), even though no special erosion control techniques were evident (e.g., cross-ditching).

Analytical results of the three samples collected at the bottom of the depression are summarized in Table 7.5. The samples from the surface (0 to 15 cm) and the trench wall (1 m) were clay loam textured, whereas the trench bottom sample was a heavy clay. All three samples were alkaline and highly saline, with pH ranging from 7.7 to 8.1 and EC from 27 to 39. Sodium was the dominant cation, contributing to very high SAR values ranging from 47 to 61.

The extremely high salt content, even from the surface sample, likely accounts for the poor vegetation growth at this location. It is possible that the surface soil collected was a result of previous disturbance in the pipeline corridor rather than natural, undisturbed conditions.

7.3 PROPOSED ALTERNATIVE WATER INTAKE PIPELINE

7.3.1 Field Assessment Methodologies

The tentative proposed route for a new water intake pipeline from Kazakh Bay was examined during a one-day field reconnaissance on March 30, 1994. The route begins at Kazakh Bay on the Caspian Sea near the resort village of Fetisovo and travels for approximately 70 km to the Uzen oil field. The main emphasis of the field survey was the siting of the intake facility at Kazakh Bay. In addition, biophysical conditions were recorded during brief inspections at three locations along the route:

- approximately 500 m inland from the site, which is likely the best location for the intake facility (KP0);
- approximately 25 km from Kazakh Bay (KP25); and
- approximately 50 km from Kazakh Bay (KP50).

The field inspections at KP25 and KP50 were located approximately 200 m to the east of the highway between Fetisovo and Uzen. Notes were taken on the following features:

- land use;
- surface expression;
- vegetation; and
- soils.

7.3.2 Sampling and Analytical Methodologies

Soil samples were taken for analysis at each of the three field inspection sites. Both the surface (0 to 15 cm) and subsurface (60 to 100 cm) soil layers were sampled and analyzed for salinity properties and macronutrients (P, K and C). Due to cost and time constraints, it was not possible to perform all analytical tests on every sample.

7.3.3 Field Assessment Results

7.3.3.1 Overview of the Pipeline Route

The route from Kazakh Bay to Uzen is nearly level except for the escarpment near the coast, approximately 3 km (following the highway) from the village of Fetisovo. Except for the immediate vicinity of the oil field and Novy Uzen, the land is used for agricultural production, mainly camel, sheep and horse grazing originating from the town of Butakoz. This is the only permanent settlement along the route and is located 3 km east of the highway (at approximately KP52 of the proposed pipeline). Depending on precise routing, approximately three to five paved roads would be crossed, as well as several pipelines.

There was very little variation in terrain features along the route and relatively little evidence of serious erosion or man-induced disturbance. Vegetation cover typically ranged from 20 to 30%, consisting mainly of *Artemisia* spp. and *Salsola* spp.

The only significant slope was the rise of approximately 30 m from near the water's edge to the top of the escarpment. The best route for the pipeline to climb the escarpment is to follow the alignment of the highway (Photo 7.17). At this location (at approximately KP4 of the proposed pipeline), the grade of the escarpment is approximately 15% over a distance of 300 m, and there is minimal erosion on either side of the highway. To the east and west of this location, the escarpment is much steeper (100% slope or more) and a considerable amount of earth-moving would be required for pipeline installation.

Table 7.5

Soil Analytical Results for the Karigan Depression Along the Existing Water Intake Pipeline Route

Parameter	Location		
	Surface (0-15 cm)	Trench Wall (1 m)	Trench Bottom (2 m)
Sand %	33	37	30
Silt %	32	28	7
Clay %	35	35	63
Saturation %	43	50	140
pH	8.1	8.1	7.7
Electrical Conductivity (mS/cm)	39	34	27
Ca (meq/L)	69	32	48
Mg (meq/L)	36	49	35
K (meq/L)	2	1	1
Na (meq/L)	430	300	390
Sodium Adsorption Ratio (SAR)	59	47	61

7.3.3.2 Proposed New Intake Facility Siting

The resort village of Fetisovo on Kazakh Bay is the only settlement in the vicinity of the proposed new intake facility. The village is operational from May to October and serves as a recreational area for the NGDU employees. There is limited infrastructure, apart from small shelters providing overnight accommodations (Photo 7.18). Up to 1000 people use the facilities on a daily basis, primarily participating in water-based recreational activities, including fishing in the bay. There is no commercial fishing in the area.

The location probably best suited for the new intake facility, from both engineering and environmental perspectives, is approximately 1 km to the west of the resort facilities. At this location the facility could be positioned between the shore and the steep escarpment and far enough away from Fetisovo to preclude disturbance due to operations. The sea floor at this site falls sharply to depths of 10 to 15 m within a few metres of the shore. To the west of this location, the escarpment meets the shore (Photo 7.19), leaving insufficient space for the facility. East of the village, the bay is very shallow and is the preferred location for recreational fishing (Photo 7.20).

7.3.3.3 Biophysical Conditions at Selected Locations Along the Pipeline Route

Biophysical conditions at the three inspection and sampling sites along the route are summarized in Table 7.6. The primary land use along the route was livestock grazing, as well as some recreational use near Fetisovo (campfires). At one location (KP25), a sign and surface disturbance indicated that there was an existing pipeline nearby (Photo 7.21). The terrain was level at each location and there was no evidence of erosion.

Vegetation cover ranged from 20 to 30%, dominated by *Salsola* spp. at the two upland sites while *Stipa* spp. dominated the vegetation near Fetisovo.

Soils along the entire route were alkaline (pH 8.0 to 8.4). Surface (0 to 15 cm) electrical conductivities and sodium adsorption ratios were low, indicating relatively low salt content, favourable for plant growth. However, the subsurface soil (60 to 100 cm) of the one site where salinity characteristics were analyzed (KP0) had a much higher EC (4.9 mS/cm). It is likely that this condition also existed at the other sites but to an even greater extent. Similar to the soils in the oil field. Saturation percentages fell within the 24 to 37% range. Levels of plant-available nutrients ranged from 3 to 23 μg/g for P and 89 to 341 μg/g for K, indicating low to moderate supply of P and high K (based on annual crop requirements). Total C in the surface ranged from 6 to 15%, most of which is assumed to be inorganic carbon in the form of calcium carbonate.

Table 7.6

Biophysical Conditions Along the Proposed Water Intake Pipeline

	Location[1]		
	KP0	KP25	KP50
Land Use	Recreation, grazing	Grazing, pipeline	Grazing
Surface Expression	Level	Level	Level
Vegetation Cover	*Stipa* spp. 20%, *Artemisia* spp. 5%	*Salsola* spp. 20%	*Salsola* spp. 30%
Soil			
Surface (0-15 cm)			
Texture	Sandy loam	Clay loam	Clay loam
pH	8.3	8.4	8.2
EC (mS/cm)	0.6	0.7	0.6
SAR	0.2	2.5	0.6
Saturation (%)	24.4	36.9	35.7
Available P (μg/g)	3	12	14
Available K (μg/g)	89	293	341
Total C (%)	15	7.7	6.0
Subsurface (60-100 cm)			
Texture	Sandy loam	Sandy clay loam	Sandy clay loam
pH	8.0	8.2	8.2
EC (mS/cm)	4.9	—	—
SAR	2.7	—	—
Saturation (%)	27.1	—	—
Available P (μg/g)	23	—	—
Available K μg/g)	103	—	—
Total C (%)	—	—	—

[1] Locations are approximate kilometre posts (KP), assuming the pipeline origin is near Fetisovo (KP0).

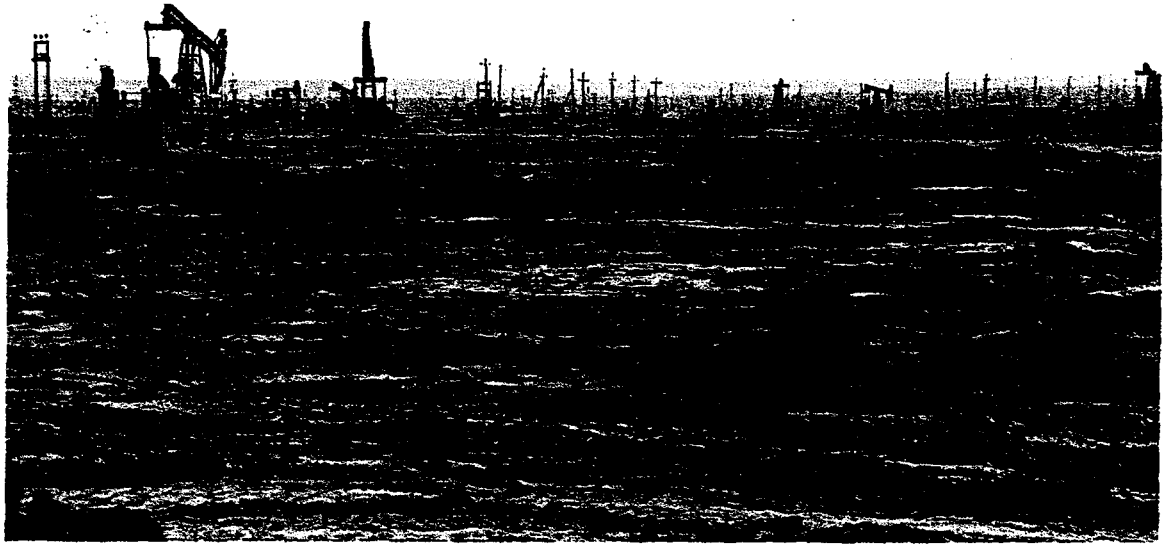

Photo 7.1 Typical view of Production Area 3 showing dense well spacing and extensive surface disturbance.

Photo 7.2 An open excavation within the oil field. Note the vegetation in the bottom of the ditch suggesting that the trench has been open for a considerable period of time.

Photo 7.3 Scattered debris within the oilfield.

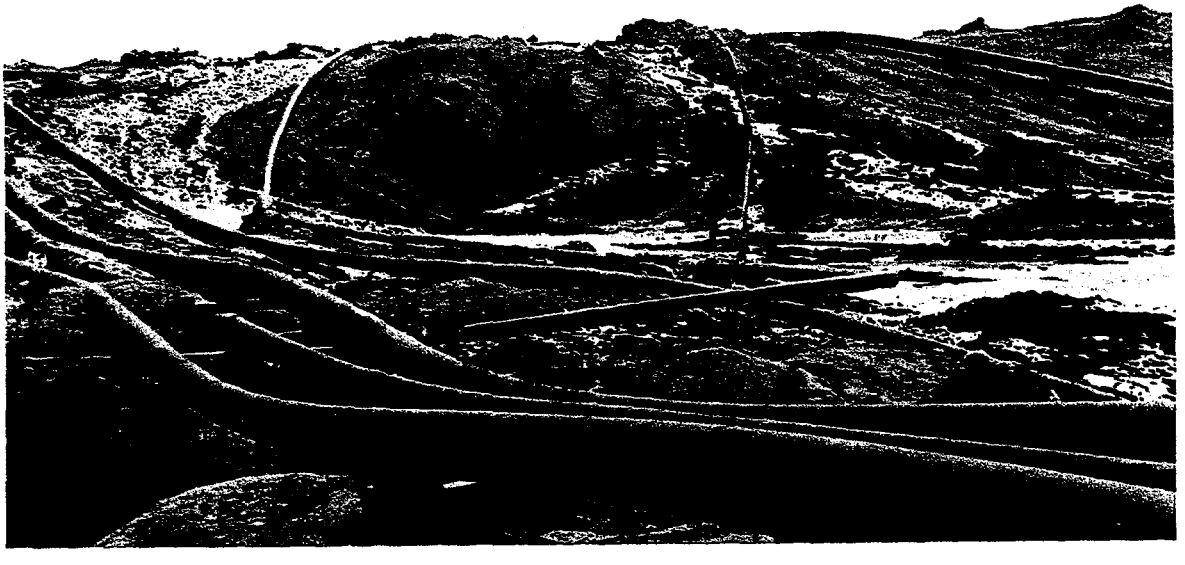

Photo 7.4 Soil contamination as a result of numerous pipeline failures within the field.

Photo 7.5 A major spill as a result of a single pipeline failure. The spilled fluids cover an area measuring approximately 100 m x 80 m in Production Area 1.

Photo 7.6 Livestock grazing immediately adjacent to the oil field.

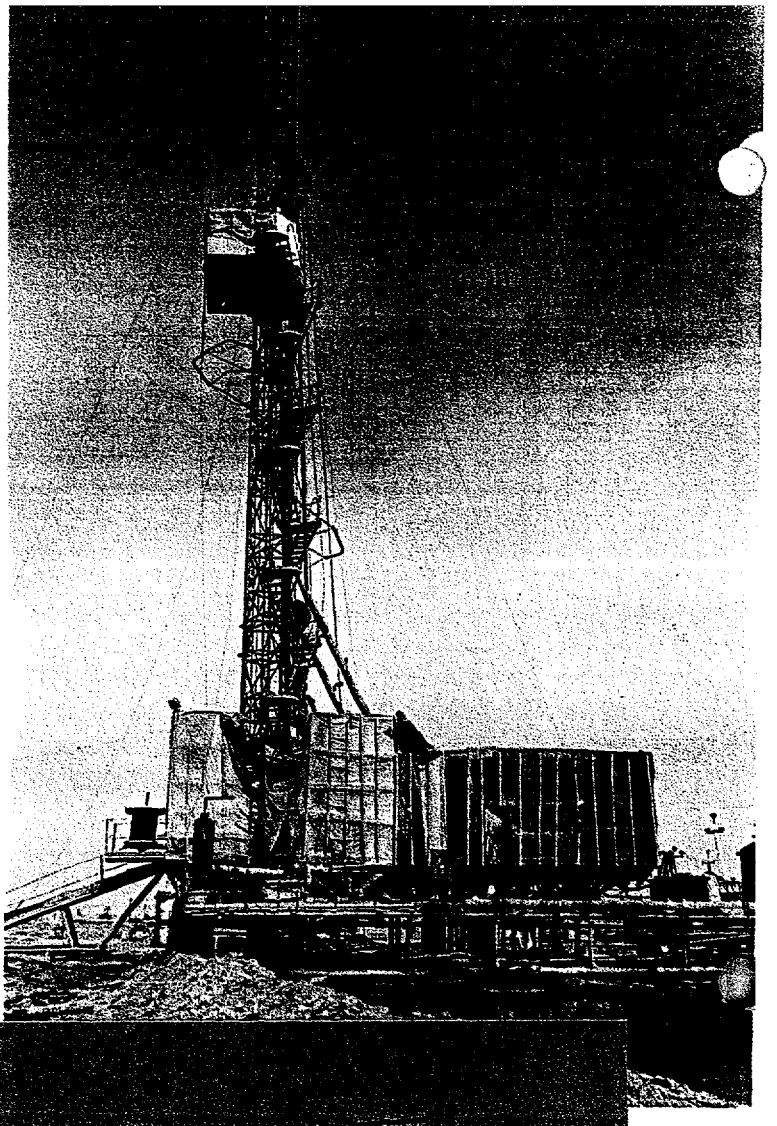

Photo 7.7 Drilling rig and sump.

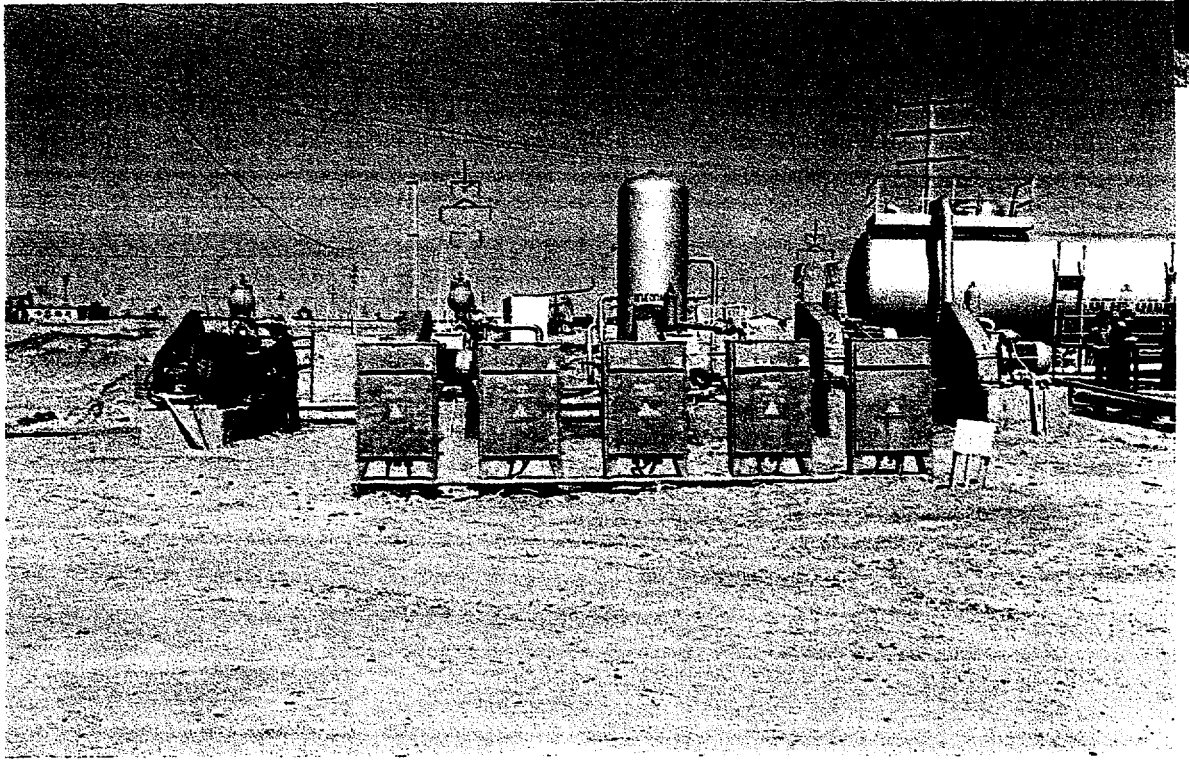

Photo 7.8 A typical group gathering station.

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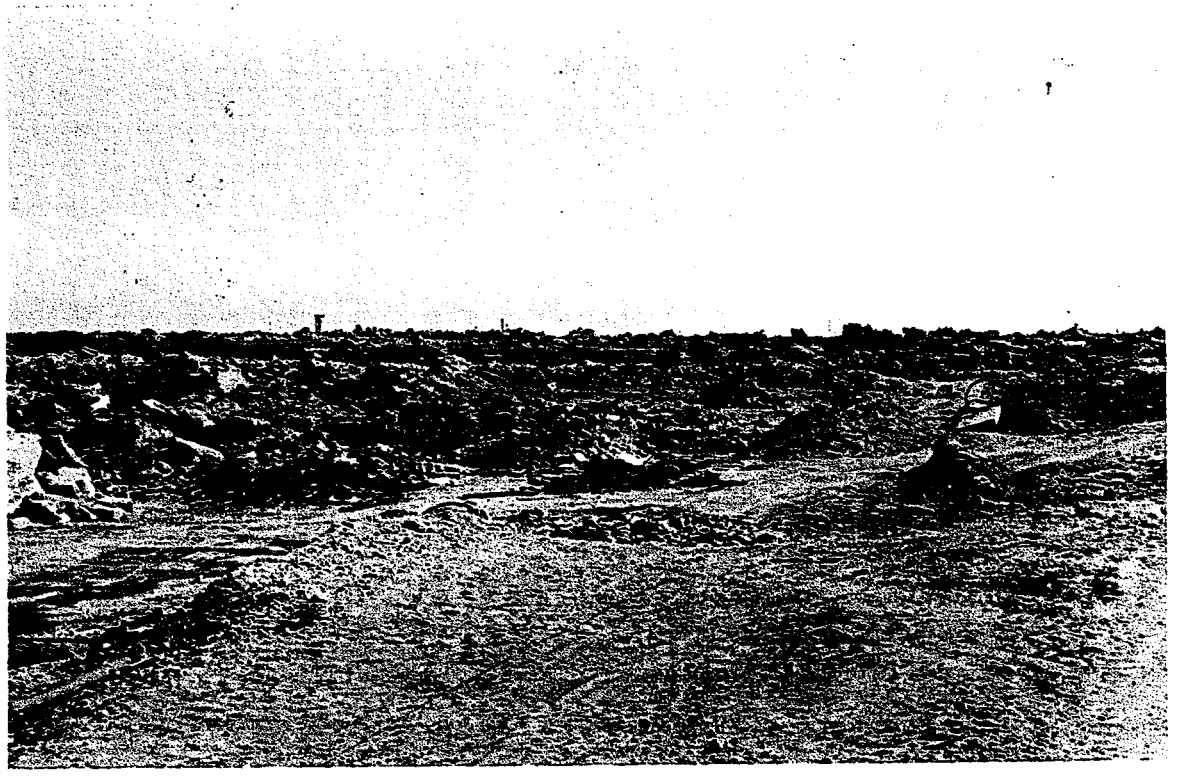


Photo 7.9 Refuse dump adjacent to the oil field.

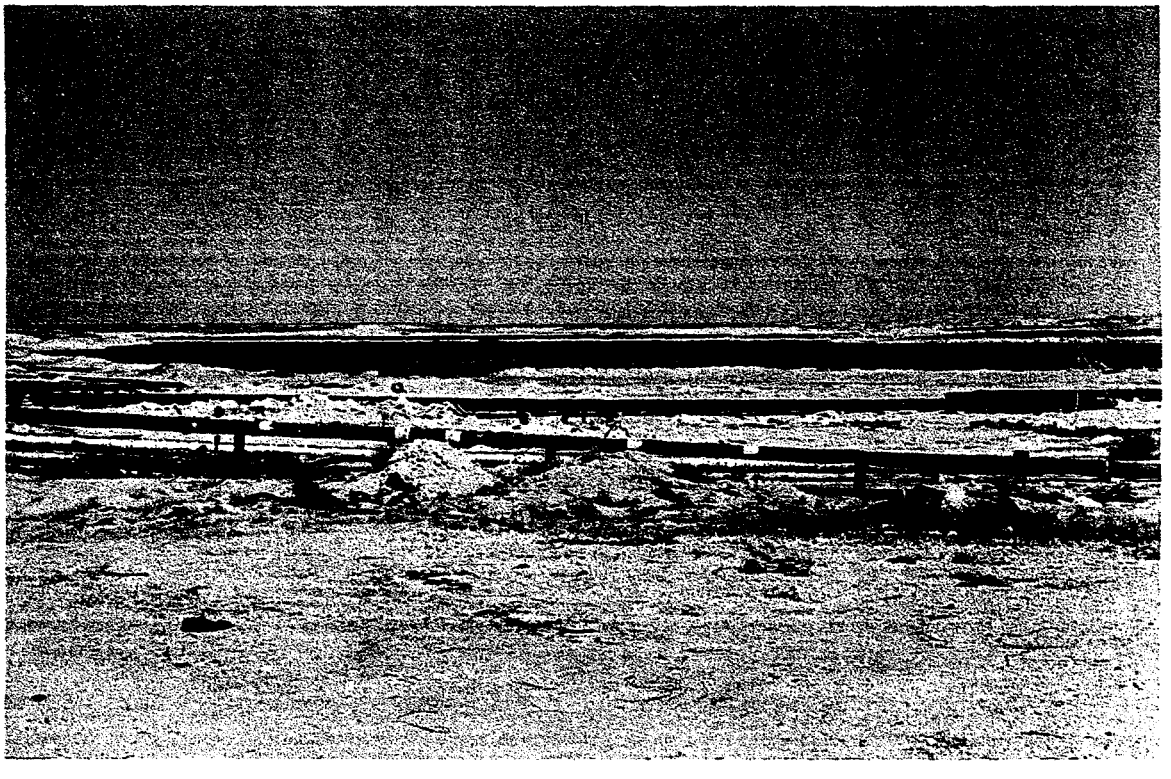


Photo 7.10 Waste pit near central processing facility (70 ha).

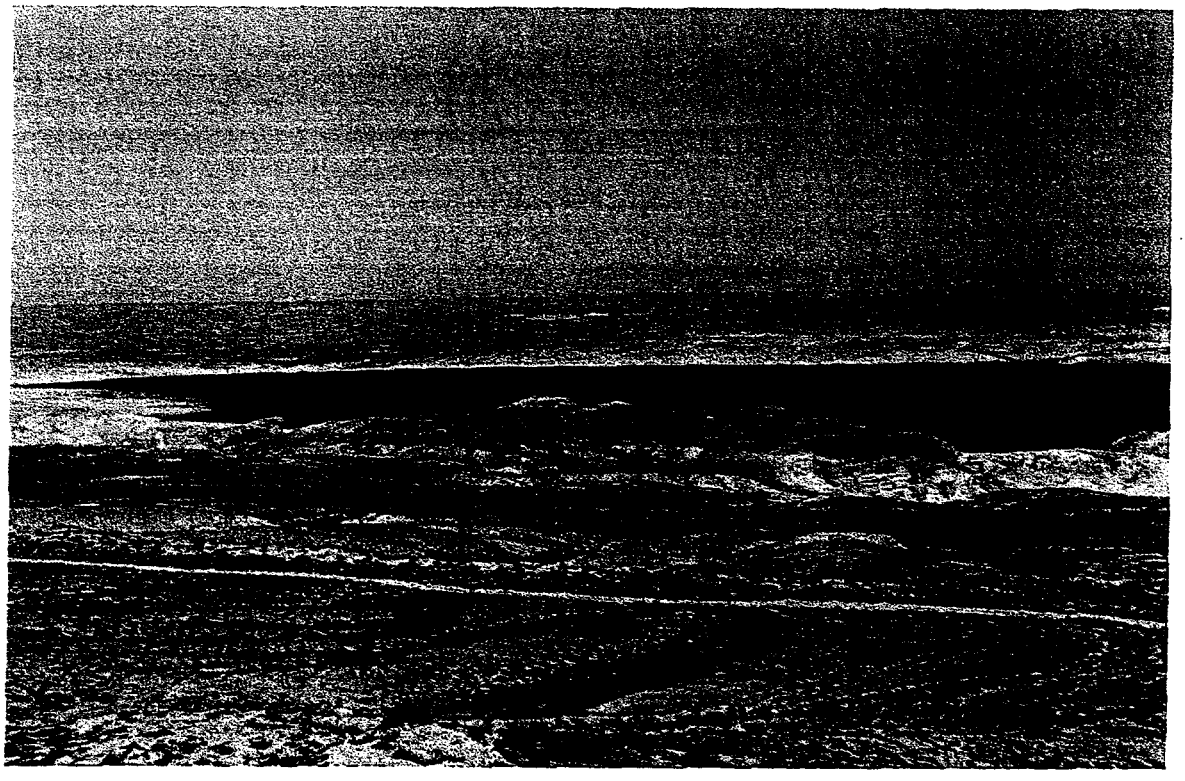


Photo 7.11 Western end of the 3600 ha waste pit. Note the film of oil around the margin.

Photo 7.12 Injection water pipeline near the Uzen oil field.

Photo 7.13 Wind erosion along the utility corridor in the Karigan Depression.

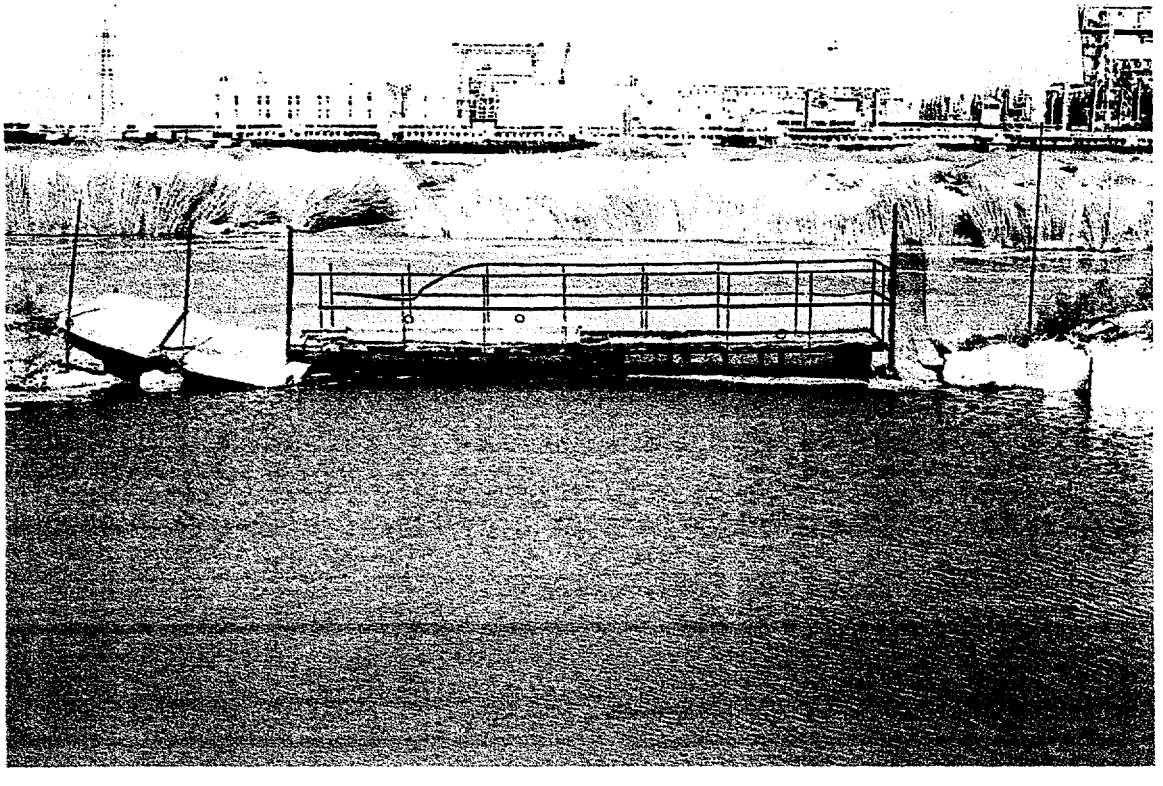


Photo 7.14 Injection water intake on the industrial canal at Aktau.

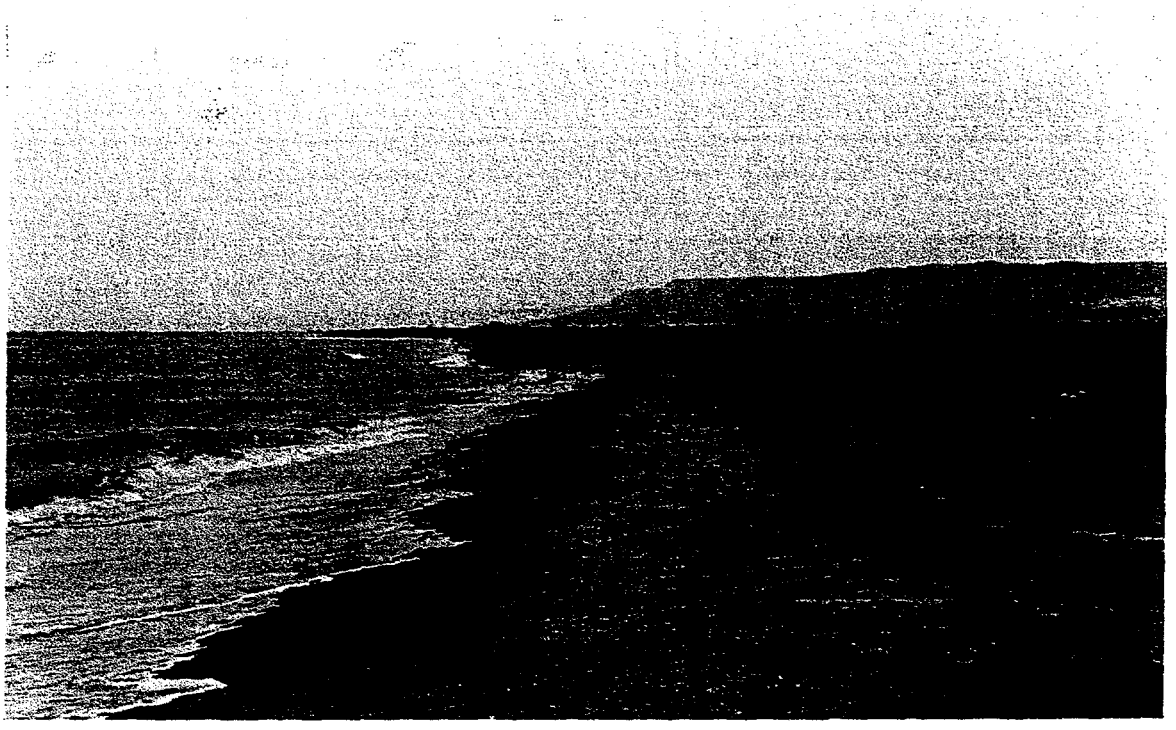


Photo 7.19 Fetisovo shoreline looking west to the preferred location for the intake facility. Note how the escarpment forms the coastline in the distance.

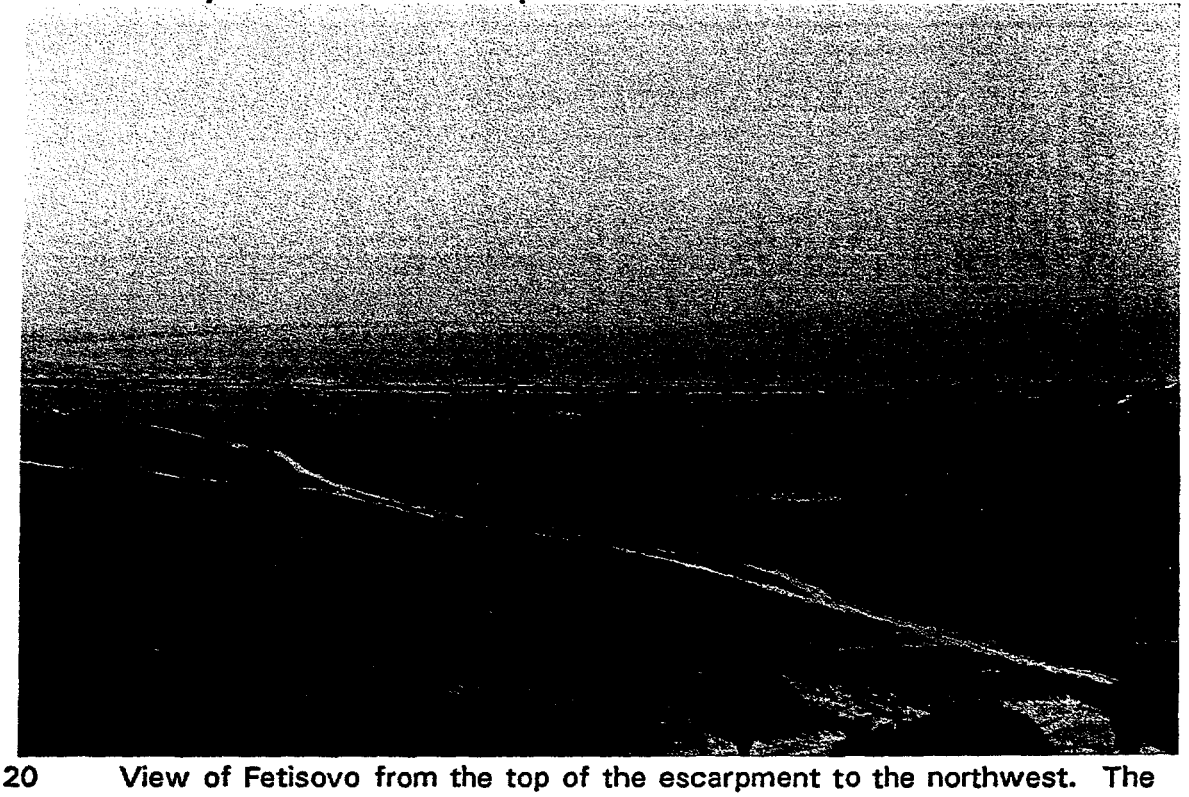


Plate 7.20 View of Fetisovo from the top of the escarpment to the northwest. The village extends from the extreme left to the middle of the photo. The preferred intake facility location is on the extreme right.

Photo 7.21 Terrain at KP25 of the proposed water intake pipeline showing evidence of past pipeline disturbance.

PART 8 - PRELIMINARY ENVIRONMENTAL AUDIT

8.1 MANAGEMENT AUDIT PROTOCOL

Environmental audits are undertaken to identify potential environmental problems associated with past use of the property or facility. Environmental audits take account of issues which have been raised by the public in connection with the site (e.g., local government records of complaints about noise from a factory), and also of issues which affect local people (e.g., whether an emergency response plan has been developed for the site and shared with local fire, police and medical services). The primary vehicle for completing environmental audits consists of informal interviews with local regulatory agencies, environmental protection agencies, facility management and the local scientific community.

The environmental audit completed for the Uzen oil field was conducted in accordance with the European Bank for Reconstruction and Development (ABRADE) audit protocols. The purpose of the audit was to review conditions, practices and operations within the Uzen oil field, and to identify environmental, and health and safety issues which need to be addressed.

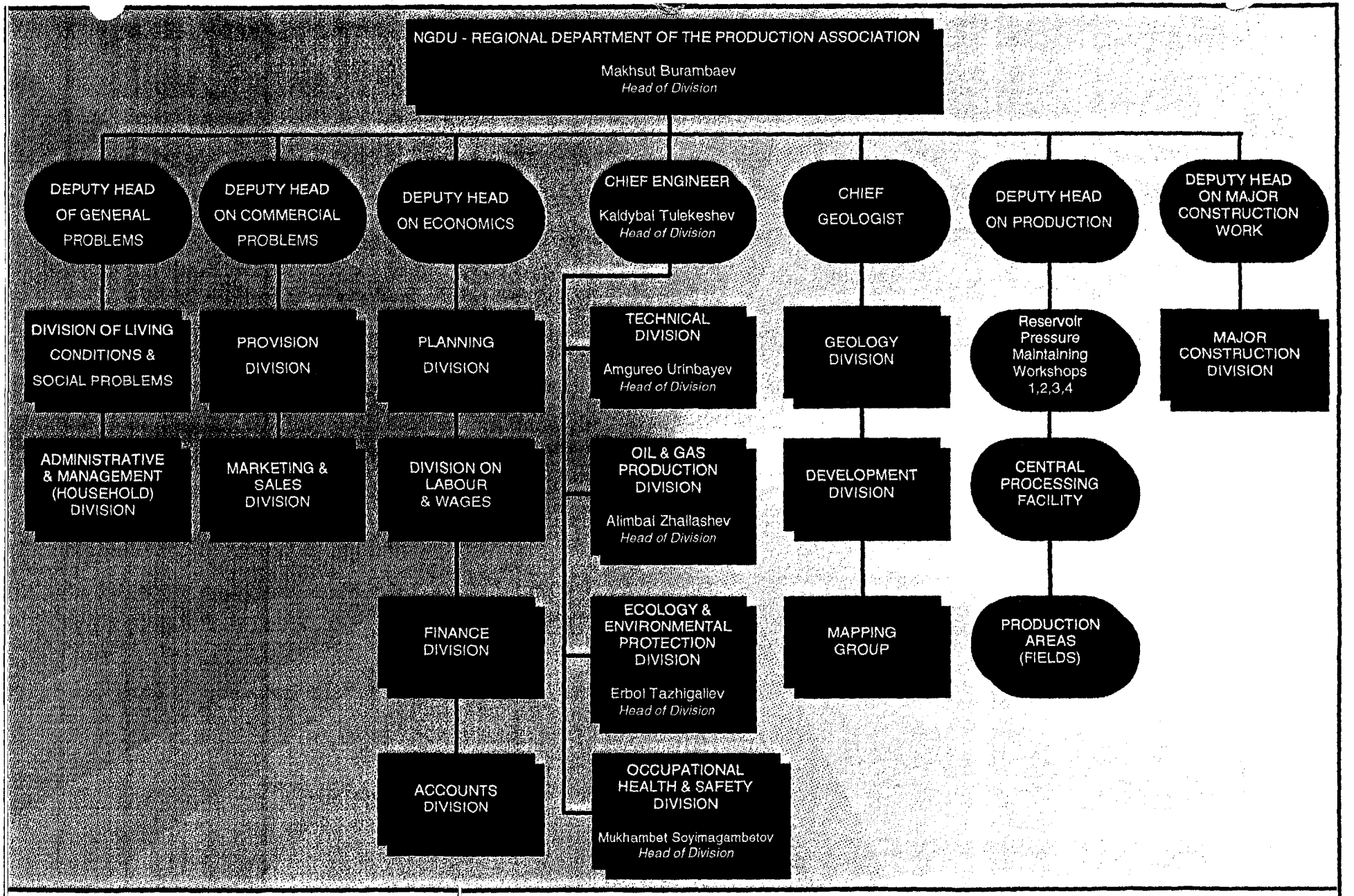
Audit information was assembled from interviews with local regulatory officials and with personnel responsible for environmental protection, and occupational health and safety at the Uzenneft NGDU Production Association. Key personnel interviewed included:

- Aness Burkitbayev - Deputy Head of Ecology and Environmental Protection Division, NGDU
- Erbol Tazhigaliev - Head of Ecology and Environmental Protection Division, NGDU
- Kolkanat Kulsaryev - Head of the Geological Department, NGDU
- Amgureo Urunbayev - Deputy Director of Operations, NGDU
- Alimbai Zhailashev - Head of Oil and Gas Production Division, NGDU
- Mukhambet Soyimagambetov - Head of Occupational Health and Safety Division, NGDU
- Ilvan Kharshin - Ecology and Bioresources Specialist, Uzen Municipal Ecological Department

8.2 AUDIT RESULTS

8.2.1 Management Structure

The existing management structure for the Regional Department of the Production Association is presented in Figure 8.1.



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Engineering & Environmental Services

Environmental Assessment: Proposed Uzen Oil Field Rehabilitation Project

MANAGEMENT STRUCTURE

FIGURE 8.1

8.2.2 Occupational Health and Safety

An audit of the NGDU Production Association was completed on April 5, 1994 with the aid of Mr. Mukhambet Soyimagambetov, head of the NGDU Occupational Health and Safety Division. Topics covered during the audit included: health and safety training, personal protection equipment, organizational rules, hazardous chemicals, vehicles and driving, employee medical programs; and accident incidence and routine record keeping. NGDU does not have jurisdiction over health and safety issues for drillers as these activities are carried out by a contractor.

8.2.2.1 Health and Safety Training

Health and safety division personnel are responsible for training on the job site. These individuals receive vocational training on first aid which is a prerequisite for hiring into this division. These individuals are responsible for training workers at the group collector units and records are kept there regarding the specific individuals who have received this training. Two types of heath and safety training are required: regular and periodic updates. Examinations to determine the comprehension of the training exercises are given annually and first aid procedures are reviewed quarterly.

A health and safety commission composed of senior managerial staff visit each of the group collector units and workshops twice a year to inspect health and safety conditions. This commission meets quarterly in the office of the Chief Engineer to review past safety incidences. They identify individuals responsible for unsafe situations and specify a date by which the responsible individual must remedy the unsafe situation. If the unsafe situation is not remedied within seven days after the appointed date, the commission has the authority to shut down a production area. Records are kept of individuals that attend the quarterly meetings and minutes of the meeting are recorded for filing.

8.2.2.2 Personal Protection Equipment

NGDU supplies all work-related clothing and personal protection equipment. Work-related clothing are divided into two types: summer and winter. Summer workwear clothing consists of cotton coveralls and high- or low-top footwear. Insulated coveralls, hats, boots and gloves are issued in the winter. Although the issued boots are made of heavy leather, metal-toed boots are not used due to the potential for spark ignition of gaseous vapours. Protective headgear (i.e. hard hats) are also issued. Ear and eye protection equipment are issued on an as-needed basis. The wearing of protective clothing and equipment is governed by rules. First time violations of the rules result in warnings and thereafter monetary penalties are imposed on individuals.

Observations of workers made during the site visit appeared to indicate a lack of safety policy enforcement, particularly with regard to the wearing of protective headgear and eye wear.

8.2.2.3 Organizational Rules

A formal work-permit system exists for the following areas:

- underground work;
- work related to gas transmission or processing facilities;
- electrical work; and
- work involving a potential source of ignition.

The work-permit system requires that these specific permits be signed by operating and supervisory personnel. Copies of these permits are filed at the group collectors sites.

8.2.2.4 Hazardous Chemicals

During the site visit, AGRA E&E personnel requested information on any surveys of "hazardous chemicals." This term was used to mean those chemicals to which workers would be exposed over their working life-time which might ultimately result in adverse health effects after some prolonged exposure period. Although the chemicals, reagents and compounds used on site were known, the answer provided by the production association suggested that gathering information on worker exposure to these chemicals and the long-term effect of these exposures had not been a high priority.

8.2.2.5 Vehicles and Driving

All NGDU personnel operating vehicles in the field must have a valid drivers licence. NGDU vehicle needs and service are provided by a contractor (owned by NGDU). The contractor is responsible for all NGDU transportation needs for personnel and equipment. The contractor has a separate health and safety program and is responsible for the maintenance and driver training program for contractor personnel. The contractor is also responsible for enforcing all driving rules.

8.2.2.6 Employee Medical Program

Employees receive annual physical examinations. Medical records and identifications of specific medical problems are filed at NGDU. Employees who develop work-related health disabilities are transferred to other positions to remediate the disability. Rehabilitation services are provided for work-related illnesses. Paid sick leave, which provides 100% of salary, is available for a maximum of four months for work-related illnesses. The compensation for non-work-related illnesses ranges from 50 to 100% salary, depending on duration of employment. Employees are responsible for their own health insurance. Special assistance programs from an independent work compensation association are also available. The cost of all medication is supplied by NGDU.

8.2.2.7 Accidents and Record Keeping

All accidents are investigated. Records are kept regarding the specific personnel involved in the accident, the location and nature of the accident and the time lost due to accidents. A summary report of work-related accidents is sent to Mangystaumunaigas each quarter for review. Mangystaumunaigas summarizes there quarterly reports into a six-month report which is sent to Kazakh Munaigas. Kazakh Munaigas passes these reports onto the Ministry of Fuel and Energy Resources.

Since 1981, there have been seven work-related deaths and an average of 3 to 5 serious work-related accidents per year. Accidents caused the loss of 464 worker-days in 1992 and 574 worker-days in 1993. The main causes of accidental injury appear to result from lifting of heavy objects, impacts of heavy objects on feet and ankles, and falls off platforms or down stairs.

8.2.3 Emergency Response

An emergency response plan was last prepared by NGDU in 1990. The plan was written for field operations and does not include administrative buildings (which only have evacuation plans). Copies of the plan are located at all gathering stations and work shops. The emergency response plan includes instructions for:

- evacuation of employees;
- designation of a central control area;
- work shutdown, fire and other emergencies; and
- notification of appropriate personnel.

The Emergency Response Plan presents, in an easily comprehendible format, a list of possible accidents or incidents. Under each type of accident or incident, specific instructions to be carried out are provided for day time personnel (i.e. operators, foremen, and the head of oil production). Specific instructions are also provided should the accident or incident occur during the night for the operator on duty, the subdivision manager on duty and the individual on duty in the oil and gas production centre.

All emergency services telephone numbers (e.g. fire stations, ambulance and hospital) are listed in the plan, plus a special, direct telephone line to the central dispatch office.

All major fires and well blowouts are the responsibility of a special fire-fighting division of the Russian military (Unit 19). This unit conducts daily training exercises in dealing with emergency fire situation. While new NGDU staff are given initial training in the use of fire-fighting equipment (e.g. fire extinguishers) regular fire-fighting drills are not held.

Emergency response equipment present at practically every gathering station include fire extinguishers, shovels, buckets, and axes. However, there is no regular maintenance program for the fire extinguishers, so that many are reported to be beyond the expiry date.

Self-contained air-packs with full-face masks as well as emergency eye-baths and showers are also absent. An emergency lighting system does not exist and there are no paramedics on duty, apparently due to the proximity of the hospital in Uzen. A formal plan for notification of the public of emergencies at NGDU facilities does not exist.

8.2.4 Environmental Protection and Monitoring

Environmental protection and monitoring at NGDU facilities is conducted according to a 1992 environmental operating directive for all of NGDU termed an "ecological passport." This ecological passport specifies the types of pollution and maximum permissible emissions of pollutants allowable from NGDU facilities. In addition, the ecological passport contains general information on the facility, such as:

- headquarters address and land holdings;
- regional climatological data;
- descriptions of the project processes and related flow diagrams;
- chemicals, reagents and compounds used on site;
- the types of air pollution from the various facilities;
- water use and wastewater disposal;
- solid waste characterization (e.g. sludge, scrap metal, garbage, etc.);
- technical reclamation for clean-up operations;
- vehicle transportation availability to site; and
- charges and fines for exceeding the maximum permissible concentrations of a pollutant or pollutants.

The ecological passport is intended to be an annual submission for regulatory approval. Following a review of the document, an audit of the facility or facilities is conducted to ensure compliance with the document. This procedure is suppose to be conducted on an annual basis, but the current ecological passport observed during the site visit was prepared in 1992. Thus, some difficulty appears present in satisfying the "annual submission" directive. A new ecological passport document was in the process of preparation during AGRA E&E's March 1994 visit.

Allowable pollutant emissions are based on regulations from the former Soviet Union. New regulatory procedures and limits are currently being formulated by the government.

Existing environmental monitoring appears limited to H_2S concentrations in the air in the production facilities, as well as limited soil monitoring. A contract exists between Mangystaumunaigas and a monitoring service based out of Atyrau to complete environmental monitoring of about nine parameters within the Uzen town limits. These parameters were not identified. An annual report, based on the findings of the contract monitoring service is suppose to be prepared and submitted to NGDU. However, reports from the contract monitoring service for 1992 and 1993 have yet to be submitted.

The Ministry of Ecology and Bioresources recently purchased a Swiss-made mobile laboratory (cost U.S. $400,000). The mobile laboratory is not yet operational, but is intended for air monitoring in the Mangystau Region.

An environmental action plan was prepared in 1993 which included a schedule and directives for action plan implementation. Mr. Erbol Tadjigaliev (Head, Ecology and Environmental Protection Division) is responsible for the plan. The environmental action plan has been submitted for review and approval to Mr. Makhsut Burambaev (Head, NGDU), the Municipal Ecological and Bioresources Group, and the Chief Physician of Uzen.

An outline of the environmental action plan is presented in Table 8.1.

Table 8.1

Environmental Action Plan - Table of Contents

1.0 INFORMATION GATHERING AND TRAINING

- 1.1 Procurement of regulatory documents
- 1.2 Implementation of a training program for NGDU staff in ecological and radiological effects and protection measures
- 1.3 Development of a format for evaluating environmental activities in the field
- 1.4 Implementation of a training program for NGDU staff on environmental issues

2.0 SCIENTIFIC RESEARCH AND DEVELOPMENT

- 2.1 Revision and updating of the ecological passport, including the identification of new pollution sources
- 2.2 Development of draft regulatory measures for maximum permissible emissions and monitoring strategies

3.0 TECHNICAL TASKS

- 3.1 Environmental protection and rational water use
  - 3.1.1 Construction of waste water pit
  - 3.1.2 Replacements of injection station pumps
  - 3.1.3 Repair of oil filtration station separator building at CPF
  - 3.1.4 Recycling of waste water
  - 3.1.5 Water injection manifolds repair
- 3.2 Ambient air protection
  - 3.2.1 Gas compressor station jurisdiction transfer to Gaspromtechmontash
  - 3.2.2 Organize the production of new stuffing boxes and repair faulty stuffing boxes and valves
  - 3.2.3 Investigate and document existing condition of valves on well head-heaters, buffer tanks, sputniks, separators and plan a repair schedule
  - 3.2.4 Investigate manifolds and pipeline networks, develop and approve pipeline ecological passports
  - 3.2.5 Workover of pipelines
  - 3.2.6 Examine air pressure values on large commodity oil tanks
  - 3.2.7 Complete repairs on the 20,000 cubic meter tank
- 3.3 Protection of subsurface resources
  - 3.3.1 Continue clean-up of the 70 ha. waste pit
  - 3.3.2 Replace sucker rod and stuffing box on the producers

Table 8.1 (cont'd)

Environmental Action Plan - Table of Contents

3.3.3 Clean-up well heads and adjacent areas
3.3.4 Clean-up oil spills within the oil field
3.3.5 Continue reclamation works around the well sites, including levelling terrain and picking up debris

3.4 Protection of subsurface resources
3.4.1 Preparation of procedures manual for clean-up of scrap metal, oil spills and radioactive sludge

3.5 Miscellaneous
3.5.1 Re-evaluate using mounds to indicate location of subsurface pipeline
3.5.2 Resolve completion of radiation map by firm "Ecologist"
3.5.3 Implementation of plan containing measures to remediate disposal of radioactive metal and sludge

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PART 9 - ENVIRONMENTAL IMPACTS AND MITIGATIVE MEASURES

9.1 IMPACT ASSESSMENT METHODOLOGY

The main purpose of the following environmental impact assessment (EIA) is to describe any potential impacts to the natural environment that may occur either directly or indirectly as a result of proceeding with the rehabilitation of the Uzen oil field. The environmental assessment follows international environmental assessment guidelines from the Russian Federation, Canada and the World Bank respecting industrial developments. The impact assessment focuses on the more potentially significant environmental impacts associated with the rehabilitation project, rather than examining in detail every possible interaction between the proposed development scenarios and the environment.

For each environmental parameter, potential project impacts have been predicted and evaluated. Impact predictions are defined as those changes from baseline conditions which are a direct or indirect consequence of the project. The baseline biophysical information presented in Section 4.0 was used as a basis for the impact assessment. This information was obtained through literature review (prepared by KazEcology) and by an onsite visit completed in March and April of 1994. Qualitative evaluation has also been included and is based on experience, professional judgement and an assessment of public views. A combination of views has been obtained from both Western and Kazakh oil industry personnel and scientists.

The potential impacts identified and described are those associated with oil field rehabilitation designed, constructed and operated with due care for environmental matters, using current and practical engineering practices. Major upsets and deviations from normal operational conditions have been taken into account in the impact assessment.

Environmental impacts for the proposed rehabilitation strategy were identified by superimposing project elements upon existing conditions and applying standard mitigative measures. Mitigative measures are applied to reduce or eliminate the potential impact. Impacts remaining after standard mitigative measures have been applied are termed residual impacts. The magnitude of the residual impacts are rated as high, medium, low or none, based on the expected affect. Table 9.1 defines magnitude qualifiers as they pertain to wildlife and biophysical components.

Residual impacts are also rated based on scope, direction and duration, as defined below:

Scope defines the population or geographic area that will be affected by the project. This could be a local area or local population, or a regional area or regional population. In some cases, as with impacts to rare or endangered species, impacts could be of a national or international significance. Where possible, quantitative estimates of the surface area affected by an impact will be provided. Terms used—local, regional, national and international.

Table 9.1

Definitions of Magnitude Qualifiers

WILDLIFE AND FISH	
Major	Exists when a regional population or species may be affected such that a decline in abundance and/or a change in distribution beyond which natural recruitment would not likely return that regional population or species to its former level within several generations.
Moderate	Exists when a portion of a regional population may be affected to a sufficient degree to result in a change in abundance and/or distribution over more than one generation, but is unlikely to affect the integrity of any regional population as a whole.
Minor	Exists when a specific group of individuals of a population in a localized area and over a short time period (one generation) may be affected.
Negligible	Exists when the degree of anticipated biological effects are less than minor.
PHYSICAL RESOURCES AND VEGETATION	
Major	Exists when physical or chemical changes (or alterations in vegetation patterns) are expected to be detected beyond 1.0 km of the proposed facilities for more than five years from the onset of disturbance.
Moderate	Exists when physical or chemical changes (or alterations in vegetation patterns) are expected to be detectable within 1.0 km of the proposed facilities for less than five years from the onset of disturbance.
Minor	Exists when physical or chemical changes (or alterations in vegetation patterns) are expected to be detectable only within 0.5 km of the proposed facilities for less than two years from the onset of disturbance.
Negligible	Exists when the degree of anticipated physical or vegetation effects are less than minor.

Direction refers to the direction of the predicted change, described as positive, negative or neutral (no change).

Duration refers to the actual time the resource will be affected by project operations. Duration is rated as short term (less than 2 years during facility construction, well conversions, construction of pipeline); medium term (2 to 6 years during drilling operations); and long term (greater than 6 years during the life of the rehabilitated field).

9.2 ENVIRONMENTAL IMPACTS OF EXISTING FIELD OPERATIONS

9.2.1 Soils

The most apparent impact of past oil field activities on soils is the oil contamination due to leakage at the wellhead, as well as numerous pipeline failures throughout the field. Based on observations made during the site assessment, most of the contamination is likely contained within the upper 15 cm of the soil surface. There are also likely many localized areas throughout the oil field where spills of produced water or brine (injection water) have occurred and resulted in contamination in the form of increased salt content in the surface soils. These spill areas are much more difficult to detect, however their significance is likely minor due to the naturally saline nature of the soils and the relatively rapid infiltration rate in most areas. Subsurface soil contamination from residual drilling muds and cuttings are also likely common in the field since the sump pits are merely drained of fluids prior to backfilling and levelling. Since most of the well sites examined during the site assessment had a substantial amount of disturbance due to various factors immediately surrounding the wellhead, it is difficult to determine the impact of the reclaimed sumps on the surface soil conditions.

Physical disturbance of the surface soil has degraded soil quality in many areas. The most obvious of these impacts is the increased coarse fragment content of the surface material in the mound over most of the buried pipelines within the field, as well as the major transportation pipelines (e.g., water intake pipeline). Less obvious, although likely as serious in terms of the soils capability to sustain vegetation growth, is the increased salinity of the surface soil due to mixing with subsoil after pipeline installation (i.e., trench excavation and backfilling without prior salvage of the less saline surface soil). Removal of vegetation has also left the surface soil susceptible to erosion by wind and water. In some locations, especially along the water pipeline to Aktau, wind erosion has covered vegetation over large areas.

Very localized areas have been impacted by rutting of the surface soils by vehicles. This occurred most often in soils with relatively high clay contents and no attempts had been made to upgrade the road.

9.2.2 Vegetation

Oil field activities have destroyed most of the vegetation within 50 m of each wellhead, as well as in areas where pipeline failures have occurred. Most of the damage to the vegetation has been a result of mechanical surface disturbance by vehicles travelling to individual wellsites from several directions instead of on one maintained access road. The same practices described in Section 9.2.1 have destroyed vegetation in many areas due to degradation of soil quality.

Other large areas where vegetation has been lost include the waste dump, waste pits and facility infrastructure (e.g., central processing facility) areas. Collectively, these areas account for several thousand hectares of vegetation loss.

9.2.3 Surface Waters

There are no known or suspected impacts on surface waters due to the scarcity of surface water in the area. Temporary runoff from infrequent storms is likely retained within the oil field, with minimal movement offsite.

9.2.4 Groundwater

There are no known or expected impacts of existing oil field operations on groundwater in the area. There appears to be little, if any, near-surface groundwater in the area. Water quality of lower aquifers is likely low due to high salinity content, such that the potential impact of contamination from produced water or brine spills is negligible. As well, the limited mobility of the crude oil spilled in the field limits the potential of groundwater contamination due to petroleum products.

9.2.5 Air Quality

Major impacts to air quality within the Novy Uzen area are sulphur dioxide emissions and emissions of benzene from the gas processing facility. Both emissions reportedly exceed occupational standard safety levels. Impacts of oil field operations, other than processing, on air quality in the area are minor. There is no petroleum refinery associated with the field, and produced gas is flared within the field itself. There is some local degradation of air quality due to unvolatized hydrocarbons from spilled oil, both on the soil and in the waste pits.

9.2.6 Wildlife and Fisheries

There is a limited amount of wildlife in the vicinity, due largely to the scarcity of fresh water in the area. Therefore, impacts are considered minor to negligible. It is unknown if oil contamination in the field has had any impact on the rodents noted in the oil field or, consequently, the saker falcons nesting in the area and presumably feeding on the rodents.

There are no freshwater fish-bearing waterbodies within the Uzen oil field itself, therefore impacts are considered negligible.

The relatively large screen size at the intake water facility in Aktau has resulted in the loss of some fish, but the overall impact on the fisheries is likely minor.

9.2.7 Archaeological Resources

It is unknown if there are significant archaeological resources in the area, so that impacts are also unknown.

9.2.8 Land Use

The main land use in the area, apart from petroleum resource extraction, is agricultural, specifically livestock grazing. Removal of vegetation due to oil field activities has had a moderate negative impact on the amount of grazing the area can sustain. This has likely been counteracted to some extent, however, due to the produced water in the field serving as a source of drinking water for the livestock.

9.3 ENVIRONMENTAL PROTECTION MEASURES

9.3.1 Existing Environmental Protection Measures

The Mangystaumunaigas Production Association and its operative unit (Uzenneft NGDU) have attempted to solve some of the environmental problems that currently characterize the Uzen oil field. These initiatives have been implemented for the purposes of regulatory compliance, and to prevent, minimize and mitigate environmental impacts.

9.3.1.1 Environmental Departments

In accordance with the environmental laws of Kazakhstan, a specialized Department of Environmental Protection was created within the Production Association. This department is divided into two main divisions: the Environmental Protection and Occupational Safety division of Mangystaumunaigas in Aktau, and the Ecology and Environmental Protection Division of Uzenneft NGDU. These divisions are responsible for:

- environmental protection and remediation;
- occupational health and safety;
- communications with the Central Ministry regarding environmental issues;
- preparation and submission of the ecological passport;
- preparation of environmental action plans; and
- environmental training.

The following individuals are responsible for environmental matters at the Production Association:

- Bege'ev Makhash Orjanovich, Deputy Chief Engineer, Head of the Environmental Protection and Occupational Safety Division - Mangystaumunaigas, Aktau
- Tazhigaliev Erbol, Head of Ecology and Environmental Protection Division - Uzenneft NGDU, Uzen
- Soyimagambetov Mukhambet, Head of Occupational Health and Safety Division - Uzenneft NGDU, Uzen
- Burkitbayev Anness, Deputy Head of the NGDU Ecology and Environmental Protection Division, Aktau

The divisions are independent branches of the organization at the same level as the technical branches (Figure 8.1). They are characterized by individuals with increasing responsibilities and decreasing administrative support. Additionally, the individuals employed within the divisions do not have any formal training in environmental matters. A lack of funding is also common, and frequently places the divisions in a position of reacting to situations, rather than being proactive and addressing environmental problems prior to them becoming an issue.

9.3.1.2 Environmental Laboratories

An environmental services laboratory was set up in 1986 in response to increasing concerns within and external to the Production Association regarding the state of the environment in the Uzen oil field. This laboratory was set up at that time as an extension of the existing oil and gas lab. The oil and gas lab was primarily involved in work pertaining to calculation of losses and emissions to the environment, and thereby determining the maximum permissible concentrations of pollutants released to the environment in the Uzen oil field.

The setup of the environmental lab in 1986 signified the first step in organizing an environmental group within the Production Association. In 1989, the entire lab was converted to an environmental services lab. The lab is presently operated by KazNIPIneft and is headed by Mr. Gabbosov Utesh. It is involved in monitoring of air and soil parameters within the Uzen oil field. The lab also completes plume dispersion models for the Uzen oil field. These models are mostly theoretical in nature and are based on few onsite measurements. The main deficiencies for the lab are lack of equipment, computers and staff. These deficiencies have resulted in an inability to conduct regular monitoring of the field or complete complicated analyses.

9.3.1.3 Ecological Passport

The ecological passport for the Uzen oil field is basically a set of operational directives for the field that focus on environmental sustainability. Within this passport, all pollution sources are described and quantified. The ecological passport forms the basis of a contract with the Kazakh Ministry of Environmental Protection for industrial land use.

The passport is prepared by KazNIPIneft and sent to the Uzenneft NGDU for implementation in their environmental protection plan. Ecological passports were not previously based on

scientific fact, but rather on theoretical situations. More recently, with the advent of monitoring for the Uzen oil field, scientific data has been incorporated.
Details covered in the ecological passport include:

- general data on the NGDU enterprise (address, etc.);
- climatological data;
- project description, including flow diagrams of processes;
- land use information;
- chemicals, reagents and compounds used on site;
- types of potential air pollutants;
- wastewater disposal and water use;
- solid waste characterization;
- reclamation data;
- environmental implications of the use of vehicles;
- fines for exceeding maximum permissible concentrations; and
- estimates for cleanup operations.

The ecological passport is to be updated on an annual basis. This is the responsibility of the Ecology and Environmental Protection Division of Uzenneft. However, because of budget constraints, the most recent passport for the field is dated 1992.

Periodically, government auditors visit the Uzen oil field for the purpose of reviewing the ecological passport, and to ensure that measures suggested in the passport are conducted in the field. However, with government budget constraints, auditing has declined in the last few years.

9.3.1.4 Environmental Monitoring

Environmental monitoring appears limited to H_2S concentrations in the air surrounding the production facilities. These concentrations are determined through air and soil samples.

Air samples are obtained with the use of absorbents located at a 2-m height above ground. Pollutant concentration levels are determined by colour change in the absorbent.

Soil samples consist of composites taken within a grid pattern and analyed for hydrocarbon content, content of volatile hydrocarbons and radioactivity. All samples are signed off by an NGDU representative. Soil sampling protocols are based on GOST standards and academic-approved procedures.

Monitoring is completed twice per quarter. In 1993, KazNIPIneft completed six scheduled monitoring programs, however payment shortages interfered with the remaining sampling program.

Recently the lab has tried to expand into vegetation and wildlife monitoring, however severe limitations in analytical equipment have prevented this from occurring.

9.3.1.5 Waste Pit Cleanup

Two proposals have been put forth to clean up the 70 and 3500 ha waste pits in the Uzen oil field. The first consists of a pilot program that would utilize waste pit oil as a source of energy for industrial units. These units would be installed around the perimeter of the waste pits and, through means of an elevated temperature and grinding action, remove the oil from the pits, convert it to vapour and use it as a power source to move the unit. This program is a local initiative that has been tried with some success at the nearby Jetebai oil field. The major drawback, as expressed by the Production Association, is that the hydrocarbon is not recovered, but simply removed and used as an energy source for the unit.

The second proposal is to have specialized cleanup and remediation firms remove and recover the oil from the pits, using conventional methods, for a percentage of the value of the recovered hydrocarbon. American Fluids International is one such company that has formed a joint venture with Mangystaumunaigas and has recently submitted a proposal for the cleanup. To date no cleanup of the pits has occurred, however dumping of produced water and hydrocarbon into the pits has ceased except as an emergency measure.

9.3.1.6 Soil Remediation

Soil remediation plans include in situ land farming of contaminated material to bring the hydrocarbon content down to 2% of the volume of the soil. This proposal was put forth by American Fluids International. To date no soil remediation has occurred.

9.3.1.7 Environmental Protection Plans

Environmental protection plans are prepared and carried out by the Ecology and Environmental Protection Division of NGDU Uzenneft. A 1993 copy of the plan was observed during the site visit. A copy of the plan is submitted to the head of the Regional Department of the Production Association - Mr. Makhsut Burambaev. A copy is also forwarded to the Chief Physician in Uzen. Table 8.1 outlines the content of this plan.

9.3.1.8 Environmental Training

As part of the environmental protection plan, a short (20 hour) training course on environmental issues pertinent to the Uzen oil field has been implemented. This course is given to senior management only on a rotational basis.

9.3.1.9 Emergency Response

An emergency response plan was last prepared by NGDU in 1990. The plan was written for field operations and does not include administrative buildings (which only have evacuation plans). Copies of the plan are located at all gathering stations and work shops. The emergency response plan includes instructions for:

- evacuation of employees;
- designation of a central control area;
- work shutdown, fire and other emergencies; and
- notification of appropriate personnel.

The Emergency Response Plan presents, in an easily comprehendible format, a list of possible accidents or incidents. Under each type of accident or incident, specific instructions to be carried out are provided for day time personnel (i.e. operators, foremen, and the head of oil production). Specific instructions are also provided should the accident or incident occur during the night for the operator on duty, the subdivision manager on duty and the individual on duty in the oil and gas production centre.

All emergency services telephone numbers (e.g. fire stations, ambulance and hospital) are listed in the plan, plus a special, direct telephone line to the central dispatch office.

All major fires and well blowouts are the responsibility of a special fire-fighting division of the Russian military (Unit 19). This unit conducts daily training exercises in dealing with emergency fire situation. While new NGDU staff are given initial training in the use of fire-fighting equipment (e.g. fire extinguishers) regular fire-fighting drills are not held.

Emergency response equipment present at practically every gathering station include fire extinguishers, shovels, buckets, and axes. However, there is no regular maintenance program for the fire extinguishers, so that many are reported to be beyond the expiry date. Self-contained air-packs with full-face masks as well as emergency eye-baths and showers are also absent. An emergency lighting system does not exist and there are no paramedics on duty, apparently due to the proximity of the hospital in Uzen. A formal plan for notification of the public of emergencies at NGDU facilities does not exist.

9.3.1.10 Fire Response

Fire response is handled by a specialized group of trained fire fighters that are distinct from the Production Association. This group is highly trained and well equipped. Staff of NGDU Uzenneft are trained in basic fire fighting skills when they are initially hired. However, there are no regular fire drills completed by the Production Association. Fire fighting equipment consists of shovels, buckets and pulaskis, and fire extinguishers. This equipment is maintained at every group gathering station. Many fire extinguishers are beyond the expiry date.

9.3.1.11 Spill Response

The Production Association responds to spills by sending available personnel that are experienced in the specific problem. These people have very little formal training in emergency response and no specialty equipment. A maintenance person is employed to inspect the field on a daily basis and shut off valves in the event of a break. Generally,

however, breaks are so frequent that it is impossible for this individual to address the situation before considerable losses are incurred.

9.3.1.12 Corrosion Minimization

No corrosion protection is currently practiced. The Production Association addresses the problem by patch welds or whole replacement of corroded pipe. In 1970 a pilot desalinization plant was constructed within the Uzen oil field for the purpose of desalinizing the sea water prior to downhole injection. It was hoped that the desalinized sea water would cause fewer corrosion problems. This program was abandoned in 1975. The main reason cited was that the desalinization process did not contribute significantly to less corrosion.

9.3.1.13 Occupational Health and Safety

An occupational health and safety division exists within the Uzenneft operating unit of the Mangistaumunaigas Production Association. This division is headed by Mr. Mukhambet Soyimagambetov and is responsible for occupational health and safety of oil field workers within the Uzen oil field, excluding the gas processing facility. Emergency response plans are completed by the Occupational Health and Safety Division, and retained at all gathering stations and workshops. Further health and safety measures include installation of telephones at all facilities and an emergency "hot line" to central dispatch. Additionally, all downhole equipment servicing crews have radio communication.

First aid training is mandatory for all individuals employed in the Occupational Health and Safety Division. Workers at all group gathering stations are trained by the Occupational Health and Safety Division in first aid. Supervisors are not normally trained in first aid unless they are employed at the group gathering stations. Records of employees that have first aid training are maintained at all group gathering stations. All employees with first aid training are given annual examinations.

Regular group safety meetings are held at the NGDU operating unit of Mangistaumuniagas. The meetings are open to a special commission on health and safety, as well as senior personnel within the Production Association. The purpose of these meetings is to evaluate the most dangerous oil field practices and to discuss with management means to avoid accidents. Also discussed at the meetings are past accidents, including critical reviews of events leading to the accidents. Based on these reviews, the commission has the authority to shut down operations if dangerous practices are not corrected. Records are maintained of individuals who attend these meetings and minutes of the meetings are kept.

Personal protective clothing consists of gloves, hard hats, insulated coveralls for winter work, cotton coveralls for summer work and heavy leather boots. Steel-toed boots are prohibited for fear that they will cause a spark and resultant fire when working around well sites. Welders are supplied with eye protection, and hearing protection is supplied for workers in group gathering stations and at the central processing facility. All clothing is supplied by the

Production Association. Wearing personal protective clothing is enforced through a pay reduction penalty system.

9.3.1.14 Accidents and Record Keeping

All accidents are investigated. Records are kept regarding the specific personnel involved in the accident, the location and nature of the accident and the time lost due to accidents. A summary report of work-related accidents is sent to Mangystaumunaigas each quarter for review. Mangystaumunaigas summarizes there quarterly reports into a six-month report which is sent to Kazakh Munaigas. Kazakh Munaigas passes these reports onto the Ministry of Fuel and Energy Resources.

Since 1981, there have been seven work-related deaths and an average of 3 to 5 serious work-related accidents per year. Accidents caused the loss of 464 worker-days in 1992 and 574 worker-days in 1993. The main causes of accidental injury appear to result from lifting of heavy objects, impacts of heavy objects on feet and ankles, and falls off platforms or down stairs.

9.3.2 Environmental Protection Plan

9.3.2.1 Approach

The Uzen oil field was developed at a time when oil production was much more important to the nation than environmental protection. Indeed, the concept of environmental protection was a novel idea. As a result, the environment within and surrounding the field has been characterized by serious environmental degradation due the following:

- frequent spillage and leakage of sea water, oil and produced fluid from the corroded surface infrastructure;
- contamination near well head areas and near borehole zones due to casing corrosion and low cementing integrity;
- soil contamination and air pollution resulting from the creation of large open oil and produced water pits;
- low-level radioactive contamination (scale) on corroded pipes and production equipment;
- possible groundwater contamination due to casing corrosion;
- damage to native vegetation and wildlife habitat from oil spills and off-road vehicle movements; and
- soil erosion and loss of grazing lands from removal of surface vegetation.

These problems prevail despite the existence of very thorough and complex environmental legislation that has existed since before the field commenced production. There are several possible explanations for the failure of the system.

- The first and foremost reason is attributed to the prevailing attitude within the former Soviet regime of "production at all cost". The Uzen oil field was developed in the mid 1960s when production associations were pressured to meet quotas; hence all resources were thus focused. Few resources (staffing and funding) were channelled to field maintenance or environmental protection.
- Production associations typically did not meet environmental regulations, hence most failed in this regard and were subsequently fined. However, since it was, and still is, common place for industry to pay fines for exceeding pollution levels, these fines were simply regarded as the cost of doing business.
- There was severe underfunding of regulatory and monitoring agencies, and deficiencies in equipment, operating budgets, staff and skills to conduct accurate environmental monitoring of the Uzen oil field. Environmental monitoring programs have, until very recently, been based on conceptual models and theoretical situations. Although these programs are useful in establishing criteria such as plume dispersion models, a detailed audit and assessment needs to be completed for the field that identifies all sources of potential environmental issues. As well, a monitoring plan customized to the field that includes enhancement of current onsite sampling needs to be developed.
- Environmental protection plans and environmental impact assessments have traditionally been based on theoretical situations, and have been prepared after the project has received approval and is already under construction. Additionally, environmental protection plans are so generalized they are basically ineffectual.
- There is a significant lack of baseline data on vegetation, soils, wildlife and groundwater resources specific to the Uzen oil field.
- There is a lack of skilled staff and operating budgets within the existing environmental unit of Uzenneft, as well as a lack of environmental cleanup and spill/emergency response equipment/personnel.
- There has been a historically low level of environmental awareness within the society as a whole and particularly within the production associations.

The approach of the environmental protection plan is simple—remediate existing damages and minimize further environmental degradation. The method wherein this will be accomplished includes training, technology transfer and equipment upgrades. Specifically, the following is recommended:

- Develop a specific environmental monitoring program for the Uzen oil field that is based on sound baseline information and that is routinely conducted.
- Provide a full environmental laboratory, mobile laboratory and corrosion laboratory. Provide training in use of this equipment and analytical techniques.
- Provide a spill prevention program focusing on the minimization of spills. Provide training on the implementation of this program.
- Develop a spill cleanup and emergency response program. The program will consist of provisions for cleanup and emergency response equipment, as well as a comprehensive training program for the use of this equipment. Maintain a core of cleanup specialists to rapidly respond to emergency situations.

- Improve the organizational structure of the existing Uzenneft and Mangystaumunaigas Production Association's environmental management units by hiring local environmental specialists to supplement the existing team. Develop an environmental management and training program for the Production Association that focuses on practical solutions to environmental problems.
- Develop a pilot remediation program (Part 11) that focuses on soil and groundwater remediation, as well as removal of hydrocarbon from surface waterbodies and revegetation as a component of erosion control.
- Provide flare assessment, including the types of flares used, gas composition, pressure flowrate, temperature and requirements for emissions and smokelessness. Implement an auto ignition program.

Environmental Monitoring

The environmental monitoring program, the specifics of which are outlined in Part 13, will be completed by KazNIPIneft in conjunction with KazEcology. Specific parameters monitored will include air quality, soil quality, surface water quality, groundwater quality and revegetation of pipeline rights-of-way. Initially, a training program will be instigated to reinforce current scientific methods and international standards for sampling and parameter analysis. An outside western consultant will be retained on an as-needed basis for one year to provide monitoring training and oversee the program. It is anticipated that staffing within KazNIPIneft will have to be moderately increased with hirings from the Kazakh scientific community. The monitoring plan is expected to continue on a bi-annual basis for the remaining life of the field, following rehabilitation.

Baseline Data Collection

Baseline data collection is required in order to further document the existing baseline conditions of air, soil, vegetation, wildlife, surface and groundwater, and existing land use within the field. Additionally, the baseline data collection will document the extent and type of existing contamination and disturbance throughout the Uzen oil field. This information will be used as the basis for the monitoring program.

Baseline data collection will involve literature review, satellite and/or aerial photography interpretation, a natural resource inventory and contaminant field assessment. The long-term objective of the baseline data collection program will be to provide for data sets that are GIS compatible to facilitate future data handling requirements and to provide for an accurate representation of existing conditions over time. The feasibility of incorporating a GIS database will be evaluated and, if feasible, will be set up at the Mangystaumunaigas headquarters and be used throughout the program.

The following resources will be used during the baseline data assessment:

- existing satellite and aerial photographs;
- existing databases documenting environmental conditions within the Uzen oil field and held at academic research institutes;

- existing databases documenting natural resources and land uses within the Uzen oil field;
- communications with selected authorities at local, regional and national levels; and
- site reconnaissance of the field areas to observe affected areas, obtain samples of typical contamination, determine the cause and nature of impacts, and map the extent of impacts.

All assessment and sampling procedures will follow internationally acceptable standards. The baseline data collection will be completed by western consultants with assistance from local institutes, the Production Association, KazNIPIneft and KazEcology. Specifically, we envision a field team comprised of western consultants; local specialists skilled in soils, vegetation and groundwater assessment, and wildlife identification; representatives from KazNIPIneft; and representatives from the environmental unit of the Production Association and Uzenneft. KazEcology will be involved as an extension service only to obtain and review existing data sets. Representatives from the Production Association and Uzenneft will be involved in order to receive training on methods of environmental assessment. The project will be managed by a western consultant, however results and report preparation will be completed by all parties. A western consultant will be retained for two years to set up the GIS system, train individuals in its use and enter data sets. Specifically, the baseline data collection program will consist of the following tasks:

- inventory of the type and extent of cover of native vegetation within the Uzen oil field and along associated sea water/product transport lines; recommended method used will be Daubenmire classification, which considers species and cover value;
- inventory of the type of soils within the Uzen oil field and along associated sea water/transport lines. Assessment of soil erosion potential, nutrient retention capability and baseline salinity values;
- assessment of wildlife and wildlife habitat within the Uzen oil field and associated sea water/product transport lines;
- assessment of baseline air quality within the Uzen oil field;
- assessment of existing surface water/groundwater quality, mapping of groundwater stratigraphy and determination of groundwater volumes;
- assessment of the types of land use within the Uzen oil field;
- assessment of the extent and type of contamination within Blocks 3 and 3A of the Uzen oil field. This assessment will include surface sampling of contaminated soils in order to characterize the contamination, mapping of facilities and spill areas, and evaluating the extent of contamination, both laterally and horizontally.

Laboratory Analysis, Field Sampling and Monitoring Equipment

Laboratory analysis, field sampling and monitoring equipment will be supplied to the Production Association to augment existing equipment. Provisions for a full analytical laboratory capable of assessing typical oil field parameters will be set up at the existing KazNIPIneft laboratory in Atyrau. In addition, a fully functional mobile field laboratory will be set up at Uzenneft. Typical parameters these labs will analyze for will include the following.

Full analytical laboratory:

- Na, K, dissolved metals;
- BETX, PAHs, TPH;
- total phenols; and
- total phosphates.

Mobile field laboratory:

- chlorides, sulphates;
- nitrates/nitrites;
- salinity;
- coliform;
- bacteria; and
- BETX, TSS, COD, BOD.

As well as the above two labs, a corrosion lab will be set up at Uzenneft. The purpose of this lab will be to evaluate the effectiveness of inhibitors for both bacterial and chemical corrosion. The lab will have the capability to test five to six chemical inhibitors. Additionally, the laboratory will also evaluate the following:

- chemistry of produced water, gas, oil and injected sea water;
- metals composition for pipes, tanks, vessels and any other equipment showing signs of corrosion;
- testing of corroded samples;
- welds analysis;
- soil and surface water analysis; and
- pipeline integrity analysis.

Along with the installation of the lab equipment, an extensive training program will be implemented both at Uzenneft and KazNIPIneft. The focus of the training will be on use of equipment, quality assurance and quality control, analytical procedures, and interpretation of analytical results. The training program will be conducted by western consultants and will last for one year. It is anticipated that two consultants will be retained for the training program to provide instruction on the environmental labs as well as the corrosion lab.

All labs will be supplied with computers for data management. The two environmental labs will also be supplied with drying ovens to remove moisture from samples to uniform levels prior to analyses.

Costs for all laboratory equipment include transport from North America. Equipment will be delivered, set up, made operational and calibrated.

Field sampling equipment will include:

- an all-terrain truck-mounted piston coring unit which is fully equipped for sampling soil, water, soil vapour and gas, and installing monitoring probes; and
- soil augers.

Air sampling equipment will include:

- lead candle sulphation stations;
- meterological stations;
- high volume samples (total suspended particulates); and
- ambient air monitoring trailer.

Groundwater sampling equipment will include:

- peizometers;
- coalescing plates;
- carbon filters;
- bioreactors;
- mobile oil and grease/organics separator unit; and
- pumps.

It is anticipated that buildings and facilities (as well as sample storage space) for the mobile field lab and the corrosion lab will be supplied by the production Association at Uzen, while the full environmental lab will be installed at the existing KazNIPIneft lab in Atyrau.

Spill Prevention Program

A spill prevention program will be implemented, with emphasis on the prevention/minimization of spills. Most spills within the Uzen oil field are a result of corrosion; therefore, the focus of the program will be on corrosion assessment and reduction. The program will evaluate the causes of both internal and external corrosion. This is important because corrosion within the Uzen oil field occurs both internally (from the use of untreated sea water) and externally (from the naturally high salinity of the soil). Three phases are predicted for the corrosion assessment:

1. Preliminary assessment of existing conditions, including sample procurement (samples as specified above under the discussion on the corrosion laboratory). The preliminary assessment will focus on identifying those conditions most likely to result in loss of pipeline/equipment integrity. Prioritization of those areas most in need of corrosion protection will be completed at this time.
2. Laboratory analysis to determine the nature of various fluid media (reservoir fluids, sea water) as well as gas. Analysis of soils and surface waters, welds analysis, testing of corroded samples, pipeline integrity analysis and metals composition.
3. Engineering analysis and reporting.

Corrosion concerns will be discussed with the Production Association through a training and field tour setting. The Production Association will participate in the preliminary assessment and become trained in:

- identifying equipment and materials most susceptible to corrosion;
- operational procedures that promote corrosion;
- proper welding and pipe fitting procedures;
- cathodic protection;
- inhibitor types and quantities, and liners; and
- specifications for materials types and construction.

The preliminary assessment will identify and categorize areas of concern, determine the causes of corrosion and obtain samples from areas most susceptible to corrosion. Lab analyses will be conducted, including any or all of the procedures identified in the section on laboratory analysis, field sampling and monitoring equipment.

Engineering analysis will identify the key causes of corrosion and develop mitigation strategies to reduce future corrosion problems. These strategies will be based on the analytical findings, and will outline the most suitable corrosion protection mechanisms for the Uzen oil field.

A final product of the spill prevention program will be generation of a corrosion protection manual, prepared by the Production Association. This manual will serve as a training manual for all oil field operations personnel. It will outline specific causes of corrosion within the Uzen oil field, particularly as they pertain to operational practices, pipe and equipment handling and storage, and welding and pipefitting techniques.

Spill Cleanup and Emergency Response

Spill cleanup and emergency response pertains mainly to provisions for emergency response equipment and training. A detailed environmental audit of the Uzen oil field will be completed by western consultants skilled in emergency response procedures in order to obtain a complete listing of currently available equipment, as well as to accurately identify equipment needs, and appropriate cleanup and response procedures. Equipment predicted to be most likely required for the Uzen oil field (based on a very preliminary audit completed as a portion of the recent field program for this document) includes:

- a trailer-mounted mobile mud liquids separation unit for cleanup of sump waste and effective recycling of drilling fluids;
- vacuum trucks for soil cleanup;
- tractor-mounted rototillers and manual rototillers;
- fertilizer applicators—both tractor-powered and manual; and
- a mobile aeration and bioagent spraying unit for bioremediation.

Cleanup equipment specifically designed for the removal of hydrocarbons from waterbodies (such as skimmers, booms and boats) will be needed only as required to recover free product

from the two waste pits within the field. No naturally occurring waterbodies exist within or close to the Uzen oil field.

As part of the cleanup and spill response program, a team of skilled cleanup specialists will be retained by the Mangystaumunaigas Production Association in coordination with other local production associations. This team will provide rapid response to spill situations and will be hired locally. They will be trained by North American spill response experts. Training will involve the proper use and maintenance of spill response equipment, in addition to spill response procedures. A manual and associated training will be developed to outline appropriate responses to releases on terrain and waterways.

We envision the spill response team to consist of five to six representatives from each of the local production associations, and that they will be recruited from existing oil field workers. It is anticipated that this team will carry out their normal job functions until required to respond to an emergency. It is suggested that several backup personnel from the production associations also be trained in spill response so that, in the event of an emergency, a full complement of specialists are available to respond.

Environmental Management and Training

The existing environmental management unit (Department of Ecology and Environmental Protection) within Mangystaumunaigas and Uzenneft is characterized by employees with a low level of environmental awareness and very little formal training in environmental issues. Although the employees voiced concern about the environmental situation in Uzen, a lack of funding, coupled with a lack of knowledge of the environment in general and sound oil field practices specifically, prohibits affirmative action.

Environmental procedures are currently governed by the submission of an ecological passport (Sections 8.2.4 and 9.3.1.3). Although this passport is intended to be updated and submitted annually for regulatory approval, lack of staffing has meant that the current ecological passport is now two years old. Additionally, an environmental action plan has been prepared by the NGDU Department of Ecology and Environmental Protection, however this plan is very generalized and relates only basic information concerning equipment/facility repairs.

In order to generate effective environmental management, the organizational structure of the existing Department of Ecology and Environmental Protection needs to be improved. Improvements will consist of the following.

- Hire local environmental scientists, familiar with the Uzen oil field, to train and head up the existing environment department. Positions will be required in both Aktau and Uzen. Ideally, the candidates for this position will have practical environmental experience with oil field activities.
- Define and document the environmental policy of the Production Association.
- Define and document the responsibility, authority and management structure of key personnel who will be responsible for environmental matters.

- Identify environmental, and health and safety standards for the Production Association. Provide incentives for consistent achievement or exceedance of these standards.
- Appoint several environmental inspectors whose responsibility is ensuring that the requirements of the standard are implemented and maintained.
- Provide environmental awareness training for all employees, emphasizing the importance of sound oil field practices and how these practices relate to the environment.
- Retain the most current legislative requirements on file. Appoint someone to keep track of regulatory changes.
- Conduct internal audits to review the effectiveness of organizational structure, administrative and operational procedures, record and report completions, and environmental performance.
- Periodically conduct environmental management reviews to ensure the environmental management system satisfies the requirements of the standard.

The most important tool to ensure the above initiatives are followed is the creation of an environmental management plan for the Production Association. Part 12 outlines a conceptual environmental management plan, which includes a spill contingency plan that describes the basic or generic environmental protection procedures for the rehabilitation of the Uzen oil field. This document is intended to be a stand-alone document for use by field construction personnel and environmental inspectors. It specifically outlines environmental protection procedures to be completed during construction and operations.

It will also be important to prepare a broader environmental management plan that deals with the following components:

- environmental clean-up and spill response;
- training and technology for recovery of hydrocarbon from groundwater, soil bioremediation, corrosion prevention and low-emission flares (experimental programs);
- training in laboratory analytical procedures, field sampling and monitoring;
- environmental baseline study; and
- training in contaminant assessment.

This latter environmental management plan should be developed by the environmental department of the Production Association and the NGDU, with the assistance of a team of international specialists. There are two main objectives of this plan:

- to improve the equipment and operating procedures of the Production Association; and
- improve the level of environmental awareness of the employees.

Each of the components of the broad environmental management plan will be implemented by a team consisting of a team leader, an assistant and approximately seven technical

experts. The experimental programs will be short in duration, headed initially by a western consultant and later by Production Association and NGDU personnel. The purpose of the experimental programs is to allow for technology transfer and training in the development of solutions to some of the more common environmental problems within the Uzen oil field. Team leaders will maintain frequent communications, and cross-training in the form of presentations and seminars will occur.

Training Manuals

Environmental management plans are best implemented through the use of training manuals. Manuals are essential for developing standardized approaches and methodologies. All manuals will be written by the Production Association and the NGDU, with assistance from specialized western contractors. The manuals will be developed to incorporate current regulations at the federal, regional and local levels. We envision the manuals to cover the following topics:

- operational practices, including facility construction, pipeline construction, waste disposal, drilling, workovers, chemical storage and containment, preventative maintenance, spill prevention, and contingency planning and response;
- quality assessment and control manuals for laboratory use, and for equipment and installations; and
- a health and safety manual covering hazard assessment and communication, accident reporting, safety data sheets, warning labels, WHMIS sheets, and procurement, use and maintenance of personal protective clothing.

Pilot Remediation Program

The pilot remediation program will focus mainly on soil remediation since soil contamination is of the greatest environmental concern within the Uzen oil field. Soil remediation techniques are outlined in detail in Part 11. However, the remediation program will also focus on:

- groundwater remediation;
- collection of oils from waterbodies; and
- revegetation.

The pilot remediation program will be the full responsibility of the Production Association. This includes procurement of services, equipment, supplies, monitoring and reporting. The Production Association will, however, be assisted by North American specialists skilled in oil field remediation techniques. The specialists will assist in training and program implementation, as well as conducting periodic quality control and acting as advisors.

The following describes the general objectives of each of the above components of the remediation program, as well as detailing the type of equipment required. Costs for equipment are included in the overall pilot remediation costs outlined in Section 9.3.2.2.

Soils: The objective of the pilot bioremediation program for soils pertains to assessing the effectiveness of existing bioremediation technologies for application in Western Kazakhstan. The study will evaluate in situ and onsite bioremediation options for treating soils affected by

crude oil spills and will focus on: native soil characteristics, indigenous bacteria types, nutrients, treatment times, mixing and aeration, and temperature. As well, assessments will be made of the most practical and effectual fertilizer type and method of fertilizer application. Required equipment includes:

- **tractor-mounted rototiller** for in situ incorporation of free product with surface soil horizons; this will assist in the breakdown of the hydrocarbon by soil microorganisms; required for large spill areas where manual incorporation is not practical;
- **manual rototiller** for small spill areas such as in front of the well heads;
- **back-hoe** for excavating onsite landfill and removal of contaminated soil;
- **gravel trucks** for hauling contaminated soil; and
- **graders** for spreading contaminated soil as an asphalt base on the road.

Generally, in situ land farming or other onsite remediation will require much less equipment than ex situ methods which also require treatment of the contaminated material prior to deposition. Ex-situ methods (landspread and treatment at a central facility) may require additional equipment such as a mobile all-terrain truck-mounted piston coring unit for the installation of piezometers.

Groundwater: Contamination of groundwater is not a major issue in the Uzen oil field. Generally, aquifers are at sufficient depths to be unaffected by surface contamination, and they are too saline to be potable. However, groundwater may become affected by loss of downhole casing integrity.

There are several acceptable methods for remediation of groundwater. The method that will be ultimately used to remediate groundwaters in the Uzen oil field will depend on three main criteria:

- type of contamination;
- degree and extent of contamination; and
- volume of water within the aquifer.

It is anticipated that much of this information will become available during the baseline data survey. The list of field equipment outlined in on page 9-16 is applicable for an extraction and treament process, which is one of the more common methods for treating groundwater. In this process, wells are drilled at strategic locations to maximize penetration of the aquifer, and pumps are installed. Water is pumped into a simple mobile oil-and-grease separator. The water is then percolated through a system of coalescing plates and carbon filters, and reinjected into the aquifer. The reinjected water is potable, free from contamination and salts. This is a very effective but costly system; the expense may not be warranted if the aquifer is naturally saline.

Alternate methods include using a bioreactor consisting of a tank of bacteria to digest the hydrocarbon. A simpler method involves only the rudimentary removal of oil and grease, with

subsequent reinjection. This method is suitable for long molecular chain hydrocarbons which are "heavy" and do not mix well with water.

Revegetation: Vegetation trials will be established, However, since natural revegetation is the most desirable for the Uzen oil field, it is anticipated that these trials will be focused only on the establishment of species suitable for cover crop and erosion control. As a component of the revegetation trial, different types of fertilizers will be applied to determine the most effective composition for the encouragement of natural revegetation. Required equipment includes:

- **tractor and fertilizer applicator** (for large areas);
- **manual cyclone spreader** (for small areas);
- **helicopter** (under lease arrangement) for pipeline rights-of-way; and
- **water truck.**

Flare Assessment

Although flaring is only a procedure used within the Uzen oil field as a pressure release mechanism during emergencies, the installation of automatic ignition devices on flare stacks is an important environmental consideration in order to reduce the release of potentially harmful emissions. Currently, flares in the Uzen oil field are manually lit. In the length of time it takes for someone to light the flares, a considerable amount of harmful emissions may be released.

Since there are several different types of ignition devices, it is important to determine the most effective ones for the Uzen oil field. Therefore, a flare assessment program will be initiated. This program will be conducted by the Production Association and by Uzenneft NGDU personnel. The purpose of the assessment is to determine specifications for new flares in order to improve combustion and reduce emissions.

The flare assessment will evaluate the existing flaring system used by the Production Association, including the types, design and amount of equipment. Data will be obtained for the evaluation of suitable replacement flares. This data includes:

- flow rate, pressure and gas temperature;
- type of flare: stack, burner, assistance, smoke control or pilot;
- availability of electricity and compressed air;
- auxiliary equipment;
- weather: wind speeds, temperature extremes and thermal inversions;
- noise restrictions;
- preferences of the Production Association and practicality of the equipment; and
- regulatory requirements for flaring systems, emissions and smokelessness.

9.3.2.2 Equipment and Manpower Costs

The environmental protection portion of the proposed rehabilitation project is estimated to cost US $ 5 520 350. A generalized breakdown of the cost estimate is provided in Table 9.2.

A list of lab equipment required for the project is provided in Table 9.3. Specific cost estimates for the full environmental laboratory and air sampling equipment are provided in Tables 9.4 and 9.5.

All cost estimates include the following:

- technical assistance;
- training;
- equipment;
- materials;
- services;
- document translation;
- program management;
- labour; and
- expenses.

Costs also include estimates for Kazakh/Russian labour, materials and use of some Kazakh equipment to complete the project.

9.3.2.3 Milestone Activities

The proposed activities of the environmental protection plan will take two years to complete (Figure 9-1). It is anticipated that the project will be implemented from March 1995 to February 1997. Due to seasonal restrictions, the field work components of the program (i.e., baseline data collection, monitoring program, pilot remediation program) will be completed during the months of May through October 1995 and 1996. Other aspects of the program will continue throughout the two-year schedule. Some of the activities will occur concurrently.

9.3.2.4 Overall Project Responsibility

The Mangistaumunaigas Production Association is responsible for the full implementation of the proposed environmental protection plan, including procurement of services, equipment and supplies, and monitoring and reporting. Assistance will be given to the Production Association by international consultants, acadamia, management and project team members.

Table 9.2

Cost Summary
(US$,000)

Environmental Clean-up and Spill Response Equipment and Training	**$ 1 500**
Laboratory Equipment and Training	
Full Service Environmental Laboratory	$ 600
Mobile Laboratory	40
Corrosion Laboratory	300
Field Testing Equipment	250
Total Laboratory Costs	**$ 1 190**
Monitoring	
Monitoring Program (including baseline data collection)	$ 300
GIS Installation and Training	500
Spill Prevention Program	300
Total Spill Prevention and Monitoring	**$ 1 100**
Pilot Remediation Program	
Soil Remediation	$ 200
Groundwater Remediation	400
Revegetation	250
Flare Assessment	400
Total Remediation Program	**$ 1 250**
General Program Costs	
Environmental Management and Training	$ 200
Program Management	170
Translation of Documents	800
Total	**$ 450**
Total Project Cost	**$ 5 490**

Table 9.3

Lab Equipment

Analytical Parameter	Primary Equipment	Secondary Equipment
BTEX Total Volatile Hydrocarbons (TVH)	Flame inonization detector Photo ionization detector Gas chromatograph (GC)	Column Standards Crimper Volumetric flasks Pressure regulator Air Hydrogen Nitrogen Tools Headspace sampler Reference materials Vials Pipettes Balance Diskettes Computer paper Water dispenser Methanol Syringes Refrigerator
Petroleum Aromatic Hydrocarbons (PAH)	Gas chromatograph/ mass spectrometer GC columns Volumetric flasks	Standards Tools Pipettes Balance Diskettes Computer paper Water dispenser Methanol Syringes Sonicator or soxhlet extractor Separatory funnel Disposable pipette Pressure regulator Reference materials Refrigerator Chemicals Funnels Test tubes Centrifuge Filter paper Water baths Evaporator Concentrators

Table 9.3 (con't)

Lab Equipment

Analytical Parameter	Primary Equipment	Secondary Equipment
Total Petroleum Hydrocarbon (TPH) by GC	Gas chromatograph	Standards GC columns Standards Tools Pipettes Balance Diskettes Computer paper Water dispenser Methanol Sonicator or soxhlet extractor Separatory funnel Disposal pipette Columns Volumetric flasks Pressure regulator Reference materials Refrigerator Chemicals Funnels Test tubes Centrifuge Filter paper Water baths Evaporator Concentrators Distillation apparatus or ion-exchange
Total Petroleum Hydrocarbon (TPH) by Infrared Spectrometry	Infrared Analyzer	Standards Square bottles Funnels Freon Volumetric flasks Shakers Balances

Table 9.4

Environmental Laboratory Equipment Cost Estimate

Item	Use	Cost
Autoclave	Sterilize glassware	$6 000
Pour and spreadplate counter		1 200
Balance	Top loading 2000 g	2 000
Balance	Analytical 310 g	4 000
Balance table		1 500
Calibration weights	Class s or ASTM class 1	900
B.O.D. bottles	Case of 24	300
Beakers, weighing boats, bottles, burrets, flasks, brushes, test tubes, separatory funnels, condensers, graduated cylinders, evaporative concentrators, thimbles, filter paper, volumetric flasks, round bottom flasks, funnels, separatory funnels, glasses (safety), pippets, safety kit, etc.		20 000
Centrifuge		2 000
Chemical Oxygen Demand		1 200
Ultrasonic Cleaner		700
Conductivity Meter with Cell		1 200
Desiccating Cabinet		800
Rotary Evaporators		4 000
Extraction Apparatus (Soxhlet)	Each	300
Extraction Rack for Soxhlet	6 positions	3 000
Oil/grease Extraction	6 positions	8 000
Filtration Apparatus	Each	300
Heating Mantles	Each	300
Hot Plate/Stirrer		500
Oven	Forced air	1 500
Dissolved Oxygen Meter	YSI	2 000
DO Meter Probe for B.O.D.		400
pH Meter/ISE		3 000
Dispensette		200
Autodilutor		4 000

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Table 9.4 (con't)

Environmental Laboratory Equipment Cost Estimate

Item	Use	Cost
Pump, Vacuum		1 000
Refrigerator	Small for Standards	2 000
B.O.D. Incubator		4 500
Refrigerator	Large	2 000
Solvent Storage Cabinet		1 500
Wrist Shaker		1 500
Vortex Mixer		400
Type 1 Water Generator		5 000
Columns for GC	Each	500
Gas Cylinder Regulators	each	500
Gas Purifier		700
Hydrogen Generator	If gas cylinders not available	7 000
Nitrogen Generator	If gas cylinders not available	9 000
Zero Air Generator	If gas cylinders not available	1 500
Total Cost		$106 400

Table 9.5

Instrument Cost Estimate

Item	Use	Cost
Environmental Lab		
UV/VIS Spectrophotometer	Phenols/phosphates/colimetric measurements	$15 000
GC/Headspace with PID/FID & Data System	BTEX & total volatile hydrocarbons	48 000
AA/Hydride System (automated)	PAH, PCB, organochlorides	95 000
ICP (automated)	Metal scan	110 000
TPH by IR		8 000
GC with FID	Total semi-volatile hydrocarbons	35 000
Ion chromatograph (automated)	Chloride, sulphate, nitrate, nitries in water	40 000
Van equipped with power/benches		72 000
Shipping		10 000
Total Environmental Lab		$433 000
Air Monitoring Equipment		
Meteorological station	Gather meterological data	$ 9 000
Total sulphation stations	SO_2 monitoring (IO stations)	3 350
High volume samples	Analysis of total suspended particulates	18 000
Total Air Monitoring Equipment		$ 30 350
TOTAL INSTRUMENT COST		**$463 350**

Note: Estimates can vary ±15%, depending upon supplier.

9.3.3 Mitigative Strategies for the Proposed Rehabilitation Program

The following section outlines specific mitigative strategies for the protection of: soils, vegetation, surface water, groundwater, marine and coastal resources, air quality, terrestrial wildlife, archaeological resources, and land use. These strategies will be implemented during the construction and operation component of the program.

9.3.3.1 Soils

Construction

Erosion of surficial materials is one of the major potential impacts of the proposed rehabilitation strategy (Table 9.6). Soils in the region are particularly susceptible to exposure due to the characteristically fragile and intermittent vegetative cover. Once exposed, high winds tend to transport surface soil particulates great distances from the source, often creating "dust bowl" type scenarios that restrict visibility, affect air quality and result in soil drifting. The exposed underlying soil stratum is very saline, hence very slow to revegetate. The ultimate result may be desertification and resultant net loss of land use.

Exposure of surface soils will occur during installation of new flowlines, transfer lines, water distribution lines and high pressure water injection lines. Soils will also be exposed during installation of group separators and test separators, construction of water injection stations, and during construction of the new sea water injection line or during upgrades to the existing sea water injection line. Surface soils may be exposed as a result of several activities such as clearing for right-of-ways, off-road vehicle travel, construction of facility pads, pipeline ditching, grading and backfilling.

Clearing will be restricted to the minimum area required for facility construction and operation. The duration of exposure time for the soils will be minimized by encouraging, as much as possible natural revegetation processes. This will be accomplished by ensuring that the relatively unsaline topsoil is stockpiled and replaced, and that levelling and recountouring occurs. Details on recommended soil handling procedures are provided in the environmental management plan (Section 12.0). Special erosion control measures will be applied on steep slopes.

Off-road vehicle and machinery movements have the potential to disturb the surface, resulting in the exposure of sediments to erosion. Soils within the Uzen oil field are particularly susceptible due to the lack of natural vegetation cover, coupled with the inability of the soil to rapidly revegetate due to climatic and nutrient constraints. Presently, within the field, off-road vehicle travel has resulted in substantial losses of vegetative cover and wind erosion of surface soils.

Table 9.6

Potential Impacts of the Proposed Rehabilitation Project on Soils

Development Activity	Potential Impacts	Mitigative Measures	Residual Impacts (Mag/Dir/Dur/Scope)[1]
CONSTRUCTION			
Clearing	• Removal/loss of productive surface soils • Exposure of saline unproductive subsurface soil • Wind erosion of surface sediments • Enhancement of desertification	• Minimize clearing to that immediately required for facility installation • Encourage natural revegetation through stockpiling and replacement of surface soils, and recontouring	Minor/Neg/Short/Local
Off-road travel	• Loss of vegetative cover, causing erosion of surface soils • Enhancement of desertification	• Restrict travel to existing access roads and trails	Negl/Neg/Long/Local
Road and facility pads	• Drainage interruption, resulting in flooding, channelization and erosion	• Road location to minimize interference with drainageways and culverts/ditches to maintain drainage system	Negl/Neg/Long/Local
Pipeline ditching, grading and backfilling	• Exposure of highly saline subsurface soils • Wind erosion	• Stockpile and replacement of surface soils • Contouring of pipeline right-of-way • Erosion control measures	Minor/Neg/Short/Local
Drilling	• Sump breach, resulting in soil contamination • Inappropriate disposal of sump fluids	• Berms with minimum 1 m freeboard constructed around sumps • Recycling of sump fluids	Negl/Neg/Medium/Local
OPERATIONS			

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Table 9.6 (con't)

Potential Impacts of the Proposed Rehabilitation Project on Soils

Development Activity	Potential Impacts	Mitigative Measures	Residual Impacts (Mag/Dir/Dur/Scope)[1]
Hydrocarbon and treated water spills	• Soil contamination	• Employee emergency response training and awareness programs • Development and implementation of spill contingency and emergency response plans • Berms constructed around wellheads and bulk storage areas • Monitoring of tanks and valves	Minor/Neg/Long/Local
Pipeline failure	• Soil contamination	• Pipeline and right-of-way conditions monitored remotely and by ground inspection • Installment of emergency shut-down valves • Implementation of a spill contingency plan • Corrosion protection measures implemented for pipeline • Check and block valves installed at tie-in points to the gathering station	Minor/Neg/Long/Local

[1] Mag = Magnitude; Dir = Direction; Dur = Duration; Scope = Scope

Access roads will be provided to all major facilities. Vehicle and machinery traffic will be restricted to the access roads. In-field personnel will be instructed on the importance of using roads whenever possible as opposed to taking short-cuts across terrain. In some instances, where access roads do not exist (i.e., wellsites), vehicles will confine themselves to main trails only and will refrain from creating additional new trails. These trails will be maintained (metal and other debris removed as required, ruts repaired) to ensure no impediments to vehicle access.

Road and facility pad construction may result in drainage interruption which leads to ponding of water, and channelization and erosion in the surrounding terrain. Although the region in the vicinity of the Uzen oil field receives little precipitation on a yearly basis, seasonal snow melt and occasional rainstorms have the potential to result in overland flow.

Any new roads and facility pads will be constructed with due consideration given to local drainage patterns. Drainage and erosion control measures, including culverts, berms and diversion ditches, will be used as necessary to minimize ponding and channelization.

Pipeline ditching, grading and backfilling may potentially result in the exposure of subsurface soils that are very difficult to revegetate due to their extremely high salinity content. In locations where several pipelines share the same corridor, the net result may be a loss of vegetative cover over the width of the corridor, with subsequent wind erosion and transport of surface sediments.

Careful stockpiling and replacement of surface soils will ensure that an appropriate growing medium is available for the re-establishment of native vegetation. Pipelines will be level with the surrounding terrain to encourage natural invasion and moisture retention. Wind erosion will be minimized through control measures on slopes leading to both the Uzen Depression and to the Tun Karakshi Depression, as well as the slope leading to the Caspian Sea along the proposed Uzen-Kazakh Bay route. Details regarding top soil salvage and handling, and erosion control measures will be further highlighted in the Environmental Management Section (Section 12.0).

Drilling may result in soil contamination through inappropriate means of sump fluid disposal or through sump breaches. Berms with minimum 1 m freeboard will be constructed around sumps. All sump fluids will be recycled.

Operation

Hydrocarbon, produced water and treated sea water injection spills may occur, resulting in soil contamination. Of these, hydrocarbon and treated sea water injection spills will likely have the most impact on vegetation and soils. Produced water is typically saline, and in that respect will likely not significantly impact the already naturally saline soils.

Hydrocarbons within the Uzen oil field are typically highly paraffinic with a pour point of 30°C. Spills observed within the region tend to solidify and remain concentrated within a localized area. This feature, although assisting in reducing penetration of the spill into

subsurface horizons (a 20-year old spill was observed to penetrate to a depth of only 12 cm) is also instrumental in retarding degradation of the spills. The 20-year old spill was comprised of completely intact slabs of paraffin with no vegetation establishment.

Treated sea water may contain a number of chemical additives (e.g., chlorine, various amines, Quaternary ammonium, imidazolines, chlorinated phenols, aldehydes and peroxygens). Several of these additives are potentially contaminating, and may result in a loss of vegetation establishment and exposure of surface sediments.

Hydrocarbon or treated sea water spills at facilities will result in soil contamination with subsequent impacts to vegetation. Bulk storage areas will be protected by dykes. Chemicals used in the treatment of sea water will be retained in a building on an impermeable surface. Contingency plans for spills will be developed and employees will be trained in their implementation. Emergency response equipment will be maintained at all group gathering stations and at the central processing facility. Since many of the spills are related to breaks of the stuffing box at wellheads, a small berm will be constructed around production wellheads to contain the oil. All test and group separators will be equipped with flow measuring and control equipment. Areas affected by spills will be remediated.

Pipeline breaks could potentially release hydrocarbons or treated sea water to the terrain, resulting in soil contamination that could persist for several years. Pipelines will be designed and operated to the highest standards. Pipelines will be buried and coated externally with PE. The pipe proposed will be steel pipe ASTM-A-106 Grade B or APL-5L with 3 mm corrosion allowance. Check valves and block valves will be installed at tie-in points to the gathering station. All flow lines will be hydrotested. During operations, the pipeline and right-of-way will be remotely monitored and periodically ground-inspected. A spill contingency plan will be developed and implemented.

9.3.3.2 Vegetation

Construction

The vegetative cover within the Mangystau Region is very fragile and intermittent. Plants are typically saline-tolerant species which are slow growing and very well adapted to severe moisture deficits, very hot summers and very cold winters. As in other arid areas of the world, these plants play a major role in preventing desertification. Loss of the vegetative cover would result in wind erosion of the semi-productive surface soils and exposure of the extremely saline, non-productive subsurface soils. As this region is dependent to a large extent on the native vegetation as a source of fodder for grazing animals, the loss of vegetation would also result in dramatic implications for local land use.

Construction activities could potentially result in the loss of vegetation (Table 9.7). However, if these activities are conducted in an environmentally responsible manner, the loss of vegetation communities can be minimized and revegetation can be encouraged.

Table 9.7

Potential Impacts of the Proposed Rehabilitation Project on Vegetation

Development Activity	Potential Impacts	Mitigative Measures	Residual Impacts (Mag/Dir/Dur/Scope)[1]
CONSTRUCTION			
Clearing	• Removal of surface vegetation • Wind erosion • Enhancement of desertification	• Clearing minimized to that immediately required for facility construction and operation • Replacement and recontouring of surface soils • Prevention of wind erosion • Fertilization to encourage revegetation on lands not immediately required for facilities	Minor/Neg/Long/Local
Pipeline ditching, grading and backfilling	• Removal of vegetation on the right-of-way • Drainage to vegetation adjacent to the right-of-way as a result of wind erosion of sediments	• Stockpile and replacement of surface soils to provide adequate growing medium • Level pipelines with surrounding terrain to encourage invasion of native species • Initial fertilization of pipelines • Use of snow fences or cover crops to reduce erosion in wind-prone areas and on steep slopes	Negl/Neg/Long/Local
Vehicle use	• Loss of vegetation due to off-road vehicle use • Loss of vegetation from fuel spills	• Restrict travel to existing roads and trails • Discourage fuelling of vehicles in the field • Vehicles fuelled on pavement or gravel surfaces	Minor/Neg/Long/Local

Table 9.7 (con't)

Potential Impacts of the Proposed Rehabilitation Project on Vegetation

Development Activity	Potential Impacts	Mitigative Measures	Residual Impacts (Mag/Dir/Dur/Scope)[1]
Vehicle use	• Loss of vegetation due to off-road vehicle use • Loss of vegetation from fuel spills	• Restrict travel to existing roads and trails • Discourage fuelling of vehicles in the field • Vehicles fuelled on pavement or gravel surfaces	Minor/Neg/Long/Local
Drilling	• Sump breach resulting in flooding/smothering of vegetation • Inappropriate disposal of sump fluids	• Berms with minimum 1 m freeboard constructed around sumps • Recycling of sump fluids	Negl/Neg/Medium/Local
OPERATIONS			
Sulphur dioxide	• Acid gases and dust could injure adjacent vegetation	• Minimize gas flaring in the field	Negl/Neg/Long/Local
Hydrocarbon and treated water spills	• Accidental spills of hydrocarbons or produced water could kill adjacent vegetation	• Bulk storage areas protected by dykes • Chemicals stored on impermeable surface in secure building • Spill contingency and emergency response plans • Emergency response equipment maintained at group gathering stations and the central processing facility • Berms around wellheads • Monitoring of tanks and valves	Minor/Neg/Long/Local

Table 9.7 (con't)

Potential Impacts of the Proposed Rehabilitation Project on Vegetation

Development Activity	Potential Impacts	Mitigative Measures	Residual Impacts (Mag/Dir/Dur/Scope)[1]
Pipeline failure	• Loss of vegetation	• Pipelines externally coated for corrosion protection • Implementation of spill contingency plan • Installation of emergency shut-down valves • Check and block valves installed at tie-in points to the gathering station • Pipeline and right-of-way remotely monitored and periodically ground-inspected	Minor/Neg/Long/Local

[1] Mag = Magnitude; Dir = Direction; Dur = Duration; Scope = Scope

Clearing will be restricted to the minimum area required for facility construction and operation. Clearing operations will include the careful removal and stockpiling of surface soils. After facility installation is completed, natural revegetation processes will be encouraged by replacing and recontouring surface soils, preventing wind erosion (installation of snow fences), and initial fertilization. In areas prone to erosion, such as slopes, a cover crop may have to be seeded to prevent soil erosion while native vegetation is again becoming established. Seeding to non-native species is not recommended for three reasons:

1. Potential for invasion of initially aggressive non-native species with long-term lower survivability into an essentially all-native environment could result in a future net loss of vegetative cover.
2. Non-native species tend to be lower in nutrients than native species.
3. Non-native species generally require more intensive management (i.e., continued applications of fertilizer and water). Neither of these commodities may be readily available.

Pipeline ditching, grading and backfilling will result in the removal of vegetation along the right-of-way, and may potentially result in damage to vegetation adjacent to the right-of-way by wind erosion of sediments off the right-of-way. In locations where several pipelines share the same corridor, the net result may be a loss of vegetative cover over the width of the corridor.

Careful stockpiling and replacement of surface soils will ensure that an appropriate growing medium is available for the re-establishment of native vegetation. Buried pipelines will be level with the surrounding terrain to encourage natural invasion and prevent surface run-off. Right-of-ways will be fertilized initially to encourage more rapid revegetation. Fertilizer applications should be timed to coordinate with the period of greatest annual precipitation. On steep slopes or other areas prone to erosion, snow fences or cover crops may have to be established until native vegetation has an opportunity to invade. Where cover crops are used, temporary fencing may be necessary to keep local livestock off the reclaimed surface.

Vehicle use including off-road travel and fuel spills may result in damage to vegetation. Access roads will be provided to all major facilities within the Uzen oil field, and in-field personnel will be instructed on the importance of using these roads. Main trails will be used to access facilities where a proper access road has not been provided. Random across-terrain vehicle movements will be discouraged. Vehicles will be fuelled on pavement or gravel surfaces whenever feasible. Fuelling of vehicles in the field, except in cases where logistics prohibit an alternative, will be discouraged. A spill contingency plan will be implemented that considers accidental spills of hydrocarbons due to fuelling procedures.

Drilling may result in the death of vegetation through flooding and smothering in the event of a sump breach. Berms with minimum 1 m freeboard will be constructed around all sumps. All sump fluids will be recycled.

Operations

Sulphur dioxide, hydrocarbon, produced water and treated sea water injection spills may occur and directly or indirectly kill vegetation (Table 9.7). Of these parameters, sulphur dioxide is of least concern and has a negligible impact on vegetation due to the minor amount of emissions that occur within the field.

Produced water affects vegetation either directly by surface contact or indirectly by increasing soil salinity levels. However, the effect is also likely to be minimal due to the fact that plants within the region are naturally very saline-tolerant.

The greatest impact to vegetation—both directly through surface contact or indirectly through soil contamination—will occur through spills of hydrocarbon or treated sea water.

Sulphur dioxide emissions currently exceed the "General Sanitary-Hygienic Requirements for Occupational Air" (GOST 12.1005-88). The majority of sulphur dioxide emissions occur from the Uzen gas processing facility. Flaring of gas is only done for emergency purposes at the central processing facility. All vegetation has been mechanically removed within the enclosure of the central processing facility.

The rehabilitation plan for the Uzen oil field does not call for any changes to the gas treatment process or the gas processing facility. Gas flaring at the central processing facility has had a negligible effect on vegetation. Mitigative strategies include the installation of knockout drums and automatic ignition devices on all flare stacks.

Hydrocarbon and treated sea water spills could kill vegetation directly on contact or indirectly through soil contamination. Bulk storage areas will be protected by dykes. Chemicals used for treatment of sea water will be retained in a building on an impermeable surface. Contingency plans for spills will be developed and employees will be trained in their implementation. Emergency response equipment will be maintained at all group gathering stations and at the central processing facility. Since many of the spills are related to breaks of the stuffing box at wellheads, a small berm will be constructed around production wellheads to contain the oil. All test and group separators will be equipped with flow measuring and control equipment. Areas affected by spills will be remediated.

Pipeline breaks could release hydrocarbons or treated sea water. If soils were contaminated and no attempts at remediation were made, the damage could affect vegetation establishment for several years. Due to the viscosity of the oil, spills of hydrocarbons tend to form hardened slabs of paraffin which are very resilient to degradation and prohibit vegetation establishment. Similarly, spills of treated sea water containing complex chemical additives for down-hole control of bacteria could result in death of existing vegetation and impediments to future vegetation establishment.

Pipelines will be designed and operated to the highest standards. Pipelines will be buried and coated externally with PE. The pipe proposed will be steel pipe ASTM-A-106 Grade B or APL-5L with 3 mm corrosion allowance. Check valves and block valves will be installed at

tie-in points to the gathering station. All flow lines will be hydrotested. During operations, the pipeline and right-of-way will be remotely monitored and periodically ground-inspected. A spill contingency plan will be developed and implemented.

9.3.3.3 Surface Waters

No naturally occurring fresh water sources occur within the study area, therefore the impact of proposed rehabilitation project on surface water resources is negligible.

9.3.3.4 Groundwater

Water-bearing strata exist at a variety of depths in the Uzen Region in deposits laid down during the Jurassic, Cretaceous, Tertiary and Quaternary periods of geological history. The majority of the water-bearing strata in the region are characterized by high salinities. Water from these formations is generally used for industrial purposes and for cattle watering. Fresh water (salinity ranging from 0.2 to 0.5 g/l) is located in the Baskuduk and Sausken sand masses within the upper Holocene and Upper Quaternary deposits. The Baskuduk and Sausken sand masses represent a reliable source of drinking water to the local population.

Potable groundwater does not exist in the Uzen oil field. Salinity levels within the field preclude its use for human consumption. However, wells in the vicinity of the field provide a source of industrial water and water for livestock. It is unknown at this time if the fresh water formations at Baskuduk and Sausken are linked in any way to the formations underlying the Uzen oil field. For these reasons, it is necessary to ensure that contamination of subsurface aquifers does not occur.

Surface construction activities associated with the rehabilitation of the Uzen oil field will likely have little impact on groundwater resources. Similarly, hydrocarbon spills during operations will not affect groundwater due to the tendency for the oil to solidify and thus remain only on surficial soils. However, subsurface remediation measures (drilling of additional wells, well conversions, and operations (injection of produced water, injection of make-up sea water) may have implications for subsurface groundwater resources (Table 9.8).

Construction

Production drilling and well conversions have the potential to impact the local groundwater regime. Drilling fluids and muds can be at higher pressures in the well bore than fluid pressures in the surrounding formations, which could potentially result in movement of these fluids into surrounding formations through defective casing.

Mitigation measures will include the installation of protective surface casings below the depth of groundwater sensitivity. In addition, dry holes will be properly abandoned and grouted to ensure that no man-made pathways for fluid migration could contaminate protected aquifer zones. Proper design and installation of tubing on both production and injection wells, as well as monitoring of annular fluid pressures to detect casing leaks, will also be implemented. Similarly, formation pressures should be monitored to prevent overpressuring that could cause hydraulic fracturing and possibly local microseismic activity.

Table 9.8

Potential Impacts of the Proposed Rehabilitation Project on Groundwater Resources

Development Activity	Potential Impacts	Mitigative Measures	Residual Impacts (Mag/Dir/Dur/Scope)[1]
CONSTRUCTION			
Production drilling and well conversions	• Contamination of groundwater by drilling fluids and muds	• Installation of protective surface casings below the depth of groundwater sensitivity • Dry holes grouted • Monitoring of annular fluid and formation pressures	Negl/Neg/Long/Local
OPERATIONS			
Injection of produced waters and make-up sea water	• Contamination of groundwater through surface spills and pipeline failures, and by ruptures/leaks in downhole injecting tubing and casing	• Establish groundwater protection zones and installation of well casings	Negl/Neg/Long/Local

[1] Mag = Magnitude; Dir = Direction; Dur = Duration; Scope = Scope

Operations

Produced waters and make-up sea water which have brine and other chemical components will be injected into the producing zones to maintain formation pressure. The potential exists for this procedure to contaminate groundwater through surface spills and leaks of pipelines and storage tanks/handling facilities, as well as by ruptures or leaks of downhole injection tubing and casing. The potential impact will be minimized by establishing groundwater protection zones and installing proper well casings.

9.3.3.5 Marine and Coastal Resources

Marine resources—including coastal and marine flora and fauna, and coastal aesthetics—may be impacted by construction and operations activities associated with the new water intake facility at Kazakh Bay, or if the present facilities at Aktau are used by implementation of sea water treatment (Table 9.9). The new water intake facility will be located in proximity to the existing recreational center of Fetisovo. The facility will consist of three identical pumps powered by electricity and housed in a block building. A power line to the proposed facility will be run from nearby Fetisovo. The pumps may draw water from an artificial reservoir constructed and screened from the bay. Additionally, a water treatment facility will be constructed which may include a lagoon system. The water treatment facility may be a substantial plant that utilizes fairly potent chemicals. If the Aktau option is considered, a similar water treatment facility will be installed at this location.

Construction

Construction impacts relate primarily to disturbance of flora and fauna along the shoreline, sedimentation of Kazakh Bay, and disturbance to the recreational opportunities in the area. The proposed facility site at Kazakh Bay will be located to minimize impacts to the environment. Construction will occur during the off-season for recreational activity in the area. The facility will be located far enough away from Fetisovo that visual and sound impacts will be minimized. The proposed site will be located away from potential fisheries spawning sites, and on a gravel shoreline that is not readily erosive. Impacts related to wildlife pertain primarily to sensory disturbance to raptor species located on nearby escarpments. To minimize this disturbance, construction will not proceed during critical nesting times. Impacts on vegetation communities are expected to be temporary during the construction phase. Those portions of the facility site disturbed during construction will be recontoured and fertilized to encourage revegetation. The use of machinery within Kazakh Bay will be minimized to prevent sedimentation. Powerline extension from Fetisovo to the proposed facility is expected to have minimum impact—that primarily related to the removal of vegetation at support structures.

Operations

Spills from chemicals used during the water treatment process or fluids from the treatment lagoons may result in contamination of the shoreline and nearby Kazakh Bay waters or waters in the vicinity of Aktau. Sea water intake pumps may trap fish.

Table 9.9

Potential Impacts of the Proposed Rehabilitation Project on Marine and Coastal Resources

Development Activity	Potential Impacts	Mitigative Measures	Residual Impacts (Mag/Dir/Dur/Scope)[1]
CONSTRUCTION			
Water intake facility	• Disturbance to flora and fauna along shoreline/fisheries • Disturbance to recreational opportunities in the area	• Construction to occur during off-season for recreation • Proposed site located away from potential fisheries habitat • Recontouring and fertilizing of disturbed terrain not immediately required for facilities • Restrictions on use of machinery in Kazakh Bay	Minor/Neg/Long/Local
OPERATIONS			
Chemical treatment of sea water	• Contamination of shoreline and Kazakh Bay waters • Fish trapped by intake pumps	• Chemicals stored in building on an impermeable surface • Emergency response equipment retained onsite • Emergency response and spill contingency plan implemented for the facility • Lagoons located away from periodic and seasonal high tides • Screens used on water intakes	Negl/Neg/Long/Local

[1] Mag = Magnitude; Dir = Direction; Dur = Duration; Scope = Scope

Chemicals will be stored in a building on an impermeable surface. The building will be bermed on the outside to prevent leakage to the environment in the event of a spill. Emergency response equipment will be provided at the site. An emergency response plan and spill contingency plan will be prepared for the facility. Employees will be trained in emergency procedures and on the proper, safe use and handling of the chemicals. All lagoons will be located away from periodic and seasonal high tides, and will be bermed with a minimum 1 m freeboard. Screens with small mesh size will be used on all water intakes to prevent drawing in of fish.

9.3.3.6 Air Quality

Construction

Machinery used for construction activities will produce noise and small amounts of unburned hydrocarbons, nitrogen oxides, sulphur dioxide, carbon monoxide, water vapour and suspended particulates (Table 9.10). Standard mufflers on vehicles will reduce noise. Emissions will only last for the construction period, and will have a negligible effect on the air quality of the area.

Operations

Dust from vehicle movements will be minimized through the use of asphalt surfaces on roads constructed to all major facilities. Of necessity due to the rough terrain, speeds will be kept low when accessing facilities which do not have a proper access road, hence dust levels will be minimal.

Flare Emissions: Flaring will not be completed in the field and will only be done in emergencies at the central processing facility. Liquid hydrocarbons will be trapped in a knock-out drum and will not be burned in the flare. Impacts due to emissions of SO_2 are anticipated to be minimal. Installation of automatic ignition devices will ensure spontaneous combustion of harmful emissions.

Noise: The only portion of the rehabilitation project which will result in increases in noise levels during operations pertains to the installation of the new water intake facility at Kazakh Bay. Noise generated from the sea water intake pumps will be reduced by insulating the housing block. Noise impacts from this facility are expected to be moderate.

Odours: Leaks of hydrocarbon vapours from wellsites and group gathering stations are expected to be minimal. Liquid hydrocarbon storage tanks at the central processing facility will emit some vapours. These tanks will be equipped with vapour recovery units to reduce the quantity of emitted vapour. Other hydrocarbons, such as compressor oil and engine oils, will be handled in a careful manner, and used products will be stored in barrels and sold by blending with a crude oil product. The impact of odours is expected to be local and is assessed as negligible.

Table 9.10

Potential Impacts of the Proposed Rehabilitation Project on Air Quality

Development Activity	Potential Impacts	Mitigative Measures	Residual Impacts (Mag/Dir/Dur/Scope)[1]
CONSTRUCTION			
Facility construction, pipeline installation	• Noise • Emissions of small amounts of unburned hydrocarbons, nitrogen oxides, sulphur dioxide, carbon monoxide, water vapour and suspended particulates	• Use of mufflers on vehicles	Negl/Neg/Short/Local
OPERATIONS			
Dust	• Injury to vegetation adjacent to roadways • Reduction in overall air quality	• Use of asphalt surfaces on roads • Restrictions on vehicle speed	Negl/Neg/Long/Local
Noise	• Increased noise near water intake facility at Kazakh Bay	• Insulation of housing block	Mod/Neg/Long/Local
Odours	• Increased hydrocarbon odours near central processing facility and test separators/group gathering stations, wellsites	• Tanks at central processing facility equipped with vapour recovery units • Careful handling of liquid hydrocarbons to minimize spills • Employees trained on spill prevention and control • Fluid monitoring alarms and automatic shut-off valves	Negl/Neg/Long/Local
Emissions release	• Uncontrolled release of SO_2 and NOx; incomplete combustion and release of hydrocarbons	• Installation of knock-out drums and automatic ignition devices	Neg/Neg/Long/Regional

[1] Mag = Magnitude; Dir = Direction; Dur = Duration; Scope = Scope

9.3.3.7 Terrestrial Wildlife

Impacts to wildlife from the development of industrial facilities generally fall into one of five categories. These categories, and subsequent impacts on species groups, are presented below. The five major categories are:

1. Habitat alteration/change in forage base - either as a loss or gain.
2. Sensory disturbance - human presence, noise and visual.
3. Blockage of movements - traditional movement corridors.
4. Increased access - associated with increased hunting and trapping.
5. Direct mortality/reduced reproductive fitness - ingestion of toxic substances, vehicle/wildlife collisions, opportunistic killing and harassment by workers, and disposal of nuisance animals.

Table 9.11 outlines the specific impacts and mitigative strategies for the protection of wildlife.

The Uzen oil field has been in production for the last 20 years. Wildlife in the field is minimal as a result of migrations from the area that occurred long ago. Wildlife that remains is well adapted to the disturbances of an operating oil field. In fact some species, such as the red-tailed mouse, have adapted to living with anthropogenic disturbances. It is therefore anticipated that the rehabilitation strategy for the field itself will have minimal impact on existing wildlife.

The majority of impacts to wildlife are anticipated with the construction and operations of the proposed water intake facility at Kazakh Bay and the construction of the 70 km water intake pipeline from Kazakh Bay to Uzen. Industrial development is presently minimal at the proposed facility site and along the pipeline route.

The ensuing discussion presents a summary of the potential impacts of the rehabilitation project on terrestrial wildlife and mitigative measures to address these impacts. Potential impacts for coastal species were presented in Section 9.3.5.

Habitat Alterations

Small Mammals: The development of new facilities will result in some initial habitat loss, especially for small mammals, as a result of habitat alteration. Habitats will be altered by clearing to accommodate facilities and for right-of-way preparation. However, facility clearing will not be substantial, nor will any unique or critical habitat be removed. Clearing to accommodate the water transport pipeline will be temporary, and efforts will be made to encourage revegetation of the pipeline.

Table 9.11

Potential Impacts of the Proposed Rehabilitation Project on Terrestrial Wildlife

Development Activity	Potential Impacts	Mitigative Measures	Residual Impacts (Mag/Dir/Dur/Scope)[1]
CONSTRUCTION			
Clearing	• Animal disturbance, causing temporary displacement and energy loss • Habitat alteration and some loss at sites for permanent facilities'	• Schedule to avoid critical period from late winter to spring	Minor/Neg/Short/Local
Pipeline, ditching, grading and backfilling	• Direct mortality of small mammals and birds • Direct mortality of mammals due to entrapment in open trench • Barrier to movement by strung pipe and open ditch	• Limit clearing to right-of-way • Use soft ditch plugs and backfill trench as soon as possible • Openings in pipe string, soft ditch plugs, backfill as soon as possible	Minor/Neg/Short/Local Negl/Neg/Short/Local
OPERATIONS			
Pipeline breaks	• Hydrocarbons or produced water spills could damage habitat • Loss of nesting sites for ground nesting birds	• Pipeline monitoring, emergency shut-off valves, spill contingency plans, reclamation	Minor/Neg/Long/Local

[1] Mag = Magnitude; Dir = Direction; Dur = Duration; Scope = Scope

Carnivores will likely adapt easily to construction activities as they are highly mobile and readily adapt to a number of prey species, depending on their relative availability. Only very sensitive species will abandon the area in the vicinity of the proposed water intake facility. Therefore, the impact of habitat alteration will be minor. This impact will likely manifest itself in the form of temporary avoidance of specific areas of high disturbance, and temporary abandonment of travel corridors in response to a reduction in the forage base. However, with reinvasion of prey populations after reclamation, it is expected that they will return to these traditionally utilized areas.

Ungulates: Impacts to ungulates in the short term will be expressed as a temporary avoidance of specific areas of high disturbance in response to a reduction in forage base and sensory disturbance. In the medium to long term, herbaceous and shrub communities will redevelop through revegetation efforts and natural succession.

Sensory Disturbance

Small Mammals: The impact of sensory disturbance due to construction and operational activities to small mammals is considered negligible in the area of the oil field development, at Kazakh Bay and along the proposed 70 km pipeline route. Small mammals are generally tolerant if secure habitats are readily available.

Carnivores: In many respects, the animals in this area have already adapted to sensory disturbance associated with oil field operations. Those that were not able to adapt simply moved out of the offending region. For species that are territorial, year-round residents—particularly small furbearers—the impact of sensory disturbance will be minor. The most critical period for these species is late winter to early summer.

Ungulates are generally considered to be relatively tolerant to human activities. However, within the majority of the existing field there has been so much activity resulting in a complete loss of the existing forage base, as well as overwhelming sensory disturbance, that no ungulates are expected to reside within the field proper. Ungulate habitat remains at Kazakh Bay and along the proposed pipeline route. At these sites, sensory disturbance is not expected to result in significant stress or distributional changes to these animals. The critical seasons for ungulates are in the fall and during calving in the spring.

Birds: The impact of sensory disturbance to birds will be minor. The impact will be greatest for raptor species with territories located along escarpments of the Uzen Depression and along the Kazakh Bay coast. These birds are particularly sensitive to disturbance during spring nesting times. The impact may result in temporary displacement to less suitable habitats during the construction phase of the rehabilitation project.

Blockage of Movements

Blockage of traditional animal movement corridors is not expected to be a major issue of the rehabilitation project. There will be no above ground facilities that cannot be easily walked around. All pipelines will be buried and levelled with the surrounding terrain. Blockage of

animals is expected, therefore, to occur only during the construction phase of the project, when pipeline trenches will be left open. Mitigation for blockage of animal movements will include breaks in spoil piles and pipeline string. Additionally, the effects of delays in backfilling will be minimized by utilizing soft ditch plugs.

Small Mammals: Considering the relatively small home range size and travel distance of most small mammals, the impact of blockage of movements will be minor for this species group. The greatest impediment to small mammal movement will be open pipeline trenches, which are generally impassable to small mammals and which constitute a hazard.

Carnivores: The impact of blockage of movements on carnivores will be minor, and will occur only during the construction phase when pipeline trenches are open. As with small mammals, most carnivores have relatively small home range sizes and will not be affected by the further development of this oil field. The exception to this is the jackal, which have traditional movement corridors and will adjust their travel patterns if these routes are temporarily altered.

Ungulates: The impact of blockage of movements on ungulates will be minor, and will only occur during the construction phase when pipeline trenches are left open.

Birds: This impact is not considered relevant to bird species.

Increased Access

The nature and extent of the existing oil field activities has already had an impact on increased access into the region and, subsequently, on wildlife. Additionally, there presently exists an all-weather access road that parallels the proposed pipeline route from Fetisovo to Uzen, and a trail exists along the coast of the Kazakh Bay. Therefore, no additional new access will result from the rehabilitation, and the project is expected to have a negligible effect on access.

Direct Mortality

Direct mortality of wildlife may occur from vehicle-wildlife collisions, removal of nuisance animals, ingestion of toxic materials, shooting, harassment and falling into open trenches. These impacts can be minimized or avoided through the implementation of several different control mechanisms. Specifically, these controls may include:

- restricted road speed limits;
- proper disposal of waste;
- control of accidental releases of toxic materials;
- storage of toxic materials in safe, inaccessible locations;
- restrictions on the possession of firearms and dogs onsite; and
- restrictions on the duration that pipeline trenches are left open.

With implementation of these control measures, the impact of direct mortality on wildlife will be minor.

9.3.3.8 Archaeological Resources

Few archaeological investigations have been completed for the study area to date. Future investigations are planned by the Institute of Archaeology and History of Kazakhstan. Until these investigations are completed, it is difficult to assess the potential impacts of the proposed rehabilitation project on the archaeological resource.

9.3.3.9 Land Use

Land use within the Uzen oil field and surrounding area consists primarily of livestock grazing (camels, sheep, horses and occasionally cattle). Since the rehabilitation project will not involve any expansion of the existing operations, the impact on local land use will be negligible. The project may actually increase land use values by promoting the establishment of vegetation on pipeline right-of-ways that were formerly unvegetated, and by reducing the amount of off-road vehicle travel.

An initial loss of grazing lands will occur during the construction of the proposed 70 km water intake pipeline from Uzen to Kazakh Bay. However, this loss will only occur during the construction phase. Reclamation following construction will ensure that the pipeline is revegetated. Impacts to land use as a result of the construction of this pipeline will be negligible.

PART 10 - SOCIO-ECONOMIC IMPACTS AND MITIGATIVE MEASURES

10.1 INTRODUCTION

The primary impacts of a given project on the human environment are usually related to changes in the size and composition of the population in response to development. Both short-term (exploration, construction) and long-term project activities (production, drilling, operations) may lead to changes in the demographics of a region which, in turn, may result in economic and social impacts. An increase in jobs in a given region often means people must move into the area to take advantage of job opportunities. The in-migration of workers and their families creates a cycle of growth, which can lead to an increase in the demand for a broad range of public and private services.

The rate and relative magnitude of these changes determines whether they are, on balance, positive or negative. However, even very rapid and large-scale population change can be managed with timely implementation of appropriate benefit enhancement and impact mitigation measures.

Phase I of the Uzen Field Rehabilitation Project is not anticipated to create rapid change in the existing infrastructure. Presently, there are declines in the existing industry and resultant unemployment. It is anticipated that there are sufficient numbers of unemployed that may be called upon to handled the bulk of the manpower requirements. However, there is a shortage of skilled labour from previous out-migrations, therefore importations of skilled labour may be required. These importations will not likely be great enough to cause a strain on the existing infrastructure.

Progression of the rehabilitation project beyond Phase I to rehabilitation of the remaining blocks in the field will likely result in regional changes to the economy. The nature of the remaining rehabilitation (i.e., involvement of a western investor) and the scale of the project dictate that both Western and Eastern European oil field workers will be imported. However, impacts to the existing social structure are seen to be more than offset by the benefits accrued, including a bolstered economy/standard of living and technology transfer.

10.2 KEY ISSUES

An issue-specific approach has been taken to assess the effects, and propose suitable mitigation strategies, for the Phase I rehabilitation project. This approach is consistent with current socio-economic impact assessment practice. The relevant issues have been identified through baseline research, consultations with local and regional officials, and a technical analysis of the rehabilitation strategies.

There are three levels of socio-economic impacts from the rehabilitation project. The first level is interaction of the project with the government regulatory regime. Effects at this level

deal with government legislation, policies and projects. Issues such as taxation, *royalties and* regulatory compliance are addressed. These impacts will be felt at the local, regional and national levels, but the primary management decisions will likely be made in consultation with officials in Uzen, Aktau and Almaty.

The second level of assessment involves the interaction between the project and the local human environment. Key issues include land use, environmental protection, employment, training and the socio-cultural impact. Socio-economic impacts at this level will be most significant for the population of Novy Uzen, and surrounding communities such as the Kyzyl Uzen state farm.

Finally, there will be some regional socio-economic impacts associated with the current material and personnel supply system already in place and servicing regional oil development. The Uzen project will, of necessity, involve logistical support from, and delivery of products through, the established oil industry complex. Impacts at this level will be mainly related to the direct and indirect economic benefits arising from employment and contracting with the regional oil field service and supply industry.

10.3 EMPLOYMENT AND TRAINING

10.3.1 Employment and Training

The major issue identified through the consultation process is the current rapid decline in oil production in the Uzen oil field as a result of the deterioration of production facilities and worsening operational practices. In addition, the outflow of skilled personnel and insufficiently qualified replacements has resulted in an inadequately trained supply of labourers.

The past years of economic hardship, resulting from political and economic restructuring, has led to the destruction of a previously stable centralized finance, supply and product distribution system which was utilized by the oil production enterprises. These enterprises, which are now self-financed, faced a vicious cycle in which the lack of financial resources prevented the upgrading of deteriorating production capacities and effective training. This, in turn, caused a further decline in production and revenue. Caught in this "loop", the production enterprises were forced to cut back on the quality of training of the work force. Additional workers had to be hired to compensate for the lack of skilled personnel.

Table 10.1 shows a 9 and 31% increase in employment since 1989 for Mangystaumunaigas and Uzenneft NGDU, respectively. The number of newly employed people was almost always greater than those laid off in the same time periods. However, during the same five-year time period, production declined by some 20%, and this decline is accelerating. This clearly indicates the current reduction of labour productivity. This evidence is supported by the 1989 employment numbers for Mangystaumunaigas as a whole and Uzenneft in particular: 74 and 61% increases in the 1989 levels for Mangystaumunaigas and Uzenneft, respectively.

Table 10.1

Dynamics of Composition of the Labour Force at Magnystaumunaigas (MMG) and Uzenneft (UN) 1989 - 1994

Year	Company	Total	Hired	Laid Off
1989	MMG	23 955	6 877	6 663
	UN	2 619	839	861
1990	MMG	24 169	6 415	5 819
	UN	2 879	796	697
1991	MMG	24 765	5 085	5 675
	UN	2 669	1 056	705
1992	MMG	22 528	N/A	N/A
	UN	—	—	—
1993[1]	MMG	26 076	536	494
	UN	3 636	127	54
1994[2]	MMG	26 081	526	490
	UN	3 428	156	50

[1] January 1
[2] February 1

If productivity in 1989 is taken as a measuring target, there is currently an excess of employment of some 26% and 39% over the level justified by the present production output. The results of these simple calculations may also reflect a decline in the individual productivity of workers, which may also be a result of poor training.

Official Mangystaumunaigas figures reflecting the composition of labour force by type of formal education (Table 10.1) are hard to interpret because of deficiencies in some years and inconsistencies in the accounting system for the labour force. They show a rather stable proportion of employees with higher secondary and technical education. This does not, however, reflect the quality of training of operators in the field, which is reportedly low.

The information above suggests that the primary human resource management objective will be to upgrade the quality of the existing work force rather than the creation of new positions. Therefore, the creation of new positions is of secondary importance. However, enhanced job opportunities as a result of project implementation cannot be underestimated because of the indirect and induced effects.

10.3.2 Employment Opportunities

The Uzen Field Rehabilitation Project will result in an increase in regional and local employment, and training opportunities in the short- and long-term. Employment and training opportunities will be created during the initial phase of the project, financed by the World Bank, and during the implementation of the second stage of the project which involves a large-scale investment project. Employment positions will be created both directly, during development and operation of the project, and indirectly through subcontracts.

The policy objective in staffing these positions should be to give preference to qualified members of the local population of the Mangystau Region. However, the work force could be supplemented with foreign experts, as required, to introduce new technology and to achieve project management objectives that maximize the benefits to all parties. These objectives are summarized in Section 15.0 - Socio-Economic Action Plans.

Presently, in other parts of the CIS, local workers employed by enterprises involving foreign investments are receiving higher than average wages, as well as other fringe benefits such as better working conditions, and health and safety plans. This above-average compensation is justified by the higher performance, quality and productivity requirements of the positions.

The management objectives of the project emphasize this aspect as it is considered to be an important factor in keeping and attracting qualified regional and local labourers. Regional and national trends indicate a loss of qualified personnel to trade, commerce and other higher-paying activities or to other economically "stable" regions.

Not enough is known about the local and regional economy to estimate the total number of jobs to be created by the project. However, indirect jobs will be created by purchases of goods and services for the project. Purchases of goods and services supplemented by increased spending by employees will, in turn, create additional employment. This is known

as the induced effect of a project. The total employment created by the initial investment in this project will, therefore, be some multiple of the direct employment opportunities created.

The rehabilitation project will maximize the use of local capabilities in the implementation of advanced techniques and operation practices which are environmentally sound and cost-effective. Drilling, workover and production operations will be executed in a manner that enables technology transfer and management training for local personnel. With local skill development as a high priority, the potential benefits include increased productivity and the transfer of skills to other local and regional enterprises. In fact, it is this management/ technology transfer (as opposed to resupply of equipment/hardware) that will likely generate the most significant long-term project benefits. This notion is supported by those who were interviewed during the public consultation project. These individuals felt that poor management has contributed greatly to the present decline in overall production and labour productivity in the Uzen oil field.

The limited quantitative data and information gathered from various sources suggests that there is an under-utilized local labour force from which the project can draw on. Some training in operationally-correct oil field practices may have to be implemented, and limited importation of skilled workers may be required. However, the project will serve to enhance local and regional employment benefits.

10.4 ECONOMIC ISSUES

In addition to the benefit of skill and knowledge transference mentioned above, substantial purchases will be made throughout the project. During all phases of project development, the objective of the Benefit Enhancement Policy will be to maximize the purchase of local/Kazakhstan goods and services and to give first preference to enterprises in the Mangystau Region on contract work. This will be subject to their ability to perform quality work at a competitive price.

It has been identified, through the consultation project, that the present "mismatch" of existing services and products with local demand is largely a result of the move towards privatization. A paradoxical situation, described as a crisis of "over-production against over-demand" has developed—while certain goods and services are available, high production costs have resulted in high selling prices and consequently the inability of local consumers to afford the products. High prices have virtually eliminated the demand for their products.

A good example of this is the Kyzyl Uzen state farm. The farm currently faces an "over-production" of camel products. Earlier, a state plan, through which the farm sold the camel fur to a factory in Actubinsk, was in existence. Today the farm must do its own marketing and selling of its products. However, potential buyers refuse to buy the fur at the price required to make production economical. As a result, 12 tonnes of camel fur has accumulated.

Privatization of the state farm provides an excellent opportunity to develop a local cottage industry. Potential industries include the sale of camel fur and carpets, and milk and meat production. This would not only provide farmers with additional revenue, but would also create employment for women who are almost entirely excluded from income-generated activities. A precondition for this type of development is an increase in income for local consumers so they can afford to buy the products. An increase in income may occur with implementation of the rehabilitation project.

If a water pipeline is built in later stages of the project implementation, the village of Butakoz may be capable of providing the labour necessary for its construction and maintenance. Again, skilled workers such as welders may have to be imported from other regions of the CIS.

The project's oil field service and supply requirements may largely be met through the existing regional oil field service centers of Aktau and Uzen. This is because of the established industrial capacity of the area and the fact that they have rail connections and roads to the field and other regions. Thus the oil field servicing and transportation facilities that are currently in decline will be enhanced by implementation of the project.

Other benefits of the rehabilitation project are exemplified by the existing private enterprise, "Ecology". This firm is presently engaged in collecting and disposing of radioactive-contaminated oil field waste and scrap metal. Since the goal of the project is the establishment of safe and environmentally sound operational practices and a clean working environment, it is expected that this enterprise will benefit from the rehabilitation project.

10.5 GOVERNMENT REVENUES

As owners of the resource to be developed, the citizens of Kazakhstan and the Mangystau Oblast, through their governments, will receive direct financial benefits as a result of the Uzen oil field project. Substantial taxation and royalty revenues will be realized over the economic life of the project, although the fiscal terms of the rehabilitation project have not yet been finalized. A significant portion of these payments will flow into regional and local budgets.

Increases in regional revenues will be particularly important to rural residents, especially the Kazakhs. Their most common concern with previous oil development is the "withdrawal" of resources for the benefit of "outside" interests and the destruction of livestock grazing land with no substantial local benefit or compensation. The sources with whom the assessment team consulted reported that the rural communities are badly in need of infrastructure. There is growing mobilization of local opinion and lobbying support from outside sources to convince local and state administrations to use the proceeds of oil and gas development to address rural problems.

10.6 ENVIRONMENTAL PROTECTION

Regional residents are concerned about the possibility of large-scale and long-term damage to the natural resources of the region. This concern is attributed to past experience with oil development activities. Environmental concerns have been expressed at two levels. First, there exists the national and regional concern of government environmental control organizations engaged in the preservation of natural resources. These include the Ministry of Bioresources and its regional and local committees, and Hunting, Fishery and Mining (Gasgortachnadzor) Inspections (Appendix E). Second, there is a local concern on the part of area residents who depend on these same resources for their livelihood.

The issues of primary concern named by government environmental control organizations include oil spills and radioactive contamination caused by mismanagement, obsolete technologies, and worn-out equipment and production facilities.

Another specific concern in this arid area is the possible contamination of drinking water. Currently there are two main sources of clean drinking water, the Tuesu and Sausken Springs. The springs are located sufficiently far away from the Uzen oil field that contamination is unlikely. Furthermore, if the field is developed in an environmentally conscious manner, the likelihood of contamination is negligible.

Concern was also expressed by the Mangystau Hunting and Fishery Inspectorate. They felt that the increase in private automobiles and guns, purchased as a result of an increase in local income, may lead to an increase in poaching on nearby protected natural habitats. Currently the level of poaching is very low. This is a valid concern which should be addressed during project implementation.

The probable construction of an injection water intake pipeline from the Kazakh Bay may have a minor impact on the migration routes of valuable and endangered hoofed animals, such an saiga and jairan (goitred gazelle). Since no new roads or railways will be constructed and the pipeline will be completely buried, potential impacts will likely only occur during the construction phase. This impact may be reduced to negligible by timing construction to avoid critical migratory periods.

10.7 LAND USE ISSUES

The primary land use issue pertains to the development of the proposed water intake pipeline from Uzen to Fetisovo. Lands along this route are currently used for livestock grazing. Concerns pertain to a net loss of land use due to the installation and operation of this pipeline.

An initial loss of grazing lands will occur during the construction of the proposed 70 km water intake pipeline from Uzen to Kazakh Bay. However, this loss will only occur during the construction phase. Reclamation following construction will ensure that the pipeline is revegetated. Impacts to land use as a result of the construction of this pipeline will be negligible.

10.8 SOCIO-CULTURAL ISSUES

As outlined previously, the implementation of Phase I of the Uzen project is not expected to result in substantial numbers of new employees establishing residence in Novy Uzen or other local communities. There will not likely be significant additional demand for local infrastructure such as housing, schools, medical services, etc. Basic labour requirements may be met from the existing under-utilized local labour force, supplemented by bringing in limited numbers of skilled workers from other points in the CIS and Eastern Europe. As a result, there will likely be limited potential for negative socio-cultural impacts.

10.9 IMPACTS TO EXISTING RECREATIONAL OPPORTUNITIES

The village of Fetisovo on Kazakh Bay is the prime summer recreation location for NGDU employees. Recreational activities are primarily water-based and consist of swimming, boating, sun-bathing and recreational fishing. There is limited infrastructure, apart from small shelters providing overnight accommodations. Up to 1000 people use the facilities on a daily basis from May to October.

Concerns relating to the rehabilitation project pertain to the construction and operation of the proposed water intake plant. The location best suited for the new intake facility is approximately 1 km west of the resort facilities. This distance should be sufficient to reduce aesthetic and noise impacts. Noise levels will be further reduced by housing pumps in an insulated building.

Construction of the facility should occur during the off-season to avoid impacts related to construction activities.

PART 11 - REMEDIATION OF EXISTING DISTURBANCES

11.1 PILOT REMEDIATION PROJECT - BLOCKS 3 AND 3A

11.1.1 Introduction

The environmental site assessment identified and described environmental liabilities within the study area. Contamination observed at assessed wellsites was generally attributable to the following types of spills:

- spills resulting from workovers;
- spills occurring during drilling activities;
- spills from leaks in pump jacks; and
- spills associated with flowlines.

The liabilities identified from the assessment of ten wellsites within Blocks 3 and 3A are summarized in Table 11.1. The assessment indicated that oil-contaminated soils are the primary concern and remediation efforts should be directed towards soil remediation. No drill pits were observed during the site assessment.

Table 11.1

Well Site Liabilities

Well	Oil-Stained Soil (m^2)	Free Product (m^2)	Estimated Volume of Contaminated Soil ($m/^3$)
3242	300	0	45
4083	1050	25	160
4082 (injector well)	30	120	17
4021	1500	5	225
3615 (injector well)	0	6	1
3613	15	3	3
3447	850	100	138
234	600	375	128
2120	3000	60	456
4094	50	125	20

11.1.2 Objectives

In general, the objective of site cleanup and remediation is to manage environmental concerns and long-term liabilities. The specific objectives for cleanup and remediation of a particular site are to ensure that the site is:

- not a source of unacceptable risk to human health and safety;
- not the cause of unacceptable effects on the environment;
- in compliance with all applicable laws and regulations;
- not an unacceptable liability to future land owners; and
- aesthetically acceptable.

11.1.3 Remediation Criteria

To evaluate the effectiveness of a cleanup and remediation project, it is necessary to develop remediation or cleanup criteria. These are numerical limits for the protection of specific uses of soil and water. The remediation criteria can be used to provide a basis for establishment of remediation objectives, and for verification of the adequacy of remediation actions. Remediation can then be considered to be complete when contaminant levels have been reduced below the levels of the remediation objectives established.

Prior to implementation of a remediation project, site-specific remediation criteria need to be established. The major factors that should be considered when developing site remediation criteria include:

- environmental and human health toxicology of the contaminants;
- background level of the contaminants;
- the amount and type of the contaminated material;
- mobility of the contaminants of concern and the migration pathways to points of human or environmental impact;
- the combined or synergistic effects of contaminants at the site;
- the sensitivity of the environment surrounding the site;
- contaminant migration control mechanisms;
- aesthetics;
- public perception;
- available treatment technologies; and
- cost.

11.1.4 Cleanup and Remediation Options

Various remediation options are discussed below. These are grouped into methods employed in-situ, onsite and offsite.

11.1.4.1 In-Situ Remediation Techniques

Leave Material in Place
This "do nothing" option may be appropriate in some circumstances. The viability of this option is governed by the following criteria:

- organic and inorganic contaminant concentrations in the soils are below criteria values; consideration should also be given to the concentration of parameters in the disturbed area, relative to background soil concentrations; and
- the risk of contaminants migrating to impact sensitive environmental receptors (e.g., water wells) is low.

Landfarm or Bioremediation
Bioremediation is the exploitation of the natural ability of micro-organisms to transform or reduce organic chemicals that have contaminated the environment. The use of bioremediation as a method for soil hydrocarbon degradation dates back as far as the 1950s. The concentration of oil in the environment will influence its biodegradation. Minute amounts of oil may be insufficient to induce the necessary populations of degradative bacteria, whereas excessive oil concentrations may be toxic or prevent adequate aeration. The biodegradation of hydrocarbons may be enhanced by supplementing existing natural bacteria, providing nutrients, providing oxygen for the bacterial action, and controlling the pH and moisture level of the soil within a range most suitable for biological activity.

11.1.4.2 Onsite Remediation Techniques

Landspread and Treatment
Landspread and treatment of oily soils and wastes is similar to landfarm or bioremediation in that the natural bacterial action in soil is employed to degrade the hydrocarbons. The contaminated soils are first excavated, spread in a layer (usually 200 or 300 mm in thickness) on the soil surface, then mixed into the upper soil zone. Nutrients and moisture content are controlled and monitored to provide optimal levels for bacterial activity. Landspread and treatment has been successfully used by the oil and gas industry in Western Canada for the treatment of hydrocarbon-contaminated soils for more than 25 years.

Onsite Landfill
Onsite landfilling of contaminated soils and sump sludges can be used for well site abandonment where proper subsoils and hydrogeology exist. Onsite landfills, if properly engineered, can reduce the potential environmental impacts of surface spills and reduce water runoff exposure pathways. Potential well site abandonment procedures in this case would include: excavation of a suitably sized landfill site in the native soils surrounding the well pad to the depth necessary to accommodate the contaminated soils/wastes; infilling with contaminated materials; and backfilling with excavated material, properly capping with clay to prevent surface water infiltration and covering with topsoil prior to reseeding for erosion control.

The only advantage achieved with onsite landfilling is the reduction of potential problems associated with uncontained migration of the contamination. The obvious disadvantage is that the contamination has not been remediated, and in some areas there could be a risk of groundwater contamination. Long-term monitoring of groundwater is generally required for landfill sites. Onsite landfilling of oil-contaminated soils should only be used at low-risk sites and when other methods are not practical.

Oil Field Reclaimer

Oil field reclaimers offer a service to the upstream oil and gas industry. They use a variety of processes to treat oil-contaminated material. Oil reclaimers recover a portion of the oil and dispose of the residual liquids and solids.

11.1.4.3 Offsite Remediation Techniques

Landspread and Treatment at a Central Facility

This process is similar to the onsite landspread and treatment operations. The advantage of centralized facilities is the fact that they operate under more stringent environmental control and achieve economies of scale. They also have the advantage that the contaminant is removed from the site, thereby reducing the risk of further exposure or impact. A drilling project would likely be required to confirm subsurface conditions and to establish design requirements. Environmental monitoring requirements (e.g., groundwater monitoring) would also need to be examined before final site selection is confirmed.

Landfill at a Centralized Containment Facility

Contaminated material may be excavated and hauled to a landfill. Care should be taken when excavating to ensure that contaminated materials are adequately removed. Samples should be collected and analyzed to ensure that adequate removal has been carried out. A source of replacement material may need to be identified in order to complete reclamation. This disposal option requires that a secure landfill capable of accepting the oily wastes is available or can be developed.

Solidification at a Centralized Processing Facility

Contaminated soil may be solidified using chemical and physical processes at a central processing facility. The resulting product may be used for construction or placed in a landfill. An example of this process is the calcification process using unslaked lime and water. The reaction of calcium oxide with water results in physical and chemical stabilization of the contaminants in the waste. Calcification is applicable to the following types of wastes:

- diesel and tank bottoms contaminated soils;
- crude oil and waste oil contaminated soils; and
- brine and heavy metal contaminated soils.

Road Application
Specific types of oil-contaminated materials may be applied to a road as a subgrade material. The contaminated material must be chemically analyzed, excavated, loaded, hauled, spread and graded. Road application is best used in cases where the contaminants are limited to hydrocarbons.

Asphalt Incorporation
Paving materials produced at hot-mix asphalt plants consist of 95% aggregate (sand, gravel) and roughly 5% hot asphalt. The aggregate is dried, heated to 350°F and sorted by size. It is then mixed with hot asphalt in a pugmill for immediate use as a paving material. Oil-contaminated soil may be added to hot-mix asphalt during the aggregate preparation process. Because the soil particle size affects the strength and durability of the asphalt mix, the clay and silt content of the soil feed is usually limited to 20%.

Much simpler technology is employed in the production of cold-mix asphalt. In this process, a surfactant produces an emulsion of asphalt cement and water. The liquid asphalt is then combined with aggregate. Oil-contaminated soil may be blended into the liquid asphalt along with the aggregate feed. Soils with high clay content or high capacity for water retention are not suitable for asphalt incorporation because they interfere with the adherence of the asphalt to the aggregate. Studies have verified that negligible impacts result from incorporating petroleum-contaminated soil into cold-mix asphalt (The Hazardous Waste Consultant 1992).

The advantages and disadvantages of each of these disposal and/or remediation methods are summarized in Table 11.2.

11.1.5 Selection of Preferred Remediation Options

11.1.5.1 Methodology

The selection of the most appropriate remediation option involves a ranking process of options having potential application. The following is a list of the selection criteria and assigned "weighting factors" used to rank the remediation options.

Effectiveness of technology: This is an important consideration for the selection of any remediation option. A technology which can accomplish the treatment objectives is most favourable. This was assigned a weighting factor of 2.

Availability of technology in Kazakhstan: This criterion was assigned a weighting factor of 2.

Environmental risk: The preferred remediation option should minimize the risk associated with potential contamination of soil, water and air. A remediation plan that completely removes contaminants will essentially result in no environmental risk when remediation is complete. Remediation strategies such as centralized landfill simply transfer expensive risks to another location. This criterion has been assigned a weighting factor of 2.

Table 11.2

Advantages and Disadvantages of Cleanup and Remediation Options for Oil Spills

Method	Advantages	Disadvantages
IN-SITU		
Leave material in place	Low cost; rapid implementation	Cleanup criteria may not be met; possible impacts to groundwater, vegetation
Landfarm	Low cost	Slow implementation; treatability studies are required; cleanup criteria may or may not be met
ONSITE		
Landspread and treatment	Cleanup criteria are met for hydrocarbons; relatively low cost; relatively simple process	Slow implementation; management requirement
Landfill	Low cost; rapid implementation; does not impact other areas	May not achieve cleanup criteria; possible future impacts to groundwater; vegetation monitoring requirements
Oil field reclaimer	Cleanup criteria are met; recovery of oil	Mobilization of reclaimer unit; potential high cost
OFFSITE		
Landspread and treatment at central facility	Cleanup criteria are met at site	Slow implementation; excavation and haulage costs; siting and construction of facility
Landfill at centralized containment facility	Cleanup criteria are met at site	Long-term liability; slow implementation if landfill has to be constructed; excavation and haulage costs; siting and construction of facility
Solidification	Cleanup criteria are met at site	Long-term liability; excavation and haulage costs; siting and construction of facility
Road application	Cleanup criteria are met at site; rapid implementation	Excavation and haulage costs; dependent on availability of suitable roads
Asphalt incorporation	Cleanup criteria are met at site	Slow implementation; excavation and haulage costs; limited availability of asphalt plants.

Costs: The costs of implementing a remedial strategy were important considerations, although cost alone should not dictate the final selection of a remediation plan. It has been assigned a weighting factor of 2.

Time: Time requirements for implementation of a remedial strategy are an important consideration. This criterion has been assigned a weighting factor of 1.

These selection criteria and weighting factors were combined with a ranking score in a table format (see Table 11.3). The ranking score was completed as follows:

- Favourable = 2 marks
- Neutral = 1 mark
- Unfavourable = 0 marks

The final score was calculated by summing the product of the "weighting factor" and the "ranking score" for all five selection criteria. The total score possible for individual remediation options is 16.

11.1.5.2 Ranking of Remediation Options

The results of ranking the remediation options are given in Table 11.3. Leaving material in place, landfarm in place and landfill onsite are the preferred remediation options for oil-contaminated soil. Leaving material in place is only applicable for sites where contaminant concentrations in the soil are below criteria values or spills are small, and the environmental risk is low. Landfarm in place is suitable for sites where the contaminant does not extend to depths below plough depth (20 cm) and the soil properties are conducive to tillage. Landfill onsite is easily implemented and relatively cheap, however this method could result in an unfavourable environmental risk.

Secondary options that may be feasible in some cases include landspread and treatment onsite, road application and use of an oil field reclaimer. Landspread and treatment onsite may be applicable where the soil contamination extends below plough depth and there is a suitable site nearby to spread out the contaminated soil for landfarming. The use of oil-contaminated soil as road base material depends on the physical properties of the soil and demand for road base material. Oil field reclaimers have potential use for removing oil from contaminated soil and they use the recovered oil to partially offset the cost of operations. However, they may not be effective in treating soils with moderate oil content (1 to 2%), and implementation time could be slow.

Table 11.3

Ranking of Remediation Options for Oil-Contaminated Soil

Option	Effectiveness of Technology	Availability of Technology	Environmental Risk	Costs	Time	Overall Ranking
In-Situ						
Leave material in place	Neutral	Favourable	Neutral	Favourable	Favourable	14
Landfarm	Neutral	Favourable	Favourable	Favourable	Neutral	15
Onsite						
Landspread and treatment	Neutral	Favourable	Neutral	Favourable	Neutral	13
Landfill	Favourable	Favourable	Unfavourable	Favourable	Favourable	14
Oil field reclaimer	Neutral	Favourable	Favourable	Neutral	Neutral	13
Offsite						
Landspread and treatment	Neutral	Favourable	Favourable	Unfavourable	Neutral	11
Landfill at central facility	Favourable	Favourable	Neutral	Unfavourable	Neutral	11
Solidification	Favourable	Neutral	Favourable	Unfavourable	Neutral	11
Road application	Favourable	Favourable	Neutral	Neutral	Neutral	13
Asphalt incorporation	Favourable	Neutral	Favourable	Unfavourable	Unfavourable	10

11.1.6 Implementation of Pilot Remediation Project

Further research is needed to confirm the technical feasibility of the six preferred remediation options given in Table 11.4. Soil samples should be collected from representative locations within Blocks 3 and 3A for chemical analysis. Samples should be analyzed for pH, nutrient levels, metals, total petroleum hydrocarbons (GC), chlorinated hydrocarbons and polynuclear aromatic hydrocarbons to further characterize the nature of contamination.

Table 11.4

Remediation Options Recommended for Further Evaluation to Ensure Technical Feasibility

In-Situ	
•	Leave material in place
•	Landfarm in place
Onsite	
•	Landfill
•	Landspread and treatment
•	Oil field reclaimer
Offsite	
•	Road application

Three of the remediation options—leave material in place, landfarm in place, and landspread and treatment—rely on the degradation of the oil contamination by natural biological activity. A biofeasibility study should be undertaken to determine if soil conditions are favourable to bioremediation, to estimate the potential of indigenous micro-organisms to bioremediate the soil, to estimate the potential to significantly reduce the oil concentrations in the soil and to evaluate the need for nutrients and bacterial inocula.

The Mangystau Region is very dry, with annual precipitation of about 200 mm, of which about half falls in March. In the bioremediation process, water acts as both a solvent and a transporter of nutrients which are essential for microbe growth. Extreme dryness can significantly reduce microbial activity and reduce hydrocarbon decomposition. The waterproofing effect of hydrocarbons can significantly lower moisture availability in the soil.

The biofeasibility study should be undertaken initially with a bench-scale simulation test. If the results are favourable, field investigations should be undertaken.

Assuming that these preliminary studies are favourable, it is recommended that a pilot remediation project investigating the landfarm in place, and landspread and treatment options be undertaken. Both of these options would most likely require several years to complete remediation.

Landfarm In-Situ

An area of oil-contaminated soil that is typical of Blocks 3 and 3A needs to be selected. The extent of contamination (including depth) needs to be determined. This method usually involves application of nutrients onto the impacted area to stimulate the indigenous bacterial populations. It is proposed that this process be limited to the "rainy" season to maximize bioremediation during this optimal period. The soils would also be ploughed to improve soil aeration for microbial action and to expose soil for photo-oxidation processes. Both control and treatment plots should be established. Soil monitoring for hydrocarbon content, nutrients and biological activity will provide information to assess treatment performance.

Landspread and Treatment

A suitable site for implementation of this remedial trial should first be selected. Site factors to consider include:

- sufficient size to accommodate the oily wastes, to a maximum depth of 0.2 m;
- sandy to clay loam textured soils with moderate permeability;
- non-saline soils; and
- low potential for groundwater contamination.

Once the treatment area is selected and levelled, the contaminated soil is stripped and spread out over the treatment area. The contaminated soil is then mixed with the surface soil, fertilizer is added and the mixture is cultivated on a regular basis. It is proposed that this process be limited to the "rainy" season to maximize bioremediation during this optimal period. Both control and treatment plots should be established. Soil monitoring for hydrocarbon content, nutrients and biological activity will provide information to assess treatment performance.

Further information is required before a pilot remediation project for the other remediation options —road application, landfill onsite and oil field reclaimer—can be proposed.

Landfill Onsite

Information on effective rooting depths of indigenous plants and groundwater conditions in Blocks 3 and 3A needs to be obtained.

Road Application

Information on the demand for road base materials and the suitability of the oil-contaminated soil for this use needs to be determined.

Oil Field Reclaimer

The field survey team were informed that the Kazakhstan operators of the Uzen oil field were actively investigating the option of using an oil field reclaiming operator to cleanup oil-contaminated soil. Such an operation can typically process soils to reduce the oil and grease content down to about 1 to 2% with a treatment process utilizing chemicals, steam and water. They can typically process about 3000 m^3/day of material. Information is needed on specifications of such an operation, including limitations on the feedstock, efficiency of treatment process, characteristics of processed material and productivity of the unit.

11.2 REMEDIATION OF ANCILLARY DISTURBANCES

11.2.1 Waste Pits

Major remediation projects are required to cleanup the two large, existing waste pits of oily wastes. It was evident during the field survey that efforts are already underway to recover the oil from the 70 ha waste pit adjacent to the central processing facility. A similar effort, but on a much larger scale, will be required to remediate the larger 3600 ha waste pit. Options for remediation of these facilities are beyond the scope of this report.

11.2.2 Industrial Refuse Dump

The large amount of scrap metal and debris in the existing refuse dump should be either recycled or disposed of in a proper landfill. In the interim, the safety hazard posed by the dump can be remediated by controlling access to the area, either by fencing and/or posting signs prohibiting unauthorized personnel in the area. There appears to be very little organic or flammable waste in the dump, so that contamination or fire hazards are likely minimal.

11.2.3 Radiation Hazard

Interviews with personnel during the field study revealed a radiation hazard exists in some areas of the field where radioactive scrap metal has been identified. These areas have apparently been mapped, but there was no evidence of signs warning of the hazards except for the separator tanks at the group gathering station. To reduce the hazard, all radioactive scrap should be collected and properly disposed of (stored) in an appropriate facility. If the radiation hazard still exists at isolated locations in the field, these areas should be posted and access controlled.

PART 12 - ENVIRONMENTAL MANAGEMENT PLAN

12.1 APPROACH

The conceptual environmental management plan, which includes a spill contingency plan, describes the basic or generic environmental protection procedures for the rehabilitation of the Uzen oil field, including general facility construction, drilling of new wells, well conversions, pipeline construction and oil field operations.

The plan focuses on those specific protection measures that must be applied in the field, such as clearing and erosion control techniques, but does not include those measures that are an integral part of the design to minimize impacts such as construction material specifications. The plan is intended to be a stand-alone document for use by field construction personnel and the Environmental Inspector. At this stage in the project, the plan may be modified to suit design changes and site-specific conditions. We recommend that the following procedures be adopted to minimize potential adverse environmental impacts during rehabilitation and future operations of the field.

The potential environmental impacts have been based on the environmental overview (Section 4.0), discussions with various government agencies, and a ground reconnaissance of the oil fields by environmental scientists from AGRA E&E.

To ensure that protection measures and environmental guidelines are correctly interpreted and implemented, we recommend that a qualified Environmental Inspector be hired onsite during construction and installation of the central processing facility and pipelines connecting the facility to the wells. The inspector will, as one of his prime responsibilities, ensure that operation of the rehabilitated oil field is conducted properly, with a minimum of offsite disturbance and pollution. The second important area will be to ensure that the proposed water intake facility, water intake pipeline from Uzen to Kazakh Bay and water injection stations are constructed with a minimum of disturbance to the environment.

12.2 PROPOSED WATER INTAKE FACILITY AND WATER INJECTION STATIONS

A new water intake facility may be constructed at Kazakh Bay which will provide the Uzen oil field with a source of treated make-up sea water. Additionally, four new water injection stations will be constructed within the field for high pressure water injection of the formation.

12.2.1 Construction

12.2.1.1 General Procedures

- The facility boundaries and access roads will be clearly staked.
- Construction vehicles will be restricted to the access road and facility site.
- Where practical, refuelling, oil changes and lubricating mobile equipment will be conducted on a pad which drains into a temporary retention pond. Fuelling and service vehicles will carry a minimum of 10 kg of sorbant material (see Fuel, Oil and Chemical Spill Contingency Plan).
- Temporary fence gates will be installed, as necessary, during construction of the water intake facility. They will be kept closed except when vehicles are passing through.

12.2.1.2 Clearing

- All vegetation on the plant site required for facilities will be cleared.
- Disturbance to surface soils will be minimized to maintain soil structure.

12.2.1.3 Debris Disposal

- All combustible debris will be burned in an enclosed incinerator in a centralized location within the field and near the water intake site, in a controlled manner.
- Fire fighting equipment will be onsite during any burning or welding activities.
- Ashes will not be buried.

12.2.1.4 Surface Preparation

- Where grading is required, construction procedures will:
  - control drainage and erosion to reduce sedimentation;
  - salvage and stockpile surface soils; and
  - provide for follow-up revegetation, as required.
- Spoil material from grading operations will not be disposed of in such a manner that wind erosion of spoil piles may occur.
- Surface preparation procedures, when finished, will maintain the original drainage conditions as nearly as practicable.

12.2.1.5 Cleanup and Reclamation

- Drainage and erosion control measures will be installed, as required, once the final grade of the site is established.
- Following cleanup, all areas not required for surface structures will be revegetated by native species. Succession will be encouraged by recontouring and levelling, fertilizer application and control of wind erosion. A specific reclamation plan will be developed for each unique soil/vegetation type within the Uzen oil field and along

associated pipeline routes. This plan will detail specific fertilizer and seedbed preparation methods.

12.2.1.6 Waste Disposal

- Surface runoff from refuelling and fuel storage areas will be directed to a retention pond for testing and/or oil skimming before being released to the surface drainage system.
- Combustible wastes will be incinerated onsite, whereas noncombustible solid wastes will be disposed of in a local landfill.

12.2.2 Operations

12.2.2.1 Air Emissions

- Dust will be controlled by the application of adhesive agents (such as calcium carbonate) on all access and facility roads, as required.
- Permanent access roads will receive an all-weather surface treatment.

12.2.2.2 Chemical Transport (proposed water intake facility)

- Chemical tanker trucks will travel on approved access roads only. Posted speed limits will not be exceeded on main roads.
- First-time chemical tanker drivers will follow experienced drivers to familiarize themselves with the road. As a spill prevention measure, drivers will attend awareness and training sessions.
- All chemical tanker trucks will carry a shovel, 30 m^2 of 20 mm polyvinyl chloride sheeting and sorbant material to cleanup 200 L of spilled fuel.

12.2.2.3 Chemical Handling and Storage

- Chemical handling will be done in a careful manner that avoids spilling of chemicals on the ground (see Fuel, Oil and Chemical Spill Contingency Plan).
- Fuels will be stored in specified areas only, on an impermeable surface within an enclosed building.
- Emergency spill equipment will be preassembled and maintained, including at least two pumps, ten empty 200 L drums and sorbant material to cleanup a 1000 L fuel spill.

12.2.2.4 Fisheries Protection

- No fishery protection measures are required within the Uzen oil field as no fish-bearing waterbodies exist.
- A screen with maximum mesh size of 2.5 mm will be installed on all water intake pumps at the water intake facility in Aktau and Kazakh Bay.

- Intake screens will be completely submerged.

12.3 PIPELINES

A number of existing pipelines will be replaced within the Uzen oil field. Specifically, these include:

- flowline systems;
- oil/water transfer lines;
- gas transfer lines;
- water distribution lines; and
- high pressure water injection lines.

Additionally, one new pipeline will be constructed to transport treated make-up sea water from Kazakh Bay to Uzen.

Existing pipelines will be plugged and abandoned. New pipe will be laid within the same trench as the existing lines wherever feasible. Limited amounts of pipeline construction will be necessary within the field.

12.3.1 Construction

12.3.1.1 General Procedures

- The right-of-way will be clearly staked and activities will be restricted within these boundaries.
- Vehicle and equipment maintenance will, if practical, not occur on the pipeline right-of-way but in areas designated for that purpose (e.g., road crossings). Spent oils, lubricants and filters will be collected and recycled. A minimum of 10 kg of suitable sorbant material will be carried on fuel and service vehicles.

12.3.1.2 Clearing

- Clearing will be confined to those areas designated and staked.

12.3.1.3 Ditching, Backfilling and Pipe Testing

- Where grading is required, construction procedures will:
  - control drainage and erosion to reduce sedimentation;
  - salvage and stockpile surface soils; and
  - provide for follow-up revegetation, as required.
- Grubbing of rocks and boulders will be limited to over the trenchline.
- Spoil from grading operations will be disposed of in designated areas and in such a manner that wind erosion does not occur.
- The trenchline will be staked prior to ditching.

- The length of time between trenching, laying-in and backfilling will be minimized as much as practical.
- Ditch plugs will be installed, where required, to prevent erosion.
- Spent welding rods will be collected and disposed of in an appropriate landfill.
- Trench backfilling will allow for normal surface drainage as much as practical.

12.3.1.4 Cleanup and Reclamation

- Wind erosion control measures will be installed as required, especially on steep slopes.
- Re-establishment of native vegetation on the right-of-way will be encouraged by recontouring, fertilizing and protection from wind erosion.

12.3.1.5 Waste Disposal

- All waste materials, garbage and debris will be removed from the right-of-way and disposed of by incinerating or landfilling, whichever is appropriate.

12.3.2 Operations

- The right-of-ways will be inspected regularly by aerial reconnaissance to detect leaks and assess erosion.
- If leaks are detected, they will be repaired and spills cleaned up immediately.
- Eroded areas will be repaired and recontoured.

12.4 ACCESS ROADS

The need for new roads is expected to be minimal. Where required, the following specific environmental protection measures are appropriate during construction and operation. Otherwise all measures listed under Section 12.2 for the water intake facility and water injection stations are applicable.

12.4.1 Construction

- Roadbeds will be prepared by end-dumping appropriate fill material of sufficient thickness to prevent severe rutting.
- Special attention will be given to erosion control and maintenance of natural drainage during access road construction. These include installation of culverts, bridges and ditch blocks, where appropriate.

12.5 DRILLING OF NEW WELLS, WELL CONVERSIONS AND WELL WORKOVERS

- Major workovers will be completed at 551 production wells and 229 injection wells in Blocks 3 and A. Conversions of 33 injectors to producers and 32 producers to injectors will also be completed. Outside of Blocks 3 and 3A, drilling of up to 970 replacement injectors and 360 new producers will be completed.
- Drilling fluid sumps will be bermed to contain the fluids. A minimum 1 m freeboard will be established on sumps.
- Sumps will either be constructed of impervious material or lined with an artificial liner or clay.
- Sump fluids will be recycled wherever feasible.
- Spoil material from excavated sumps and flare pits will be stockpiled for reclamation use following abandonment.
- Solid wastes will not be disposed of in sumps or flare pits.
- Use of water-based drilling muds will be encouraged.
- Use of high salt content drilling muds will be minimized.

12.6 FLARING

12.6.1 Potential Problems

Emergency flaring of gas within the Uzen oil field may release large quantities of SO_2, NO_x and particulate matter into the air, resulting in significant impacts to vegetation and soils.

12.6.2 Preventative Measures

Knock-out drums on flare stacks will ensure complete removal of hydrocarbon prior to flaring. Installation of automatic ignition devices will ensure complete combustion of harmful elements.

12.7 CLOSURE PLAN

The closure plan deals with abandonment of all facilities at the end of oil field production. In some cases (e.g., wells and access roads), this may occur intermittently through the life of the project. The following environmental protection measures will be employed.

- All above ground facilities will be removed and all roads will be stabilized.
- Erosion control structures will be left in place.
- Drilling fluids will be disposed of, either by:
  - downhole disposal (where feasible);
  - squeezing or trenching; or
  - decanting.
- All sumps will be backfilled and capped.
- All disturbed areas will be recontoured, as required, to restore natural drainage, scarified if necessary and fertilized to promote revegetation of native species.

- All landfills will be capped and revegetated.

12.8 FUEL, OIL AND CHEMICAL SPILL CONTINGENCY PLAN

12.8.1 Potential Problems

Chemicals used at the proposed sea water treatment facility will be supplied to the facility via truck transport.

Chemical spills from truck accidents, the transfer from trucks to storage facilities via hoses, or pipeline leaks pose the greatest hazard because of the volumes involved. Vehicle accidents on roads or valve/coupling failures could result in spill volumes up to 23 m^3 from individual truck tankers, and up to full capacity of individual storage tanks.

Petroleum products associated with equipment maintenance (e.g., hydraulic fluids, oil, solvents, antifreeze) and other chemicals associated with plant facilities (e.g., detergents, chlorine, sewage treatment chemicals) are used in relatively small quantities. Storage and transfer is usually via 200 L drums or smaller containers, therefore spill quantities are limited. Oil spills from pipeline failures pose the greatest hazard due to the potential for large volume releases.

Oil, fuels and chemicals, as a rule, are damaging to vegetation and wildlife, toxic to aquatic organisms, and often pose a fire hazard.

12.8.2 Preventative Measures

Preventative measures to avoid the potential for spills are included as standard practices for each of truck transport and buried pipelines, depending on which system is used.

12.8.2.1 Truck Transport

- Hiring experienced drivers and fuel/chemical handling personnel. As a spill prevention measure, drivers will attend driver awareness training sessions. All fuel tanker trucks will carry a shovel, 30 m^2 of 20 mm polyvinyl chloride sheeting and sorbant material to cleanup 200 L of spilled fuel.
- Enforcement of road speed and access restrictions.
- Placement of signs and flagging at hazardous and trouble spots to assist drivers in regulating their speeds.
- Locating fuel transfer and storage facilities on level terrain.
- Constructing a dyke around the stationary fuel containers and around the chemical storage facility at the water treatment plant.
- Fuel or chemicals stored in drums will be stored in groups of 50 or less. They will be tightly sealed against corrosion and rust.
- Chemicals will be stored in secure locations, within the facility ste and away from traffic of hazardous activity areas, such as welding.

- Fuel and chemical storage will be inspected on a day-to-day basis by the Field Operation Supervisor, with periodic checks by the Environmental Inspector.
- Inventory records of fuel/chemicals consumed and stored will be kept at the stationary fuel storage tanks by the Central Processing Facility Superintendent. Stationary fuel/chemical storage tanks will be equipped with locking valves to prevent spills caused by vandalism.
- Only properly functioning valves, meters and nozzles will be used and inspection of fuel/chemical tanks and hoses will be done frequently. All transfer lines will be provided with check vales so as to prevent backflow of the product and spillage in the case of failures.
- All fuel and chemical storage areas, nonportable transfer lines and other transfer lines, where in place, will be clearly marked and barricaded to ensure that they are not damaged by moving vehicles. The markers will be placed in all corners of the area and be brightly coloured so as to be visible in adverse conditions.
- Emergency spill equipment, including at least two fuel pumps, ten empty 200 L drums and sorbant material to cleanup 1000 L of fuel will be preassembled and maintained at the fuel storage tanks.

12.8.2.2 Buried Pipeline

- Facility and field personnel will be trained in spill awareness and prevention procedures.
- Fluid monitoring alarms and automatic shut-down equipment will be in place to limit the volume of fluids released in the event of a leak.
- The pipeline right-of-way will be clearly marked with signs indicating that AOC must be contacted prior to any excavation or crossing by heavy vehicles.
- The right-of-way will be inspected for leaks regularly by qualified personnel.

12.8.3 In the Event of an Oil, Fuel or Chemical Spill

12.8.3.1 Detection

- Individuals will make a reasonable attempt to immediately stop leakage and contain contaminant flow.
- Report spill location, type of fuel or chemical and volume, and terrain condition at the spill site (e.g., slope, river channel) to the Central Processing Facility Superintendent, Field Operation Supervisor or Environmental Inspector as soon as possible.

12.8.3.2 Action

The Central Processing Facility Superintendent or Field Operation Supervisor will:

- Make every effort to contain the fuel spill at the site.
- Establish containment points and/or dykes.

- Deploy containment booms on water if the contaminant floats.
- Establish emergency communications and inspect the spill site with the Environmental Inspector.
- Assess site conditions and impact of various cleanup procedures.
- Assess the potential for fuel recovery versus burning.
- If on a public transportation route, provide for detour and subsequent repair.
- Prepare fire control crew if fire hazard is high.
- Deploy trucks, four labourers and nearest crew to assemble and bring standby fuel pumps, empty 200 L drums and other emergency spill equipment to the spill site. The emergency spill control material will be preassembled at the plant site. Tools from the fire fighting equipment will also be used.
- As the dozer and crew arrive, deploy to build containment dykes and commence pumping contaminant into drums.
- Apply sorbants as required.
- *Dispose of all contaminated debris, cleaning materials, sorbants, etc. by burning or* placing in a landfill at the plant site.

12.8.3.3 Cleanup Criteria

The final decision on cleanup methods is made by the Central Processing Facility Superintendent of Field Operation Supervisor on advice from the Environmental Inspector. For spills in environmentally sensitive areas, a specialist consultant may be brought to the site to advise onsite personnel on cleanup and reclamation.

Criteria used in decision making:

- minimize danger to persons;
- minimize pollution of water by spill;
- minimize area affected by spill; and
- minimize area and degree of disturbance to land and water surrounding the spill *during cleanup.*

12.8.3.4 Cleanup Procedures

Spills on Land

- Following containment and recovery of ponded substrate, light hydrocarbons mixed with substrate may be burned if the fire hazard is acceptable.
- Unburned, contaminated substrate (and sorbants, if used) will be collected and incinerated.
- Where the Central Processing Facility Superintendent or Field Operation Supervisor, in consultation with the Environmental Inspector, determines that the impact of removing the contaminated material exceeds that of the contamination alone, the site will be left undisturbed and treated with fertilizer to accelerate biodegradation and assist in re-establishment of vegetation.

PART 13 - ENVIRONMENTAL MONITORING PROGRAM

There are three major objectives of the environmental monitoring program for the rehabilitation of the Uzen oil field:

- collection of baseline data on air, soil and groundwater quality in order to document existing levels of contaminants (or the lack of contamination) prior to the rehabilitation of the field;
- collection of data on ambient air, soil and groundwater quality to confirm that the various operations in the rehabilitated field meet the design requirements; and
- continued, periodic collection of data on the environment to assess the environmental impact of emissions from the rehabilitated field.

The monitoring data will be compared to Russian regulatory standards as well as to Albertan (Canadian) criteria to determine compliance with existing environmental protection criteria.

The laboratory analyses of the samples from environmental monitoring will be conducted in Kazakhstan to the extent that appropriate facilities are available. The remainder of the required analyses may be conducted in North American laboratories. Periodically, the analysis of a complete set of duplicate samples may be analyzed in other western laboratories to provide quality control and quality assurance.

The environmental monitoring program will be conducted by individuals with a technical background and who are familiar with the collection and recording of scientific measurements. Individuals will be trained in the specific aspects of environmental monitoring, with emphasis on standardized methods and techniques, calibration of instruments, and record keeping. Ideally, the environmental monitoring program will be conducted by local institutes. A third party, such as an independent consulting or service company, may oversee the program.

13.1 ENVIRONMENTAL COMPONENTS TO BE MONITORED

13.1.1 Air Quality

Specific air quality parameters, sampling locations and sampling frequency will be detailed in a more rigorous site assessment conducted just prior to the initiation of the environmental program. Specific features of the rehabilitation plan (e.g., installation of new gas-fired heaters and the sulphur content of the gas used as fuel) will be used to formulate a rationale for the determination of the air quality parameters to be monitored in the program. From past experience with oil and gas field air quality, sulphur and nitrogen oxides as well as carbon monoxide would be likely candidates for monitoring. Total volatile hydrocarbons (as would be present in emissions from large waste pits or pipeline ruptures) might also be candidates for monitoring. The monitoring of specific hydrocarbons (e.g., benzene, hydrogen sulphide)

which have been established to cause specific adverse health effects in humans may also be considered for monitoring.

13.1.2 Soil Quality

Emissions of sulphur dioxide from the gas processing facility have the potential to cause soil acidification. The standard analyses for soil acidification consists of acidity (pH), electrical conductivity, sulphate, total sulphur and buffering capacity. Soil sensitivity to acidification would be calculated and assessed with the data collected by the analysis of these parameters. The analytical analysis of soil parameters will follow standardized procedures such as those established by McKeague (1978).

Initial soil sampling will be conducted as part of the Site Characterization Study. Sampling locations will be located in representative areas both upwind and downwind from known emission sources of sulphur dioxide. Both the current and future sampling frequency will be an integral part of the overall soil monitoring program design.

13.1.3 Surface Water Quality

Where significant quantity of surface water exist (i.e., produced water) and for which a definite use has been established (e.g., cattle watering), a monitoring program will be established to monitor water quality parameters appropriate to the designated use or uses. The methods used in the analysis of water quality parameters will be those recognized by the international scientific community as being appropriate.

13.1.4 Groundwater Quality

The groundwater quality monitoring program will have the following objectives:

- monitoring of existing groundwater supplies to assess the maintenance of appropriate quality for a designated use (e.g., industrial process water, livestock watering);
- monitoring of groundwater to assess the extent of contaminant migration from areas of known soil and groundwater contamination to uncontaminated areas;
- determination of groundwater stratigraphy; and
- determination of groundwater volumes.

Prior to implementation of the groundwater monitoring program, a hydrological survey of the area should be conducted to identify the variability and characteristics of the groundwater systems for which monitoring is proposed.

13.1.5 Pipeline Right-of-Way Monitoring

The condition of the pipeline rights-of-way should be checked frequently by aerial and ground surveillance to identify leaks, erosion, subsidence and the potential for accidents to the pipeline. Repair or restoration measures will be initiated immediately to remedy any situations requiring attention. Natural revegetation of the soil covering the pipeline will also be monitored.

13.2 REPORTING

Annual monitoring reports containing an outline of the program design, methods and results of sample analyses will be submitted for regulatory review. The report will also outline actions proposed or taken to remedy any exceedances of monitoring criteria and present any recommendations (along with the appropriate rationale) for modifications of the existing environmental monitoring program.

While the role of each regulatory agency and its jurisdiction is not yet clear and is subject to change, it is anticipated that most of the Kazakhstan government agencies which have authority over resource development and environmental protection will want to be part of the regulatory review process.

PART 14 - STRENGTHENING LOCAL ENVIRONMENTAL MANAGEMENT CAPABILITIES AND INSTITUTIONS

The International Bank for Reconstruction and Development is committed to strengthening local environmental management capabilities and institutions to deal with environmental concerns and to integrate them into the identification, design and implementation of economic development activities. The Uzen Field Rehabilitation Project has initiated a long-term objective of reinforcing the institutional structures and processes of Kazakhstan and Mangystau Oblast to ensure that natural resource use is consistent with environmentally sound and sustainable development. This objective can be achieved through adherence to the World Bank's own environmental rules and policies, and by following Kazakhstan's regulatory acts and practices in the area of environmental management. The project will provide a good example of environmentally sound and socially sensitive economic development, and the manner in which it can be achieved.

The environmental rules and practices developed by the World Bank have been tested through various development projects throughout the world. When implemented in the project, these rules and practices can provide valuable input to the developing environmental policy and regulatory framework in Kazakhstan. At the same time, Kazakhstan's own regulatory procedures and socio-cultural characteristics will enrich the project with a strong national content, making it custom-tailored to the country and locality. Potential benefits of the rehabilitation project include the following.

- The Environmental Department of the Presidential Council and the Parliament are in the process of formulating policies and legal acts on environmental protection and the use of natural resources. Projects with foreign investment encourage development of appropriate national policies and regulations and provide an important international information exchange.
- The Ministry of Ecology and Bioresources is currently developing its regulatory approach to large-scale development projects, the environmental review process and regulations with specific regard to environmental impact assessments (EIAs). Personal communication with Ministry officials revealed the desire of the Ministry to learn about the various approaches taken to EIAs in foreign countries. The environmental component of the project provides this learning experience.
- Interagency coordination is one of the most difficult issues in national environmental management systems. Kazakhstan is also experiencing disputes between various agencies engaged in environmental control. The project financed by the World Bank specifically addresses this issue by attempting to provide each of the involved government agencies with a clearly defined role and stake in the project.
- Various agencies, such as the Ministries of Economy, Energy and Geology, may define more specific EIA procedures applicable to their specific jurisdiction, while reviewing the environmental assessment for the project within the framework of national or agency guidelines.

- The newly-formed environmental engineering and consulting companies frequently bear the burden of the Soviet-style narrow approach to complex problems and a non-competitive mentality. Only through active participation in projects, as exemplified by this project, can they advance their professional capabilities in the new realm of commercial market-economy consulting.

14.1 ENVIRONMENTAL MANAGEMENT INSTITUTIONS

14.1.1 List of Institutes and Agencies

The environmental management institutions relevant to the project embrace a wide range of state control agencies that oversee implementation of government regulations by economic units, citizens and the appropriate departments of the production associations. Generally, such government and economic organizations are structured according to an established hierarchy in Kazakhstan. The following presents a brief listing of those institutions and agencies who will be involved in assessing the project.

Government Control Agencies

- The Environmental Department of the High Economic Presidential Council and Cabinet of Ministers of Kazakhstan is the supreme agency responsible for the state environmental policy-making activity and policy formulation.
- The Parliament of Kazakhstan, as the legislative branch of state power, is responsible for formulating laws related to environmental protection and the use of natural resources.
- The Ministry of Ecology and Bioresources of Kazakhstan (with regional departments in Mangystau Oblast (Aktau) and the Town of Uzen) is responsible for:
  - overall enforcement of environmental legislation in the areas they administer;
  - environmental review of feasibility studies of developments (see "Structure of Environmental Substantiation of Economic Activity in Mangyhshlak" for an overview of selected laws and regulations of Kazakhstan); and
  - issuing permits for the use of natural resources.
- The Ministry of Fuel and Energy, through its Environmental Department, provides guidance to environmental activities within this economic sector, including oil and gas fields, and production associations.
- The Ministry of Geology is responsible for efficient use of mineral resources. This authority is shared with the Ministries of Energy and Ecology in terms of the licensing of mineral resource uses.
- The Hunting and Fishery Inspectors of Aktau are subsidiaries of the Ministry of Ecology and provide for enforcement of relevant hunting and fishery regulations and the protection of rare and endangered species.
- The State Mining and Technical Inspectors (Gasgortechnadzor) of Aktau and the Town of Uzen oversee occupational safety and the implementation of technological regulations by the operators of the oil fields.

- The Sanitary and Public Health Inspectors of Aktau and the Town of Uzen oversee the implementation of sanitary standards and issue relevant permits for the disposal of municipal waste, etc.
- The State Hydrometeorology Committee (which has a departmental office in Aktau) conducts environmental monitoring.

Economic Enterprises

- The Munaigas State Holding Company embraces several oil and gas production associations. Its Department of Perspective Development and Ecology is responsible for conducting environmentally sound production, development and exploration activities by the production associations.
- The Mangystaumunaigas Production Association, through its Department of Labour Safety and Environmental Protection, is responsible for environmentally sound and safe activities.
- The Uzenneft NGDU, a production unit within Mangystaumunaigas, has an environmental department responsible for implementation of the various environmental protection measures relevant to this production unit.

Design and Research Institutions

- KazNIPIneft is the principle design and research institute directly involved in development of the Uzen oil field.

Non-Governmental and Public Organizations

- The Tabigat Green Party (or movement) is nominally established in Almaty but is not present in Aktau.
- The Society for Environmental Protection is a remnant of a Soviet-style, government-controlled public "green" organization. It is reported to be almost non-existent in Aktau.

Environmental Consulting and Engineering Companies

There are two noteworthy organizations in this category:

- KazEcology is a company associated with the Ministry of Ecology which provides a wide range of environmental consulting services and does several ecological research and development programs. Kazecology is a partner in this study.
- Eikos is an organization which designs, manufactures and services various environmental control devices. Eikos has been consulted regarding this study.

14.1.2 Existing Approvals Process/Responsibilities

The environmental assessment of the rehabilitation program will be reviewed initially by the Federal Ministry and associated departments. The assessment will also be submitted to the Aktau Committee for approval. The Ministry office in the Town of Uzwn will be directly responsible for reviewing the Uzen oil field component of the project.

14.2 EXISTING ENVIRONMENTAL MANAGEMENT AND INSTITUTE DEFICIENCIES

There are several common problems of environmental management organizations identified in the consultation program. These are:

- financial difficulties and material/equipment shortages;
- low priority given to environmental protection; and
- lack of human resources.

14.2.1 Financial Difficulties and Material/Equipment Shortages

This was the most serious problem identified by all the consulted agencies and organizations. The crisis of national economy and breakage of ties between the former Soviet Union states is the main cause of this problem. The project may help solve this problem in two ways. First, the project is of national importance and may bring additional funding from the national government to the agencies overseeing project implementation. The existing facilities of some regional environmental control agencies (such as Hydromet and the Department of Ecology) will be contracted to do monitoring, chemical analyses, etc. This should also bring in additional funding.

14.2.2 Low Priority of Environmental Protection

The attitude that environmental protection is a low priority was a standard approach in the Soviet era. This trend toward environmental management has been slowed in recent years by the economic crisis of restructuring. Another prevailing attitude is "production at any (environmental) cost". With the short-fall of production and the problems with interagency payments, the enforcement of laws which would penalize non-complying enterprises was practically impossible. In some cases, these enterprises did not have the funds to pay any penalty. The result is that environmental offenses were frequently covered up or ignored simply because the control agencies understood the difficulties that enterprises encountered. As well, the standards and targets to which these enterprises were to comply were frequently unrealistic. Protection of the environment and the use of environmentally sound technologies are key priorities of the project and will make it an example for other oil development enterprises. This will raise the priority of environmental protection on the list of economic priorities and also increase the status of environmental control and management agencies.

14.2.3 Human Resources

The drain of qualified specialists from governmental agencies due to low wages has also become a serious problem. The training program outlined above also embraces employees of environmental departments of production associations. They will be given good opportunities for professional growth and supported with equipment, adequate salaries, incentives and career paths. Training courses for local environmental inspectors are also expected to be organized within the project framework. The high status of the environmental component of the project will increase the stature and authority of the environmental inspectors.

14.3 RECOMMENDATIONS FOR STRENGTHENING LOCAL ENVIRONMENTAL INSTITUTIONS

The following items are required to achieve effective environmental management at the national level:

- development of sound environmental policies and laws;
- incorporation of environmental concerns into economic development planning and budgeting;
- interagency coordination on environmental issues which cross jurisdictional boundaries;
    - mechanisms to resolve interagency disagreements on natural resource-use decisions;
    - operation of monitoring programs;
    - establishment of guidelines for environmental assessments; and
    - provision for the independent review and approval of environmental assessments prepared for the appropriate agencies.

The Kazakh government will require assistance to achieve the above directives. The following are recommended to strengthen local environmental institutions and environmental management capabilities.

- **Create an interface with international organizations.** Ensure that national and local institutions are assisted by international specialists and are encouraged to:
    - participate in environmental assessments;
    - participate in project planning and design;
    - issue the required permits;
    - monitor construction activities and impacts;
    - implement certain mitigation measures;
    - monitor project operations;
    - operate public works as a part of the project;
    - control induced development; and
    - satisfy higher demands for municipal services.
- **Import foreign specialists in specific areas to facilitate skill and technology transfer.** Ensure individuals are trained in specific aspects of environmental management, such as monitoring. Training should emphasize standardized techniques and methods, calibration of instruments, and record keeping.
- **Enhance employment benefits, working conditions, and health and safety plans through training and awareness programs.**
- **Improve the use of existing technologies through skill technology upgrading.** Train local personnel to use existing computer hardware and software for environmental management. Improve databases and analytical techniques.

- **Implement a coordinated strategic approach to environmental management** in consideration of the National Environmental Action Plan. A key component of this plan is the World Bank Technical Assistance Project.

PART 15 - SOCIO-ECONOMIC ACTION PLANS: PUBLIC PARTICIPATION

15.1 INTRODUCTION

The overall objective of this project is the rehabilitation of the Uzen oil field in a manner that encourages the protection of the environment, limits socio-economic disruption and maximizes local benefits. To meet this commitment, project management will work closely with governments, local communities and other appropriate interest groups in project planning, construction, and operation and maintenance activities.

Socio-economic action plans are developed to help optimize the socio-economic effects of the proposed programs and facilitate effective management of these programs. The following outlines key elements of the socio-economic action plan.

15.2 INFORMATION ACTION PLAN

A factor in public acceptance of the project is preconceived ideas of what the rehabilitation project is and how it will affect people. The public's perceptions may be based, in part, on previous oil development activity that has taken place in the region and the resulting environmental, economic, social and cultural concerns that arose. The information component of this plan will attempt to address these preconceptions by providing information about all aspects of the Uzen Field Rehabilitation Project.

The community information program will be designed to meet the following objectives.

- Assist the general public to understand the rehabilitation project so they can anticipate and prepare for project involvement by seeking employment or business opportunities.
- Provide a communication link for information on specific local economic opportunities.
- Acquaint the public with the proponent's socio-economic and environmental plans and policies.
- Establish a feedback mechanism to enable the proponent to address issues and public concerns during project implementation.

Project-related information will be available to all interested parties on a timely basis. The following specific guidelines will characterize the information program.

- All personnel involved in public communications will receive briefing and orientation on the existing socio-economic and environmental circumstances of the area in general, and on any specific communities they will be visiting.

- The roles and responsibilities of all personnel involved in public communications will be clearly established.

The proposed information program will cover at least three geographic areas: the town of Novy Uzen and the adjacent community of Tenghe; the rural villages of Butakoz, Kulandy and Oktiabrskoe; and the city of Aktau. Communications will be made through televised announcements, radio and newspaper, as well as through community consultation programs.

15.2.1 Public Information Plan

The public information plan will target communities most affected by the project. It will present detailed, factual information concerning all components of the Uzen Field Rehabilitation project in a manner that facilitates the identification of local concerns by residents of these communities. The general content of the project will include, but not be limited to, the following information:

- What is the Uzen Field Rehabilitation project and how does it differ from development projects of local/national oil companies?
- What is the role of the World Bank and how do they differ from other potential investors?
- A project description of the Uzen Field Rehabilitation Project, including the initial phase financed by the World Bank (i.e., program and project description).
- An overview of the project's objectives and management philosophy, such as: increased production, the economic benefits for Kazakhstan and local communities, technology/skill transfer, and responsible operating practices, including environmental protection and enhanced socio-economic benefits.
- Details of the Environmental Protection project: environmental impact assessment, site assessment, remediation programs and limitations as to what can be accomplished.
- Details of the socio-economic action plan: employment and training opportunities, business/contract opportunities, and cross-cultural orientation.
- An overview of western industry practices and experience to ensure environmentally sound and socially sensitive development.

15.3 BUSINESS OPPORTUNITIES ACTION PLAN

Maximization of regional participation in the rehabilitation of the Uzen oil field will be encouraged. The project will endeavour to create a number of local business opportunities. Regional business development, particularly where the business can be maintained following completion of the rehabilitation project, will also be supported as much as possible.

Some basic premises have been established to help ensure that expectations are reached and positive results are achieved through the potential business opportunities created by the project:

- The regional business community should accept its responsibility to take the initiative by vigorously pursuing potential opportunities on a competitive basis.
- Investment of venture capital in the establishment of new businesses or the expansion of existing business to meet the needs of the project will be encouraged, only if it can be demonstrated that viable longer term opportunities are available.
- Technical advice to local contractors with respect to contract details and logistical matters generally will be provided.
- All contractors will be required to utilize regional goods, services and labour to the maximum extent possible.

There are several socio-economic initiatives that may be undertaken to enhance the beneficial opportunities of the project. Most of these initiatives relate to the supply of goods and/or services. Specific opportunities have not yet been detailed, but the following list offers some examples.

- Environmental monitoring and remediation: establish regional environmental services capability to do the on-going field sampling of water, soil and air. Become involved in any future cleanup or remediation work. These initiatives would contribute to the project's objective of strengthening local capabilities. Such services can be established in cooperation with existing environmental control facilities and organizations.
- Catering and camp services: encourage the formation of a joint venture between regional interests/enterprises and an experienced catering contractor to service camps.
- Service/drilling rig contractor: offer arm's-length business/management advice to existing contractors and assess their potential to provide a comprehensive service, possibly through a joint venture.

15.4 ORIENTATION ACTION PLAN

New employees will require project orientation. This will include working procedures and rules, as well as environmental and socio-economic conditions.

A comprehensive cross-cultural orientation regarding business practices/standards and workplace behaviour will also be conducted. Such an orientation will enable increased productivity without social disruption. This will be particularly important in subsequent phases with the involvement of foreign workers.

The orientation program will be consistent with overall rehabilitation project objectives and will cover, but not be limited to, the following topics:

- project familiarization, including the project venture, contractor and government relationships;
- terms and conditions under which the project will be undertaken;

- physical environment within which the project will be undertaken, including environmental inspection and monitoring arrangements (with particular reference to environmental rules, regulations and penalties);
- socio-economic environment, including cross-cultural training;
- local economic and cultural characteristics to enhance local business involvement;
- regulations, including conduct codes, rules governing equipment and vehicle use, hunting arms control, and penalties for illegal alcohol and drug abuse; and
- living and working conditions, and safety and security measures.

15.5 CONSTRUCTION AND OPERATION TRAINING, AND THE EMPLOYMENT ACTION PLAN

Project managers should work closely with contractors to enhance regional employment opportunities by developing a plan that will ensure:

- provision of information which identifies project-related labour requirements, including job descriptions for all employment opportunities; and that
- all workers participate in an orientation program which outlines the project policies and applicable government regulations.

The rehabilitation project will help develop a permanent regional labour pool with the capabilities to provide a safe, reliable and effective operation. In doing so, this plan will assist regional residents in achieving the maximum long-term employment benefits associated with the project. It will also help retard the out-migration of qualified personnel from the region.

Manpower training should be initiated in order to provide qualified personnel for the rehabilitation project. Selected individuals employed by the Uzenneft Production Association will be involved in a training program which targets the establishment of a joint Western-Kazakh-Russian Project Implementation Team. The plan will include training in the following areas: management, English and Russian language, computer/word processing, technical area specifications, cross-cultural and social issues, environmental assessment, and legal considerations.

The program venture will ensure that regional residents receive preferential opportunities for permanent employment.

15.6 COMMUNITY INFRASTRUCTURE ACTION PLAN

Housing is not currently a key concern of the residents as many people have recently left the area. However, quality of housing is an important issue. Since the project is not expected to result in an increase in population, the main emphasis of the Housing Program will be improvement of existing housing conditions through repair and renewal.

15.6.1 Medical Services Action Plan

The project will provide and enforce a safe working environment for its employees. The project will also ensure that adequate emergency facilities and personnel will be available to deal with most situations through a regionalized health infrastructure. Medical equipment upgrades and additional training may be required.

Consultation with responsible health care agencies will be required to assess the potential capabilities and capacity of the regional medical services delivery infrastructure. Specifically, consultations will help agencies determine the number and type of additional personnel needed, as well as the facilities/equipment required. In addition, dedicated project facilities, personnel and equipment will be made available to relevant local emergency centres.

15.6.2 Security Action

Project management will work closely with the appropriate authorities to ensure that security and enforcement systems in the region are adequate to meet any additional demands that may be placed on them as a result of the rehabilitation project.

PART 16 - CONCLUSIONS AND RECOMMENDATIONS

Without rehabilitation, the economic viability of the present Uzen oil field is limited. Under the current oil field management practices the amount of recoverable reserves is nearing completion. Markets for commodity oil are limited due in part to the presence of high levels of impurities in the oil coupled with the lack of available technology to remove these impurities. Many workers have not been paid for several months, hence many skilled workers have already left. Unemployment is also prevalent as many workers have been laid off. Financial constraints have meant that facilities have not been maintained; the result is environmental degradation. Penalties for exceeding maximum permissible pollution standards have remained unpaid, and are generally ineffective as the Production Association has not received payment for the commodity oil for some time.

The Uzen Oil Field Rehabilitation Project represents an important opportunity to correct many of these problems. There are definite direct and indirect positive impacts expected from this project on economies at the local, regional and national levels, as well as the environment on a local level. Directly, the rehabilitation project is expected to bolster the level of recoverable reserves for the field to 35% of the original-oil-in-place. This should, in itself, prolong the life of the field for 20 years. Additionally, with improved technology and linkage with western investors, further exploration will be made into viable markets for the commodity oil.

Indirectly, the project is expected to enhance employment by direct hiring to implement the project, stimulating local oil field service industries, and enhancing the local light industry and food and service industries. The project will also generate an environment of technology transfer—an aspect that is critical in enabling the region to obtain economic sustainability. The project will also enhance occupational health and safety through training and incentive projects.

From an environmental standpoint, the rehabilitation project will have a direct positive impact through the cleanup and remediation of existing disturbances. Indirectly, through the replacement of worn-out and defective facilities, and through the implementation of proper oil field practices, the project will ensure that future operations within the Uzen oil field are conducted in an environmentally conscious manner. Implementation of the project also has the potential of generating a new environmental awareness and greater understanding of how oil field practices can affect the environment.

Recommendations to be considered for future project implementation include the following:

- Data gaps should be filled, as outlined in this report.
- More data should be collected to characterize the nature and extent of contamination from spills in the field and the waste pits so that the appropriate remediation options can be implemented.

- Construction activities associated with the rehabilitation plan should be conducted in such a manner as to minimize surface disturbance and prevent mixing of highly saline subsoil with topsoil.
- Hazardous areas in the field should be delineated and access into these areas should be controlled. These include areas of radiation hazard and the refuse dump.
- A thorough environmental monitoring program that includes analysis for known and suspected contaminants should be implemented for air, soil and groundwater, to assist in establishing baseline conditions.
- Follow-up public consultation programs should be implemented.
- Existing occupational health and safety training programs should be extended to include all workers, and modified to include the importance of environmentally sensitive oil field practices.

PART 17 - DATA GAPS

Database

- More information on rare and endangered plant species is required. In particular, it is important to know their scientific names and more detail on the status of their populations.
- More complete information (e.g., habitat requirements, nesting areas, breeding periods, etc.) is required for all species of birds within the Mangyhshlak Region.
- Spawning sites and critical fisheries habitat within Kazakh Bay need to be identified.
- More information on reptiles of the Uzen oil field area is required.

Pilot Remediation Program

- Applicability of pilot remediation measures in view of existing climates. Especially pertinent to landfarming.

Surface Water/Groundwater

- Investigations of surface water quality for livestock watering (source and quality) should be determined and potential impacts assessed for the oil field.
- More information is required on the stratigraphy and volumes of groundwater within the Uzen oil field.

Air Quality

- All sources of existing air emissions should be identified (benzene).
- Identify the impact of the existing oil field operations on small mammals to determine, through food chain linkages, impacts to the endangered Saker falcon.
- The level and extent of radiation hazard requires further action.