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ENVIRONMENTAL IMPACT ASSESSMENT

NURA RIVER CLEAN-UP PROJECT

REPUBLIC OF KAZAKHSTAN

Committee for Water Resources
of the Ministry of Natural Resources and Environment
Republic of Kazakhstan
Astana, Kazakhstan

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EXECUTIVE SUMMARY

BACKGROUND

The Nura River in the northeastern part of Kazakhstan served for many years as a receptacle for a brew of untreated industrial wastes. Of particular concern, the carbide factory in Temirtau discharged large quantities of mercury into the river for 25 years. Mercury is a very toxic, mobile, persistent and bioaccumulative pollutant. The discharges ceased when the factory closed, but surveys of the factory site, river channel and floodplains conducted by international and Kazakh experts suggest that large quantities of mercury remain in the environment.

Some 1.5 million people live in the Nura-Ishim river basin. Most live in the national capital, Astana, and the cities of Karaganda and Temirtau, which together have a population of 925,000. The agricultural users in the Nura basin are found in scattered, small communities throughout the basin. Farmers once relied on highly subsidized irrigation systems, but with the removal of subsidies, most farmers abandoned irrigation and now rely on subsistence rainfed farming. Although many industrial enterprises have closed or scaled down production in the face of world market competition, water-consumptive heavy industry continues to employ the bulk of workers in the basin. In addition to serving direct human needs, the Nura eventually discharges into the Kugaldzino wetlands, an internationally-recognized nature reserve.

For many years, the basin residents consumed the highly polluted waters, but with Kazakhstan's independence, the mercury and other pollution became known and human use of Nura waters virtually ceased. Water supply alternatives to the Nura exist, however the Kazakhstan National Environmental Action Plan and other studies have assessed water management options and identified Nura River mercury cleanup as a top priority for providing long-term water supply to the basin.

In order to solve the problem of future water supply for the region, the Government of Kazakhstan (GOK) has requested the World Bank to prepare a loan for mercury cleanup from the Nura. The project objective is to provide users in the Nura-Ishim basin with access to safe, reliable, and affordable water supplies by cleaning up the mercury pollution, instituting effective water quality protection measures, and optimizing use of available water resources. Improved water supply from the Nura will in turn help meet additional demand for Astana; increase reliance on local water resources by basin users; and increase summertime flows to the Kurgaldzhino wetlands.

This loan project is part of the integrated World Bank Strategy for Kazakhstan. The Borrower for this project is the GOK Ministry of Finance. The main beneficiary is the GOK Committee for Water Resources of the Ministry of Natural Resources and Environmental Protection (CWR). The main components of the loan are clean-up of sites contaminated with mercury in the Nura River basin; rehabilitation of the spillway at the Intumak Reservoir; and institutional strengthening for water quality protection and water resources management. The Intumak Reservoir rehabilitation is included conditionally in the loan program, depending on the outcome of a 1-year study of the nature and significance of mercury methylation processes in the reservoir sediments.

REASONS FOR PROJECT CLASSIFICATION

The proposed project's primary objectives are environmental restoration, specifically the cleanup of mercury contamination in the waters and soils of the Nura River basin, as a necessary step in assuring safe water supply and agriculture for humans and a clean environment for natural habitats and ecosystems. However, contaminated ground cleanup is a very complex process, not as predictable or as amenable to conventional engineering project management as other types of pollution control or infrastructure development. This is especially true where such a large number and diversity of sites must be addressed over an area as large as an entire river basin, and where the primary contaminant of concern is as toxic, mobile, persistent and bioaccumulative as mercury. The need for very careful planning and very specialized precautions and mitigating measures to prevent, minimize or respond to inadvertent releases of mercury compounds and associated pollutants requires conducting an Environmental Impact Assessment (EIA) and preparing an Environmental Management Plan (EMP). The proposed cleanup project has therefore been classified as a Category A project, because it could cause significant environmental impacts affecting an area broader than the sites or facilities subject to remediation.

JUSTIFICATION FOR RECOMMENDED CLEANUP ACTION AND PERFORMANCE LEVELS

The mercury cleanup will utilize a flexible approach involving a combination of Kazakh and various World Bank or other international reference standards, in addition to risk-based cleanup levels, to determine both what level of existing contamination of soil, groundwater, sediments or surface water should trigger cleanup action at a specific site and what concentrations of hazardous substances can remain in the environment in order for cleanup to be deemed complete at a specific site. Reliance on multiple sources of standards is necessary, especially for soil cleanup, because few countries have a complete set of soil cleanup standards capable of addressing all envisaged cleanup situations. More importantly, given the magnitude and complexity of the proposed cleanup project, site-specific risk assessment, which quantifies contamination sources, pathways and receptors for each mercury contamination site in the river basin, is the most efficient and effective means of conducting the cleanup. Similarly, a risk-based approach (possibly in combination with European Union standards) is recommended for design of the landfill where contaminated materials will be moved for disposal.

PROCEDURES USED TO PREPARE THE REPORT

The CWR procured the services of a team of international and domestic environmental consultants to prepare the EIA. It should be emphasized that the EIA consultant team is independent of the project proponents – CWR and World Bank – as well as other project participants such as the feasibility study consultants. The team includes a project manager with extensive international experience in both EIA and contaminated site cleanup, as well as experts in public consultation, hydrogeology, geochemistry, geotechnical engineering, chemical engineering, biology, ecology and mercury cleanup. The team visited the project vicinity twice. During the first visit, the team met with the World Bank, CWR project implementation office and social impact assessment consultant in Astana and with the Nura-Ishim Water Basin Authority, Karaganda Region Akimat and Regional Department of Ecology in Karaganda; held initial public hearings in Karaganda and Temirtau cities; visited the contamination sites at AO Karbid and along the Nura River; and gathered and reviewed all available background documentation. The second visit focused on coordinating preparation of the EIA with the Feasibility Study; conducting the second set of public hearing in Karaganda cities; and obtaining and responding to World Bank and CWR comments on the Draft EIA.

ENVIRONMENTAL BASELINE CONDITIONS

Several studies of mercury contamination in the Nura River basin have been conducted over the past 10-15 years. In general, mercury-contaminated soils and sediments have been discovered in the following high priority sites in the Nura River basin:

- The main mercury contamination sources in the Temirtau area, including the AO Karbid factory site (five buildings, main sewer line from production areas to wastewater treatment plant (WWTP), WWTP site, banks of main drain from WWTP to Nura), the Zhaur Swamp, and the old ash lagoon at the power plant
- The river bed and river banks for 25 km below the Samarkand reservoir, including the backwaters of the river and oxbow lakes on the floodplains
- Floodplains in the same 25 km river stretch, including an estimated 3% of whose topsoil (5.8 km2) is considered hazardous

There are other heavy metals and organic pollutants found in the Nura River basin, but the mercury contamination is the most significant obstacle to assuring safe, reliable and affordable drinking water supply to residents of the basin. There are also other man-made and natural sources of the mercury, but the sources listed above are the primary sources.

ALTERNATIVES CONSIDERED

The EIA identifies and evaluates several alternatives to the proposed project, including the no action alternative; alternative ways of providing clean drinking water to the region; several cleanup technology alternatives, including different combinations of technologies and locations of their application; alternative off-site storage/disposal locations; and some implementation program alternatives. Despite the risks involved with a hazardous waste site cleanup of this magnitude, the benefits for public health and environment, especially by enabling the Nura River to serve as a future source of water supply to the region, outweigh the risks. Other sources of water supply in this dry region have been evaluated and found to cost more to develop and sustain than cleaning up the Nura River.

Different technologies, and different combinations of technologies and locations of their application (i.e., in-situ, on-site and off-site) may be appropriate for different contamination situations in the river basin. It is unlikely that a single solution will be found that addresses every situation. Therefore, further study of the appropriateness of specific cleanup technologies to specific contamination sites should be conducted during remedial design for each site or group of sites. (This process is already underway for the cleanup of the AO Karbide site and the Old Ash Fill.) In addition, water and land use restrictions should be imposed in appropriate areas of the basin to minimize risks to public health before, during and after remediation.

Likewise, alternative locations and designs are evaluated for a centralized landfill facility for treating and disposing the removed contaminated materials. The EIA concludes that: (1) the suitability of the Zhaur Swamp relative to Kazakh and international standards for landfill location and design would need to be better established with flood mapping and soil permeability testing; (2) if the swamp were to be used as a landfill, then additional flood protection should be provided; (3) alternative sites to the swamp may be more suitable as landfill locations due to reports of multiple floods around the swamp and existence of a more porous stratum, that may be serving as an aquifer or conduit to the river, that underlies a portion of the swamp and is separated from the swamp by a relatively thin layer of sub-clay soils; and (3) the clay thickness and permeability and groundwater depth, flow direction, flow rate, quality and use at alternative landfill sites should be studied further before final site selection.

Implementation program alternatives being considered include breaking the cleanup program into more manageable groupings of similar sites; combining the remedial design contracts with the remedial action oversight contracts for each group of sites; packaging any necessary additional sampling and analysis and treatability studies with the remedial design and remedial action for each group of sites to expedite cleanup wherever possible; and providing independent contractors for program-wide oversight of environmental assessment and monitoring, health and safety assurance, and public consultation.

PREDICTED IMPACTS OF THE CHOSEN ALTERNATIVE

No single alternative will be selected for cleanup of mercury contamination in the entire Nura River basin. Rather, the chosen strategy utilizes cleanup approaches tailored to site-specific conditions of each contamination area, including type of environment (buildings, swamp, river bed, river banks, floodplain, etc.), nearby population and land use, type of contaminated media (surface water, ground water, type of soil, etc.), size of site and volume of contaminated material, concentration of mercury, presence and concentrations of other contaminants, distance from disposal areas, etc. Some of these site-specific cleanup decisions will be made during the remedial design and remedial action stage based on further sampling and analysis, treatability studies, etc. (This process is already underway for the Temirtau area source sites, such as the AO Karbide site, Zhaur Swamp site and Old Ash Fill site.) Certain unit processes, however, will be common to many of the site-specific cleanup approaches and their environmental impacts can be predicted. Most cleanup operations will involve excavation and removal of mercury-contaminated sediments, soil or building materials. The biggest risks of such operations are inadvertent increases in mercury releases to the environment, especially air, soil and surface water, of mercury that had been to some extent chemically or physically contained . Releases to the air are particularly problematic since mercury readily vaporizes, can be suspended in the air for long periods, transported long distances, and then redeposited on land or surface water during rain or snow thus starting the cycle over again. Releases to surface water can occur through the stirring up of river bed sediments and river bank soils and through erosion of removed or residual contaminated soils from river banks and floodplains. All of these removal-related impacts will be short-term (during the cleanup period), very minor and avoidable or reducable by implementing the mitigation measures described in the Environmental Management Plan, or EMP (see below).

As mentioned, however, the cleanup design process is already underway for the Zhaur Swamp site where one option for cleanup would involve isolating the contaminated materials in place using a cover, berms and cut-off walls, rather than excavating and transporting them to an off-site landfill. This option may be acceptable environmentally only if it could be demonstrated that the isolated area would not be subject to flooding by the Nura River and that there is no risk of breakthrough of contamination below the swamp to a subsurface layer serving as an aquifer or route for transport of contamination to the river. The data available are conflicting with regard to both concerns. The flooding issue may be resolved by some combination of increasing the capacity of the Samarkand dam and reservoir, enlarging or moving the channel of the Nura River near the swamp, and encircling the swamp with a flood barrier. However, even if the possibility of flooding or subsurface transport to the river were relatively small, the consequences of such events could be catastrophic for public health and the environment, given the volume, mobility, persistence and toxicity of mercury. For this reason, it is important to look very long-term. For example, flooding of the swamp may occur every 10 years or only once in 100 years. Either way, the consequences are unacceptable and therefore it is recommended that the contaminated materials in the Zhaur Swamp be excavated and transported to an alternative landfill location.

Another exception to the remove and transport approach is the option selected by the Feasibility Study for cleanup of the river bed itself. The proposed plan involves excavating a new river channel in clean soils so that the river water would not be in direct contact with contaminated materials at active cleanup sites in the existing channel. After cleanup, the river would be redirected to its current channel. Three alternative versions of this approach are possible, including using an ancient channel that is now dry; digging a new channel the full length of the the river where the cleanup sites will be; and digging the new channel in short sections only around individual cleanup sites and using them only during the cleanup of the respective sites. The last alternative is preferable from an environmental perspective, because it allows minimization of the length and time of river to be redirected at any one time. Also, it is likely that flooding in the past few decades has reached the ancient river channel and left some mercury contamination there, while there is more flexibility to locate new channel sections in clean soils. In general, many impacts of this approach would be similar to those of excavating and transporting contaminated materials from upland areas, as discussed elsewhere in this summary. In addition, however, redirecting the river channel would adversely impact the natural ecosystem and biota of the existing channel for the short- to mid-term. Redirecting the river in short sections for short time periods will minimize these impacts and maximize the ability of the ecosystem and biota of clean upstream sections to recover and repopulate downstream sections.

The net ecological effect on the existing channel of cleaning up the mercury contamination is expected to be positive.

Additional impacts of the excavate and transport approach are possible from the transport of contaminated materials; these include the possibility of mercury-contaminated dust blown from transport trucks as well as the more typical impacts of truck traffic such as noise, vibration and air emissions of hydrocarbons, nitrogen oxides and carbon monoxide from truck exhaust. Again, all of these impacts will be short-term (during the cleanup period), very minor and avoidable or reducable using the mitigation measures in the EMP.

Land disposal will be used to manage the removed mercury-contaminated materials. Unless properly located, designed and operated for the specific wastes being deposited, landfills pose a risk of wind-blown mercury-laden dust, mercury methylation and release of mercury vapors, formation of mercury-containing leachate entering ground water, and erosion and transport of mercury-containing materials through runoff to surface waters. As discussed under Alternatives Considered above, there are some concerns about the suitability of the Zhaur Swamp as a landfill site that should be addressed before a site is selected. The risks of the Nura River flooding the swamp and breaching the landfill cover or of eventual leakage of contamination to subsurface layers that provide a transport route to the river make this location less suitable from an environmental perspective than alternative sites. Any additional impacts from the increased number or length of truck trips needed to transport contaminated materials to an alternative landfill location would be very minor, short-term (during the cleanup period), and avoidable or reducable using the mitigation measures in the EMP. These transport impacts pose small incremental risks as compared with the potential catastrophic consequences of a flood of the swamp or of breakthrough of contamination below the swamp. One of the alternative landfill sites described in the Feasibility Study can be selected on the basis of economic suitability (transport costs, land availability, construction costs, etc.) and designed, constructed and operated to provide more protection of surface and ground water than the Zhaur Swamp. In summary, once in the environment, mercury is of great concern as it is mobile, persistent, bioaccumulative, bioconcentrating, and acutely toxic in some forms. It is these same properties that require the proposed project to be implemented in the first place. Therefore, it is important that the selected cleanup approaches be tailored to be as technically effective as possible at individual contamination sites in the river basin, while being sufficiently economical to allow most of the significant contamination areas to be cleaned up. In addition, though, each site cleanup should be designed and carried out with adequate mitigating measures and emergency response procedures to avoid inadvertent short-term releases to other environmental media, and hence to remediation workers, nearby residents and sensitive species, habitats and ecosystems. It is believed that all of these impacts can be avoided or mitigated to a large extent through implementation of the EMP (see below) which includes physical and institutional measures to prevent, minimize, monitor, contain or otherwise respond to releases during and after remediation.

The EIA also assesses the potential environmental impacts of economic and population growth induced by increased water supply resulting from the proposed project. Such impacts are very difficult to predict at this time but will probably be minimal. Residents and agriculture are already using contaminated water, so the project will be supplying more clean water as a proportion of the total water supply. In addition, parallel programs to repair leakages in the water supply networks of the region's cities will improve water supply efficiency and reduce the need to increase abstraction from the Nura River. Further, it is unclear that additional water supply by itself will be sufficient to stimulate economic growth in the region; a wider range of environmentally sustainable development measures will likely be needed. A separate water resources planning study to be conducted using British DFID funding will address water supply needs and recommend rational water allocation among the cities, industries, agriculture and wetlands in the region.

SUMMARY OF THE ENVIRONMENTAL MANAGEMENT PLAN

The EMP provides a thorough presentation on mitigation measures applicable to the stages of mercury contamination cleanup likely to be recommended in the final Feasibility Study. These include:

- Site management and institutional controls – limiting access to cleanup sites and restricting land and water uses where appropriate

- Health and safety protection for cleanup workers and nearby residents – medical monitoring, airborne mercury monitoring, personnel training, use of personal protective equipment, decontamination of equipment, communications

- Contingency planning and emergency response – on-site emergency response, community emergency response, incident reporting, practicing responses, first aid procedures and equipment, training, spill control and countermeasure plan

- Mitigation measures for removing wastes from buildings – recommended tools and techniques, including vacuum technology and cleanup kits, specialized for mercury removal

- Soil removal mitigation measures – timing of operations to avoid wet weather, flooding and high winds; covering of excavation areas and stockpiled soils to prevent mercury vapor and dust emissions and rain erosion, underlining of soil stockpiles to prevent leaching to clean soil and groundwater, installation of berms and ditches to control surface water run-on and run-off

- Soil transport mitigation measures – waste characterization and segregation, labeling and manifesting of trucks, safe loading and unloading, wetting wastes and covering trucks with canopies to prevent dust generation, emergency response, truck decontamination, truck maintenance

- Landfill mitigation measures – separate landfill cells for wastes with high moisture and/or high levels of organic mercury compounds, liners equivalent to European Union (EU) or other international standards; further evaluation of the need for leachate and gas collection and treatment; cover meeting EU or other international standards, waste analysis and acceptance procedures, facility inspection plan, contingency and emergency response plan, personnel training plan, environmental monitoring plan, and closure and post-closure plan.

The EMP also summarizes a series of environmental monitoring programs, aimed at measuring contamination in air, soil, surface water, sediments, ground water, drinking water, fish, crops, livestock, and humans before, during and after cleanup. Monitoring parameters, locations, frequencies and methods are provided for each cleanup program activity.

A program of capacity building is proposed, including organizational development, staffing, training and equipment procurement relating to health and safety, contingency planning and emergency response, environmental mitigation and monitoring, and social assessment and public consultation.

Institutional arrangements, schedules and costs for implementing the mitigation, monitoring and capacity building measures are also provided. Implementation will be accomplished primarily through a project management structure led by CWR/BVO and supported by staff of relevant government agencies seconded to the project and domestic and international consultants.

CONSULTATIONS WITH AFFECTED GROUPS AND LOCAL NGOS

A public consultation process has been implemented whereby a local coordinator was hired; local NGOs and government officials were brought into the planning process; initial public meetings were held in early February 2002 in two locations, Karaganda and Temirtau cities; a final public meeting was held in late April 2002 on the Draft EIA; and mechanisms were developed to facilitate ongoing public consultation on the project through the implementation phase. A large number of local government officials, academics, students and NGO representatives attended the initial public meetings. The project and EIA process were described; comments were solicited on what should be considered in the scope of the EIA and what key issues the EIA should focus on. There was excellent participation and discussion. The major comments related to what agencies are responsible for the project; what the decision-making process is; how the project will be paid for; what areas are contaminated and to what degree; what kinds of testing has been done and is planned; and what cleanup approaches and technologies are being proposed and what their respective environmental impacts are likely to be. Lists of attendees and summaries of their questions and concerns have been prepared (see Appendix C, Record of Public Meetings) and have been addressed in the EIA.

COMPLIANCE WITH WORLD BANK SAFEGUARD POLICIES

This EIA has been prepared and submitted in compliance with all applicable World Bank Safeguard Policies relating to EIAs. The overall EIA complies with the Environmental Assessment safeguard policy (OP4.01). EIA Sections 3.1.7-9 and 4.3.2 address compliance with the Natural Habitats safeguard policy (OP4.04). The Dam Safety safeguard policy (OP4.37) is addressed in a separate report (see Appendix B, References). The International Waterways safeguard policy (OP7.50) will be addressed separately through a letter from the Government of Kazakhstan to the Government of Russia. The Cultural Property safeguard policy (OPN11.03) will be addressed during the detailed design stage through the development of a "chance find" protocol that can be utilized during project implementation. The Pest Management (OP4.09), Forestry (OP4.36), Indigenous Peoples (OD4.20), Involuntary Resettlement (OD4.30), and Child and Forced Labor (Policy Statement) safeguard policies are not applicable to the proposed project.

ENVIRONMENT-RELATED LOAN CONDITIONALITIES AND COVENANTS

Environmental loan conditionalities and covenants will relate to the implementation of recommended mitigation, monitoring and capacity building measures, as described above.

1.0 POLICY, LEGAL AND ADMINISTRATIVE FRAMEWORK

It is intended that this Environmental Impact Assessment (EIA) be prepared in close conformance with Kazakhstan's and the World Bank's EIA content requirements. Therefore, this section outlines the EIA-related laws and regulations of the Government of the Republic of Kazakhstan (GORK) and the World Bank. Other laws and regulations may be mentioned in subsequent sections where relevant to discussion of the project's environmental impacts. It is beyond the scope of this EIA, however, to provide a full identification and analysis of all laws and regulations that may relate to the mercury remediation and water resources management components of the proposed project. The reader is referred to the Institutional Assessment (IA) and the Feasibility Study (FS) for more detail in these areas. Section 1.1 discusses Kazakhstan's EIA laws and regulations while Section 1.2 covers the World Bank's EIA policies and procedures.

1.1 KAZAKHSTAN LAWS AND REGULATIONS

The Constitution of the Government of the Republic of Kazakhstan (GORK) stipulates in Article 38 that "Citizens of the Republic of Kazakhstan must protect the environment." As the superior law of the land, the Constitution seeks to establish a legal framework for environmentally, socially and economically sustainable development of the country. Article 63(3) establishes that the RK Parliament can adopt laws on environmental protection.

Kazakhstan adopted its first Environmental Protection Law (EPL1) in 1991, a few months prior to the collapse of the former Soviet Union (FSU). It was modeled upon the FSU law and proclaimed the scope and various objectives of environmental management, mandated a ***state ecological expertise*** (SEE) and articulated certain requirements related to ***environmental impact assessments*** (EIAs) for various activities and projects. The SEE was mandated for national, regional and sectoral development plans and programs, individual projects, norms and standards, new technologies, regional environmental situations, and existing facilities having a negative impact on the environment as a whole and its various media.

In 1997, a new law ***On Environmental Protection*** (EPL2) was adopted. Article 2 establishes EPL2 as a framework and umbrella environmental legislation stipulating that certain aspects not covered by its provisions will be regulated under separate legislation on water, air, flora and fauna protection. Article 3 proclaims major principles of environmental protection, which include: priority of protecting human life, health and the environment; balancing of environmental, social and economic development objectives; ensuring ecological security (safety) and rehabilitation of degraded ecosystems; biodiversity conservation, prevention of environmental damage and of the state environmental regulation and control.

Articles 7–10 of EPL2 establish functions and responsibilities of a central executive environmental body of the RK, currently the Ministry of Natural Resources and Environmental Protection (MNREP), and of regional and local authorities in environmental protection. In accordance with the EPL2, the GORK is entrusted with overseeing the EIA process in Kazakhstan; establishing a list of and procedures for permitting and licensing nature use activities; establishing state environmental monitoring procedures and system; and regulating the SEE; among other responsibilities.

Articles 46–62 establish ecological requirements – particularly environmental quality criteria, maximum permitted concentrations and emissions (discharges, MPC/MPD) in various environmental media, norms for environmental, sanitary, water and other protection zones – for economic and other types of activity within project planning, design and EIA processes. Article 46 stipulates that an EIA has to a) identify environmental and other consequences of proposed economic and management decisions, b) develop recommendations to improve the environment, and c) prevent destruction, degradation, exhaustion of and damage to natural ecological systems and resources. An EIA process results in an EIA document [EIA Statement (EIAS)], which is an integral and obligatory part of pre-planning and design documentation. The EPL2 prohibited project development and implementation without carrying out an EIA and preparing an EIAS. Furthermore, the law prohibits retrofitting, liquidation and change of ownership for enterprises that have negative environmental impacts without carrying out an EIA, the implementation of necessary environmental improvements and mitigation of environmental damage. These measures must be approved by the MNREP.

In 1997, a law ***On Ecological Expertise*** (EEL) was signed by the President. The EEL elaborates on the relevant provisions of the EPL2, providing for: objectives and scope of the EE; responsibilities and accountability of public authorities, the private sector and civil society during EE process; and requirements and procedures of the EE. Article 5 establishes an EE as a mandatory, objective, comprehensive, integrated, scientifically justified, independent, transparent assessment process open to public that takes place prior to decision-making by a relevant authority on implementation of a proposed activity. In accordance with Article 6, all green-field construction, reconstruction, retrofitting and decommissioning design, project documentation and agreements are subject to the SEE.

Article 16 of the EEL outlines the concept of an EIA. Public or private sector proponent of an activity is responsible for conducting an EIA at pre-planning and design phases, and submitting an EIA report, together with other activity-related documentation, for the SEE. The law establishes that a proponent is responsible for carrying out an EIA, which is a mandatory part of pre-planning and project deign documentation, and related information dissemination and public participation. An EIA must include a) an assessment of types and magnitude of environmental impacts and risks, b) a forecast environmental changes due to the proposed activity and c) environmental protection measures to ensure compliance with all legal requirements. An EIA shall also evaluate impacts on human health due to environmental change. The EEL established that state and local administrative bodies, civil society organizations, judicial authorities, an office of the attorney general, affected citizens and an enterprise itself can initiate an EIA process.

- In addition to the above laws, there are corresponding implementing regulations dealing with EIA. ***This EIA has been prepared in conformance with the content and process requirements of the applicable and effective Kazakhstan EIA regulations, including:***

"Tentative Instruction on Procedure for Environmental Impact Assessment of Planned Activities in the Republic of Kazakhstan (OVOS)", Ministry of Ecology and Bio-resources, Almaty, 1993, PHD # 03.02.01-1993.

- "Recommendation on Environmental Impact Assessment to Biodiversity (Soil, Vegetation, Fauna)", Ministry of Biological Resources and Ecology, Almaty, 1996, PHD # 211.3.02.05-95.
- "Methodical Instruction on EIA of the Stored Industrial Waste in Warehouse and Stored Products and Materials on Open-type Storage", Ministry of Environment, Almaty, 1994, PHD # 03.04.01-94.

In general, the EIA instructions above provide:

- Descriptions of the EIA process and status, phases or levels, and duties and responsibilities of EIA process participants
- Scopes of EIA materials and contents of EIA documents required to be submitted at the different levels (environmental review, preliminary environmental assessment, and final environmental assessment)
- Forms for Declaration of Intent and Statement of Ecological Consequences (provided in Appendixes E and F).

1.2 REQUIREMENTS OF THE WORLD BANK

Environmental Assessment (EA) is one of the 10 Safeguard Policies of the World Bank. EA is used in the World Bank to examine the environmental risks and benefits associated with Bank lending operations. The Bank's environmental assessment procedures are described in OP/BP 4.01 (Operational Policy, Bank Procedures).

The Bank's policy stresses that EA should be thought of as a process rather than specific product. Key considerations when in the EA process include: linkages with social assessments, analysis of alternatives, public participation and consultation with affected people and NGOs, and disclosure of information. Like economic, financial, institutional and engineering analysis, EA is part of project preparation and therefore is the borrower's responsibility.

In World Bank operations, the purpose of Environmental Assessment (EA) is to improve decision making and to ensure that project options under consideration are sound and sustainable. EA is expected to inform decision makers on the nature of environmental risks such as human health effect, habitat loss, pollution levels, and land use change among other issues. EA is a process whose breadth and depth depend on the nature, scale and potential impact of a proposed project. EA is broad in scope and takes into account the natural environment as well as human health and socio-cultural aspects, focusing in on those issues and potential impacts that are determined as critical for a project's environmental soundness and sustainability. EA runs parallel with the process of identifying a potential project, designing it, and implementing it.

Close integration of EA with other types of project analysis ensures that environmental considerations are given appropriate weight in project selection, siting and design.

The Bank undertakes environmental screening of each proposed project to determine the appropriate extent and type of EA. The Bank classifies the proposed project into one of four categories, depending on the type, location, sensitivity, and scale of the project and the nature and magnitude of its potential environmental impacts. According to classification of the World Bank based on Operational Directive 4.01, this project is determined as category "A" which means that it is likely to have significant adverse environmental impacts that are sensitive, diverse, or unprecedented. These impacts may affect an area broader than the sites or facilities subject to physical works. EA for a Category A project examines the project's potential negative and positive environmental impacts, compares them with those of feasible alternatives (including the "without project" situation), and recommends any measures needed to prevent, minimize, mitigate, or compensate for adverse impacts and improve environmental performance. For a Category A project, the borrower is responsible for preparing a report, normally an EIA (or a suitably comprehensive regional or sectoral EA) that includes, as necessary, elements of the other instruments referred to above.

For all Category A project proposed for IBRD or IDA financing, during the EA process, the borrower consults project-affected groups and local nongovernmental organizations (NGOs) about the project's environmental aspects and takes their views into account. The borrower initiates such consultations as early as possible. The borrower consults these groups at least twice: (a) shortly after environmental screening and before the terms of reference for the EA are finalized; and (b) once a draft EA report is prepared. In addition, the borrower consults with such groups throughout project implementation as necessary to address EA-related issues that affect them.

For meaningful consultations between the borrower and project-affected groups and local NGOs on all Category A projects proposed for IBRD or IDA financing, the borrower provides relevant material in a timely manner prior to consultation and in a form and language that are understandable and accessible to the groups being consulted.

For a Category A project, the borrower provides for the initial consultation a summary of the proposed project's objectives, description, and potential impacts; for consultation after the draft EA report is prepared, the borrower provides a summary of the EA's conclusions. In addition, for a Category A project, the borrower makes the draft EA report available at a public place accessible to project-affected groups and local NGOs.

Once the borrower officially transmits the Category A EA report to the Bank, the Bank distributes the summary (in English) to the executive directors (EDs) and makes the report available through its InfoShop. If the borrower objects to the Bank's releasing an EA report through the World Bank InfoShop, Bank staff (a) do not continue processing an IDA project, or (b) for an IBRD project, submit the issue of further processing to the EDs.

During project implementation, the borrower reports on (a) compliance with measures agreed with the Bank on the basis of the findings and results of the EA, including implementation of any

EMP, as set out in the project documents; (b) the status of mitigatory measures; and (c) the findings of monitoring programs. The Bank bases supervision of the project's environmental aspects on the findings and recommendations of the EA, including measures set out in the legal agreements, any EMP, and other project documents.

2.0 PROJECT DESCRIPTON

2.1 BACKGROUND

In August 1950, the Karaganda Synthetic Rubber (SR) Factory began operations in Temirtau in Karaganda Oblast in the Republic of Kazakhstan. One of the process units at this plant, the acetaldehyde unit, used sulfuric acid and a sulfate salt of mercury (II) to catalyze the hydration of acetylene to acetaldehyde, a key component in the production of SR. This unit had a design capacity of 43,200 tons per year, expanded to 65,000 tons per year by 1964, and to 76,500 tons per year by 1975.

The plant became the joint stock company AO Karbide in the early 1990s. By 1995 output had been reduced to 36,000 tons per year due to a decrease of demand for acetaldehyde and equipment wear. Production at the acetaldehyde unit ceased in 1997, and in 1998 AO Karbide was split into three independent plants. The acetaldehyde unit was retained by state-owned AO Karbide.

During the acetaldehyde reaction process some of the mercury was transformed to metallic mercury and organic mercury compounds. Most of the mercury left the process either as a sludge from contact acid regeneration or in the residue from the distillation unit that separated acetaldehyde from unreacted acetylene. Distillation of mercury sludge from the contact acid regeneration process resulted in a treated sludge that from 1976 had been sent to the Nikitovski Mercury Combine for reprocessing. Mercury was also released to the atmosphere as gaseous emissions through venting of impurities from the hydration process, as well as from chilling of re-circulated cooling water and contact acid sludge dry distillation. Much of this was thought to be deposited on the grounds of the plant. A significant amount of mercury entered the AO Karbide plant wastewater stream.

The first stage of wastewater treatment at the Karaganda SR Factory began operations in 1950 at 3 000 m^3/day, and the second stage in 1954 at 5 500 m^3/day. Both stages featured biological filter beds. The sewage was then transferred into treatment tanks where it was chlorinated and silt from the biofilters settled. Overflow was discharged to the Main Drain through an underground collecting channel, and from there into the Nura River. Tank silt accumulated in the treatment tanks were deposited onto a sludge drying bed. Further expansion of treatment facilities was completed in 1966. Until 1969, sludge of poor quality was discharged into the depression known as the Zhaur Swamp, which is un-drained. In 1969 sludge filtration beds were constructed at the AO Karbide site. Mercury-containing sludge had also been deposited throughout plant operations in the 'old' ash lagoon of the KarGES-1 thermal power plant, located on the banks of the Nura River. There were numerous failures in the KarGRES-1 lagoon, which lead to periodic uncontrolled discharges of power plant ash and mercury-containing sludge to the Nura River.

Until 1975, wastewater treatment was not designed for removal of mercury from the wastewater stream. In that year a plant designed for removing mercury was conceived, and operations began in 1977. This treatment included neutralization of wastewater by alkali (sodium hydroxide) and coagulation. The plant capacity is 180 m^3/hour, and purification of inlet water (3-10 mg/l) was provided up to 0.7 to1.0 mg/l. Dilution of this waste stream lead to a further reduction in mercury concentration to 0.001 to 0.002 mg/l in the discharge from the Main Drain. Nevertheless, in spite of significant reductions of mercury in the discharge to Nura River, the mercury content in the discharge still exceeds the Maximum Permissible Concentration of 0.0005 mg/l in the Republic of Kazakhstan.

2.2 OBJECTIVES

In order to solve the problem of future water supply for the region, the Government of Kazakhstan (GOK) has requested the World Bank to prepare a loan for mercury cleanup from the Nura. The project objective is to provide users in the Nura-Ishim basin with access to safe, reliable, and affordable water supplies by cleaning up the mercury pollution, instituting effective water quality protection measures, and optimizing use of available water resources. The project intends to:

- Assure availability of Nura River water for meeting additional demand for Astana
- Increase reliance on local water resources by basin users
- Improve the water quality and increase summertime flows of the Nura River to the Kurgaldzhino wetlands

This loan project is part of the integrated World Bank Strategy for Kazakhstan. The Borrower for this project is the GOK Ministry of Finance. The main beneficiary is the GOK Committee for Water Resources of the Ministry of Natural Resources and Environmental Protection (CWR). The main components of the loan are:

- Clean-up of sites contaminated with mercury in the Nura River basin
- Rehabilitation of the spillway at the Intumak Reservoir
- Institutional strengthening for water quality protection and water resources management

The Intumak Reservoir rehabilitation is included conditionally depending on the outcome of a 1-year study of the nature and significance of mercury methylation processes in the reservoir sediments.

The specific objectives of the feasibility study contract are:

- To implement a Feasibility Study in order to develop a viable program for remediation (clean-up) of sites contaminated with mercury based on technical, economic, financial, social and environmental considerations.

- Assess the condition of the Intumak Reservoir and estimate the cost of works needed to reinstate the dam. This would allow the reservoir to serve as an effective settling basin for possibly contaminated river sediments.
- Assess the institutional needs for long-term water resource monitoring (including volume and quality) in the Nura River basin, primarily to support evaluation of the performance of the proposed loan.
- Assess compliance and enforcement in the Nura River basin: prepare a water pollution inventory; assess existing environmental standards, pollution fees and fines; assess enforcement capacity of the environmental authorities; recommend measures for strengthening the existing pollution control system.

The mercury clean-up component involves the clean up and disposal of mercury-contaminated soils and sediments from the following five high priority sites in the Nura valley:

- The main mercury contamination sources in the Temirtau area, including the AO Karbid factory site (five buildings, main sewer line from production areas to wastewater treatment plant (WWTP), WWTP site, banks of main drain from WWTP to Nura), the Zhaur Swamp, and the old ash lagoon at the power plant
- The river bed and river banks for 25 km below the Samarkand reservoir, including the backwaters of the river and oxbow lakes on the floodplains
- Floodplains in the same 25 km river stretch, including an estimated 3% of whose topsoil (5.8 km2) is considered hazardous

  Figure 2-1 shows the site and vicinity , including the features discussed above. Section 4.2.1 summarizes the alternative selected by the Feasibility Study for mercury cleanup in the Nura River basin.

3.0 BASELINE DATA

3.1 NATURAL SYSTEMS DESCRIPTION

This section provides a brief summary of the natural systems within the project area. More detailed information is available in the FS and earlier studies referenced in the FS. Figure 3-1 shows the area of influence of the proposed mercury cleanup project.

3.1.1 Geology

The stratigraphy of the project area is outlined below:

Upper Cambrian and Lower Ordovician formations are comprised of sequences of jasper-quartz rock, siliceous argillites, siltstones, and sandstones interlayered with strata of volcanic origin. Mid- to upper Ordovician formations are comprised of flysch-like siliceous sandstones, siltstones, and limestones interlayered with tuffs and volcanic basalts, which are exposed in the cores of anticlinal structures.

Lower to middle Devonian rocks of volcanic origin, a part of the Karaganda synclinorum, occur widely.

Sedimentary formations of carboniferous age are comprised of siltstones, sandstones, and conglomerates which form synclinal structures and troughs. Weathered zones comprised of weathered rock and speckled clays of Cretaceous-Low Paleogene period are well developed in the Paleozoic basement from several meters to tens of meters thick.

Upper Paleogene deposits of ancient river valleys comprised of clayey sands and gravel (up to 7 to 24 m thick), are overlain by neogenic clays and eroded where basement rock is exposed at the surface.

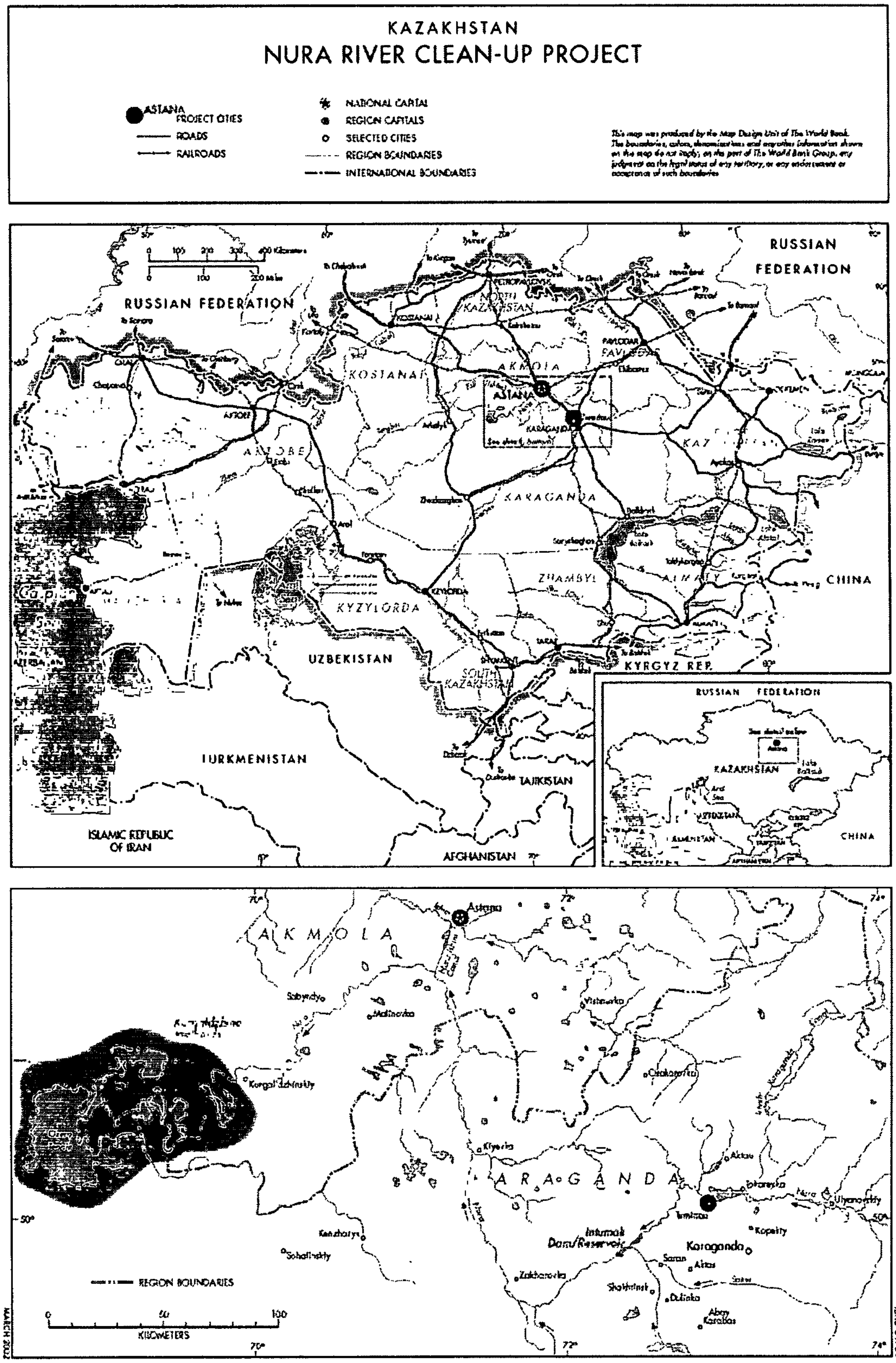
Neogenic deposits, comprised of greenish-gray Aral and reddish-brown Pavlodar clays, interlayered with lenses of sand, form deep valleys and distinct erosion channels in the Paleozoic basement. Neogenic deposits are 40 to 60 m thick.

Quaternary deposits are described in the following section on hydrogeology of the project area. Ore deposits have not been found in the Nura River valley within the project area.

3.1.2 Ground Water

Ground water is present within most of the formations underlying the Nura River basin and the project area. This section describes the major groundwater resources present.

Figure 3-1


KAZAKHSTAN
NURA RIVER CLEAN-UP PROJECT
ASTANA
PROJECT CITIES
ROADS
RAILROADS
NATIONAL CAPITAL
REGION CAPITALS
SELECTED CITIES
REGION BOUNDARIES
INTERNATIONAL BOUNDARIES
RUSSIAN FEDERATION
RUSSIAN FEDERATION
NORTH KAZAKHSTAN
KOSTANAI
AKMOLA
ASTANA
KARAGANDA
ZHAMBYL
KYZYLORDA
SOUTH KAZAKHSTAN
UZBEKISTAN
TURKMENISTAN
ISLAMIC REPUBLIC OF IRAN
AFGHANISTAN
TAJIKISTAN
KYRGYZ REP.
CHINA
RUSSIAN FEDERATION
KAZAKHSTAN
CHINA
AKMOLA
Astana
KARAGANDA
Temirtau
Intumak Dam/Reservoir
Karaganda
REGION BOUNDARIES
KILOMETERS
MARCH 2002
IBRD 31786

Water-bearing horizon of alluvial Quaternary deposits The shallow alluvial aquifers of the Nura River are the most important local groundwater resource. Aquifers are comprised of sandy and sandy-gravel deposits ranging from a few meters thick to 25 to 30 meters thick. The aquifer is situated at a depth of 0.4 to 10-11 m, and is overlain by loams, sandy loams and clays. Impermeable neogenic clays and weathered zones serve as an aquitard. Well yields in the alluvial deposits vary but are generally high (27 to 45 l/sec with drawdowns of 5 m). Aquifer transmissivity varies from 20 to 300 m/day. Hydraulic conductivity is from 160 to 4,600 m^2/day.

The shallow alluvial aquifers are hydraulically connected to the Nura River. Therefore, groundwater quality is directly dependent upon the quality and level of contamination of Nura River flows. Shallow aquifers are recharged by flood water and infiltrated precipitation. They discharge into river reaches. Maximum levels of groundwater are observed in spring. The lowest levels are observed in late winter (March).

Four shallow groundwater aquifers in the project area have been explored. The Nizny Bief aquifer is located downstream of the Samarkand reservoir dam and supplies domestic and potable water to Temirtau. The aquifer yield is estimated at 26.9 thousand m^3/day. Local domestic and potable water consumption amounted to 2.7 thousand m^3/day in 2000. Three other aquifers (Severnoie, Rostovskoie and Molodetskoie) have estimated yields of approximately 108 thousand m^3/day. However, they are located downstream of the central consolidated discharge of wastewater and are not used due to contamination. According to data from monitoring wells in these three aquifers, mercury concentrations ranged from 1.2 to 5.5 mg/l, or up to 2.4 to 11 times the MACdp (MACdp is 0.5 mg/l); in addition, other pollutants (phenols, nitrates, petroleum products) were also observed during 1997-1999.

Water-bearing zones of fractured and faulted Paleozoic rock. Rock formations of different composition are jointed up to depths of 20 to 60 m. These water-bearing zones are fed by atmospheric precipitation and infiltration of runoff. Groundwater is saline in low rounded hills and intermountain areas.

Groundwater storage and transmissivity are greater in areas of tectonic faulting. In these areas, aquifer yield is sufficient for local withdrawals by small agricultural businesses and settlements.

3.1.3 Soils

The soils in the project area support mostly pasture lands and some haylands spread throughout the Nura River valley. Up to 25-30% of land in the valley is arable if irrigated. A large variety of soils are present in the project area, including sandy-loamy, sandy, chestnut, alkali and saline soils. Chestnut, dark chestnut, poorly-developed and incompletely developed rubble soils with 10-20% alkali soils are present in the valley. Within the floodplain of the river, meadow and meadow chestnut, slightly saline soils are present. Meadow swamp soils are present in Zhaur Swamp.

3.1.4 Terrestrial Ecosystems

The relief of the area along the Nura River is undulating, hummocky and plain. The climate is strongly continental. Average temperature in July is +20 to +25 C and –18 to –20 C in January. Annual precipitation is 200 mm.

Terrestrial ecosystems include: northern semi-desert absinthe-grass steppes in the north, a series of tyrs communities in the south, grading into petrophytic communities. Vegetation in the valley is represented by fescue-feather steppes, fescue-tyrs steppes (often complexed with absinthe, fescue-absinthe communities), and agricultural lands that have replaced fescue-feather steppes. Grass meadows used as haylands are located in the river floodplain. The river floodplain is heavily vegetated with shrubs in some areas.

3.1.5 Surface Water

Climate in the Nura region is dry. Most of the region's precipitation falls as snow that runs off in the spring thaw. As a result, infiltration and groundwater recharge is minimal. The Nura River is a steppe river that has very low base flows for most of the year (only a few cubic meters per second). The actual flow depends on reservoir releases and wastewater discharges. Very little of the riverbed is normally covered with water. At the time of the spring thaw, flows of several hundred cubic meters per second (as high as 900 in years of heavy snow and rapid thaw) can occur. The result is that the river is prone to flooding and the riverbed is very unstable, with frequent changes of channel.

Nura River is completely contained within Kazakhstan, originating in southeast Karaganda region on the north slopes of the Keregetas and Zhaman-Karazhal Mountains, and terminating in Korgalzhino Lake. The river is 899 km in length. The watershed area is 53,150 square kilometers. The stretch of river from the Samarkand reservoir to the Intumak reservoir receives inflows from the Oshagandy, Sherubai-Nuru and Sokyr Rivers. The elevation of the river channel descends from 479 m downstream of the Samarkand reservoir dam to 462 m near Rostovka Village, 460 m near Kyzylzhar Village and to 441 m north of Intumak reservoir.

The current channel of the Nura River is 20-50 m in width. It is well reworked and consists of sandy-gravel and silt. The channel has been meandering, eroding terrace deposits above the floodplain and rocks of the slopes near the channel. In addition to the main channel, there is well established meander channel in a river floodplain. The distance between them varies from hundreds of meters to 1-2 km. The river valley is 1-5 km in width. The floodplain occurs on both sides of the river and is inundated every year.

Nura River flow is regulated by the Samarkand reservoir which has a capacity of 254 million m^3. The Intumak reservoir is under construction. Its capacity is anticipated to be 190 million m^3. Average annual flow of multiyear runoff of the Nura River in the project area ranges from 619 million m^3 in an average year and to 89 million m^3 in a very dry year.

In accordance with the Regulations for Water-Preserving Zones and Belts #102 (approved by the Kazak Government on 01/27/1995) the size of water-preserving zone for Nura River is 500 meters on each side of the river.

3.1.6 Aquatic Ecosystems

Aquatic ecosystems include those of the Nura River bed, Nura River waters, and the cascade of lakes of Kurgaldzha preserve, including Tengiz Lake. Aquatic organisms present include plankton (floating) and nekton (swimming) species for which vertical and horizontal migrations are typical. Lake benthos species include bacteria, Actinomycetes, algae, fungi, Protozoa, segmented worms, crustaceans, insect larvae, and mollusks. Periphyton species (species attached to the sediments) include diatoms, fungi, Chilopoda, Bryozoa, crustaceans and mollusks.

Nura River mud and sand are the least favorable types of bottom as fauna and flora there are the poorest in terms of both quality and quantity. As compared with lake plankton, the role of plankton in the river ecosystem is insignificant.

In the Nura River basin, from Samarkand Reservoir downstream to Tengiz Lake in Kurgaldzha Preserve, there are approximately 560 species of plants and 164 species of vertebrates identified, including 32 fish, 3 amphibians, 5 reptiles, 80 birds and 44 mammals. In addition, there are over 80 species of birds of which 12 are rare and endangered (Red Book of Kazakhstan, Vol. I, Animals, Part 1, Vertebrates, 1996).

3.1.7 Threatened and Endangered Species

This section provides a listing of the threatened and endangered species identified in the project area, and their current status. The list below is divided into first those species found primarily in the Kurgaldzha Preserve and second those found elsewhere along the Nura River. Note that the great majority of endangered species are found in the preserve.

Species found mainly in Kurgaldzha Preserve

1) Palas's sea-eagle (Halaetus leucorhyphys)

   Status: endangered (Category I). Only a few have been seen in Kazakhstan: in Kurgaldzha preserve, Chu River, Irtysh River

2) Little curlew (Numenius minutus)

   Status: rare (Category III). In Kazakhstan, Kurgaldzha preserve, usually observed only during seasonal migration.

3) Great black-headed gull (Larus ichthyaetus)

Status: rare (Category II). It nests in Kurgaldzha preserve.

4) Dalmatian Pelican (Pelecanus crispus Bruch)

   Status: rare (Category II), local habitat only. Pelican nests within water basins of the Ural region, in the Naurzum, Kurgaldzha preserve.

5) Whooper swan (Cygnus cygnus)

   Status: vulnerable (Category II), decreasing in number. The greatest number are found in the Kurgaldzha preserve, and in wintering sites on the Caspian coastal plain.

6) Flamingo (Phoenicopterus roseus)

   Status: vulnerable (Category II), rare and decreasing. It nests in Kurgaldzha preserve, Tengiz Lake, on the Caspian coast.

7) Bewick's swan (Cygnus bewickii Jarrel)

   Status: out of danger (Category V). This swan has been restored in its habitat on the Siberian tundra where it nests and breeds. Approximately 1000 individuals migrate in the spring and autumn to the western part of Kazakhstan. Swans stay on Kurgaldzha preserve before migrating for the winter.

8) Feruginous pocard (Aythya nyroca)

   Status: rare (Category III), significantly reduced population. It nests in lakes located in Kurgaldzha preserve.

9) White-winger scoter (Melanitta fusca)

   Status: rare (Category III), significantly reduced population. The total population in Kazakhstan is unknown. No more than several tens of pairs are nesting in Kurgaldzha preserve and Kokshetau region.

10) Red-brested goose (Rufibrenta ruficollis Pallas)

    Status: vulnerable (Category II), rare with narrow range and declining numbers. It nests in Siberian tundra, a few are seen in Kurgaldzha preserve.

11) Pallas's sandgrouse (Syrrhaptes paradoxus Pallas)

    Status: indeterminate (Category IV). It nests in Kurgaldzha preserve.

12) Eurasian spoonbill (Platalea leucorodia Linnaeus)

    Status: vulnerable (Category II), rapidly decreasing in number. The overall number in Kazakhstan is no more than 400-650 pairs. No more than several tens of pairs are nesting in

Kurgaldzha and Naurzum preserves and lakes located in South Kazakhstan and Turgai region.

13) Crane (Anthropoides vigra)

14) Zaleskii feather grass (Stipa zaleskii)

15) Korjiski licorice (Glycyrrhita korjiski)

16) White water lily (Nymphaea alba) – hygrophyte, reserves insignificant

Species found elsewhere along the Nura River

17) Thin poppy (Papaver tenellum)

Status: endemic species (may be extinct)

18) Glue alder (Alnus glutinosa)

Status: rare species of trees

19) Gazelle (Gazella subgutturosa)

20) Stone marten (Martes foina) and marten (Vormela peregusna)

3.1.8 Sensitive Habitats

This following table lists the environmentally sensitive habitats identified in the project area, and the potential receptors and impacts associated with pollution of each. This is followed by a discussion of Kurgaldzha Preserve.

Table 3-1. The Most Sensitive Areas and Components to Be Protected

Sensitive Habitat	Potential Receptors	Sensitivities
Zhaur Swamp and old ash dump	People: Local and downstream residents Biota: Soil and vegetation	As this area is one of major sources of pollution by mercury. Mercury in the swamp soil and ash may volatilize, erode or infiltrate into groundwater.
Nura River bed and banks	Aquatic community: phytoplankton, zooplankton, small fish, predatory fish Benthos species, periphyton	Storm- and flood-generated turbidity and sedimentation may contribute to contamination of food chain organisms and damage to fixed benthic organisms. Decrease in level of water may pose dehydration threat to aquatic organisms.

	Rare and endangered species of plants and animals: • Thin poppy (Papaver tenellum) – endemic species (may be extinct) • Glue alder (Alnus glutinosa) – rare species of trees • Gazelle (Gazella subgutturosa) • Stone marten (Martes foina) and marten (Vormela peregusna)	Mercury may bioaccumulate in plants through uptake of contaminated water and in animals through contact with and ingestion of contaminated water or prey. Mercury is potentially toxic with long-term exposure and may damage plants and animals. Ecosystem biodiversity may be reduced, with irreversible loss of species.
Flood plain of Nura River	People: domestic supply, irrigation, swimming, and fishing. Important agricultural areas: Irrigated,azhrek, feather-grass, hay lands and pasture lands with 400-800 kg/ha of yield. The western part is represented by feather-grass, herbage and pastures (80% of the area is tilled).	Excavation of bottom deposits and ground, especially in summer time, would lead to higher concentrations of mercury vapor in the air and affect on people health. Changes in traditional mode of life: decrease in fishing activities, and cattle breeding; elimination of orchards; potential settling-out of the locals would lead to higher social concerns. On the other hand, implementation of the project would create new jobs.
Intumak water storage basin	Aquatic organisms People: swimming, fishing, irrigation	Water contamination may damage aquatic organisms and reduce supply for irrigation, reduce fishing activities, reduce sources of income for the local population and limit available recreation areas.
Tengiz Lake area	Rare and endangered species of plants, including: • Zaleskii feather grass (Stipa zaleskii) • Korjiski licorice (Glycyrrhita Korjiski) • White water lily (Nymphaea alba) – hygrophyte, reserves insignificant	Water contamination and diversion may threaten rare and endangered plants, including irreversible loss of species.
Lakes located in Kurgaldzha preserve	Aquatic organisms *Rare and endangered species of birds, including:* • Flamingo (Phoenicopterus roeus) • Swan (Cygnus cygnus) • Crane (Anthropoides vigra) • Curly pelican (Pelecanus crispus)	Decrease in level of water in Nura River would lead to disturbance of water balance, desalinization of salinization of water in lakes and disturbance of biocenosis resistance Water contamination and diversion may threaten the habitats of rare and endangered species, resulting in damage and loss of birds and aquatic organisms.

3.1.9 Protected Areas

Kurgaldzha State preserve, a lakes and wetlands area of international significance established in 1968, is located approximately 300 km downstream of the Samarkand Dam. It is based in the southwest part of the Tengize-Kurgaldzhin trough, administratively on the territory of Akmola region. Its area is 237,138 ha, with 199,200 ha of lakes and wetlands, including Lakes Tengiz and Kurgaldzhin (the largest lakes in North and Central Kazakhstan) and a system of small lakes. The main sources of inflow are the Nura, Kon and Kulanutpes Rivers. Only the Nura River provides constant flow, while the other two partly dry up by summer.

Lake Kurgaldzhin has an area of 330 square kilometers, but 80% of the water surface is occupied by reeds (Phragmites communis) and cattails (Typha angustilosa). Introduced plant species are widespread, especially duckweed (Lemna sp.) and algaes. Zooplankton is poor, with Rotatoria sp. dominating.

Lake Tengiz is a large bitterly salty reservoir with an area of 1,590 square kilometers. There is very little emergent vegetation, basically algaes. Zooplankton is represented by gill ratchets (Artemia salina) and harpacticides (Harpacticoida sp.).

The unique hydrological mode of the lakes is the periodic fluctuations of water level.

Relief is mostly flat, gradually descending to Lake Tengiz. Elevations range from 304-426 meters above sea level. Climate is sharply continental, characterized by large daily and annual amplitudes in air temperature. The maximum temperatures are in July at 44 C, and the coolest are in January at -49 C. Annual rainfall is 200-350 mms.

Soils in the north are shone-chestnut, and in the south they are dark-chestnut. Flora is presented by cereals and various grass associations characteristic of steppes and semi-deserts. In the preserve there are no trees, but there are 16 varieties of shrubberies (Salix sp., Rosa sp., Lonicera tatarica, Caragana frutex). Plant cover consists of Agropyron sp., Artemisia sp., Poa bulbosa, Allium sp., and Tulipa sp. (Tulipa biflora, Tulipa scherenkii and Regel are rare species). The greatest varieties are exhibited by the cereals (Gramineae).

The Preserve Lakes are unique as a waterfowl reservation in their advantageous geographical position, wide area, and rich source of food. This is not a park, so it is not visited. Kurgaldzha State preserve is united with Kurgaldzha reserve-hunting farm, one of the most valuable sources of commercial birds in Kazakhstan, Central Asia and West Siberia. The preserve lakes are a northernmost refuge for nesting flamingos. As of 1980, 231 species of birds: 80 nesting, 12 wintering, 100 passing through, and 39 migrating. 22 species of birds are listed in the Red Book of Kazakhstan, and 12 birds are listed in the International Red Book. Kurgaldzha preserve is included in the category "A" list of water-wetlands grounds of international significance. (International convention on the protection of places of waterfowls nesting, rest and wintering.)

3.2 EVIRONMENTAL POLLUTION

3.2.1 Areas of Mercury Contamination

The following sections discuss the distribution of mercury contamination in soil, sediments and surface water, based on data available from recent studies.

Sources of Data. Data on mercury contamination of the Nura River and its flood plain in the area of Temirtau was collected during work undertaken by the Almaty-based BG Chair of Environmental Technology, based at the Almaty Institute of Power and Telecommunications, in association with Southampton University of the UK and other contractors. This work was carried out under the auspices of the EU's INCO-Copernicus Programme, INTAS-Kazakhstan, and the UK Government's Foreign and Commonwealth Office grants. The work was completed in 1998.

Technical papers based on this data report significantly lower concentrations of mercury in the river and its floodplain than those previously reported (especially those carried out in the 1970s). This decrease is believed to be an artifact of the improved sampling techniques used, rather than an in-situ decline in mercury concentrations. The distribution of mercury in the Nura River basin downstream of Temirtau is presented in Figure 3-2 and discussed in more detail below.

Primary Source of Mercury – JSC Karbid. Beginning in 1950, mercury has been discharged to the Nura River and surrounding environmental from the acetaldehyde production facility at the former JSC Karbid. Mercury, used primarily as oxidic salts of mercury, was used as a catalyst in the hydration of acetylene acetaldehyde. The main units that used mercury and produced or stored mercury-contaminated waste were the acetaldehyde production unit, the wastewater treatment plants of former JSC Karbid, and the industrial landfills at the former JSC Karbid. Mercury-contaminated wastes were discharged to the Nura River at the wastewater outfall, and disposed on land around and near JSC Karbid. Currently, high concentrations of mercury remain at the facility, in building materials, in surface and subsurface soil, and in the atmosphere.

Mercury in Power Station Fly Ash. At the time that high concentrations of mercury were being discharged into the river (1950s to 1970s) from AO Karbide, the power plant KarGRES-1 discharged several million tonnes of fly ash into the river, directly upstream of the AO Karbide wastewater outfall. This is significant because research has documented the affinity of power station ash for mercury, although the mechanism for this affinity is still being researched. The result is that the ash components within the Nura River basin have very high concentrations of mercury associated with them.

Throughout most of the year, during periods of low river flow, the ash was deposited on the riverbed and adjacent low-lying land immediately downstream of the discharge point. During spring thaws, high velocity river flows scoured the river bed and redeposited the ash and associated mercury contamination onto the floodplain.

Mercury in Riverbed Sediments and Floodplain Soils. In general, it has been estimated, based on the results of the INTAS-Copernicas study, that well over 200 tonnes of mercury are present in the river bed sediments and river bank and floodplain soils in the study region.

Mercury appears to be migrating at a slow rate down the Nura River from the AO Karbide wastewater outfall. Generally, the highest concentrations of mercury in the riverbed sediments (averaging between 150 and 240 mg/kg) were found in the first 15 kms downstream of the Karbide outfall. It is estimated that about 95 % of the mercury-containing, riverbed sediments is located within the first 25 km stretch of the river downstream of the outfall. It is also estimated

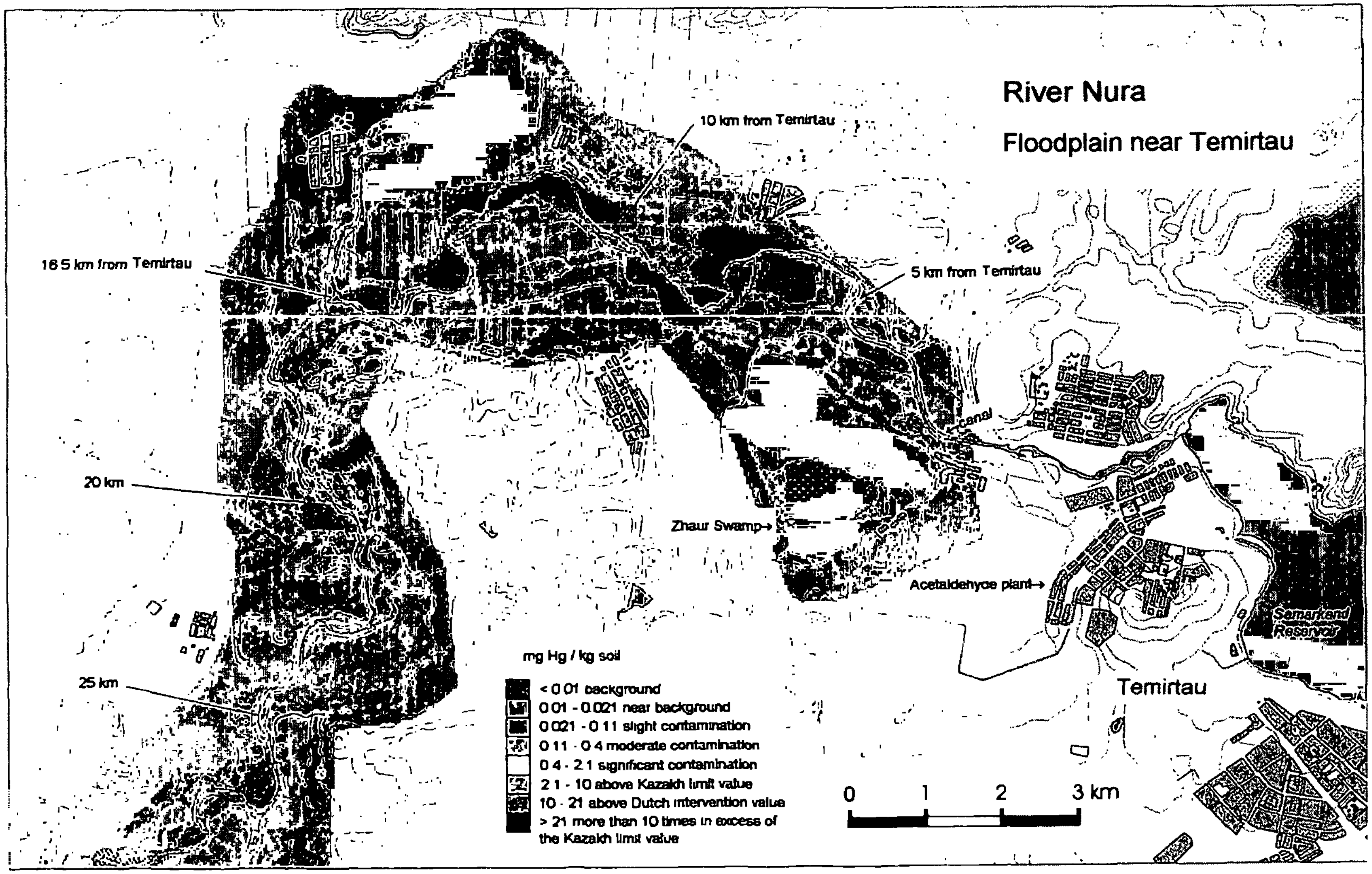


Figure 3-2. Spatial Distribution of Total "Mercury in the Topsoils of the Floodplain in the First 25 km from Temirtau

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that the riverbed sediments located in the 75 km stretch of the river between Temirtau and the Intumak Reservoir contain about 10 tons (463,000 to 550,000 m^3) of mercury. About 4 tons (160,000 m^3) of mercury are contained in the river embayment sediments, and about 2 tons (290,000 m^3) of mercury are contained in oxbow lake sediments and floodplain soils.

Similar to the movement of the power station fly ash, significant volumes of mercury-containing sediment are removed from the riverbed and redeposited in the flood plain during floods. As a result of continued downstream movement, contaminated sediments have accumulated at the inflow to the Intumak Reservoir. Concentrations of mercury in the Reservoir appear to be lower than those in the river, however, additional study is needed to confirm this distribution.

Similarly, the majority of the mercury-containing floodplain soil is located within the first 25 km stretch of the river downstream of Temirtau. It is estimated that there are about 53 tons of mercury in the floodplain soil, about 70% of which is located within the first 25 kms downstream of Temirtau. Approximately 5.8 km^2 of the floodplain has mercury concentrations over 10 mg/kg, resulting in 880,000 m^3 of contaminated soils.

Another 1,720,000 m3 of silt deposited on the river bank is estimated to contain about 65 tonnes of mercury.

Some of the highest concentrations of mercury in soils were found in Zhaur Swamp, a low-lying depression of 1 km2 area close to the factory where waste sludges and wastewater with very high concentrations of mercury were disposed, resulting in 62 tons of mercury. The HPS 1 old ash fill contains another 32 tons of mercury.

Mercury in Nura River and Intumak Reservoir Water. The concentration of mercury in all water tested was close to the detection limit of the analytical instruments used. The results must therefore be interpreted with caution. In general, mercury concentrations in the Nura River decreased with distance downstream of the discharge point to the inflow into the Intumak Reservoir. However, concentrations in the reservoir waters were as high as those measured in the river at Temirtau. The results show that mean concentrations of mercury in the river water do not exceed the present WHO safety guideline of 1 μg/l mercury in drinking water or the EU's suggested maximum allowable concentration of 1 μg/l total mercury for inland waterways.[1] Mean concentrations do exceed the Kazakh legal limit of 0.3 μg/l for fish-inhabited waters in some areas.

Summary. Based on data obtained from the INTAS-Copernicus survey and used in the FS, significant areas of the Nura River basin were contaminated by JSC Karbid's discharge of mercury-containing wastewater and by HPS 1's discharge of flyash. The contamination is concentrated in the 25 km stretch of the Nura River from the Samarkand Reservoir dike to the Intumak Reservoir. Overall, the quantity of mercury present in the Nura River valley is estimated as follows:

[1] The 1993 WHO drinking water guidelines also contain a limit for ingestion of 3.3 μg of mercury per kilogram of body weight per week.

The sources and areas containing the greatest concentration of contamination include:

- JSC Karbid site, including the wastewater treatment plants, sludge drying beds and the main wastewater outfall channel
- HPS 1 old ash dump of
- Zhaur swamp
- River channel sediments within 25 km downstream of the JSC Karbid wastewater outfall
- Floodplain soils (six specific areas with high mercury concentrations are identified by the FS)

As part of the FS process and implementation of mercury cleanup, the contamination in these areas should continue to be assessed for their impact on human health and the environment, and be prioritized for additional study and cleanup. All of these areas currently serve as continuing sources of contamination of the domestic water supply (surface water and ground water), of soils in settlements and agricultural lands to be used for crop production and pasturing, and of soils, surface water and groundwater in sensitive areas that support native plants and animals.

3.2.2 Other Sources of Environmental Pollution

There are a variety of natural features, man-made facilities and human activity that contribute contamination and pollutants to the Nura River and associated river basin environments. These sources are concentrated along three different sections of the Nura River system:

- Upper reach – from base of the Samarkand Reservoir to intersection with the Irtysh-Karaganda channel,
- Middle reach – from the Irtysh-Karaganda channel to Intumak Reservoir, includes the large Karaganda-Temirtau industrial district; and
- Lower reach – from Intumak Reservoir to the Nura-Ishim channel and the Tengiz-Korgaldzha lakes.

The following sections provide a brief discussion of the sources of pollution impact the Nura River valley and basin.

Natural features. Ore mines, ore bodies and other types of mineral resources are located mainly in the upper and middle reaches of the Nura River basin. These features can contribute elevated concentrations of potentially hazardous elements, including lead, zinc, mercury, cadmium, copper, molybdenum, chromium, nickel and other heavy metals to the surrounding environment. It is estimated that approximately 35% to 45% of the watershed area soils contain naturally-occurring concentrations of these elements. In some areas in-situ concentrations may exceed typical guidelines and limits for contaminated soil. As a result, these features may negatively impact the quality of surface water. However, their impact relative to other sources are difficult to measure.

Natural processes such as water and wind erosion in this semi-arid climate can cause a large amount of soil, other particulates and organic matter to enter surface water bodies where it may have an adverse impact on water quality. Other processes such as natural fluctuations in groundwater levels can cause the accumulation of salts in soils in near surface horizons, reducing the productivity of agricultural lands.

Manmade sources. These include agricultural and industrial facilities, as described in the following sections.

Agricultural facilities. A large number of facilities (former collective farms, farmers associations, cattle farms, and poultry plants) is located throughout the length of the Nura River valley and along its tributaries. Many of the components associated with agricultural activitiy may be sources of contamination, including:

- solid waste landfills
- manure piles
- storage areas for fertilizer, toxic pesticides and herbicides, organic-mercury seed disinfectants, petroleum products and other farm chemicals

The impact of these facilities has not been quantified. The pathways for these sources of contamination in the river basin have not been fully defined. The volume of contaminants has not been measured.

Industrial sources. A large number of regional, industrial complexes are present in the Nura River valley, particularly along the middle reach around Karaganda-Temirtau. Industrial sources include mining, metallurgical, and chemical companies, fuel and power facilities, and land development. Many of the components associated with these activities may be sources of contamination, including:

- industrial waste discharged from manufacturing and production activities, and domestic waste discharged from urban areas,
- surface runoff from contaminated areas of enterprises and development lands, particularly industrial waste landfills such as sludge basins, mine tailings dumps, mining rock dumps, and
- legal and illegal air pollutant emissions and their further migration in soils, surface and *ground water.*

3.2.3 Evaluation of Baseline Data and Recommendations for Additional Work

The following tasks included in the FS Terms of Reference should be completed:

- Review the composition of various types of mercury-containing soils and materials, and estimate their volume by type (i.e., clay, sand, organic substances), moisture content, volumetric weight, and other geotechnical features to aid in the design of treatment, transportation and storage.

- Conduct additional field surveys in areas of high mercury contamination to collect data on subsurface stratigraphy and geotechnical characteristics, groundwater quality and hydraulics, and soil contamination to provide additional data for detailed geologic cross-sections.

- Conduct additional sampling of dissolved and suspended mercury in wastewater and surface water during normal and low water periods.

- Conduct a more detailed field survey of the acetaldehyde production unit at JSC Karbid and the associated treatment plants, including monitoring well installation, and groundwater and soil sampling and analysis, to better quantify the volume of contaminated material at the facility.

- Collect additional data from the Intumak Reservoir to better assess it potential role as a deposition basin for mercury contamination during cleanup activities.

- Conduct field surveys of baseline and contamination mercury levels to assess contamination of agricultural products (potatoes, grain et al.), forage grass and pasture grass, aquatic bioita (fish).

As discussed in the previous section, many other potential sources of mercury and other contaminants are present in the Nura River basin. During the conduct of additional field surveys, data should be collected on other constituents such as heavy metals, polyaromatic hydrocarbons (PAHs), petroleum, and other water quality parameters (nitrates, sulfates, etc.) by taking and analyzing samples from typical areas.

While the available recent data provides an overall picture of the major areas of concern, a number of deficiencies and gaps in the data are identified. The following types of information will likely be needed for the design and implementation of the mercury cleanup activities:

- Additional data should be collected and/or evaluated to more accuratly quantify the size of cleanup areas, the volume of soils and other materials to be handled, and their associated mercury concentration.

- Although areas of contamination have been mapped by mercury concentration levels, additional information should be collected and maps should be generated on the location and size of major types of contaminated environments in the river basin (i.e., channel sediments, floodplain soil, swamp areas, and manmade deposits).

- Data should be collected and maps should be generated of the location and extent of environmentally-sensitive areas that warrant protection by and during the implementation of cleanup activities.

3.3 SOCIO-ECONOMIC BASELINE DATA

The Karaganda region is situated in the Central part of the republic. It is the largest region in Kazakhstan, with a territory of about 428,000 sq. km. Population of the region is 1,410,218, including 1,158,948 urban and 251,270 rural residents. The urban population includes 437,117 in Karaganda city and 181,344 in Temirtau city. The rich mineral resource base of the region is represented by deposits of coal, iron, manganese, copper, tungsten, lead, zinc, cobalt, and nickel.

The high concentration of pollution- and energy-intensive industrial production, and lack of separation of industrial and living zones, poses ongoing risks to public health and environment in the Karaganda region. Today several hundred enterprises of many kinds of industries are concentrated in the Karaganda region. Industries include ferrous and non-ferrous metallurgy, coal mining, power generation, machine building, chemical manufacturing, agriculture and other industries in the Karaganda region.

In the last 10 years, the situation in the region has changed dramatically. Industrial activity has decreased sharply, resulting in a decrease in the urban population of Karaganda and Temirtau. The original plans for large irrigated farm development eventually failed. Abandonment of the state farm system led to a quick decrease of irrigated area in the region. With the general downturn in the economy, closure of industries and state farms, farmers could no longer rely on highly subsidized irrigation systems and had to turn to subsistence rain-fed farming.

The agriculture sector is slowly recovering, in spite of plans to use treated urban wastewater to develop an intensively irrigated area (mostly for gardening) between Karaganda and the Nura River. These plans are viewed with great concern by farmers.

Despite closures and scaled down production, industry continues to employ the bulk of workers in the river basin area. Industrial water consumption is not yet rising, as the conversion of existing industrial processes in the main complexes to more profitable ones is proceeding slowly. Any gains in water use are offset by the progressive closure of coal mines, which previously were one of the main economic activities in this region.

4.0 ENVIRONMENTAL IMPACTS

The proposed project's primary objectives are environmental restoration, specifically the cleanup of mercury contamination in the waters and soils of the Nura River basin, as a necessary step in assuring safe water supply and agriculture for humans and a clean environment for natural habitats and ecosystems. However, contaminated ground cleanup is a very complex process, not as predictable or as amenable to conventional engineering project management as other types of pollution control or infrastructure development. This is especially true where such a large number and diversity of sites must be addressed over an area as large as an entire river basin, and where the primary contaminant of concern is as toxic, mobile, persistent and bioaccumulative as mercury. The need for very careful planning and very specialized precautions and mitigating measures to prevent, minimize or respond to inadvertent releases of mercury compounds and associated pollutants requires conducting an Environmental Impact Assessment (EIA) and preparing an Environmental Management Plan (EMP). The proposed cleanup project has therefore been classified as a Category A project, because it could cause significant environmental impacts affecting an area broader than the sites or facilities subject to remediation.

4.1 BACKGROUND ON MERCURY, ENVIRONMENT AND HUMAN HEALTH

4.1.1 Mercury and the Environment

The following are some basic facts about mercury that are important to assessing the impact of mercury contamination on human health and the environment:

- Mercury is a metal that exists as a silvery-white liquid at ambient temperatures and pressures; it vaporizes readily and can be suspended in air for over one year.

- Mercury can exist in three main states: organic compounds (e.g., methyl mercury), elemental (pure mercury), and inorganic compounds (e.g., mercuric chloride salt). Properties and behavior of mercury depend on its physical and chemical form.

- Mercury both bioaccumulates and bioconcentrates in the environment.

- Long range transport of airborne mercury in dust or vapor form and subsequent deposition via rain or snow into water bodies is a significant source of mercury contamination of land and surface waters.

- Mercury has a long retention time in soil; it cycles through the environment and continues to be released back into ecosystems for decades.

- When elemental mercury is released into the air it interacts with ozone to form inorganic mercury, which is highly soluble. In this form, it returns to the earth's surface with rain and snow and becomes transformed into methyl mercury by bacteria which reside in lakes and rivers.

- Methylation of mercury is a key step in the entrance of mercury into food chains. The biotransformation by microbes of mercury to methylated organic mercury in water bodies can occur in the sediment and the water.

- Methyl mercury bioaccumulates to a greater extent than other forms of mercury.

4.1.2 Mercury and Human Health

The main exposure route of mercury in case of soil contamination is oral. Methyl mercury is both an eco-toxicologically and a human toxicologically important substance. There is no evidence that mercury or methyl mercury are carcinogenic.

The critical human organ attacked by mercury or methyl mercury is the central nervous system. It causes intoxication paralysis. Its symptoms are feeble walking, hampered speech, and loss of both sight and hearing. Methyl mercury is a teratogenic substance that can cause brain damage in the fetus. The fetus shows a 2 to 5 times higher sensibility to methyl mercury than adults.

The most important source of exposure for mankind is consumption of fish with relative high concentrations of methyl mercury. The average daily exposure under normal circumstances is 5-10 μg per person (the airborne part is 160 ng a person).

4.1.3 Land Use and Mercury Exposure

The impacts of mercury contamination on land use in the Nura River basin can be subdivided into two main land use categories, agricultural and recreational.

The vulnerable zone for agricultural use is the rooting zone of crops. The depth of this rooting zone is approximately 0 – 0.5 m below ground level. The uptake of metals in plants is expressed as "bio concentration factor" (BCF). The BCF value varies in literature between 0.1 – 1.0. The BCF for Holland has been determined to be 0.3. This BCF is 3 times less than the BCF for heavy metals like zinc and cadmium, which means that mercury is less likely to be absorbed by crops than zinc or cadmium.

In the Nura River basin, existing data indicates that there is no uptake of mercury by potatoes grown near Zhaur Swamp and the Main Drain of AO Karbide, both severely contaminated areas with soil mercury concentrations between 100 and 6000 mg/kg. Irrigation water for these potato crops is supplied from the Main Drain of AO Karbide. Currently, there is insufficient data to determine the exact risks for human exposure from crops. Therefore, the FS Contractor proposes to use toxicological limits for ecosystems and humans to establish the total daily intake limits.

The two most important recreational activities in the Nura River basin are fishing and water sports. Fishing, including consumption of the catch, is an important source of methyl mercury. Water sports result in ingestion of untreated water, which is the other main route of exposure to mercury, particularly for children.

An important role in assessing the impacts of mercury contamination on ecosystems and humans is played by the toxicological limits. These limits are established as explained below:

- ***Human toxicological limit.*** The WHO Committee on Food Additives has set a "provisional tolerable weekly intake of 300 μg per person, which is equal to a Total Daily Intake (TDI) of 43 μg per person per day. TDI is a measure of the exposure limit for humans taking into account all possible exposure routes, including food and drinking water ingestion, skin contact and soil ingestion. The human toxicological limit is based on a model animal comparable to humans with respect to metabolic pathways and effects. The tolerable weekly intake of 300 μg per person includes a maximum of 200 μg per person for methyl mercury and 100 μg per person of mercury and other (inorganic) mercury compounds. These TDI values are based on epidemiological studies of methyl mercury from fish consumption. The "provisional tolerable weekly intake" of 300 μg per person represents 10% of the minimal toxic dose for adults to protect against fetal damage?
- ***Eco-toxicological limit.*** The eco-toxicological limit is based on field and laboratory research This eco-toxicological limit is based on the HC_{50}. The HC_{50} is the limit where 50 % of the species in the ecosystem are affected.

Limit levels The human toxicological limit proposed for mercury in soil is 87.1 mg/kg. The eco-toxicological limit for mercury in soil is 10 mg/kg. The groundwater level of mercury for consumption excluding all other exposure routes is 19 μg/l; higher than the WHO limit on drinking water of 1 μg/l. Soil typically contains up to 10% moisture called "pore-water". The pore-water is in equilibrium with the concentration of mercury in the soil. For the eco-toxicological limit for mercury in soil of 10 mg/kg, the corresponding equilibrium concentration of mercury in the pore-water is 3 μg/l.

4.2 ENVIRONMENTAL ASSESSMENT OF SELECTED ALTERNATIVE

4.2.1 Description of Selected Alternative

The FS describes the preferred alternative for cleanup of mercury contamination in the Nura River basin, as below.

The provisional recommendations to guarantee the water quality at the downstream discharge of the **Nura River** are:

- Excavate a stable flood channel for the Nura River
- Excavate and remove any polluted soils in contact with either the new channel or the Intumak Reservoir.
- Remove the excavated material to a safe modular designed storage facility – do not treat to remove the contamination.

The provisional recommendations for the **Zhaur Swamp** (unless this area is selected as the disposal site for the mercury-contaminated waste) are:

- Temporarily drain the Swamp and strip the surface soils and vegetation
- Remove the contaminated material to a safe modular designed storage facility – do not treat to remove the contamination.

The provisional recommendations for the contamination across the **flood plain** are:

- Zone the flood plain into use zones and enforce them
- Excavate locally the contaminated soils where that is shown to be justifiable by economic or fitness for purpose criteria
- Remove the excavated material to a safe modular designed storage facility – do not treat to remove the contamination.

Whilst not included in the risk assessment at the time this draft report was developed, it is clear that the **AO Karbide factory** and the associated historical **ash lagoons** are hazardous and need addressing. However, certain conclusions can be reached prior to the availability of the results from that study. The buildings of former acetaldehyde production must certainly be demolished. The cost-effective way of mercury cleanup is excavation of contaminated ground and debris, and the deposition of the same in specially designed landfills. The most highly polluted soil and construction debris, which have mercury concentrations higher then 1500 mg/kg, must be treated prior to disposal. The design of removal of contaminated soil must be done on the basis of additional sampling and analyses.

In addition, the Draft Final FS has concluded that one of the optimal sites for landfill disposal of the removed mercury-contaminated wastes is in Zhaur Swamp, near the site of the AO Karbide factory. Its advantages include:

- Eliminates the need to excavate and transport the contaminated soil in the Swamp itself
- Accommodates all of the other contaminated material needing to be removed and disposed in the river basin
- Minimizes the costs and impacts of transporting contaminated materials from the other sites due to its close proximity to those sites, especially the factory site

To make this already contaminated site more suitable as a final disposal site, the FS proposes that:

- The site be isolated from upstream surface runoff by installing a drain along the upstream side of the Swamp or by restoring existing irrigation and drainage canals for this purpose
- Surface or subsurface release from the site to the river be prevented by some means of below- and above-ground wall

In summary, the actions comprising the preferred cleanup program have the following three general steps in common:

- Removal of contaminated materials from the site, through either demolition of buildings, excavation of soils or dredging of riverbed sediments
- Transport of mercury-contaminated materials by truck
- Placement in some type of landfill, either for temporary storage or for final disposal

The potentially adverse impacts of these three steps are evaluated further in Sections 4.2.2 through 4.2.4 below. The probable positive impacts of the preferred alternative are summarized in Section 4.4 below.

4.2.2 Potential Negative Impacts of Removal Operations

The proposed project involves removal of mercury-contaminated sediments, soil or building materials by either dredging, excavation or demolition. The FS does not provide a technical description, including quality control measures, of proposed removal technologies. Dredging is the removal of rock, sand, gravel, mud and clay from the bottom of waterways using equipment to scrape, scoop or pump it. Excavation is the removal of soils from contaminated land sites using power shovels, loaders, bulldozers and scrapers. Demolition is the dismantling of contaminated buildings using careful deconstruction or other techniques. In all three cases, the FS proposes to load the removed material directly onto trucks (except that highly contaminated building materials and soils from the AO Carbide site may be treated prior to transport).

Typically, the biggest risks of such operations are inadvertent short-term increases in mercury releases to the environment, especially to air and surface water. Releases to the air are particularly problematic since mercury readily vaporizes, can be suspended in the air for long periods, transported long distances, and then redeposited on land or surface water during rain or snow thus starting the cycle over again. Releases to surface water can occur through the stirring up of river bed sediments and river bank soils if care is not taken to avoid contact with the river water during and after remediation, and through erosion of removed or residual contaminated soils from river banks and floodplains.

In addition, although the focus of the project is the removal of mercury, other toxic and hazardous industrial wastes likely coexist with the mercury. With the limited information available on the historical industrial operations, solvents, polyaromatic hydrocarbons and polychlorinated biphenyls can be expected to be found. The project will result in the removal of some portion of these materials, with similar potential for small-scale and temporary secondary impacts related to the removal operation and overall positive long-term primary impacts.

The impacts of removing contaminated riverbed sediments, contaminated river bank and floodplain soils, and contaminated building materials are discussed separately below.

Dredging or Removing Contaminated Riverbed Sediments

The following lists the potential impacts of conventional dredging of mercury-contaminated materials from the Nura River and associated oxbow lakes:

- The airborne concentration of mercury vapors will increase due to sediment disturbance and subsequent deposition, and airborne mercury can be redeposited on land, crops, and surface water bodies

- Dredged material stockpiled on land for dewatering will generate dust, some of which may be mercury-contaminated

- Dredging will increase the downstream water concentration of suspended solids and mercury directly impacting aquatic species through reduced light and dissolved oxygen and by covering downstream bottom habitats with sediment

- Increased water concentration of mercury and other contaminants will impact humans and terrestrial plants and animals through ingestion and bioaccumulation

- Dredging causes noise and poses physical hazards to workers

- Dredging will alter the river bottom physically and may change the river channel's profile and course

The proposed plan addresses these issues by excavating a new river channel in clean soils so that the river water would not be in direct contact with contaminated materials at active cleanup sites in the existing channel. After cleanup, the river would be redirected to its current channel. In general, the impacts of this approach would be limited to those more similar to excavating and transporting contaminated materials from upland areas. In addition, however, redirecting the river channel may adversely impact the natural ecosystem and biota of the existing channel during the short- to mid-term period. Redirecting the river in short sections for short time periods will minimize these impacts and maximize the ability of the ecosystem and biota of clean upstream river sections to recover and repopulate downstream sections. The net, long-term ecological effect on the existing channel of cleaning up the mercury contamination using this approach is expected to be positive.

Excavating Contaminated River Bank and Floodplain Soils

The following lists the potential impacts of excavation of mercury-contaminated soil from contaminated land sites, such as the Nura River banks and floodplains, AO Carbide site, sludge drying bed, Zhaur Swamp and Old Ash Fill (note that the Draft FS does not yet address cleanup approaches for the Old Ash Fill, but that it is assumed here that it will be cleaned up using the excavation, transport and landfill approach):

- Soil disturbance resulting in mercury vaporization and increase in airborne concentration of mercury, and subsequent redeposition on land, crops and surface water bodies

- Generation of mercury-contaminated dust during excavation and local storage of soil stockpiles

- Erosion of excavation site or soil stockpiles resulting in contaminated storm water runoff or floodwaters which transport the contaminant to the Nura River or other surface water bodies

- Rainfall and surface water run-on onto excavation sites and stockpiles potentially resulting in leaching of contaminants into the soil and shallow ground water

- Direct exposure of humans and wildlife to contaminated soil in excavation and stockpiles

- Noise and physical hazards from excavation equipment and operations

- Habitat destruction in the existing river bed and river banks will be unavoidable due to sediments removal, heavy equipment movement and dehydration. In addition, individuals of one or more of the four endangered species occupying these habitats may be adversely affected.

Flood plain zoning is proposed as an alternative to excavation and transport of contaminated materials in areas where lower levels of contamination exist. While this approach would protect against direct contact of humans and agriculture with the contaminated areas, it would leave some contamination in the environment that would have been removed under other alternatives. Compensation for loss of land, relocation to more productive areas, etc. do not eliminate entirely the risk remaining with the contamination.

<u>Demolition or Deconstruction of Contaminated Buildings</u>

The FS has not yet fully specified a cleanup approach to the various components of the AO Karbide factory site. In addition, no treatment method has been selected yet for heavily contaminated demolition debris (or soil) prior to its being landfilled. It is therefore difficult to evaluate environmental impacts of cleanup in these areas without selected approaches and the data their selection is based upon. It is recommended that the studies currently underway for these sites be completed before a final decision is made on cleanup approaches for this source area.

4.2.3 Potential Negative Impacts of Transport Operations

The FS recommends that untreated mercury-contaminated materials that have been removed from contaminated areas be loaded onto trucks and transported from the cleanup sites to waste treatment, storage and disposal facilities. The following impacts to human health and environment can be anticipated from this approach:

- ***The typical impacts of construction project truck transport through settled areas can include increased traffic, noise, vibration, dust (particulates) raised from the road, and exhaust emissions (containing particulates, hydrocarbons, carbon monoxide, nitrogen oxides and, depending on the fuel used, possibly lead).*** The severity of these impacts will depend on numerous factors, not yet known, including the number and locations of cleanup sites originating truck traffic; the number and locations of waste management sites for which the trucks are destined; the routes selected for truck transport and their proximity to residents, businesses, farms, habitats, etc.; the number or frequency of trips, the daily hours of transport, and overall duration of the transport program; the size, model and maintenance condition of the trucks used; and the type, surfacing, maintenance condition and traffic levels of roads used.

- ***The impacts related to the contaminated material being transported and the contaminated region through which transport will occur.*** It is possible for small amounts of waste materials contaminated with mercury or other pollutants to be released from the trucks in the form of dust (if materials are dry) or liquid (if materials have been dredged from the riverbed and are not fully dry yet). These releases can be minimized by proper preparation (e.g., drying) of the wastes prior to loading, use of truck bed liners and canopies to prevent dust or moisture from being released, and cleaning of truck wheels after loading and before leaving the cleanup site. The truck routes may traverse unpaved roads in areas of contaminated soil, especially along the river and in the floodplain, resulting in generation of dust potentially contaminated with mercury or other contaminants. (The potential impacts of pre-transport drying of dredged materials, e.g. exacerbating the methylation and vaporization of mercury from the cleanup site, must be weighed against the losses of very small amounts during transport and methylation and vaporization at the disposal sites, considering the ability to mitigate such impacts during each of these stages of cleanup.)

Existing truck transport on dirt roads (or paved roads with significant blowing dust) in the Nura River basin may already be causing impacts similar to those described above. However, the proposed project will increase the frequency and intensity of such impacts during the cleanup period, especially where heavy trucks will be using unpaved construction roads in the floodplains and along the river banks. In addition, the psychological impacts of the fear of dangerous materials being transported through the community should also be considered.

4.2.4 Potential Negative Impacts of Landfill Operations

The FS recommends that land storage/disposal to manage the removed mercury-contaminated materials. Unless properly located, designed and operated for the specific wastes being deposited, landfills pose risks of:

- Mercury methylation and generation of landfill gas emissions, including methane and volatile organic compounds, as well as mercury compounds; these compounds may contribute toxic or carcinogenic contaminants to the atmosphere
- Generation of wind-blown, mercury-laden dust that can be inhaled, ingested or re-deposited on land or surface water
- Erosion and transport of mercury-containing materials through runoff to surface waters
- Formation of mercury-containing leachate entering ground water; the FS recommends an in-situ or engineered clay liner for the material disposal site; the liquid removal and monitoring

systems installed with this type of liner require long-term operation and maintenance to prevent any leaching of mercury and other contaminants from reaching the groundwater table

There are some concerns about the suitability of the Zhaur Swamp as a landfill site that should be addressed before a site is selected. The risks of the Nura River flooding the swamp and breaching the landfill cover or of eventual leakage of contamination to subsurface layers that provide a transport route to the river make this location less suitable from an environmental perspective than alternative sites. Any additional impacts from the increased number or length of truck trips needed to transport contaminated materials to an alternative landfill location would be very minor, short-term (during the cleanup period), and avoidable or reducable using the mitigation measures in the EMP. These transport impacts pose small incremental risks as compared with the potential catastrophic consequences of a flood of the swamp or of breakthrough of contamination below the swamp. One of the alternative landfill sites described in the Feasibility Study can be selected on the basis of economic suitability (transport costs, land availability, construction costs, etc.) and designed, constructed and operated to provide more protection of surface and ground water than the Zhaur Swamp.

4.3 IMPACTS ON RECEPTORS

The following sections present the impacts of the proposed project on human health and socio-economics and on natural ecosystems, respectively.

4.3.1 Impacts on Human Health and Socio-economics

The following table summarizes the impacts to human health that could result from implementation of the selected alternative for mercury cleanup.

Table 4-1. Impacts on Human Health

Receptors to Be Affected	Medium to Be Affected	Adverse Impact and Degree of Impact
Potable water production	Surface water and ground water	• Risk of higher concentration of mercury-containing substances in water-bearing horizons during excavation.
Air to be inhaled	Air	• Increased concentration of mercury-containing substances in the air during excavation
Crop production	Agricultural soil	• Suspension of crop production over construction period.
Meat and milk production	Pasture lands	• Limited use of pasture lands during construction period and decrease in livestock population.
Fish to be eaten	Surface water	• Additional contamination of water by mercury-

Table 4-1. Impacts on Human Health

Receptors to Be Affected	Medium to Be Affected	Adverse Impact and Degree of Impact
by people		containing substances, reduction of fertility of fish and their population. • Reduction of commercial fishing (Intumak, Nura River bed).
People	Air, water and soil	• During construction, risk of increase in disease caused by bioaccumlation of mercury through chronic exposure.

Cleanup workers are at the highest risk of all receptors of the impacts of the proposed project. Their close proximity to removal, transport and disposal operations greatly increases their risk of inhalation of airborne particulates containing mercury compounds or mercury vapors, and dermal exposure to mercury compounds. More detail on the impact of mercury on human health is provided in Section 4.1 above. Special precautions to prevent or reduce these impacts are described in Section 6.1, Mitigation Measures, in the Environmental Management Plan.

There are no known special or protected cultural properties or indigenous peoples in the immediate vicinity of the cleanup sites identified to date. However, if new cleanup sites are identified and as already identified sites are further assessed and cleaned up, the cleanup program should remain vigilant for the possibility that such resources may be discovered and would need to be protected. A "chance find" protocol should be developed at the detailed design stage for utilization during project implementation.

4.3.2 Impacts on Natural Ecosystems

The following table summarizes the impacts to natural habitats, including wetlands, watersheds, ecosystems and biodiversity, that could result from implementation of the selected alternative for mercury cleanup.

Table 4-2. Impacts on Natural Ecosystems

Organisms to Be Affected	Medium to Be Affected	Adverse Impact and Degree of Impact
Water organisms	Surface water	• Disturbance of aquatic community, available trophic levels and food chains in the area of Nura

Table 4-2. Impacts on Natural Ecosystems

Organisms to Be Affected	Medium to Be Affected	Adverse Impact and Degree of Impact
Benthic organisms	Sedimentary materials	River bed (0 to 25 km) that would lead to decrease in populations and decrease in biological diversity. • Additional contamination of water and food chain by mercury. • Long period of recovery of natural aquatic community.
Plants	Water and soil	• Reduction of species diversity along Nura River bed, Zhaur basin, Intumak basin. • Decrease in gross primary and net productivity of biocenosis. • Decrease in the amount of oxygen forming in the course of photosynthesis.
Predators, eating fish	Fish	• Reduction of natural spawning locations, reduction of habitat, reduction of population, migration down the river bed and disturbance of food chains.
Soil inhabitants; predators, eating worms	Soil	• Additional contamination of soils by mercury-containing substances on construction site will lead to contamination of water-bearing horizons • Disturbance of food chains (e.g. Protozoa worms predatory fish reducers)
Microorganisms	Water and soil	• Mechanical destruction of habitat, disturbance of biological cycle

Habitat Destruction and Endangered Species

During the cleanup period, some habitat destruction in the existing river banks and river bed will be unavoidable due to sediments removal, heavy equipment movement and dehydration. In addition, it is possible that individuals of one or more of the four endangered species living in the river bank and river bed habitats would be adversely affected.

Impacts on Kurgaldzha Preserve

The area surrounding the Kurgalzhin and Tengiz Lakes is a very valuable, internationally significant and protected wetland habitat. Aside from the typical values of a wetland to ecosystems and man, these wetlands provide habitat to numerous rare and endangered birds species. Insufficient water supply and/or poor water quality severely jeaporadize the viability of the wetlands and the survival of the plant and animal communities the wetland supports. However, the proposed project is not expected to pose significant adverse environmental impacts on endangered or other species in this unique protected area. While there may be some short-term, minor secondary impacts of mercury releases during the removal, transport and landfill operations, these are not anticipated to reach as far as the Kurgaldzha Preserve. Further, the eventual planned increase in summertime water levels in the lakes and wetlands of the preserve, as a result of improvements to the Intumak and upstream reservoirs, will greatly improve the health of this unique ecosystem.

4.4 IMPACTS OF INDUCED GROWTH

The potential environmental impacts of growth induced by the proposed project should be considered. The project will increase water supply to users in the Nura River Basin and this could result in increased agricultural, industrial or other economic activity, as well as population growth and urbanization, and the environmental impacts attending such growth. Such impacts are very difficult to predict at this time but will probably be minimal. Residents and agriculture are already using contaminated water, so the project will be supplying more clean water as a proportion of the total water supply. In addition, parallel programs to repair leakages in the water supply networks of the region's cities will improve water supply efficiency and reduce the need to increase abstraction from the Nura River. Further, it is unclear that additional water supply by itself will be sufficient to stimulate economic growth in the region – a wider range of environmentally sustainable development measures will likely be needed. A separate water resources planning study to be conducted using British DFID funding will address water supply needs and recommend rational water allocation among the cities, industries, agriculture and wetlands in the region.

4.5 CONCLUSIONS

The primary objective of the proposed project is environmental restoration, so it is anticipated that the project will result in significant net positive environmental impacts.

The FS selects a preferred cleanup alternative by determining which approach minimizes the risk associated with the residual mercury after cleanup. The residual risk depends on the cleanup action and target levels selected, the effectiveness of the cleanup, and the accuracy and precision of testing to locate contamination and measure cleanup effectiveness. This complexity makes it difficult to predict precisely, with the available data and analysis, how much risk will be reduced and how much will remain at each individual cleanup site. However, in general, the selected alternative would result in significant net positive impacts to environment and human health, as follows:

- Significant long-term reduction in the release of mercury compounds to air, in particulate or vapor form, from the sites cleaned up by the project

- Significant long-term reduction in inputs of mercury compounds to the Nura River and associated ox bow lakes, and thus reduction of mercury transfers from the river to the river bed, river banks and floodplain.

- Significant long-term reduction in release of mercury compounds to groundwater, from the sites cleaned up by the project or from the Nura River

- Reductions in mercury-related risks to drinking water, agriculture, recreation and important downstream habitats dependent upon the Nura River, thus improving the feasibility of using the Nura as a future source of drinking water for the City of Astana

- Significant improvement in the health of people, socio-economy and ecosystems in the region

However, the project addresses the cleanup of a toxic and persistent chemical that can take on many forms; is mobile in all environmental media – air, surface water, soil and groundwater; and is found in a variety of environments over a wide region. For this reason, some adverse impacts to human health and environment are possible and should be evaluated. There is insufficient data presented or analyzed in the FS to determine site-specific negative environmental impacts for the cleanup of every known or potential contaminated site in the Nura River basin. However, these impacts are mostly short-term and minor increases in transfers of mercury and other contaminants to air, surface water or groundwater through inadvertent releases incidental to the waste removal, transport and disposal processes.

The most significant possible exceptions are the potential long-term impacts of the following:

- ***AO Karbide factory site and Old Ash Lagoon cleanup.*** The FS has not yet fully specified a cleanup approach to the various components of the AO Karbide factory site, or the Old Ash Lagoons. In addition, no treatment method has been selected yet for heavily contaminated demolition debris prior to its being landfilled. It is therefore difficult to evaluate environmental impacts without a selected approach and the data its selection is based upon. It is recommended that the studies currently underway for these sites be completed before a final decision is made on cleanup approaches for these source areas.

- ***Temporarily redirecting Nura River channel to facilitate cleanup.*** The proposed plan involves excavating a new river channel in clean soils so that the river water would not be in direct contact with contaminated materials at active cleanup sites in the existing channel. After cleanup, the river would be redirected to its current channel. In general, many impacts of this approach would be similar to those of excavating and transporting contaminated materials from upland areas. In addition, however, redirecting the river channel would adversely impact the natural ecosystem and biota of the existing channel for the short- to mid-term. Redirecting the river in short sections for short time periods will minimize these impacts and maximize the ability of the ecosystem and biota of clean upstream sections to recover and repopulate downstream sections. The long-term net ecological effect on the existing channel of cleaning up the mercury contamination is expected to be positive.

- ***Occupational safety and health impacts for cleanup workers.*** As described in this section, the greatest overall risks posed by the proposed project are to the safety and health of the workers responsible for removal, transport and disposal of mercury-contaminated materials. The EMP in Section 6 provides some mitigation, monitoring, capacity building and implementation measures to help prevent and reduce these impacts.

- ***Leaving wastes in the Zhaur Swamp and locating the landfill there.*** . The swamp is a saturated area in or near Nura River floodplain. It may be possible to prevent or mitigate impacts by controlling run-on to the disposal area, run-off from the disposal area to the river, leachate generation, and subsurface leachate migration toward groundwater or the river. However, the FS does not provide sufficient data or analysis, or does not directly address, such factors as frequency, depth and coverage of flooding from the Nura River; direction and rate of shallow groundwater flow at the site toward the river; and likelihood and consequences of disposal systems failure under flooding or other extreme conditions. It is recommended these factors be studied further before a final decision is made to utilize the swamp as a landfill site.

- ***Proposed landfill operation.*** There are several potential long-term environmental impacts of operating a landfill in any of the alternative locations studied. These impacts basically represent a transfer of the impacts from the cleanup sites to the disposal site. Ostensibly, the landfill site will be more suitable and better engineered and controlled than the cleanup sites where the wastes came from. However, these facilities, without proper design and operation, may allow ongoing low level releases to the environment and pose a risk of catastrophic failure and sudden large-scale releases as well. Alternatives to landfilling and landfill mitigation measures are discussed in Sections 5 and 6, respectively.

- ***Zoning the floodplains.*** Zoning may leave some contamination in the environment that would have been removed under other alternatives. Compensation for loss of land, relocation to more productive areas, etc. do not address the risk remaining with the contamination.

It is projected that the proposed project will result in an overall net positive impact on human health and environment. However, it remains important to determine if there are alternative approaches to the project that would result in less risk remaining at cleanup sites and if there are measures that can prevent or reduce the incidental, short-term impacts caused by cleanup operations. These are the topics of the Sections 5 and 6, respectively.

5.0 ANALYSIS OF ALTERNATIVES

5.1 INTRODUCTION

Alternatives analysis was included in the feasibility study. Since the project is an environmentally beneficial cleanup, all alternatives proposed in the FS should result in net positive environmental impacts. Therefore, this EIA focuses on critical review of whether the alternatives analysis is thorough, unbiased and transparent; addresses technical, economic, social and environmental criteria; and provides alternatives for design, location, technology, implementation, operation and mitigation.

This section describes and evaluates several categories of alternatives to the cleanup program described in the FS, including the "no action alternative", technology alternatives, prioritization and phasing alternatives, programmatic and organizational alternatives, and location alternatives. A final subsection provides some conclusions regarding alternatives.

5.2 NO ACTION ALTERNATIVE

One of the main objectives of the proposed environmental management and rehabilitation project is to build a foundation for the future supply of clean drinking and irrigation water to Astana, Karaganda and other residents in the Nura River basin. the The no action alternative is defined as not attempting to clean up the mercury contamination in the Nura River basin, and either accepting current contamination levels or depending on natural processes to reduce contamination levels over time.

Several of the findings and conclusions of the risk assessment conducted during the feasibility study do not support the no action alternative. These points, summarized below by environmental medium, result from both the Tier 1 comparison with various water quality standards and the Tier 2 analysis using health risk levels.

- ***River Water.*** The quality of existing Nura River water varies from poor, to suitable for livestock only, to suitable for drinking water, depending on the timing and location of sampling. In general, maximum and mean levels in the samples did not pass water quality standards used in the assessment. This means, for example, that flooding events, which are known to mobilize sediments, can increase river water mercury concentrations to levels exceeding water quality standards. This phenomenon was verified by sampling and analysis during this year's spring flooding event.

- ***Sediments.*** The sediments in the Main Drain are very contaminated and represent a continuing source of mercury contamination to the Nura River. In addition, spring flooding scours the river bottom, causing a re-bedding the river bottom, carrying some sediments downstream, and depositing some sediments in the floodplain. Therefore, previously buried sediments are exposed to the river water, air and soil, thus presenting new risks to human health and the environment. Further, even without flooding, sediments in general act as a slow but continuous source of contamination to the river water (based on comparisons of sediment and pore water concentrations in the oxbow lakes and backwaters where river flow dilution effects are minimized).

- ***Soils.*** The Zhaur Swamp poses an unacceptable risk to public health and should be cleaned up. In addition, there are some hot spots in the flood plain that should either be cleaned up or zoned to restrict land and water uses.

One alternative to cleaning up the mercury contamination would be to provide clean drinking water to residents in Astana and Karaganda, as well as to those living in small rural communities along the river, by treating all drinking water supply for mercury removal at the municipal wastewater treatment plants (vodokanals) prior to other forms of treatment and input to the distribution system. This option is not preferred for the following reasons:

- It would be infeasible from both economic and technical perspectives. Mercury treatment is very expensive and is technically difficult because the mercury kills most bacteria used to provide biological treatment for other water contaminants. In addition, many residents are not hooked up to city water distribution systems, requiring either that the distribution systems be extended to remote areas or that these sources be provided with individual treatment systems, both of which would be prohibitively expensive to install, operate and maintain.

- The river would continue to be unsuitable for other uses such as fishing, swimming and other recreation.

- Parts of the floodplain would continue to be unsuitable for growing crops and pasturing livestock.

- The soil and water that is the foundation for the natural habitats and ecosystems in the river basin would not be restored, thus allowing their continued degradation by ongoing mercury release through leaching, erosion, volatilization, etc., endangering rare species, critical habitats and unique ecosystems such as the Karagaldhzino Wetlands.

For these reasons, the no action alternative is not considered to be feasible.

5.3 CLEANUP AND DISPOSAL TECHNOLOGY ALTERNATIVES

Technology alternatives are discussed below for contamination cleanup and waste disposal in Sections 5.3.1 and 5.3.2, respectively.

5.3.1 Cleanup Technology Alternatives

Selected Cleanup Technology

The FS adequately assesses the various technology alternatives for cleaning up mercury-contaminated sites. The range of alternatives, evaluation criteria, and evaluation itself appear to be reasonable, with the exception that detailed cost information does not appear to be provided for some of the alternatives. The reader is referred to the FS for detailed information.

While there may be some notable exceptions, such as waste isolation for the Zhaur Swamp, the cleanup technology selected by the FS generally involves excavation and removal of mercury-contaminated sediments and soil (and demolition and removal of building materials in the case of the AO Karbide factory site). As discussed in more detail in Section 4, the biggest risks of such operations are inadvertent short-term increases in mercury releases to the environment, especially air and surface water, of mercury that had been to some extent chemically or physically contained.

Alternative Cleanup Technologies

The major options to removal are isolation and in-situ treatment. These options, however, may have significant technical and cost limitations, especially given the extensive area of contamination, and large number and wide geographic distribution of contaminated sites. Some concerns are discussed below:

- *In-situ treatment* requires application of large amounts of chemicals and therefore poses hazards of pollutant discharge to the Nura River and its tributaries.

- *Isolation by surface capping (HOPE polyethylene – foil with geotextile, bentonite clay, asphalt with geotextile) or vertical barriers (polyethylene, insulation plates and bentonite clay).* Isolation techniques do not typically extend underneath the contaminated area, so that mercury may migrate downward to water-bearing horizons. Installing vertical walls down to a water-resistant horizon requires extensive engineering-hydrogeological works. Surface capping may lead to formation of artificial water-proof surfaces subject to damage by local residents, as well as reduce pasture land. Isolation may also adversely impact the hydrologic regime of the river and ground water and lead to formation of stagnating and dirty water in a fenced area which.. The quality of construction of isolation techniques may not always achieve established objectives.

Application of in-situ treatment and isolation methods in large areas may be less feasible, however this does not exclude them from being feasible and appropriate to apply in well-studied local areas.

Site-specific Cleanup Technology Decisions

The general reasonableness of the excavation and removal option for the proposed Nura River basin cleanup is acknowledged. However, the additional alternative of making remedial technology choices on a site-specific basis, when sufficient site-specific information is available, should be considered seriously. The rationale for this alternative follows.

Once in the environment, mercury is of great concern as it is mobile, persistent, bioaccumulative, bioconcentrating, and acutely toxic in some forms. It is these same properties that require the proposed project to be implemented in the first place. However, there is a large variety of site and waste conditions that may be encountered in the Nura River basin. Therefore, it is important that the selected cleanup approaches be tailored to be as technically effective as possible at individual contamination sites in the river basin, while being sufficiently economical to allow most of the significant contamination areas to be cleaned up as fast as practical. In addition, because these characteristics will not necessarily be known until possibly as late as the RD/RA stage, there is a need for flexibility to use other technologies.

Specifically, the chosen strategy should utilize cleanup approaches tailored to site-specific conditions of each contamination area, including type of environment (river bed, river banks, floodplain, etc.), nearby population and land use, type of contaminated media (surface water, ground water, type of soil, etc.), size of site and volume of contaminated material, concentration of mercury, presence and concentrations of other contaminants, distance from disposal areas, etc. For example, some individual cleanup sites may be too close to residential areas to risk excavation and some form of in-situ remediation may be safer. In addition, an alternative for removing river bed sediments, suggested by local engineers, would be to use "hydro-elevator technology" to minimize roiling sludge and to "hydro-transport" or vacuum remove them using equipment developed by Industrial Mathematics Ltd. (Karaganda).

One example waste segregation scheme would be to distinguish slightly contaminated areas where mercury concentrations are below standard (<10 mkg/kg) and therefore not requiring purification, and by analyzing the volumes of contaminated sludge and degree of sludge consolidation. Using these data, the river basin can be divided into five types of areas with similar characteristics relative to suitability for extracting, burying, and isolating mercury contaminated materials, as follows:

1. Areas in the river channel and bank layer adjacent to them.

2. Floodplain areas in the floodplain lows with ground layer over 0.4 m.

3. Floodplain areas in the floodplain lows with ground layer less than 0.4 m.

4. Floodplain areas used for agricultural purposes.

5. Floodplain areas outside agricultural lands.

Extraction and burying of contaminated materials would be the preferred option for areas of types 1, 2 and 3; also a sub-option of preliminary treatment followed by landfill burial is considered for areas of types 3 and 4. Isolation of contaminated areas can be considered for areas of types 2 and 5.

5.3.2 Landfill Disposal Alternatives

Unless properly located, designed and operated for the specific wastes being deposited, landfills pose a risk of wind-blown mercury-laden dust, mercury methylation and release of mercury vapors, formation of mercury-containing leachate entering ground water, and erosion and transport of mercury-containing materials through runoff to surface waters. For these reasons, landfilling is often the last choice among waste management options.

Landfilling may still be the most viable technical solution in general for contaminated sites in the Nura River basin. However, it may not be, by itself and permanently, the most appropriate choice for all waste streams generated by mercury cleanup in the Nura River basin. Even if it is assumed that a landfill will be the primary waste management alternative, more site- and waste-specific data and evaluation are needed to determine what wastes will be suitable for landfilling and what landfill design and controls will be appropriate. Such an analysis should focus on segregating waste streams, either by type or mercury contamination levels, into three groups:

- Those suitable from a resource recovery standpoint
- Those which require pre-treatment or stabilization before landfilling
- Those which may be sent directly to a landfill (and within this alternative there are different landfill designs for different waste characteristics)

Technologies and combinations of technologies should be evaluated and recommended that meet the following objectives:

- Achieve well-defined and targeted reductions of mercury
- Achieve the targeted mercury reductions without introducing other toxic chemicals into the environment and creating additional health risks and adverse impacts to the ecology
- Are cost-effective

Life-cycle costing analysis tools should be used to arrive at a recommendation for the most economical and environmentally effective combination of alternatives.

The following subsections address, respectively, the alternative approaches of pre-treating wastes before landfilling and utilizing different landfill designs for different waste types.

Mercury Recovery and Pre-Treatment of Wastes Before Landfilling

Technologies that could be used to recover mercury or pre-treat mercury-contaminated matrerials before landfilling are described briefly below and in more detail in the FS.

- *Thermal Desorption.* Mixed wastes, including large volumes of soil and debris, as well as some types of process residues contaminated with mercury can be treated. These operations involve the recovery of mercury. Recovered mercury must then be amalgamated or otherwise stabilized for disposal. A treatability study would be needed to demonstrate applicability to site-specific wastes.

- *Stabilization.* Portland cement is used to stabilize many types of sludge, soils, and homogeneous solids in mixed low-level waste; however fly ash and heavy metals prematurely degrade the waste form. This problem is resolved by mixing low proportions of the mercury containing waste material with cement. The disadvantages of this approach are that it significantly increases waste volume, multiplying waste handling costs and consuming scarce disposal capacity. The applicability of this technology to stabilizing small volumes of high-level mercury contaminated fly ash and sludge should be assessed with a waste-specific treatability study.

- *Sludge Disinfection.* Because mercury undergoes methylation by microbial action, standard sludge conditioning techniques should slow the rate of biotransformation. Lime may be recommended for some mercury-contaminated soils that are microbial-enriched. The applicability of this approach to site-specific sediments and sludges may need to be determined using a treatability study. The approach likely will work on sludges with high bacteria and microbial activity. Lime doses will kill or reduce microbial and bacterial action, and further would tend to encapsulate soil and sludge particles. Lime is inexpensive, and should also be considered as a temporary barrier for covering waste piles during staging operations to minimize volatilization of mercury.

Different Landfill Types for Different Wastes

Landfill design can be varied from cell to cell by employing a combination of pollution control technologies selected to address specifically the characteristics of the incoming waste streams. Mercury compounds and concentrations, moisture content, organic content, and the presence of other pollutants are some of the principal factors governing landfill cell design. Waste materials with a high moisture content will require an effective liner, leachate collection and treatment system, and leak detection and ground water monitoring systems. Waste materials with a high organics and moisture content, e.g. river sediments or wetland soils and possibly even some wooden building demolition materials, will additionally require a gas collection and treatment system. Dry, inert wastes will require less pollution control. Mercury recovery and/or pre-treatment can alleviate the need for some of these controls and make a “mono-fill” more feasible.

5.4 PRIORITIZATION AND PHASING ALTERNATIVES

There are several alternative prioritization and phasing schemes and concerns that should be considered as alternatives to the proposed cleanup program, as follows:

- It is arguable that the first priority for the cleanup program should not necessarily be to cleanup the most risky site contaminated with mercury. Rather, it should be to institute water and land use restrictions where appropriate in the river basin to protect residents already exposed to unsafe levels of mercury in their drinking water or in their fish or agricultural products. For example, it may be necessary to close some wells and provide alternate water supplies. It may be necessary to continue such controls throughout the cleanup and for some period afterward so that there is time for monitoring to demonstrate the safety of the water supply.

- In phasing the cleanup of contaminated source areas and hot spots, it will be important to balance getting the overall job done as quickly as possible (and before additional spring floods move the sites to unknown new locations) while minimizing the cumulative short- and long-term impacts of having multiple concurrent cleanup sites open, i.e. impacts of multiple increases in inadvertent releases to air and surface water and impacts of so many concurrent operations' on the trucking operation, the landfill operation, and the environmental monitoring, health and safety monitoring, public consultation, equipment operation and maintenance and general management programs, given the limited capacities of the agencies involved. Also, time is needed to pilot all technologies and approaches before using them on a large scale.

- In general, in order to minimize re-polluting areas subject to contaminant migration from other areas, it will be very important to clean up the upstream source sites first and then work downstream within the river basin. The following order of site cleanup is proposed: AO Karbide site (buildings first, then drains, wastewater treatment plant, sludge drying beds, and Main Drain), then Zhaur Swamp, then Old Ash Fill, then river basin sites from upstream to downstream (flood plains first, then river banks and riverbed sediments).

- The proposed plan proposes to address these issues by excavating a new river channel in clean soils so that the river water would not be in direct contact with contaminated materials at active cleanup sites in the existing channel. After cleanup, the river would be redirected to its current channel. Three alternative versions of this approach are possible, including using an ancient channel that is now dry; digging a new channel the full length of the the river where the cleanup sites will be; and digging the new channel in short sections only around individual cleanup sites and using them only during the cleanup of the respective sites. The last alternative is preferable from an environmental perspective, because it allows minimization of the length and time of river to be redirected at any one time. Also, it is likely that flooding in the past few decades has reached the ancient river channel and left some mercury contamination there, while there is more flexibility to locate new channel sections in clean soils.

- Increasing flows over the Samarkand Dam should not occur until after the mercury cleanup program is complete and any dam and reservoir enlargements or improvements are complete

5.5 PROGRAMMATIC AND ORGANIZATIONAL ALTERNATIVES

There are many programmatic and organizational alternatives that will improve the overall cleanup project. These include:

- *Application of international standards that provide acceptable protection of public health and environment while also providing flexibility in implementation.* The proposed project should be designed and implemented according to both Government of Kazakhstan (GOK) and World Bank requirements. Neither institution provides detailed and specific guidance for contaminated site cleanup and hazardous waste landfill disposal. In such cases, the Bank allows for the application of "international reference standards" appropriate to the situation.

Such reference standards can be taken from one or more international sources, such as the US or EU, depending on what countries have an applicable standard, how analogous the situation is in the country the standard comes from, and how well the proposed standard can be implemented in the country receiving the development aid. In addition, the Bank supports the use of risk assessment and risk management as cost-effective means of accomplishing environmental objectives in its projects. However, both international reference standards and risk-based cleanup approaches must be acceptable to the GOK as well. The Draft FS does not make final decisions about which such standards to apply in the proposed cleanup. The environmental consultant believes that decisions about what standards to apply can be made in some cases at the stage of detailed design for cleanup. At this stage, though, it is recommended that risk-based cleanup be utilized in the removal operations and that EU standards be evaluated for their applicability to the proposed landfill design and operation due to their flexibility in liner design.

- *Further sampling and analysis, treatability studies, etc., packaged with remedial design and remedial action.* Allows quick action on sites where sufficient information exists, while affording the opportunity during the next stage to collect site-specific data where necessary.

- *Contractor procurement for remedial design packaged with remedial action.* Provides for a simpler and less expensive procurement process, while allowing continuity of the specialized expertise critical to the success of the cleanup program.

- *Program for of land and water use control, restoration, compensation and resettlement.* Needed to plan, implement and enforce needed land and water use controls and zoning; assure restoration of remediated land to original use; make and implement resettlement decisions; and compensate for temporary or permanent loss of land and water use.

- *Separate independent consultants for implementation phase support.* Provide specialized support to the PIU on critical program implementation elements, including environmental assessment and monitoring, worker and resident safety and health protection, contingency planning and emergency response, and social assessment and public consultation.

These alternatives are discussed in more detail in Section 6, Environmental Management Plan.

5.6 LOCATION ALTERNATIVES

The locations of the sites needing to be cleaned up are fixed by current circumstances. Section 5.5 above offers alternative site location prioritization and phasing strategies. The following subsections address alternative transport routes, landfill sites, and village resettlement.

5.6.1 Alternative Transport Routes

The FS does not identify waste transport routes. However, the FS attempts to minimize waste transport in general by selecting the Zhaur Swamp as the landfill site, thus eliminating the need to transport contaminated materials from cleanup of the swamp and minimizing the distance wastes must be transported from the other cleanup sites in the Nura River basin. Whatever disposal sites are selected, transport routes should be selected to minimize travel distance to minimize road dust and noise and releases of hazardous vapor, dust, water and soil from trucks. Routes should also favor paved roads to minimize dust and noise and paved roads with lower traffic levels to minimize the risk of accidents and spills. Most importantly, selected routes should avoid populated areas and areas with sensitive habitats.

5.6.2 Alternative Landfill Locations

The FS evaluates several alternative locations for a centralized landfill facility for disposing the removed contaminated materials. The suitability of the Zhaur Swamp relative to Kazakhstani and international standards for landfill location and design would need to be better established with flood mapping and soil permeability testing, the existing data for which is both lacking and contradictory. There are reports of multiple floods around the swamp and existence of a more porous stratum, that may be serving as an aquifer or conduit to the river, underlying a portion of the swamp and separated from it by a relatively thin layer of sub-clay soils. If the swamp were to be used as a landfill, then any cost reductions accruing from reduced waste transport should be balanced against the costs of the additional flood protection that very probably would need to be provided. The consequences for drinking water supply, public health and environment, at river basin scale, of a mercury landfill failure in the swamp, even if unlikely to occur, would be unacceptable. Therefore, alternative sites to the swamp may be more suitable as landfill locations and should be evaluated further. In particular, it will be more feasible to control the surface water migration of pollution from landfills not sited in a floodplain and more feasible to install an impermeable liner that would prevent groundwater contamination at landfills that can be constructed without the constraint of pre-existing waste deposition. The clay thickness and permeability and groundwater depth, flow direction, flow rate, quality and use at alternative landfill sites should be studied further before final site selection.

5.7 CONCLUSIONS REGARDING ALTERNATIVES

This section was intended to supplement the FS in providing an alternatives analysis that meets the World Bank's requirements to be thorough, unbiased and transparent; address technical, economic, social and environmental criteria; and provide alternatives for design, location, technology, implementation, operation and mitigation.

The "no action alternative" is not cleaning up the mercury contamination in the Nura River basin. This option is not considered to be realistic given the objective of providing clean drinking water to residents of the basin including Astana and the technical and cost difficulties of providing additional mercury removal at the vodokanals.

The FS evaluation and selection of cleanup and disposal technology alternatives are generally reasonable, but several additional alternatives should be considered that relate to providing site-specific solutions based on site-specific data collection during the remedial design and remedial action stages. Strategies that segregate wastes by physical and chemical characteristics, hazards posed, treatability, etc., should be considered in evaluating whether landfilling is the most suitable option by itself, or in combination with pre-treatment technologies and, if so, what specific landfill design and controls are most appropriate. This in turn suggests that multiple landfill types or cells may be called for.

The FS landfill site selection criteria and process is generally satisfactory, but more study needs to be made to show that the selected site, the Zhaur Swamp, is suitable for its purpose and/or that leaving the existing contamination in the Swamp is acceptable. Transport routes have not been identified by the FS, but some criteria for their selection are provided here.

Phasing and prioritization alternatives are provided. Institutional controls on land and water uses for nearby areas that will be the most affected by cleanup operations should be implemented before cleanup begins. The speed of the overall project should be balanced against the need to minimize the number and area of contamination sources exposed to the environment at any given time during cleanup and the need to conduct the cleanup in an ordered fashion from upstream to downstream to minimize re-contamination of cleaned areas by areas not yet cleaned.

A number of programmatic and organizational alternatives are provided. First, deciding what standards to apply can be made in some cases at the stage of detailed design for cleanup; however, it is recommended that risk-based cleanup be utilized in the removal operations and that EU standards be evaluated for their applicability to the proposed landfill design and operation due to their flexibility in liner design. Other programmatic alternatives include packaging further sampling and analysis with remedial design and remedial action, and procuring independent consultants for environmental assessment and monitoring, worker and resident safety and health protection, contingency planning and emergency response, and social assessment and public consultation. A program for managing land and water use controls and zoning, land restoration, and compensation is also proposed.

The FS does not yet provide sufficient information to allow a valid alternatives analysis relative to cleanup of the AO Karbide factory site and the Old Ash Lagoon.

6.0 ENVIRONMENTAL MANAGEMENT PLAN

6.1 MITIGATION

Each site cleanup should be designed and carried out with adequate mitigating measures and emergency response procedures to avoid inadvertent short-term releases to other environmental media, and hence to remediation workers, nearby residents and sensitive species, habitats and ecosystems. It is believed that all of these impacts can be avoided or mitigated to a large extent through implementation of the EMP which includes physical and institutional measures to prevent, minimize, monitor, contain or otherwise respond to releases during and after remediation.

Sections 6.1.1 through 6.1.7 present recommended mitigation measures, the environmental impacts they are intended to address, the conditions triggering their application, the cleanup program phase the apply to, and details of their design and implementation. In general, mitigation measures are already built into the main cleanup alternatives in the form of designs and standard operating procedures required or recommended by most western environmental ministries, since they are remedial alternatives intended to produce environmental benefits.

6.1.1 Site Management and Institutional Controls

A Site Management Plan should be developed describing the security measures that will be taken during remedial design and remedial action phases at specific cleanup sites. The plan should address:

- Methods for limiting access to the site, including temporary barricades on roads, security fences, well posted signs warning public of health hazards, and security guards
- Secure waste disposal practices
- Management responsibilities, including developing protocol for security breaches and accidents, conducting security inspections and maintaining security fences

Other institutional controls recommended to further reduce risks of public exposure to safety and health hazards posed by the cleanup operations include:

- Restrictions on the use of surface water or well water derived from the Nura River
- Restrictions on catching, selling or eating fish or other food products from the Nura River
- Restrictions on swimming, boating, fishing or other recreation in the Nura River
- Restrictions on growing crops, pasturing livestock, working or recreating on land in the Nura River floodplain

These restrictions should be limited to specific cleanup or landfill sites, and their vicinities, for temporary periods as appropriate to reduce or eliminate the hazards posed by the cleanup operations there.

6.1.2 Health and Safety Measures for Remediation Workers and Local Residents

Health and safety mitigation measures apply to all cleanup project phases – including removal, transport and landfilling – that involve exposure to contamination and hazardous wastes. The primary concern is for on-site remediation workers. However, local residents and off-site workers are addressed in the contingency and emergency response planning described in Section 6.1.3 and in the monitoring program discussed in Section 6.2 below. Where site-specific conditions merit, the on-site health and safety plan can be extended to protect local residents who may be at risk from cleanup operations.

Medical Monitoring for Workers Exposed to Metallic and Inorganic Mercury

- Establish Baseline and Periodic Examinations
- Initial examination should be performed on all employees exposed to potentially hazardous levels of mercury:

- Medical history and symptom questionnaire, with emphasis on:

  - The nervous system (target organ for chronic exposure)
  - The kidneys (target organ for acute and chronic exposure)
  - The oral cavity (target organ for chronic exposure)
  - The lungs (target organ for acute exposure)
  - The eyes (affected by chronic exposure)
  - The skin (mercury is a skin sensitizer)

- Monitor signs and symptoms for mercury intoxication

  - Personality changes
  - Weight loss
  - Irritability
  - Fatigue
  - Nervousness
  - Loss of memory
  - Indecision
  - Intellectual deterioration
  - Complaints of tremors
  - Loss of coordination

- Physical examination should focus on target organs
- Obtain baseline handwriting sample

  - Handwriting samples should be compared to baseline sample for evidence of tremor

- Laboratory evaluation should include at a minimum a complete urinalysis

- Repeat annually
- Compare results with baseline examination for changes suggestive of mercury toxicity
- Neurobehavioral test
- Kidney damage – Test for presence of proteins in urine
- Biological Monitoring, i.e., blood testing (serves as backup to environmental monitoring)

- Evaluate individual and group samples (early mercury poisoning may cause only very mild, clinically insignificant increase in symptomatology in each individual which, when seen in aggregate, might provide clues that toxic exposure is taking place)

- Remove individuals from exposure and rotated to non-exposure assignments if:

  - Symptoms detected on physical exam, or
  - Biological monitoring levels equal or exceed either:

    - 50 ug/g creatinine in urine
    - 3 ug/dL in blood

Develop Worksheets for Information About Work Involving Mercury and Controls

Site-specific worksheets should be developed for gathering information about work involving mercury and controls for mercury to establish risk levels, assist in monitoring exposures, and to aid in rotating individuals from exposure to non-exposure tasks (to lower TLV exposure).

Checklist of Recommended Written Procedures

- Written certification that a workplace hazard assessment has been performed to determine if hazards are present that require the use of personal protective equipment (OSHA 1910.32)
- Written hazard communication program (*suggested guide – OSHA 1910.1200*)
- Written mercury medical surveillance and medical removal procedures
- Written respirator program (OSHA 1910.134)
- Written mercury exposure and control assessment
- Written mercury waste handling and control procedures
- Written mercury contaminated waste clean-up procedures
- Written employee decontamination procedures

Airborne Mercury Monitoring

Mercury vapor meters will be needed both to assess airborne exposure and to decide whether the area has been cleaned-up well enough. For both these purposes a mercury meter is better than other ways of measuring mercury in air for two reasons. First, the meter gives an immediate reading so that decisions concerning the level of respiratory protection required and whether more clean-up is necessary can be made at once. Second, a meter is the only direct reading method that is sensitive enough to read down to the recommended clearance level. Meters must be calibrated regularly.

Training of Personnel Involved in the Clean-Up

Workers should be trained and competent at the level at which they will be expected to function.

- Methods to detect mercury
- Health hazards of mercury
- Protective work practices and emergency procedures
- When PPE is necessary
- What PPE is necessary
- How to properly put on, remove, adjust, and wear PPE
- Proper care, maintenance, useful life, and disposal of PPE

Personal Protective Equipment to be Used During the Cleanup
(Respiratory Protection – Refer to OSHA/PEOSH standard 1910.132)

- Perform air monitoring using mercury vapor meter for correct respirator protection
- Beware air levels of mercury vapor will increase 10-20 times during clean-up due to mercury being disturbed
- ACGIH TLV of 0.025 mg/m^3 should be used in selecting appropriate respirator for protection against mercury vapor because it is the most protective published exposure limit.
- If airborne exposure to Hg vapor does not exceed 0.25 mg/m^3, a half-mask cartridge respirator approved for protection against Hg can be selected.
- If airborne exposure to Hg vapor does not exceed 1.25 mg/m^3 (50 times the TLV), a full-face cartridge respirator can be selected.
- If airborne exposures exceed 1.25 mg/m^3, a self-contained breathing apparatus (SCBA) should be used.

Other Personal Protective Equipment

- Chemical resistant clothing
- Gloves
- Boots or shoe covers
- Eye and face protection
- Materials recognized for mercury cleanup applications: viton, neoprene, PVC, butyl neoprene, 2-ply Tyvek/Saranex, Barricade.

Decontamination

- Protective clothing and spent respirator canisters should be treated as hazardous wastes
- Collection and disposal
- Isolation and staging areas for decontamination

- Temporary showers
- Minimize laundering – washwaters can be considered a hazardous waste and may create additional cleanup problems

Health and Safety Planning

- HASP (site-specific health and safety plan) – written
- Respirator fit testing program
- HSO (Health and Safety Officer) – may require 24 hour on call
- Safety meetings and protocols
- Worker safety training
- Fire response protocol and training
- Emergency response contact numbers and organizational chart
- Confined space entry protocol, procedures and rescue equipment
- Coordination with air and health monitoring
- Maintaining PPE and respirators
- Incident reporting and corrective actions
- Reporting procedures to project and site management

Communications

- Consider two-way radios
- Protocols for hand signaling
- Confined space entry communications protocols
- Daily safety reviews and work task reviews/planning

Public Relations

- Keep local residents informed
- Periodic meetings with town officials
- Town meetings to voice concerns
- Local newspaper articles
- Maintain good relations with NGOs

Public Risk Issues

Exposure to airborne mercury vapors and daughter compounds may be high due to site activities

- Institute water and land use restrictions, and possibly village resettlement, including villages frequently flooded by Nura and those near proposed transport routes and disposal sites; limitation of the use of the river water for residential purposes, and for irrigation of agricultural lands; limitation of fishing in the areas adjacent to or affected by remediation sites; withdrawal of certain agricultural lands out of service – all before, during and after remediation.
- Periodic air sampling using mercury vapor meters in town and inside dwellings

- Focus on sensitive receptors (schools, hospitals)
- Establish emergency evacuation procedures
- Establish ties with local emergency medical services, police department, hospitals
- Medical monitoring of people residing in the areas adjacent to construction site
- Promote awareness of preventive-medical action

6.1.3 Contingency Planning and Emergency Response

A contingency and emergency response plan should be developed to provide guidance in case of emergencies on specific cleanup sites to on-site remediation workers and nearby residents. The plan can be divided into two parts, one for on-site worker response and one for community response, with provisions as follows:

On-site Emergency Response

- Information on site topography, layout and prevailing weather condition
- Procedures for reporting incidents to relevant government agencies
- Capabilities and limitations of local community emergency response teams
- Periodic rehearsal, review and updating of emergency response procedures
- Integration of emergency response into overall site operation training programs
- Availability of emergency response plan for review by workers and government agencies

Community Emergency Response

- Name of person responsible for responding in event of emergency
- Plan and date for meeting with the local community, including local, oblast and national agencies involved in the cleanup, as well as local emergency teams and hospitals
- First aid and medical information including names of personnel trained in first aid; map with locations of medical facilities clearly marked; all necessary emergency phone numbers; fire, rescue, local hazardous materials teams
- Air monitoring plan, if there is an air pathway risk, including personnel, on-site, perimeter and off-site monitoring and action concentrations for relevant air contaminants (see Section 6.1.2 above)
- Spill control and countermeasure plan, including methods, means, personnel, equipment and facilities to prevent environmental contamination due to spills or other waste discharges by containing the discharges, removing spilled material and contaminated media, and decontaminating affected equipment, structures, etc. (see Section 6.1.2 above)

The on-site emergency response plan should be incorporated into the Health and Safety Plan described in Section 6.1.2 above. The potentially affected local communities should be involved early on in the process of developing both the on-site and community emergency response plans, and those plans should be copied to and made available for on-site review by the local communities. Further, the local communities should be encouraged to develop their own community-wide emergency response plans to address the full range of emergencies that can be anticipated for the community, not just those dealing with the mercury cleanup.

6.1.4 Mitigation Measures For Removing Mercury Wastes from Buildings

Buildings at the AO Karbide factory site will need to be demolished or deconstructed and the resulting mercury-contaminated building wastes will need to be treated and/or disposed, depending on the nature and extent of mercury and other contamination. Site-specific security management, health and safety, and contingency and emergency plans will need to be prepared and followed; these plans are discussed in Sections 6.1.1, 6.1.2 and 6.1.3, respectively. The following additional mitigation measures are recommended:

- Metallic mercury can relatively easily be collected and sent off-site for recovery of pure mercury. The cleanup contractor should look for deposits of metallic mercury on and beneath the floors of the contaminated buildings.

- Recovered mercury in this form should be contained in small vessels and over-packed into 55-gallon steel drums for transport to a recycling facility. Common practice is to place mercury flasks into steel drums lined with plastic drum liners and containing cardboard bracing. The drums are then sealed.

- Manual technologies involve labor intensive cleanup operations performed by workers. The following is a partial list of equipment needed. Contractor should identify special equipment needs based on site-specific conditions:

    - Rubber squeegee
    - Dust pan
    - Plastic trash bags
    - Plastic bags with zipper shut
    - Flashlight
    - Wide mouth containers
    - Large trays or boxes
    - Paper towels or napkins
    - Powdered sulfur (visualizes mercury by turning from yellow to brown)
    - Powdered zinc (amalgamates mercury)
    - Syringe with blunt needle (optional)
    - Eye dropper (optional)
    - Mercury vapor meter
    - All clean-up equipment that comes in contact with mercury should be discarded as a hazardous waste.

- Mercury spill clean-up kits are commercially available and convenient, but are generally geared to handle relatively small spills. In addition to devices to pick up the mercury, these kits contain equipment to roughly measure mercury in the air, chemicals to visualize mercury, and/or to convert mercury to a form that will not vaporize (solutions of 20 % calcium sulfide or 20 % sodium thiosulfate).

- Vacuum technology is a cost-effective means of removing metallic mercury. Never use a conventional industrial vacuum cleaner to pick-up mercury; the machine's exhaust will contain mercury vapors that will contaminate the work area environment. Mercury vacuums are commercially available, however they are expensive.

- Depending on the estimated quantities of metallic mercury, the contractor may consider a small vacuum truck. This has the advantage that the liquid waste can be directly transported to the recycling or disposal facility without packing considerations. The unit is better positioned on job site than normal vacuum trucks due to its compact size. Unit has option of being operated in a continuous mode, meaning loose debris can be loaded directly into dumpsters or liquid mercury could be vacuumed and deposited directly into drums. Note if this option is employed contractor should consider constructing temporary canopy with positive pressure ventilation over drums to minimize fugitive emissions, such as is used for asbestos cleanup. VectoLoader 721 can be equipped with HEPA (high efficiency particulate air) filtration for vacuuming hazardous solid waste streams.

6.1.5 Soil Removal Mitigation Measures

Soil removal will be a major part of the cleanup of the AO Karbide factory site (including areas around process buildings, wastewater treatment plant area, sludge drying beds, and wastewater drainage ditches), Old Ash Fill, Zhaur Swamp, and Nura River banks and selected floodplains. Site-specific security management, health and safety, and contingency and emergency plans will need to be prepared and followed; these plans are discussed in Sections 6.1.1, 6.1.2 and 6.1.3, respectively. Proper on-site waste segregation and staging operations are addressed in Section 6.1.7 below. Proper monitoring of soil removal sites is addressed in Section 6.2. In general, a plan should be developed specific to each cleanup site with details on excavation procedures, safeguards, etc. It is recommended that the following additional mitigation measures be addressed in the plan:

- Site excavation and stockpiling of contaminated soils should be conducted in a very organized way; methylation and volatilization of mercury compounds should be prevented by segregating wet wastes from dry wastes, drying the wet wastes using solar evaporation, and by separating wastes with high organic matter from those with low organic matter and storing the wastes with high organic matter under aerobic conditions

- Wind erosion of in-situ or removed and stockpiled soil that may be contaminated should be prevented by using standard techniques, as appropriate to site-specific conditions, including covering all inactive working areas and stockpiles with tarps or light water spraying or otherwise stabilizing them to prevent dust generation; use of tarps would also prevent rainfall from contacting the stockpiles of soil

- Soil removal operations should not be conducted during the windiest periods of the year and should be ceased immediately and the site secured in the event of a wind storm or strong wind in the direction of populated or otherwise sensitive areas at any time;

- Air monitoring, including wind direction, should be conducted at soil removal sites, per the air monitoring plan included in the health and safety plan (see Section 6.1.4) and monitoring program (see Section 6.2), and operations should be ceased immediately and the site secured whenever the action trigger levels stated in the plan are exceeded

- Water erosion of in-situ or removed and stockpiled soil that may be contaminated should be prevented by using standard techniques, including drainage ditches, berms and catch basins, as appropriate to site-specific conditions, for preventing run-on of surface water from off-site areas to the cleanup site and preventing run-off of contaminated surface water from the cleanup site to off-site areas where it may contaminate soil, ground water and surface water bodies

- For site cleanup operations very near the Nura River or other surface water body, additional measures should be taken to protect the water body from run-off from the cleanup site, such as sediment traps and collection basins positioned in between the water body and the cleanup site

- Site cleanup operations should not be planned for early spring when snowmelt usually causes flooding and should be ceased immediately and cleanup sites secured in the event of an imminent flood at any time of year. The optimal time to conduct cleanup would be soon after the spring floods recede and while the soils are still moist to minimize wind erosion.

- Care should be taken to prevent soil removal operations from penetrating aquitards protecting uncontaminated shallow groundwater aquifers; if soil removal operations must extend into shallow aquifers, then the materials removed should be disposed as a hazardous waste along with the contaminated soils

- Contaminated soils with high moisture content due to contact with either surface water or ground water should be transferred immediately to transport trucks with water-tight linings and covers (or tankers, depending on solids content) for transfer to the landfill, and this material should be solidified and stabilized before landfilling and/or deposited into landfill cells especially designed for wastes with high moisture content

- All soil stockpiles should be lined with an impervious synthetic material such as 10 mil HDPE to prevent soil and ground water contamination below the stockpiles

- All excavated and cleaned areas should be restored to original topography using appropriate clean fill (e.g., from excavation of new river channel sections or the landfill); the surface soils should be recultivated and revegetated with native species appropriate to the area

- Move the river from the existing channel and conduct the sediments removal in short stretches, and conduct the cleanup from upstream to downstream along the river and from floodplain to river bed at any given stretch on the river. In this way, the period of impact for any given stretch can be minimized and the potential for recovery and repopulation from clean source stretches upstream can be maximized.

- Conduct surveys for the four endangered species of plants and animals that may exist along and in the river and to remove and relocate individuals discovered to similar areas already cleaned up or not involved in the cleanup program.

6.1.6 Transport Mitigation Measures

The majority of the site cleanup operations will involve truck transport of removed materials to a landfill disposal facility. Operation-specific security management, health and safety, and contingency and emergency plans will need to be prepared and followed; these plans are discussed in Sections 6.1.1, 6.1.2 and 6.1.3, respectively. Proper monitoring of the transport operation is addressed in Section 6.2. In general, a plan should be developed specific to the transport operation with details on transport procedures, safeguards, etc. The following are generic guidelines for safe loading and transportation of the waste stream that is destined for landfill. A recommended reference is HMR 181 (U.S. Hazard Materials Regulations), Code 49 of the CFR (Code of Federal Regulations). These regulations contain technical guidelines for the safe transportation of mercury contaminated wastes.

Waste Segregation and Characterization

The cleanup project includes a large industrial complex and many separate sites. There is a likelihood of encountering incompatible wastes that would be chemically unstable when mixed. To reduce the risks of fire, explosion and injuries during remediation and transport, wastes should be segregated at the source. This will ensure:

- Safe staging
- Safe containment
- Safe loading and transport

In addition, metallic mercury is a recyclable material and highly contaminated soils, sludge and fly ash can be desorbed and the mercury recovered and sold into a recycle market. Segregation and characterization of wastes on the basis of:

- Physical Forms
    - Mercury contaminated liquid wastes
    - Mercury contaminated solid wastes
    - Mercury contaminated sludge
- Hazard Classification

    - Flammable
    - Corrosive
    - Poison/toxic
    - Reactive or unstable

- Metallic mercury should be segregated from other wastes

    - Mixtures containing glass, plastic and mercury are acceptable and can be recycled with metallic mercury
    - Do not mix sulfur, charcoal or water with elemental mercury
    - Towels and debris should be segregated and labeled mercury-contaminated debris

- Establish safe guidelines based on nature of wastes

    - Oxidizers react vigorously with reducing materials.

        - The reaction can lead to fire or explosions.
        - Keep oxidizers away from flammables, combustibles (e.g., paper or wood) and other reducing agents (e.g., chlorine is an oxidizer; it should not be mixed with solvents like acetone)

    - Acids – do not mix with other chemicals for disposal

        - List acid strength and solution pH on the Hazardous Waste Tag
        - Strong acids are oxidizing agents

    - Bases – Keep bases separate from all other wastes

        - Bases are corrosive and react violently with acids
        - Do not mix acids and bases in the same waste container

    - Solvents

        - Do not mix solvents that have high BTU value, such as ketones and alcohols
        - Do not mix solvents with low BTU solvents such as halogens, or those that have a high water content
        - Drum the materials in compatible containers, tag the wastes
        - If any materials are to be incinerated (*high BTU value materials may be used for energy generation*), identify the percentage of material in the container (e.g., 33 % acetone, 33 % methanol, 34 % hexane)

    - Unknowns

- If materials (*particularly liquid wastes*) are unknown, obtain at least a pH to ascertain compatibility in mixing with other waste streams.
- Consider full waste analysis profiling on case by case basis

Labeling and Manifesting

The nature and quantities of wastes suggest two general types of containers: large carboys (10 and possibly 20 tonne vehicles that will contain loose debris) and smaller containers (e.g., 55 gallon drums).

In the event that drummed wastes are to be recycled or treated, then apply following guidelines and consider establishing programs for:

Drums and small containers (e.g., overpacks)

- Deface all labels on containers you decide to use as waste is first accumulated

- Securely attach a Hazardous Waste Tag to the container. The following information should appear on the Hazardous Waste Tag:

    - Contact name
    - Phone number
    - Hazard classification (flammable, poison, corrosive, etc.)
    - Chemical name and volume percent of each constituent totally 100%
    - pH if applicable; if not, use N/A

For 10 and 20 tonne carboy vehicles transporting loose debris hazardous wastes:

- Vehicles placarding on three sides of vehicle
- Chain of custody documentation
- Manifest documentation
- Tear weight and waste shipment quantities included on manifests
- Electronic data base management of manifests

Loading, Securement and Unloading

For drums and small containers (overpacks):

- Rely on technical procedures in HMR 181 or comparable
- Use of handtrucks and pallet staging

For 10 and 20 tonne carboy (dump) vehicles transporting loose debris hazardous wastes:

- PE tarp coverage and securement on open face dump truck vehicles to minimize fugitive air emissions during transport

Emergency Response

For drums and small containers (overpacks)

- Emergency response procedures for spills, leaks, bulging and fuming drums
- Overpack procedures

For 10 and 20 tonne carboy vehicles transporting loose debris hazardous wastes:

- Emergency response plans for roadway incidents
- Guides for use of booms and dikes
- Identification of clean-up materials and procedures
- Emergency responders- first response team definition and capabilities
- Written emergency response procedures and contact numbers
- Identification of local EMS and fire brigade

Waste Staging Procedures

Site Remediation (drums)

- Protocols for drum staging and palletization
- Protocols for segregation based on hazardous and recycling properties
- Protocols for identification and timing schedules for off-site transport

Site Remediation (loading activities for 10 and 20 tonne transport dump vehicles)

- Protocols for egress and access routes
- Protocol for establishing command center
- Protocols for communications
- Protocols for temporary waste pile staging
- Protocols for minimizing fugitive dusts and emissions
- Beware air levels of mercury vapor will increase 10-20 times during clean-up due to mercury being disturbed – Provide aggressive air monitoring program, PPE/respirators, and establish safe evacuation procedures
- Maintain high humidity conditions (spray waste piles; consider water runoff hazardous and include provisions for collection and disposal of residues)

Decontamination

Drums

- Drum cleaning and recycling – residues are hazardous wastes and should disposed of properly, therefore rinsing procedures should include collection and proper disposal of the hazardous waste
- Drum inspection criteria -- to ensure:

- Drum integrity for further use (recycle in remediation)
- Minimize cross-contamination with incompatible wastes
- Accurate labeling for successive waste loads maintained
- Transport vehicle and front end loader/other excavation machinery
- Periodic cleaning may be needed for maintenance purposes
- Depending on mercury contamination levels, residues from washing vehicles may be hazardous. Make provisions to collect and dispose of the mercury contaminated residues.
- Stage washing operations separate from main remediation – minimize disruptions of site activities, segregate liquid waste streams as these cannot be included in dump truck transports

Truck Maintenance and Driver Training

- Truck tires and bodies should be decontaminated daily using a high-pressure water wash with the washwater being collected and treated before discharge
- Trucks should be inspected and maintained daily for safety, including especially tires, brakes, shocks, window washers and wipers, lights, horns, gates, canopies
- Truck drivers should receive training in safe driving, hazardous materials transport procedures, emergency response, spill cleanup, first aid

6.1.5 Landfill Mitigtion Measures

The majority of the site cleanup operations will involve landfilling of contaminated materials removed from the cleanup sites. Operation-specific security management, health and safety, and contingency and emergency plans will need to be prepared and followed; these plans are discussed in Sections 6.1.1, 6.1.2 and 6.1.3, respectively. Proper monitoring of the landfill facility is addressed in Section 6.2. In general, a plan should be developed specific to the landfill design and operation with details on landfill procedures, safeguards, etc. That plan should address the following recommended mitigation measures:

Design Aspects

- If the landfill will be used on only a temporary basis, the maximum term of storing mercury-containing ground should be provided

- Separate landfill cells or possible sarcophagus with drums encased in concrete for wastes with higher mercury concentrations, e.g. metallic mercury (in case it is decided not to recycle it)

- Separate landfill cells with lime stabilization or solidification for wastes with higher moisture and/or organics content (or otherwise incompatible wastes) to delay methylation and volatilization

- Liner systems according to EU standards for permeability, materials and thickness

- Leachate collection and treatment and surface water run-on and run-off controls according to EU standards

- Relatively flat and shallow landfill profile to minimize wind and water erosion and improve accessibility to the base of the landfill in case of liner or leachate collection system failure

- Restoration of entire landfill site, including cap, by recultivating and revegetating surface soils

Operational Aspects

Operating plans and procedures should be developed and implemented, as follows:

- Waste analysis plan, waste acceptance criteria and procedures
- Waste segregation and staging procedures
- Inspection planning and procedures
- Contingency planning and emergency repsonse procedures
- Personnel training planning
- Closure and post-closure planning
- Leak detection,leachate monitoring and groundwater monitoring planning
- Surface water and air monitoring

6.2 MONITORING

6.2.1 Water Quantity Monitoring

In order to provide the information required by good quality monitoring for the calculation of polluting flows along the axis of the Nura and the Ishim and to get a general idea of the hydrological status of the basin, a hydrometric network is needed as described in the FS for the Nura and Ishim river basins: Six existing stations are proposed for continued use on each river in the first phase of development, followed by addition of three stations on the Nura and two on the Ishim in the second phase.In addition to these stations, it is necessary to obtain from dam managersdaily information on the flows released from the Samarkand dam on the Nura and the Toporskoe dam on the Sherubai Nura.

The water levels in Lake Tengiz and Kurgaldzha should also be monitored regularly. Adverse changes might be expected in this area due to:

- The filling-up of upstream dams, over-sized as compared to the natural flow, leading to the elimination or reduction of floods
- The increase of evaporation in the dam-reservoirs, thus leading to a reduction of flow, especially during summer time
- Water consumption without any backflow

- Poor quality water supplied by the Nura

Monitoring lake water level is essential to understanding the mechanisms of changes in water levels and being able to propose measures to stop or reverse the process. In a first step, monitoring will consist of precisely mapping the lakes, using aerial imagery and later adding the water level records. *Environmental Monitoring Related to the Nura River Basin Mercury Cleanup*

Table 6-1 at the end of Section 6 summarizes the recommended environmental monitoring program for the Nura River Basin mercury cleanup project. The monitoring program addresses the major sources of mercury contamination, the environmental media or pathways of contaminant transport, and the principal receptors at risk from the contamination. Both short- and long-term monitoring, as well as both cleanup site-specific and river basin-wide monitoring are recommended. This monitoring program is intended as only an outline of what the environmental assessment and monitoring team described in Section 6.3 below will start with and fully develop as the cleanup program moves into the design and implementation stages.

6.3 INSTITUTIONAL RESPONSIBILITIES AND CAPACITY BUILDING

6.3.1 Institutional Responsibilities for Mitigation and Monitoring Measures

Table 6-2 at the end of Section 6 identifies the local institutions responsible for implementing each mitigation and monitoring measure. An implementation organization chart is provided in Figure 6-1, also at the end of Section 6.

6.3.2 Capacity Building and Training Supporting Mitigation and Monitoring Measures

The following capacity building and training components are recommended to support the institutions responsible for implementing the recommended mitigation and monitoring measures. Each component provides a consulting team and funding to:

- Provide technical assistance in developing and overseeing implementation of plans relevant to their respective components
- Recommend organizational changes toward forming local teams to implement their respective components of the cleanup project, as well as building long-term capabilities
- Recommend, plan and provide staff training needed to implement their respective components
- Specify and assist in procurement of necessary tools and equipment required to implement their respective components

The capacity building components are described in more detail below.

- ***Safety and health assessment and monitoring.*** A separate consultant will be responsible for assisting the PIU to prepare a detailed project-specific health and safety plan, create a central project health and safety team (HST) and resource base within the PIU, organize and train the HST, and oversee and assist in implementation of the project health and safety assessment and monitoring plan. The plan and team will address safety and health concerns for both remediation workers and the general public in the vicinity of cleanup sites, as well as longer-term medical monitoring of the population relative to the project (i.e., before, during and after the project). The plan will cover prevention, monitoring and mitigation.

- ***Environmental assessment and monitoring.*** A separate consultant will be responsible for assisting the PIU to prepare a detailed project-specific environmental monitoring plan, create a central project environmental monitoring office and resource base within the PIU, organize and train the project environmental monitoring team (EMT), and oversee and assist in implementation of the project environmental monitoring plan. The plan and team will address monitoring of drinking water, fish, crops, livestock, and wildlife, as well as soil, sediments, surface water and groundwater. In addition, the team will conduct any site-specific environmental assessments or risk assessments needed during the implementation phase, e.g. because of changes remediation planning due to unforeseen circumstances.

- ***Contingency planning and emergency response.*** A separate consultant will be responsible for assisting the PIU to prepare a detailed project-specific contingency and emergency response plan, create a central project mobile emergency response team (ERT) within the PIU, organize and train the ERT, and oversee and assist in implementation of the project contingency and emergency response plan. The plan and ERT will address leaks, spills, fires and explosions involving hazardous materials, including both containment of the incident and emergency medical response.

- ***Social assessment and public consultation.*** A separate consultant will be responsible for assisting the PIU to prepare a detailed project-specific public consultation plan, create a project public consultation team (PCT) within the PIU, organize and train the PCT, and oversee and assist in implementation of the project public consultation plan. The plan and team will address the public's involvement in and oversight of the project environmental assessment and monitoring, health and safety assessment and monitoring, and contingency planning and emergency response plans and teams.

- ***Institutional capacity building and training.*** A separate consultant will be responsible for assisting the PIU to carry out the institutional component of the overall loan program, specifically how to integrate the capacity building and training needed to implement the mercury cleanup loan component with the broader capacity building and training identified in the Institutional Assessment as being needed for longer-term sustainability of the project and government organizations involved in it.

6.4 IMPLEMENTATION SCHEDULE AND COST ESTIMATES

6.4.1 Implementation Schedule for Mitigation and Monitoring Measures

Table 6-2 at the end of Section 6 presents the proposed schedule for implementing the recommended mitigation, monitoring and capacity building measures.

6.4.2 Costs for Mitigation and Monitoring Measures

Table 6-2 also provides estimated annual cost ranges, including labor and equipment, for the mitigation, monitoring and capacity building measures proposed for the Nura River basin mercury cleanup program. In general, costs are highly variable and depend greatly on mercury concentrations, physical state of wastes, presence of other contaminants, and waste quantities. The contractor responsible for clean-up operations should make efforts to design mitigative measures and select cleanup equipment that best meet the site requirements in a cost-effective manner.

In addition, the FS provides a preliminary estimate for the proposed water quantity monitoring program of USD 282,000 for the first phase or minimal system (six stations each on the Nura and Ishim Rivers) and USD 333,000 for the second phase or "safe and sound" system.(three additional stations on the Nura and two additional stations on the Ishim). These costs should be added to those provided in Table 6-2, since water levels in the basin affect those in the Kurghaldzhin Preserve.

6.5 INTEGRATION OF EMP WITH PROJECT

The Environmental Management Plan (EMP) outlined in Sections 6.1 – 6.4 above should be integrated into the overall Kazakhstan Environmental Management and Rehabilitation Project as described below.

- ***Mitigation Measures.*** During remedial design, the selected design engineer(s) should review and further elaborate and incorporate the mitigation measures described in Section 6.1 in the tender packages as appropriate for each type, phase and location of cleanup operation. Contractor selection should be based in part on the contractor's experience, capability, plan and willingness to implement the specified mitigation measures. During remediation, the selected contractor should implement the mitigation measures and the construction supervisor should check that they have been implemented adequately. A project oversight committee with representatives of the public, NGOs, and relevant government agencies should oversee compliance with the mitigation measures and monitoring of their effectiveness. The committee should draw on the resources of the independent environmental consultants selected for implementation stage assessment and monitoring.

- ***Monitoring Program.*** The monitoring measures recommended in Section 6.2 should be reviewed and further elaborated by the selected design engineer(s) as appropriate for each type, phase and location of cleanup operation. An environmental monitoring consultant should be selected to assist the PIU to prepare a detailed project-specific monitoring plan, create a central project monitoring office and capability within the PIU, organize and train the project monitoring team, and assist in and oversee implementation of the project monitoring plan. The monitoring measures should be implemented by an integrated team of staff from relevant government agencies. The team should be trained through the capacity building and training program described in Section 6.3 above, as supported by the environmental assessment and monitoring consultant. The project oversight committee described above should evaluate the results of the monitoring relative to the effectiveness of project cleanup and mitigation measures, and periodically review and revise the monitoring plan to make it more effective and to remain consistent with the progress of cleanup.

- ***Capacity Building and Training.*** The capacity building and training program described in Section 6.3 above is based on the recommendations of both the FS and the Institutional Assessment. It should be carried out as a separate component of the overall project loan. A separate independent consultant should be procured to plan and implement the institutional capacity building and training program. The program should address organizational and legal issues as well.

Table 6-1. Environmental Monitoring Program for Nura River Basin Mercury Cleanup

Pathway Component / Cleanup Activity	Monitoring Parameters	Monitoring Locations	Monitoring Frequencies	Monitoring Methods
SOURCES				
Removal of Building Materials, Soils, Sediments	**Air** **Mercury, particulates**	Onsite, perimeters & 1 km offsite	Daily during & quarterly after cleanup for 10 years	Per standards TBD
	Surface Water Mercury, heavy metals, suspended solids	Upstream, at & downstream of discharge points	Weekly & after storms during cleanup & quarterly after cleanup for 10 years	Per standards TBD
	Ground Water Mercury, heavy metals	Onsite & upgradient & downgradient	Monthly during & semi-annually after cleanup for 10 years	Per standards TBD
		Onsite	As needed to delineate & confirm during cleanup	Per standards TBD

Table 6-1. Environmental Monitoring Program for Nura River Basin Mercury Cleanup (Continued)

Pathway Component / Cleanup Activity	Monitoring Parameters	Monitoring Locations	Monitoring Frequencies	Monitoring Methods
	Soil & Sediment Mercury, heavy metals			
Transport of Contaminated Materials	**Air** Mercury, particulates	At heaviest travel points along transport routes	8-hour averages	Per standards TBD
	Spills & Leaks Liquids, solids	Continuously along entire transport routes	Twice daily during cleanup	Visual inspection
	Truck Maintenance Integrity of waste containment (canopies, tanks, compartments), tires, brakes	Truck depot	Daily	Visual inspection

Table 6-1. Environmental Monitoring Program for Nura River Basin Mercury Cleanup (Continued)

Pathway Component / Cleanup Activity	Monitoring Parameters	Monitoring Locations	Monitoring Frequencies	Monitoring Methods
Landfill Disposal of Contaminated Materials	**Air** Mercury, particulates	Onsite, perimeters, 1 offsite	8-hour averages daily	Per standards TBD
	Leak Detection Liner breach	Below landfill liner	Monthly	Using bailer in monitoring wells; Per standards TBD
	Leachate Mercury, heavy metals, organics	Leachate collection system	Monthly	Per standards TBD
	Ground Water Mercury, heavy metals, organics	Upgradient, perimeters & downgradient offsite	Quarterly	Per standards TBD
	Surface Water & Sediments Mercury, heavy metals, particulates	Perimeters & discharge points	Monthly & after storms	Per standards TBD

Table 6-1. Environmental Monitoring Program for Nura River Basin Mercury Cleanup (Continued)

Pathway Component / Cleanup Activity	Monitoring Parameters	Monitoring Locations	Monitoring Frequencies	Monitoring Methods
PATHWAYS				
River Water for Drinking, Cooking, Bathing, Etc.	Per Final FS or Kazakh/WB standards	Per Final FS or Kazakh/WB standards, selected end-of-pipe & FS river water quantity locations	Per Final FS or Kazakh/WB standards	Per Final FS or Kazakh/WB standards
Ground Water for Drinking, Cooking, Etc.	Per Final FS or Kazakh/WB standards	Selected wells in shallow alluvial aquifers in Nura floodplain	Per Final FS or Kazakh/WB standards	Per Final FS or Kazakh/WB standards
Fish and Other Food Taken from River	Mercury, heavy metals, organics, disease, stress	Commonly used commercial food fishing spots whose waters are known to be contaminated; consider gms/day intake by various groups	Two times per year	Electro-fishing &/or sample of commercial catch, visual observation, liver histology & reproductive studies

Table 6-1. Environmental Monitoring Program for Nura River Basin Mercury Cleanup (Continued)

Pathway Component / Cleanup Activity	Monitoring Parameters	Monitoring Locations	Monitoring Frequencies	Monitoring Methods
Crops Grown in Floodplain	Mercury, heavy metals, organics, disease	Hot spots & control spots in Nura floodplain where vegetables that absorb contaminated water are grown, e.g. cucumbers & potatoes; consider gms/day intake for various groups	During growing season & after harvesting, up to 3-4 times per year	Per Final FS or Kazakh/WB standards
Livestock Pastured in Floodplain	Mercury, heavy metals, organics, disease	Representative sample of meat without fat and milk; consider gms/day intake for various groups	Two times per year	Per Final FS or Kazakh/WB standards
RECEPTORS				
Remediation Workers	Mercury, illness per Health & Safety Plan (see Section 6.1.4)	At cleanup sites, landfills & transport facilities	Monthly	Per Health & Safety Plan (see Section 6.1.4)
Local Residents	Mercury, illness per Health & Safety Plan (see Section 6.1.4)	Near cleanup sites, landfills & transport routes & facilities, as risk requires	Monthly	Per Health & Safety Plan (see Section 6.1.4)

Table 6-1. Environmental Monitoring Program for Nura River Basin Mercury Cleanup (Continued)

Pathway Component / Cleanup Activity	Monitoring Parameters	Monitoring Locations	Monitoring Frequencies	Monitoring Methods
Aquatic Wildlife	**Community/Population** Species diversity, population sizes, presence of indicator species, sensitive/endangered species **Individuals** Stress, disease, deformities, tissue concentrations of mercury, heavy metals, organics	Selected locations of Nura, & in tributaries, oxbow lakes, & Lakes Tengiz & Kuralgadzhin	Two times per year	Electro-fishing, followed by counting, visual observation, liver histology & reproductive studies

Table 6-1. Environmental Monitoring Program for Nura River Basin Mercury Cleanup (Continued)

Pathway Component / Cleanup Activity	Monitoring Parameters	Monitoring Locations	Monitoring Frequencies	Monitoring Methods
Terrestrial Wildlife	**Community/Population** Species diversity, population sizes, presence of indicator species, sensitive/endangered species **Individuals** Stress, disease, deformities, tissue concentrations of mercury, heavy metals, organics	Selected locations of Nura floodplain, & near tributaries, oxbow lakes, & Lakes Tengiz & Kuralgadzhin	Quarterly or per Final FS or Kazakh/WB standards	Trapping, followed by counting, visual observation & bioassay, or per Final FS or Kazakh/WB standards

Table 6-2. Institutional Responsibilities, Costs and Schedules for Implementation of Mitigation, Monitoring and Capacity Building Measures

Mitigation or Monitoring Program	Institutions Responsible for Implementation	Estimated Annual Costs (Including Labor and Equipment)	Recommended Implementation Schedule
MITIGATION MEASURES			
Site Management & Institutional Controls, Per Section 6.1.3	SCWR & Project Management Consultant (PMC), with asst. from land owners on site access, & numerous agencies on access to or use of surface & ground water, agriculture, etc.	Designation, announcement & enforcement of zones of restricted access or use are government functions at no cost to project; costs for fencing & signing of cleanup and landfill areas will depend on precise dimensions of those areas (assume 50 km of fence @ $1K/km including signage & installation, sub-total $50K); costs for guards will depend on no. of areas active at any given time (assume 5 full-time guards for 5 yrs @ $2K/yr, sub-total $50K); guards equipment costs (assume 4WD vehicle, 2-way radio, uniform for each @ $10K plus vehicle fuel & maintenance @ $2K/yr, sub-total $100K) – total estimated at $200K; costs can be reduced if local governments will provide guards and some equipment/maintenance	Throughout remedial design and remedial action phases

Table 6-2. Institutional Responsibilities, Costs and Schedules for Implementation of Mitigation, Monitoring and Capacity Building Measures (Continued)

Mitigation or Monitoring Program	Institutions Responsible for Implementation	Estimated Annual Costs (Including Labor and Equipment)	Recommended Implementation Schedule
Health & Safety Protection, Per Section 6.1.4	PMC Health & Safety Team plans, assesses, procures equipment, provides training to cleanup workers, monitors & evaluates; Cleanup Contractors implement personnel safety & health protection measures	PMC Health & Safety Team to include Team Leader (International Expert) @ $100K/yr fully loaded, 2 Assistants (Local Experts) @ $25K/yr, & 3-5 seconded staff from relevant government agencies (SEMES, hospitals, clinics) @ no cost to project, sub-total $750K for 5 yrs; equipment at two levels: Level D for all workers is presumed appropriate, but all workers should be equipped to move up to Level C if site monitoring indicates necessary; Level D involves standard safety helmet, washable coveralls (not to be taken home), & safety boots, while Level C involves chemically-resistant disposable tyvek coveralls, rubber boots & gloves, & respirator with appropriate cartridge for mercury & dust; assume 100 each of Level D & C outfits (1/yr for 25 workers for 4 yrs @ $50 & $125, respectively, sub-total $17,500), plus a supply of 1,200 cartridges (1/week for 25 workers for 3 mos/yr for 4 yrs @ $18, sub-total $21,600) & 6,500 tyvek suits (1/day for	PMC recruits & mobilizes team within 2 mos after start of contract (ASOC) & 6 mos before cleanup begins Team coordinates with design and other expert support teams & prepares plan within 4 mos ASOC & 2 mos before cleanup begins Team procures, commissions and trains on equipment within 6 mos ASOC & before cleanup begins

Table 6-2. Institutional Responsibilities, Costs and Schedules for Implementation of Mitigation, Monitoring and Capacity Building Measures (Continued)

Mitigation or Monitoring Program	Institutions Responsible for Implementation	Estimated Annual Costs (Including Labor and Equipment)	Recommended Implementation Schedule
		25 workers for 3 work mos/yr for 4 years @ $3, sub-total $19,500) – total protective equipment estimated at $58,600 plus labor of $750K = $809K *(this plan does not address safety gear for cleanup of the AO Karbide buildings, WWTP, etc. where further study may determine that entry into hazardous atmospheres may be necessary, requiring self-contained breathing apparatus, supplied air)*	Team implements plan during cleanup and agreed post-cleanup periods Team monitors & evaluates performance & adjusts plan every 6 mos Team prepares post-mortem task completion report after cleanup and post-cleanup periods
Contingency Planning & Emergency Response, Per Section 6.1.5	PMC Emergency Response Team plans, procures equipment, provides training to cleanup workers, monitors & evaluates; Cleanup Contractors implement in case of emergency; AES coordinates community	PMC Emergency Response Team to include Team Leader (International Expert) @ $100K/yr fully loaded, 2 Assistants (Local Experts) @ $25K/yr, & 3-5 seconded staff from relevant government agencies (AES, fire departments, hospitals) @ no cost to project, sub-total $750K for 5 yrs; equipment includes spill detectors,	Ditto

Table 6-2. Institutional Responsibilities, Costs and Schedules for Implementation of Mitigation, Monitoring and Capacity Building Measures (Continued)

Mitigation or Monitoring Program	Institutions Responsible for Implementation	Estimated Annual Costs (Including Labor and Equipment)	Recommended Implementation Schedule
	responses, as necessary	cleanup kits & stations, absorbents, sponges, vacuums, signs & labels, etc., all specialized for mercury, two complete sets @ \$7.5K, sub-total \$15K; mercury analyzer, two @ \$20K, sub-total \$40K; mercury vacuum truck, one @ \$50K; total estimated at \$855K; costs can be reduced by using Health & Safety Team to carry out this funciton	
Building Materials Removal, Per Section 6.1.6	PMC Cleanup & Environmental Teams design; Cleanup Contractor implements; PMC Cleanup Team checks implementation; PMC Environmental Team monitors & evaluates performance	Environmental Team costs included under Monitoring Measures; all other costs TBD at cleanup design stage when cleanup site dimensions, topography, drainage, proximity to surface & ground water, & cleanup procedures are more precisely known; inclusion & costing of these mitigation measures is standard international cleanup design practice	Mitigation measures designed & incorporated into contractor tender documents during design period, within 6 mos ASOC Mitigation measures implemented, as appropriate, during cleanup & agreed post-cleanup periods for individual cleanup sites

Table 6-2. Institutional Responsibilities, Costs and Schedules for Implementation of Mitigation, Monitoring and Capacity Building Measures (Continued)

Mitigation or Monitoring Program	Institutions Responsible for Implementation	Estimated Annual Costs (Including Labor and Equipment)	Recommended Implementation Schedule
Soils Removal, Per Section 6.1.7	Ditto	Ditto	Ditto
Sediments Dredging, Per Section 6.1.8	Ditto	Ditto	Ditto
Transport of Contaminated Materials, Per Section 6.1.9	Ditto but substitute PMC Transport Team for PMC Cleanup Team	Costs of mercury air analyzers is included under Health &Safety above; costs (labor & fuel) for road inspections (spills, potholes) can be included under health & safety – same staff can do these inspections during their normal travels; vehicle safety (tires, brakes, canopies, etc.) check costs can be included in normal vehicle maintenance checks; no costs for routing & scheduling to minimize impacts on residents; wetting of dirt haul roads can be included in on-site mitigation measures	Ditto
Landfill Disposal of Contaminated Materials, Per Section 6.1.10	Ditto but substitute PMC Landfill Team for PMC Cleanup Team	Costs TBD at landfill design stage when landfill site dimensions, topography, drainage, proximity to surface & ground water, & cleanup procedures are more precisely known; inclusion & costing of these mitigation	Ditto

Table 6-2. Institutional Responsibilities, Costs and Schedules for Implementation of Mitigation, Monitoring and Capacity Building Measures (Continued)

Mitigation or Monitoring Program	Institutions Responsible for Implementation	Estimated Annual Costs (Including Labor and Equipment)	Recommended Implementation Schedule
		measures is standard international landfill design practice; illustrative U.S. landfill capital costs include: In-situ clay liner (2 ft thick) @ $22K/acre Synthetic liner (single) @ $20K/acre Synthetic liner (double) @ $40K/acre Leak detection system @ $15K/acre Leachate collection system (not incl leachate transfer) @ $27.5K/acre Protective cover soil (18 inch screen and place on-site material)@ $10K/acre Leachate treatment system ? Gas collection system (if necessary) @ $15K/acre (varies greatly depending on waste type & depth) Natural clay cap (2 ft thick clay screen & place on-site material) @ $51K/acre	

Table 6-2. Institutional Responsibilities, Costs and Schedules for Implementation of Mitigation, Monitoring and Capacity Building Measures (Continued)

Mitigation or Monitoring Program	Institutions Responsible for Implementation	Estimated Annual Costs (Including Labor and Equipment)	Recommended Implementation Schedule
		Multi-layer cap (2 ft thick clay screen & place on-site material) @ $71K/acre Closure cap run-off, erosion & sedimentation controls @ $21.5K/acre Site drainage @ $12K/acre Illustrative U.S. landfill operations costs, for non-hazardous wastes range from $5 to $25 per ton based on location and size of landfill	
MONITORING MEASURES			
Sources – including all on- or near-site environmental media (soil, ground water, surface water, sediment), except air (see Receptors below) at: Cleanup Sites	Sampling – PMC Environmental Team Analysis – Kazhydromet with backup or dupes by Dept. of Ecology & universities, TBD later based on survey of capabilities	Sampling costs: sampling labor to be provided by PMC Environmental Team to include Team Leader (International Expert) @ $100K/yr fully loaded, 2 Assistants (Local Experts) @ $25K/yr, & 3-5 seconded staff from relevant government agencies (Kazhydromet, Dept. of Ecology, et al.) @ no cost to project, sub-total $750K for 5 yrs; sampling equipment for: surface water – stream dip samplers, bottle samplers,	Monitoring measures designed & incorporated into contractor tender documents during design period, within 6 mos ASOC Monitoring measures implemented, as

Table 6-2. Institutional Responsibilities, Costs and Schedules for Implementation of Mitigation, Monitoring and Capacity Building Measures (Continued)

Mitigation or Monitoring Program	Institutions Responsible for Implementation	Estimated Annual Costs (Including Labor and Equipment)	Recommended Implementation Schedule
Transporters Landfill	capabilities Data Certification – Kazhydromet	boats for deep water, filters; ground water – well bailers, wire & cord, filters; sediments – grab sampler, core sampler with trap, wire, rods; soil – trowel, shovel, hand auger (stainless steel), spatulas, buckets; air – canisters, samplers, filters; sub-total approximately $20K in the U.S. for one set of necessary meters, samplers and ancillary equipment & supplies; Analysis costs: analysis labor to be provided by Kazhydromet or other government laboratories; major analysis equipment to be specified and costed by FS Team or PMC Environmental Team (FS survey results not sufficiently detailed to derive specs and costs), but rough illustrative costs for mercury analysis equipment in U.S. are Cold Vapor Atomic Adsorption @ $10K, ICP Trace Analyzer @ $70K, & Organics GC-FID (if necessary) @ $30K; analysis supplies to include glassware, plastic ware, preservatives, coolers & acids, sub-total estimated	appropriate, during cleanup & agreed post-cleanup or post-closure periods for individual cleanup sites

Table 6-2. Institutional Responsibilities, Costs and Schedules for Implementation of Mitigation, Monitoring and Capacity Building Measures (Continued)

Mitigation or Monitoring Program	Institutions Responsible for Implementation	Estimated Annual Costs (Including Labor and Equipment)	Recommended Implementation Schedule
		$5K/year	
Pathways – including quantity and quality Surface Water (Nura, Lakes, Tributaries) Ground Water (Selected Wells)	Sampling – PMC Environmental Team Analysis – Kazhydromet with backup or dupes by Dept. of Ecology, SEMES (recreational ponds), & Tsentrmonitoring (ground water), TBD later based on survey of capabilities Data Certification – Kazhydromet	Included in Sources sampling & analysis above	Ditto
Receptors – **Agriculture & Wildlife**	Sampling – PMC Health & Safety Team Analysis (Agriculture) – Min. Agric. with backup dupes by universities, TBD	Cost TBD	Ditto

Table 6-2. Institutional Responsibilities, Costs and Schedules for Implementation of Mitigation, Monitoring and Capacity Building Measures (Continued)

Mitigation or Monitoring Program	Institutions Responsible for Implementation	Estimated Annual Costs (Including Labor and Equipment)	Recommended Implementation Schedule
Fish Crops & Pasturage Livestock Wildlife **Humans** Air Drinking Water Workers Residents	later based on survey of capabilities Analysis (Humans) – SEMES with backup or dupes by hospitals, clinics, universities, TBD later based on survey of capabilities Data Certification –SEMES		

Table 6-2. Institutional Responsibilities, Costs and Schedules for Implementation of Mitigation, Monitoring and Capacity Building Measures (Continued)

Mitigation or Monitoring Program	Institutions Responsible for Implementation	Estimated Annual Costs (Including Labor and Equipment)	Recommended Implementation Schedule
CAPACITY BUILDING MEASURES			
Institutional Assessment & Capacity Building (IACB)	PMC Institutional Team per Section 6.3	Labor to be provided by PMC Institutional Team to include Team Leader (International Expert) @ \$100K/yr fully loaded, 2 Assistants (Local Experts) @ \$25K/yr, & 3-5 seconded staff from relevant government agencies (e.g., universities) @ no cost to project, sub-total \$750K for 5 yrs; equipment to include annual training facility rent at \$10K for 5 yrs & initial audio-visual equipment, training films & furniture costs @ \$10K, sub-total \$60K; total \$810 K	PMC recruits & mobilizes team within 1 mo after start of contract (ASOC) & 5 mos before cleanup begins Team coordinates with other expert support teams, prepares plan & procures training facilities & equipment within 3 mos ASOC & 3 mos before cleanup begins Team works with other expert teams to provide initial train-the-trainers within 5 mos ASOC & 1 mo before cleanup begins

Table 6-2. Institutional Responsibilities, Costs and Schedules for Implementation of Mitigation, Monitoring and Capacity Building Measures (Continued)

Mitigation or Monitoring Program	Institutions Responsible for Implementation	Estimated Annual Costs (Including Labor and Equipment)	Recommended Implementation Schedule
			Team works with other expert support teams to provide initial and regular followup training to all appropriate contractor and government staff
Health & Safety Assessment, Protection & Monitoring	PMC Health & Safety Team Leader	Assume initial & followup training to be provided by Expert Team at no additional cost to project (Team labor included under Mitigation Measures or Monitoring Measures)	PMC recruits & mobilizes team within 2 mos after start of contract (ASOC) & 6 mos before cleanup begins Team coordinates with design and other expert support teams & prepares plan within 4 mos ASOC & 2 mos before cleanup begins

Table 6-2. Institutional Responsibilities, Costs and Schedules for Implementation of Mitigation, Monitoring and Capacity Building Measures (Continued)

Mitigation or Monitoring Program	**Institutions Responsible for Implementation**	**Estimated Annual Costs (Including Labor and Equipment)**	**Recommended Implementation Schedule**
			Team procures, commissions and trains on equipment within 6 mos ASOC & before cleanup begins
Contingency Planning & Emergency Response	PMC Emergency Response Team per Section 6.3	Ditto	Ditto
Environmental Assessment, Mitigation & Monitoring	PMC Environmental Team per Section 6.3	Ditto	Ditto
Social Assessment & Public Consultation	PMC Social Team per Section 6.3	Ditto	Ditto

Figure 6-1. Project Organization Chart

**State Committee for Water Resources –
Project Implementation Unit**

**International Project Management Contractor –
Cleanup Design, Tendering, & Supervision**

LOCAL CONTRACTORS

Source Control Sites
(AO Karbide, WWTP, Zhaur Swamp,
Old Ash Fill)

River & Floodplain Sites
(River Beds, River Banks, Floodplains)

Transporters

Landfill

Laboratories
(Kazhydromet, with Dept. of
Ecology, SEMES, Min. of Agriculture)

EXPERT TEAMS

Emergency Response

Health & Safety

Environmental

Social

Institutional

Cleanup

Transport

Landfill

APPENDIXES

APPENDIX A. LIST OF EIA REPORT PREPARERS

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- Daniya Asanova, Ph.D., Project Ecologist, Head of Department, Department of Doctoral and Post-Graduate Studies, Al-Farabi Kazakh National University, Almaty, Kazakhstan
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APPENDIX B. REFERENCES

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APPENDIX C. RECORD OF PUBLIC MEETINGS

C.1 OVERVIEW

The World Bank's EIA guidance recommends that public meetings be held near the beginning of the EIA process, to aid in scoping the EIA, and then again at the end of the process, to incorporate the public's views into the final EIA.

C.2 INITIAL PUBLIC MEETINGS

Due to the very short timeframe the EIA team had in which to provide public notice of the initial public meeting, it was decided to hold public meetings in two locations, Karaganda City and Temirtau. Two locations made it more convenient for more people to attend, improving the likelihood of a meaningful participation. In addition, it was easier to define stakeholders along community lines. The following two subsections provide summaries of the two meetings, respectively, as well as lists of attendees and press releases.

Summary

The public hearings on the project for purifying Nura River from mercury were held in Karaganda and Temirtau on February 6 and 7, 2002, respectively.

Preparation for the hearings and subsequent awareness of the public about such an important event started 3 days before the day of the hearings immediately after arrival of Timothy Van Epp. Preparation for such event and its holding in Karaganda were made possible in much due to organizational efforts made by oblast governor's office (S.T.Tungyshbekov, Deputy Governor) and Oblast Council. In Temirtau we got help from Ispat Karmet that give us the space for meeting and invited people to attend.

Information was provided in the regional media (Karaganda TV) on the eve of the hearings. That did not allow to get major groups of people to be affected in the course of the project implementation involved and to make the public be aware of the issue. According to generally accepted standards information about expected hearings was supposed to be published at minimum 60 days in advance.

Venue – House of Friendship Sary Zhailau – is in the downtown of Karaganda. It was selected because it is easily accessible and well known in Karaganda. However people residing close Nura River basically had no access to that place. It is obvious that transportation and prompt notification of people should have been arranged in advance. In Temirtau we had a conference room of Ispat Karmet facility. It is much closer to inhabitants of Nura river basin but the announcement of Temiratu meeting was not made in mass media.

Appointment of a respected and at the same time neutral person, being aware of the issue and able to chair sessions, as a chairperson is one of the important factors of holding public hearings. It is generally agreed that Mr.V.E.Kist, member of Oblast Council, Deputy Chairman of the Standing Committee of Oblast Council on Agriculture and Ecology is the best candidate. Mr.Kist agreed to be a chairperson and appeared successful in that. In Temirtau the function of a chair was executed by Mr. Fedchuk, the deputy chief of devision of nature protection.

About 120 to 125 people attended the public hearings in Karaganda and about 45-50 people in Temiratau. In particular, it was attended by the representatives of the governor's office, oblast council, environmental and sanitary organizations, information and public accord department, scientists, professors and students of major universities of the city and environmental NGOs. The public hearings consisted of two sessions namely providing information to the public on the expected project and discussion including questions/answers, exchange of opinions and comments.

Information about the project included initial general information about significance of the project, about technical difficulties faced by those local organizations which were involved in developing the Feasibility Studies (Grazhdanproekt), and issues of funding the work on FS development. Information about alternative ways of purification was not provided, that raised a lot of questions about justifiability of the hearings at which solutions offered in FS were not addressed. The fact that the final report on FS would be submitted only late February cast some doubt on the necessity for hearings.

At the same time important comments were made and questions asked which may be valuable and significant in developing EIA. In general one may note that sufficiently high degree of interest of the public in the issue and the fact that a decision has been made in Karaganda on establishing a working group to be actively involved in decision making process for this project. The working group consists of the representatives of oblast council, NGOs, scientists, state environmental organizations and students. It was offered to participants of Temirtau meeting to be involved in working group but nobody joint yet. Some of the members of the group intend to take a part in FS discussion scheduled for February 22 in Astana.

Information about the outcome of the public hearings was published in the media in Karaganda and in Temirtau; local journalists are planning to publish a number of articles in the papers. Information about an opportunity to get involved in decision making by taking part in hearings on March 4 will be made available through the media. Besides, residents of the oblast are informed of the fact that during the entire process of EIA development it will be possible to contact an organizational committee on preparing public hearings at 56 29 22 (Karaganda EcoCenter).

In conclusion it should be noted that as an interested governmental authority the Committee on Water Resources and its regional representative office – Nura Sarysu Water Department – did not practically participate in coordinating the preparation process. If the governor's office and oblast council did not take an active part in the public hearings, they would not get the public really involved. During the hearings it was really not clear who was interested in the project, whom the public may appeal to, whose action may be influenced, who and how makes decisions, and who bears responsibility for decisions made. It is obvious that the above issues should be tackled in the course of the next public hearings.

According to information obtained in the course of the report made by Mr.Lukinykh the state inspection will be held later. Thus, according to national laws procedures it is difficult to determine position and role of the outcome of the held hearings in the decision-making process.

C.2.1 Karaganda

Venue: House of Friendship Sary Zhailyau, Karaganda City

Date: February 6, 2002

Subject: Project for Purifying Nura River from Mercury

The public hearings were held under the EIA Project following the recommendations made by the World Bank. The public hearings were attended by 120 people, representing the public, oblast governor's office and Karaganda mayor's office, oblast council, governmental environmental authorities and sanitary organizations of Karaganda Oblast, scientists, professors from educational institutions, NGOs and students. The public hearings were attended by the journalists from the national TV broadcasting company ("KTK"), oblast TV and radio broadcasting companies ("Ortalyk Kazakhstan" and "Industrialnaya Karaganda") and city mass media (Channel 5, Novy Vestnik, Radio Station TERRA, and Vzglyad). Members of the presidium included V.E.Kist, Timothy Van Epp, Ye.Sh.Akimbekov, Ye.G.Lukinykh, A.A.Zolotaryov, and N.A.Yeskendirov (facilitator).

The chairperson – Viktor Eduardovich Kist, Deputy Chairman of the Standing Committee of Oblast Council on Agriculture and Environmental Protection, announced the opening of the public hearings at 3:00 pm. The chairman briefed the attendees on the objectives of the public hearings, their procedure and time-limit, and introduced the members of the presidium to the audience. According to the rules of procedure the public hearings consisted of two sessions: information session and discussion (questions/answers, exchange of opinions, and recommendations). The first session of the public hearings included reports made by the following persons:

- Timothy Van Epp, EIA Task Leader, Director of EEA (USA);
- Ye.Sh.Akimbekov, Local Coordinator of EIA Project;
- Ye.G.Lukinykh, Technical Consultant, Water Resources Committee under the Kazak Ministry of Natural Resources and Environmental Protection;
- A.A.Zolotaryov, Director of Grazhdanproekt Institute;
- K.Ya.Atakhanova, Director of Karaganda EcoCenter;
- Sh.I.Zhangozhina, Deputy Chief Sanitary Officer of Karaganda Oblast;
- Yu.D.Obukhov, Dean of Industrial Ecology Faculty of Karaganda State Technical University; and

- K.M.Akpanbetova, Associate Professor of the Chair of Geography, Karaganda State University after Ye.A.Buketov

B.N.Dyu, Deputy Head of Oblast Environmental Protection Department, also made a report. Discussion of the Project for Purifying Nura River from Mercury awoke the audience's interest. Comments were made that the information provided by Mr.Zolotaryov and Mr.Lukinykh when making the reports on the project was not sufficient; therefore a lot of questions were asked to them by the attendees of the public hearings. Getting more detailed information on the selected method of removing mercury was one of the first requests of the audience. Mr.Zolotaryov and Mr.Lukinykh referred to a meeting scheduled for on February 22, 2002 in Astana in which Final Report on Feasibility Studies would be presented.

Some questions were asked about funding of the Feasibility Studies Project and work to be performed on Nura River. The full list of questions appears at the end of this subsection. During the discussions such issues as sanitary, impact of mercury on health of people and environment, water supply in the region, industrial contamination of Nura River and Samarkand Water Storage Basin by mercury were addressed. There were also asked questions about impact of the project on operators (farmers and fishermen), about works expected to be performed on each section of the river, and whether mercury would affect the environment when being removed and disposed. There was made a proposal to arrange for more thorough review of this issue attracting local experts including researchers from Karaganda State Technical University and Karaganda State Medical Academy. It was also proposed to address such issues as mercury migrations, concentration of mercury in biota, water, algae etc. It was also noted that there was a necessity for detailed review of excavation method effects on health of people and potential risks associated with the method. There was made an emphasis on the necessity for public awareness campaign and for considering alternative sources of finance of the project for mercury removal. There was expressed the necessity for paying more attention to a source of pollution – Karbid Plant (especially Workshop # D19) where there was still large amount of mercury. There was proposed to allow the public to take a part in the discussion of the Feasibility Studies in the meeting scheduled for February 22 in Astana.

The major questions asked and comments made in the course of discussion in Karaganda include:

- What kind of works will be performed on each section of Nura River?

- Will mercury evaporate in the air posing threat to vegetation and water when recovering clastic deposits?

- Who will pay for implementing the project for purification of Nura River? Common people?

- Under Karbid factory area there is much mercury, which is likely to be spreading widely underground! This should be taken into account!

- Sick rate and mortality data have not been made available to the public. Would that be addressed in FS?

- Why are alternative ways of mercury removal not considered? Is this information confidential? It should be discussed at public hearings! Otherwise what are we looking at here?

- Is anyone looking for investments in the project implementation? There should not be taken a loan which would have to be repaid by the next generations!

- Was this grant utilized only for reviewing Nura River problem?

- What area is covered by the proposed project? What is located in that area?

- Did anyone test data on contamination? Were biological tests used as an elementary task?

- Have parameters of determination of mercury migrations speed been found?

- It is necessary to demonstrate the public various degrees of impact of various methods of mercury removal, which may be used in the project, upon environment.

- How do method of excavation of clastic deposits, and their further disposal specifically impact environment and people health?

Following a suggestion made by Mr.Yeskendirov major explanations were given by Mr.Zolotaryov who was involved in developing the Feasibility Studies, Mr.Ye.G.Lukinykh, Technical Consultant of the Water Resources Committee, Mr.Van Epp, EIA Task Leader and Mr.V.Sh.Khasanov, Deputy Head of Nura-Sarysu Water Management Department.

One of the resolutions passed during the public hearings was to get the public more involved in the project decision-making process and to establish a public working group consisting of the following interested persons and organizations:

- V.E.Kist, Oblast Council. Telephone # 42 06 46.

- K.Ya.Atakhanova, EcoCenter. Telephone # 56 29 22.

- D.Kalmykov, NGO EcoMuseum. Telephone # 41 33 44.

- Shabdarbayeva, Malika Sadykovna, Professor, Karaganda State Medical Academy. Telephone # 48 49 48 (office), 75 58 28 (home).

- Akpambetova, Kamshat Makpalbayevna, Chair of Geography. Telephone # 74 59 82 (home)

- Dippel, Nadezhda Zakharovna, Hydrometeorological Center.

- Omarov, Sairan Kydyrbayevich, Karaganda State Medical Academy, Chair of Utilities Sanitary. Telephone # 48 49 48 (extension 123), 52 74 75 (home).

- Zhangozhina, Shakhida Yeskandirovna, Oblast Sanitary and Epidemiological Station. Telephone # 41 14 59.
- Zhanysbai, Suindik Zhumabayevich. Telephone # 43 57 78.
- Kim, Veniamin Valerievich, student, Faculty of Biology, Karaganda State University. Telephone # 74061 94.
- German, Aleksandr Vladimirovich, volunteer of NGO EcoMuseum.
- Zhirkov, Valentin Vasilievich, student of Karaganda State University
- Yesmaganbetov, Nurlan Aminovich, student of Karaganda State University
- Agibai, Serik Karibayevich, Oblast Council. Telephone # 42 11 06
- Mikhailov, Viktor Grigorievich, Chief Expert of Oblast Flora and Fauna Protection Department. Telephone # 74 49 51.
- N.A.Yeskendirov, EcoCenter. Telephone # 74 52 63.

Members of the public working group will attend the meeting in Astana. After the meeting a meeting of the working group will be held in Karaganda. The next public hearings are scheduled for March 4, 2002 at 3:00 pm at the House of Friendship Sary Zhailyau. The public hearings lasted for 2 hours 40 minutes. They finished at 5:40 pm.

Chairman V. E. Kist

Secretary M. Kurmashova

List of Attendees of the Public Hearing, Karaganda City, February 6, 2002

No.	Full Name	Organization	Telephone #
1.	Kist, Viktor Eduardovich	Oblast Council	
2.	Lukinykh, Yevgeny Gennadievich	Water Resources Committee	41 13 50
3.	Shabanov, Viktor Anatolievich	Water Resources Committee	48 38 64
4.	Zhangozhina, Shakhida Yeskandirovna	Oblast Sanitary-Epidemiological Station, Deputy Chief Medical Officer	41 14 59

No.	Full Name	Organization	Telephone #
5.	Anufrieva, Raisa Nikolayevna	Oblast Sanitary-Epidemiological Station, sanitary medical officer	41 14 37
6.	Rakhimzhanov, Alpys Rakhimzhanovich	Agricultural Machinery Department	56 95 97
7.	Zhanysbai, Suindik Zhumabayevich	Ortalyk Kazakhstan (TV Broadcasting Company)	43 57 78
8.	Ospanov, Yeren Mukashevich	Oblast Committee on Land Management	43 22 28
9.	Kirin, Nikolai Vasilievich	Resident of Karaganda City	42 61 48
10.	Arkatov, Anatoly Petrovich	Secretary of Temirtau City Council	
11.	Vurman, Viktor Isakovich	Ekom Ltd.	41 46 78
12.	Gorbunova, Polina Nikolayevna	Forestry and Bioresources Department	41 58 68
13.	Yu.A.Gabov	International IT Academy	43 99 40
14.	T.B.Kozhakhmetov	Head of Environmental Protection Department	41 09 66
15.	B.N.Dyu	Deputy Head of Environmental Protection Department	41 09 66
16.	O.V.Myagkikh	Industrialnaya Karaganda (TV Broadcasting Company)	43 58 14
17.	Mikhailov, Viktor Grigorievich	Flora and Fauna State Monitoring Department	74 41 59
18.	M.S.Shabdarbayeva	Medical Academy, Professor	48 34 72
19.	S.K.Omarov.	Medical Academy	48 34 72
20.	A.D.Yefimova	Medical Academy	48 34 72
21.	T.K.Ordabayev	SRE Karaganda Water Facilities	41 11 24

No.	Full Name	Organization	Telephone #
22.	Yu.D.Obukhov	Karaganda State Technical University, Professor	56 24 10
23.	K.M.Akpanbetova	Karaganda State University, Lecturer at the Faculty of Biology.	73 37 03
24.	B.Zh.Turgayev	Oblast Department of Emergencies	48 20 04
25.	Amanbayev	Oblast Council	
26.	Agibayev	Oblast Council	
27.	N.Ivanini	City Council	41 24 28
28.	S.V.Zharov	Polytechnical College	54 75 50
29.	K.D.Tekinedi	Polytechnical College	
30.	V.M.Stratishenko	Center for Hydrometeorology	56 55 44
31.	N.Z.Dippel	Center for Hydrometeorology	
32.	V.Sh.Khasanov	Deputy Head of Water Management Department	41 13 30 (office)
33.	Ye.V.Kogai	Oblast Environmental Protection Fund	41 23 91 (office)
34.	Svich	Vzglyad (City TV)	43 44 69 editor's office
35.	Sokovsky	Vzglyad (City TV)	43 44 69
36.	O.I.Metsik	TERRA Radio Station	42 09 09
37.	M.A.kenzhegozin	Oblast Governor's Office	
38.	N.A.Yeskendirov	NGO EcoCenter	56 29 22
39.	K.Ya.Atakhanova	NGO EcoCenter	56 29 22
40.	D.Asanova	Counterpart Consortium	
41.	M.A.Kurmasheva	NGO EcoCenter	56 29 22
42.	Ye.T.Baizhanov	NGO EcoCenter	56 29 22

No.	Full Name	Organization	Telephone #
43.	D.V.Sheryayev	Student, Geoecological Faculty	41 41 15
44.	M.Kh.Farakhov	Student, Geoecological Faculty	41 41 15
45.	D.Ye.Raisova	Student, Geoecological Faculty	41 41 15
46.	I.T.Kozhabayeva	Student, Geoecological Faculty	41 41 15
47.	M.Z.Bekenova	Student, Geoecological Faculty	41 41 15
48.	N.Ye.Botkina	Student, Geoecological Faculty	41 41 15
49.	B.S.Satbergenov	Student, Geoecological Faculty	41 41 15
50.	B.O.Zhazybekov	Student, Geoecological Faculty	41 41 15
51.	L.K.Alieva	Student, Geoecological Faculty	41 41 15
52.	A.V.Mutina	Student, Geoecological Faculty	41 4115
53.	M.V.Khutinayeva	Student, Geoecological Faculty	41 41 15
54.	A.M.Charugina	Student, Geoecological Faculty	41 41 15
55.	B.V.Zhumabekov	Student, Geoecological Faculty	41 41 15
56.	Ye.O.Nishetov	Student, Geoecological Faculty	41 41 15
57.	Zhulan	Student, Geoecological Faculty	Ms.Khalidulina, course leader 41 41 15
58.	M.N.Kurotinchko	Student, Faculty of Biology, Karaganda State University	dean's office 73 37 02

No.	Full Name	Organization	Telephone #
59.	Ye.M.Kuchevasova	Student, Faculty of Biology, Karaganda State University	dean's office 73 37 02
60.	A.V.Kim	Student, Faculty of Biology, Karaganda State University	dean's office 73 37 02
61.	A.Tonkobayeva	NGO EcoObraz	dean's office 73 37 02
62.	A.German	Student, Faculty of Biology, Karaganda State University	dean's office 73 37 02
63.	N.Yesmaganbetov	Student, Faculty of Biology, Karaganda State University	dean's office 73 37 02
64.	V.Zhirkov	Student, Faculty of Biology, Karaganda State University	dean's office 73 37 02
65.	V.Kim	Student, Faculty of Biology, Karaganda State University	dean's office 73 37 02
66.	R.Yeskendirov	Student, Faculty of Biology, Karaganda State University	83182 75 50 75
67.	Ye.V.Kogai	Student, Faculty of Biology, Karaganda State University	dean's office 73 37 02
68.	T.A.Larina	Student, Faculty of Biology, Karaganda State University	dean's office 73 37 02
69.	D.R.Asauova	Student, Faculty of Biology, Karaganda State University	dean's office 73 37 02
70.	B.B.Ualieva	Student, Faculty of Biology, Karaganda State University	dean's office 73 37 02

No.	Full Name	Organization	Telephone #
71.	R.G.Mukasheva	Student, Faculty of Biology, Karaganda State University	dean's office 73 37 02
72.	Sh.T.Botanova	Student, Faculty of Biology, Karaganda State University	dean's office 73 37 02
73.	A.A.Mukasheva	Student, Faculty of Biology, Karaganda State University	dean's office 73 37 02
74.	I.K.Kokzhalova	Student, Faculty of Biology, Karaganda State University	dean's office 73 37 02
75.	Zh.D.Nurgalieva	Student, Faculty of Biology, Karaganda State University	dean's office 73 37 02
76.	O.I.Metsik	Student, Faculty of Biology, Karaganda State University	dean's office 73 37 02
77.	M.A.Kenzhegozhin	Oblast Governor's Office	
78.	K.Kalmykov	NGO EcoMuseum	41 33 44
79.	V.V.Ryaguzov	NGO EcoObraz	75 00 28
80.	I.V.Shamgunova	NGO Razvitie	41 95 60
81.	K.Rudenko	NGO Water World	74 16 85
82.	R.A.Yeskendirov	NGO Solyaris	Pavlodar City
83.	Zh.M.Khasenov	Karaganda Department of Information and Public Accord	41 14 87
84.	A.A.Alin	Department of Culture, Youth Policy Division	41 14 73
85.	S.K.Dosarov	Karaganda Department of Information and Public Accord	41 22 91
86.	Samalykov	Student, Karaganda State Medical Academy	48 34 72

No.	Full Name	Organization	Telephone #
87.	Tanabayev	Student, Karaganda State Medical Academy	48 34 72
88.	Zhienbekova	Student, Karaganda State Medical Academy	48 34 72
89.	Satybayev	Student, Karaganda State Medical Academy	48 34 72
90.	Berdikel	Student, Karaganda State Medical Academy	48 34 72
91.	M.V.Udalov	Student, Karaganda State University	72 11 60
92.	I.I.Lipitov	Student, Karaganda State University	73 06 32
93.	Y.E.Kusakina	Student, Karaganda State University	73 06 32
94.	T.S.Dyagileva	Student, Karaganda State University	73 06 32
95.	Ye.M.Stayevich	Student, Karaganda State University	73 06 32
96.	K.Bakirov	NGO EcoCenter	41 19 12
97 through 120	Attended but were not registered.		

Press Release for Public Hearing, Karaganda City, February 6, 2002

As part of the project for water supply of Astana, Karaganda and Temirtau the Committee on Water Resources under the Kazak Ministry of Natural Resources and Environmental Protection is planning to implement the project for purifying Nura River from mercury. According to the regulations of the Kazak Ministry of Natural Resources and Environmental Protection, State Environmental Expertise Department and the World Bank the first stage of the public hearings on EIA is expected to take place to address social, economic and environmental issues related to the project to be implemented in Karaganda Region.

Such issues as alternative ways of removing mercury from Nura River, potential environmental and health effects, social and economic aspects of the project implementation will be tackled during the public hearings. Much attention will be paid to considering opinions, requests and proposals to be made by the public and public organizations located in Karaganda Region. Thus, residents of Karaganda City, Temirtau and adjacent settlements will have a chance to get reliable information about expected activities and to make comments, which will be considered when preparing an EIA report as well as to get answers and advice from experts of the World Bank.

The public hearings will be held on February 6, 2002 at 3:00 pm at the House of Friendship (2nd floor, 4, 40th Anniversary of Kazakhstan Street). Free admission. Contact details:

Oblast Governor's Office

Nurmaganbetova, Gulfaruz

Telephone: 42 11 35

Basin Water Management Department, Water Resources Committee

Lukinykh, Yevgeny

Telephone: 41 13 30

C.2.2 Temirtau

Venue: Conference Room, Training Center of CJSC Ispat Karmet

Date: February 7, 2002, 3:00 PM

Subject: Project for Purifying Nura River from Mercury

Attended by 35 people. The public hearings were attended by the officials of the municipal council, CJSC Ispat Karmet, Karaganda Metallurgical Institute, local media (Metallurg Paper) and the sanitary and epidemiological station. The presidium consisted of the following persons (a chairperson, major speakers and a facilitator):

- V.F.Fedchuk, Deputy Head of Nature Preservation Division, CJSC Ispat Karmet;
- Timothy Van Epp, EIA Project Task Leader;
- Ye.Sh.Akimbekov, Local Coordinator, EIA Project;
- Ye.G.Lukinykh, Water Resources Committee, Technical Consultant;
- A.A.Zolotaryov, Director of Karagandagrazhdanproekt Civil Design Institute;
- N.A.Yeskendirov, Public Hearings Facilitator; and
- Natalia, translator.

Mr. Fedchuk, Vyacheslav Fyodorovich, the chairperson, announced the opening of the public hearings at 3:00 pm. He made a brief general report on contamination of Nura River, briefed the audience on the objectives of the public hearings and introduced the members of the presidium. Major reports were made by Mr.Lukinykh, Mr.Zolotaryov, Mr.Van Epp and Mr.Akimbekov. The speakers provided information about funding the project for preparing the Feasibility Studies and the project for removing mercury from Nura River, about technical aspects of contamination of the river by mercury, and aspects of performing an EIA in compliance with international and national recommendations and standards.

Mr.Yeskendirov proposed the audience to make comments, to share views and to ask questions about the project. Questions were asked mainly about the environmental issues related to operations of facilities located near Samarkand Water Storage Basin and Nura River and contaminating the latter. The following questions were addressed:

- In particular, there was asked a question about expected gold mining operations near Samarka River, i.e. whether this kind of issues will be addressed in the environmental management plan to be developed under the project.

- It was stated that there was a necessity for paying an attention to contamination of Samarkand Water Storage Basin by mercury and other substances and to underground migration of mercury away from Workshop # D19.

- There was asked a question whether management of CJSC Alash was involved in resolving that problem. It was stated that contamination by manganese should have been considered and that manganese content in water top the limit.

- There was asked a question about methods of mercury recovery and a preferable method. It is necessary to consider biological treatment methods.

- There were asked some questions about environmental aspects of mercury disposal, sites of localization of recovered deposits, their effects on ground water, and methods of isolation.

- Is insurance of environmental risks associated with the implementation of the project expected?
- It was stated that assessment of the project impact upon ground water was required.

Some questions were not directly related to contamination by mercury. In conclusion, it was stated that the public would have a chance to participate in the discussion of the project in the meeting in Astana. The next public hearings will take place in Karaganda on March 4, 2002. The public will have an opportunity to contact the EcoCenter with proposals and recommendations at 56 29 22. The chairman thanked the attendees for participation in the discussions. The public hearings lasted for 1 hour 40 minutes.

List of Attendees of the Public Hearing, Temirtau, February 7, 2002

No.	Name	Organization	Telephone #
1.	Ye.G.Lukinykh	Water Resources Committee, Technical Consultant	
2.	A.A.Zolotaryov	Director of Karagandagrazhdanproekt Civil Design Institute	56 16 23
3.	Ye.P.Truskina		6 21 23
4.	T.Satubaldina	Ispat Metallurg Paper, reporter	6 27 81
5.	A.A.Chernyshova	Senior Lecturer at the Labor Safety Chair, Karaganda Metallurgical Institute	6 27 81
6.	N.M.Ismagulova	Senior Lecturer at the Chemical Technology Chair, Karaganda Metallurgical	6 27 81

No.	Name	Organization	Telephone #
		Institute	
7.	D.M.Kocheryuk	Nature Preservation Division ("NPD")	6 34 43.
8.	N.N.Maichuk	Ispat Karmet, Engineer	6 28 61
9.	N.D.Andreyeva	NPD	6 28 61
10.	G.N.Drozdova	NPD	6 09 13
11.	F.Ye.Valeyev		92 21 22
12.	V.A.Gordeyeva	Engineer, NPD	6 01 34
13.	G.I.Ivanova	NPD	6 01 34
14.	T.Ya.Sadovskaya	NPD	6 01 34
15.	L.N.Chilintseva	Head of Pond Preservation Team, NPD	6 16 64
16.	I.V.Kolomina	NPD	
17.	A.D.Bezukladova	NPD	
18.	N.K.Zhapparova	NPD	
19.	Z.K.Auezhanova	NPD	
20.	G.B.Bekbosynova	Sanitary and Epidemiological Station	5 85 55 (direct) 5 24 86 (secretary)
21.	N.V.Briko	Sanitary and Epidemiological Station	5 24 86
22.	G.B.Torshkova	Ispat Karmet, Engineer	6 01 34
23.	T.N.Korlova	Ispat Karmet, Engineer	6 01 34
24.	T.G.Semyonova	Ispat Karmet, Engineer	6 25 41
25.	N.L.Tevs	Ispat Karmet, Engineer	6 12 71
26.	T.G.Melnik	Ispat Karmet, Head of Bureau	6 25 41
27.	O.F.Ziyazhdinova	Labor Safety Division, lab worker	
28.	M.N.Stepanova	Labor Safety Division, lab worker	

No.	Name	Organization	Telephone #
29.	N.V.Vostrikova	NPD, locksmith	
30.	O.R.Karpova	NPD, locksmith	
31.	N.A.Yeskendirov	EcoCenter, EM Coordinator	56 29 22
32.	Tim Van Epp	Nura River Project Task Leader (USA)	
33.	Ye.Sh.Akimbekov	Program Assistant	
34.	Natalia	Translator	Soros Fund
35.	Ye.T.Baizhanov	EcoCenter, Technical Manager	56 29 22

C.3 FINAL PUBLIC MEETING

The final public meeting was held in Karaganda city at the House of Friendship, Sary Zhailyau, on April 25, 2002.

Participants: Oblast Akimat representatives in the person of Mr. Kalishev, Oblast Maslihat representative in the person of Mr. Kist, 110 invited students, professionals and local residents; project participants in the persons of Mr. Krzyzanowski, Mr. Lukinikh, Mr. Zolotariov, Mr. VanEpp, Mr. Akimbekov, Mr. Vurman and Mr. Alexandrov.

Questions and Answers

Question – Mr. Sukhorukov, Ecologist: Were the following points considered during the feasibility study?

- Sites of landfill
- Watersheds connections
- Any environmental impacts

Answers:

- You could find the common information on the landfill sites in the FS summary.
- Places of landfill were thoroughly analyzed by our team in accordance with the EIA recommendations. The Zhaur swamp is not suitable for landfill according to the Republican regulations on the hazardous wastes land filling.
- The document of the expertise will be prepared later, which would reflect the Ministry of Ecology regulations and standards of Environmental Impacts considerations.

Questions: Mr. Khalmanov, Director of the Institute of Applied Math:

- What is the exact problem considered- cleaning the Nura river from what?
- Is there a real possibility of the mercury penetration into the Intumak reservoir?
- Technology of landfill is not clear.
- Is there any world experience of such project implementation known?
- Mercury salts are spread -- is it the fact or assumption?

Answers:

- The group of scientists from Great Britain and Almaty has done the research in the river basin on demetiliration of mercury.
- Not much of data is available on the Intumak reservoir.
- Division of the soil fraction and landfilling them separately is considered as the most economic and safe way of landfilling.
- The project objective is to rehabilitate the natural condition of the river, as it plays an important part on the Republican level of water supply. Also there is importance to preserve the world known sanctuary -- Kurgadzhino.
- *Mr. Van Epp:* World experience: Japan (seashore decontamination from mercury), Europe (Donau river), the USA (Hudson river)
- *Mr. Krzyzanowski*: There is international experience based on lessons learned from cleanup activities worldwide. As an example I would like to mention the Minamata bay in Japan, where population of local fisherman was affected by organic form of mercury in fish tissue (main diet). Minamata bay case could serve as a good example of successful mercury cleanup combined with medical and social measures. There are another examples in Central Europe. There is a large scale mercury-contaminated site in the North of Russia, where pollution is few times higher than here. Bank's role is to bring those cases together, discuss and agree on the most suitable solutions.
- *Mr. Alexandrov*: Mercury is not able to migrate in the water, only through solid materials, soils, for instance. However, mercury migrates in the River as sediments. During the flooding periods mercury migrates downstream up to Kurgaldzhino.

Question – Mr. Masahnov, Student: Will the riverbed be cleaned and redeposited?

Answer – Mr. Vurman: The old riverbeds will be used for the time of the present riverbed cleaning.

Question: What researches were done to examine soils, sands, neogenic clays, and the quotients of contamination at the river site?

Answer: We have all data available at our consultants.

Question – Mr. Pak, Author of the Demercurization of the River Project: According to your data, 3-5 million tons of mercury contaminated soils are planned to be landfilled at the Zhaur Swamp. It means that Zhaur Swamp should be not less than 100-200 meters deep. Mr. Zolotariov declines our project of vacuum technology, why?

Answer – Mr. Zolotariov: Unfortunately I have gotten to know about your project only yesterday. We need to work together.
Questions – Mrs. Kalmikova, NGO "Ecomuseum": What standards were used for cleaning according to volumes? Why do you plan to clean the river only to Rostoka settlement?

Answer – Mr. Zolotariov: We suggested to use our standards documentation. The most contaminated territory is situated between Temirtau and Rostovka settlement. Farther, from Intumak reservoir up to Amangeldi settlement we will monitor.

Question – Mrs. Kalmikova, NGO "Ecomuseum": Were the biological ways of soil treatment considered?

Answer – Mr. Zolotariov: We do not believe that the biological ways are not expensive as we consider the cost issue as an important one.
Question – Mrs. Kalmikova, NGO "Ecomuseum": It is known that there is a cheap way of soils treatment, which is using bacteria.

Answer – Mr. Zolotariov: Our experts did not approve this method.

Question: Are there ways of using bacteria?

Answer – Золотарев: No experts can say the methods are effective.

Question – Mrs. Martiusheva: What are technologies of the ash decontamination?

Answer – Mr. Vurman: We are going to dig it out. However, we do not have enough information about the layers of ash, on that account we need to make more borings. Also we need to gather data on the groundwater at the Old Ash Lagoon and hydropower station.

Question: Did you work out the plan of the residential safety for the water use?

Answer – Mr. Zolotariov: Water in the river is corresponds the standards. As soon as we clean the riverbed it can be used for agriculture needs.

Question – Mrs. Khalmanova: Now we are facing a strange situation. We can ask questions today and the answers we will be able to get only later, and the results of the experts can be revealed later. It would be more convenient to let us know the results and than we would be able to ask more sufficient questions. We are afraid of the secondary contamination. It is known that 50 years ago, when flooding occurred, the old river bedding was polluted and the riverbanks as well. I suggest to clean the riverbanks first and than proceed to the riverbed.

Mr. Khalmanov, Director of the Institute of Applied Math: The problem we are facing is very complicated. As any other project, here we need to take into consideration engineering part, and technical part. But, the scientific considerations are not well examined. Have anyone of you ever seem how fast can mercury penetrate through solid materials? Studying in Moscow I was an eyewitness when the amount of mercury was spilled on the third floor of a building. 3 hours later it was already under the ground. Here we have 5 million tons of mercury in the river. WE have migrating sediments here or I don't clearly understand what we are trying to catch in the river. Your monitoring does not sound clear. Yu need to work more on technical parts and present the project to people first and then ask for questions.

Question, Martusheva, Development Fund of Temirtau:

- Were the ashes from GRES (hydro power station) considered during the study and what are you going to do with ash wastes? Will the secondary contamination of the urban atmosphere be happening when cleaning the river from ash sources?

- OJSC Carbide's site several times exceeds maximum permissible concentration of mercury, how this issue is being solved?

Answer, Zolotarev: Problems of Carbide factory are serious. Nobody can say definitely now how much mercury the site contains. Moscow and Leningrad's studies and the report on geology with the drawings and the design of the factory are available, besides 10 years ago Karaganda scientists from KARGIIZ (Karaganda Scientific Institute) have conducted some studies on the plant's site. In the conclusion of the report it is said that soil foundations are compact Neogene. This is not kind of Pavlodar critical situation at Chimprom factory (chemical plant). The mercury is still their and has not moved, we need to clean it starting from Carbide factory. It is going to be a large campaign.

Martusheva: The Institute of Metallurgy and Refinery of Kazakhstan has the technologies to clean the territory of Carbide. You are talking about complete mercury removal from the factory's site and treatment. The buildings will be demolished and treated. We will burn the bricks in vacuum device and not constructing landfill.

Zolotarev: Buildings are 30 meters long, but the bricks shall be destroyed completely. Your method is rather expensive. We are ready to get aware of your methods. We appreciate you conducting such type of works.

Matushenko: You haven't answered regarding what were going to do with 5 mln tons of ashes in sludge? After you dehydrate the soil ashes will go up and winds will be bring them immediately to the city territory causing secondary contamination as we were consulted by ecologists. We were warned by them about this could happen.

Vurman: We intend to remove these lenses; there 2-3 of them, which the constructors tried to use earlier for civil construction. Contamination in terms of depth has not been studied, we need to drill wells. Ground water also need to be studied. FS projects paid a lot attention at TETS-3, GRES (hydro power station), and in developments of EIA we are trying to minimize the problems related to landfills.

Question, NGO "Eco Museum":

- Have you done the mapping highlighting the cleanup areas?
- Are the technologies compliant with the Kazakhstani norms being met?

Vurman:

- Both EIA and FS provide recommendations and maps of contamination, but they have not been processed properly yet.
- There are no norms in the Republic. There allowable – 2 maximum permissible concentrations (MPC), moderate and hazardous – 5 MPC (10 kg/mg) norms. I consider this approach to be correct.

Question: Have the protection of the population living on the banks of Nura River been envisaged?

Answer, Zolotarev: Water quality in Nura River is compliant to the GOST (state standards developed in Soviet times). If the soils are cleaned, then swim and irrigate the gardens!

Matushenko: We do not have data on soils, secondary contamination by mercury ashes is dangerous and we are concerned about it! If we shake up everything it is going to get worse. What will happen to the oil pipeline in Intumak; is it a serious risk? There scientists that do not recommend touching this sludge - it brings the threat of secondary contamination! How the secondary contamination is going to be prevented? Water is polluted during flood time.

Vurman: When transporting and disposing wastes everything will be monitored on everyday basis. There are other contaminants in Nura River, i.e. chemical ones. They will be eliminated as well. There is no laboratory in Karaganda on mercury measurement.

The data on Carbide factory were very diverged. Effluents are contaminated by mercury. It is necessary to once again launch the laboratory works. The entire control system existing till the last moment was disturbed. There were funds allocated to Hydromet and the Department of environmental protection, therefore there is no motivation to implement the control. We should learn to trust each other, we shall speak one language.

Aleksandrov: The oil pipeline design has been prepared 10-15 years ago by Turkmenia considering future expansion of the reservoir. Then the project was frozen. Rehabilitation of Intymak will be reconsidered, the new project will be developed; the emergency tributary of the new pipeline has already been laid in order to minimize the risk.

Vurman: This issue has been raised during the campaigns by ecological society. Oblast administration was pushing this subject and the second side-line of the pipeline was laid.

Litvinov: I participated in innovative water projects.

- I suggest to create Fund or Center of innovative projects. There are technologies, which allow for swallowing mercury. The river contains the whole table of Mendeleev.
- In case of disposing on a landfill, who has considered the cost of land?
- What are the forecasts in this regard that you have?
- During what season the disposal will be conducted? It is interesting to know the thoughts of designers.

P.Krzyzanowski: . It is expected that project implementation would take 6 years in two stages. 1-st stage – cleaning the source of pollution in order to avoid risk of future secondary contamination, it means the plant itself, main drain, lagoons, most polluted river section and the flood plains, where the ash is deposited and in the 2-nd stage – "Intumak"- we should be absolutely clear about mercury's behavior after the spillway is finished and water level in reservoir is higher. We are going to do additional one year monitoring and some modeling to be able to predict potential impact of Intumak dam completion on mercury methylation. Under the project there will be enough funds to conduct good and reliable water quality monitoring..

Mrs. Khalmanova: It is difficult for us to access the situation. We are asking questions today and the results of works can be revealed tomorrow. It would be more correctly to let us know the results first and then expecting questions from us. We are afraid of the secondary contamination. It is known that 50 years ago, when the spring floods occurred, the oxbow lakes and river banks were polluted. I suggest to clean the riverbanks along 17 km first and then proceed with the riverbed. We are completely agree with the concerns expressed by Mss. Kalmykova and Matushenko from Temirtau.

Question: What about the mercury salts that you did not mention?

Answer, Akimbekov E.: There is a work of Ilushenko group that contains the soils assessment.

Mr. Khalmanov, Director of the Institute of Applied Math: The problem we are facing is very complicated. As any other project, here we need to take into consideration engineering part, and technical part. But, the scientific considerations are not well examined. Have anyone of you ever seem how fast can mercury penetrate through solid materials? Studying in Moscow I was an eyewitness when the amount of mercury was spilled on the third floor of a building. 3 hours later it was already under the ground. Here we have 5 million tons of mercury in the river. WE have migrating sediments here or I don't clearly understand what we are trying to catch in the river. Astana City needs water; it could be supplied in other way, for instance near the riverbed and from the banks. 50% of water is lost in open channels. We need to use pipes, and based on our experience, possible using ashes, but it is very difficult to do it with regard to salts. Your monitoring does not sound persuasive. You need scientific elaboration of details.

C4. SUMMARY OF EIA RESPONSE TO PUBLIC MEETING COMMENTS

Genearl areas of concern raised by members of the public during the initial and final public meetings and the the EIA locations where responses are provided are listed below:

- Project sponsors and funding sources – Section 2, Project Description. Project preparation is being funded by various bilateral trust funds available to the World Bank. Project implementation will be financed by a loan from the World Bank. The Committee for Water Resources and Basin Water Authorities will lead implementation. A proposed project organization chart is provided in Section 6, Environmental Management Plan.

- Contaminants of concern – Section 2, Project Description, and Section 3, Baseline Data. The project focuses on mercury, in all of its chemical and physical states, including mercury salts and methylated organic forms of mercury, as the most prevalent, persistent, mobile and bioaccumlative contaminant and the one that most complicates drinking water treatment. The EIA encourages the project sponsors to consider also the human health and environmental impacts of other contaminants in the Nura River basin that may be co-located with the mercury deposits or otherwise limit the quality and uses of river basin water and land.

- Area of project, spread of contamination in ground water and surface water bodies – Section 2, Project Description, and Section 3, Baseline Data. The project involves the entire Nura River Basin, including all waste source areas and all surface and ground water bodies that may be or have been shown to be contaminated with mercury. Source areas include the AO Karbide site buildings and drainage ditches, the on-site wastewater treatment plant and adjacent sludge drying beds, the Main Drain to the Nura River, Zhaur Swamp, HES 1 old ash fill, Surface water bodies include especially the Nura River, but also its oxbow lakes, embayments and tributaries, the Intumak Reservoir and downstream on the Nura all the way to to its terminus at Lakes Tengiz and Kurgaldzhino. All past and ongoing studies of contamination that were available to the EIA team have been summarized and taken into account in the Feasibility Study and EIA and were used in mapping the contamination in the river basin. There appeared to be a lack of available data on the effects of mercury on human health, agriculture and wildlife in the river basin, so these effects were extrapolated based on information in the literature from other mercury contamination sites around the world.

- Cleanup standards and areas – Section 2, Project Description, and Section 4, Environmental Impacts, describe the soil cleanup standards to be used in the cleanup and their influence on the area and volume of soils to be removed, transported and landfilled. In general, however, the EIA recommends the use of the risk-based cleanup approach, rather than fixed standards, and if fixed standards must be relied upon, the EIA recommends using some combination of European Union and Kazakh standards as appropriate to the various cleanup and landfill situations encountered. Final decisions on these standards can be made during the detailed design stage.

- Secondary pollution – Secondary pollution potentially resulting from the cleanup activities is a major focus of the EIA. Section 5, Alternatives, and Section 6, Environmental Management Plan, propose numerous measures for limiting inadvertent ash/dust generation, releases of contamination to surface water and ground water, and exposure of cleanup workers and nearby residents to mercury due to removal, transport and landfill operations. Schemes for prioritizing, phasing and scheduling these operations is proposed which will minimize potential secondary contamination. Application of institutional water and land use controls before, during and after cleanup is strongly recommended in the EIA.

- Alternative cleanup and landfilling technologies – Section 5, Alternatives, identifies and evaluates numerous alternatives for cleanup and landfilling. These alternatives include especially the preservation of flexibility to use approaches other than the excavation, transport and landfill approach proposed by the Feasibility Study, where site-specific conditions relative to mercury form and concentration and water and organic content of the contaminated materials may dictate. Solidification and stabilization of these materials before landfilling is recommended. Also recommended is the utilization of multiple landfill cells with some cells being equipped with more effective liners and other pollution controls to handle the more concentrated, wet or organics laden waste. Other cleanup techniques are considered in the Feasibility Study and EIA and reasons for their rejection, usually based on cost or technical implementability issues, are given.

- Landfill site selection – Section 5, Alternatives, addresses the proposed landfill site of the Zhaur Swamp, indicating that the consequences of landfill system failure in the swamp's floodplain/aquifer location would be irreversible and unaccepatable and that better sites could probably be found among the alternatives listed in the Feasibility Study.

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