Republic of Azerbaijan

URGENT ENVIRONMENTAL INVESTMENT PROJECT
(AZ-PE-55155)

ENVIRONMENTAL ASSESSMENT

AUGUST 10, 1998

State Committee of Ecology
Republic of Azerbaijan
# AZERBAIJAN

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**ENVIRONMENTAL ASSESSMENT**

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The following supporting documents are available upon request: An Initial Survey of Mercury Levels in Human Hair and the Marine Environment; Mercury Contaminant Waste and Soil at the Sumgait Industrial Area - Investigations and Proposals for Remediation and Safe Landfill; and separate environmental reviews of the sturgeon hatchery and oil cleanup components.
AZERBAIJAN
URGENT ENVIRONMENTAL INVESTMENT PROJECT
ENVIRONMENTAL ASSESSMENT

A. Preface

1. This environmental assessment was prepared for the State Committee on Ecology of the Republic of Azerbaijan by a team of foreign and local consultants. Foreign participants included John Munthe (Lead Scientist), Swedish Environmental Research Institute (IVL); Jan Sundberg, Karsten Håkansson, Jan Rogbeck and Bertil Nord, the Swedish Geotechnical Institute (SGI); Gilbert T. Rowe and William J. Rogers, Texas A&M University. Azeri participants included the State Committee on Geology and the Institute of Prophylactic Medicine.

B. Policy, Legal and Administrative Framework

2. To address the most urgent actions identified in the Azeri National Environmental Action Plan (NEAP), the World Bank and the Government of Azerbaijan agreed to prepare an environmental investment project. A large number of potential projects were screened using three criteria: (a) critical importance for the environment and economy of Azerbaijan; (b) urgency of the recommended actions; and (c) size and complexity, with a preference for relatively small projects of a demonstrative or pilot nature. From the list of potential projects, four were selected. Due to the urgent environmental situation in Azerbaijan, the proposed project was prepared, appraised and negotiated in less than six months.

3. The objectives of the proposed project are: (a) restoring the capacity of Azerbaijan to produce sturgeon fingerlings by building a new hatchery; (b) demonstrating mercury cleanup technologies and procedures by cleaning up one area heavily polluted by mercury; (c) testing and demonstrating onshore oil field cleanup methodologies by cleaning up one oil field in the Abseron peninsula; and (d) improving the institutional and regulatory capacity of the Azeri environmental management system. The project would provide a sound basis on which a follow-on or supplemental environmental project could be based.

4. The project would consist of five components: (a) a 15-million fingerling sturgeon hatchery; (b) demonstration mercury cleanup; (c) pilot onshore oil cleanup activities; (d) strengthening environmental management capacity; and (e) project management and supervision support. The proposed project has neither resettlement nor adverse impacts on cultural heritage.

5. The project has been assigned to environmental category A because of the mercury cleanup component. Therefore, a full environmental assessment has been done, and as per World Bank procedures given in OD 4.01, the Environmental Assessment was be distributed to the Bank's Board of Directors prior to the Appraisal mission.

6. This Environmental Assessment (EA) covers in detail the mercury cleanup component of the Azerbaijan Urgent Environmental Investment Project which would be financed by a US$20 million IDA credit. This project is scheduled for Board presentation in June 1998. The cost of the mercury cleanup component would be approximately US$8.1 million. There are no cofinanciers for this component of the project. The strengthening of institutional capacity would be cofinanced by the UK Know How Fund and a Japanese PHRD grant.
Ecology Law of the Azerbaijan Republic

7. The State policy of the Azerbaijan Republic for environmental monitoring and natural resources rational use is based on the following laws enforced in the Azerbaijan Republic after 1991, when Azerbaijan achieved independence:

- Law No. 80 on Nature Protection and Use, dated 25 February 1992
- Decree N176 of the President of the Azerbaijan Republic
- Provision on State Ecology Committee and Natural Resources Use, dated 7 September 1992
- State Ecology and Natural Resources Use Committee within the frame of UNDP developed and put in force: Environment Assessment Provision in the Azerbaijan Republic (1996)
- Resolution of the Cabinet of Ministers of the Azerbaijan Republic: Responsibility for Environmental Pollution, dated 3 March 1992
- Resolution N130 of the Milli Mejlis of the Azerbaijan Republic (Parliament) on the State Environment Committee, dated 21 May 1992
- Resolution N319 of the Cabinet of Ministers of the Azerbaijan Republic: Norms and Limits Approval and Illegal Development Damage Compensation, dated 8 July 1992

8. The following normative acts (regulations) are relevant to the issues of environmental protection:

- Penalty calculation methods on over-limit discharges of toxic matters into the atmosphere, in compliance with assessment procedures (1993)
- Recommendations on structure and composition of PDV projects and industrial discharges (1994)
- Penalty assessment methods on atmosphere pollution caused by fire (1994)
- Normative documents on State Ecology Expertise
- Atmosphere Protection Code
- Approval of the Law of the Azerbaijan Republic Radiological Safety of the Population
- Complex Environmental Protection Plan in the Azerbaijan Republic for the period up to 2010 (1987)

9. Local environmental permits and clearances are only granted in Azerbaijan after the detailed design of the project has been completed and reviewed. Preliminary approval to proceed with the detailed design of the project has been given by the State Committee of Ecology.

C. Project Description

10. Sturgeon Hatchery. This component would build a 15-million fingerling sturgeon hatchery near the town of Neftchala on vacant land owned by the municipal government. Project funds
would be used to prepare the site, purchase the equipment, and install the components on a turn-key basis. The site was selected as the best combination of proximity to the sea and safe elevation above the potential flood plain of both the Kura river and the Caspian Sea. The site also has road access and electrical power. The hatchery would be of a proven design similar to those used in France and the United States and would incorporate recent advances in sturgeon hatcheries.

11. The main environmental issues associated with the sturgeon hatchery environmental issues include: (a) extraction by the hatchery of about 600 liters of water per second during intermittent periods of operation (less than 1 percent of the Kura's average flow with over 95% of the water returned to the river); (b) collection and disposal of hatchery wastes (mainly offal from the feed mill and dead fish); and (c) cross-breeding of sturgeon species; and (d) dust from the hatchery's feedmill.

12. To mitigate these impacts, the hatchery component would include: (a) wastewater treatment for all the hatchery (evaluations conducted as part of the environmental review indicate that the nitrogen load from these waste waters would not have a significant impact on aquatic life in the river due to its small amount and dispersion in the channel); (b) collection of wastes in concrete bins and burning on a regular basis to avoid disposal of these materials into the river or other water courses; (c) use of separate tanks to segregate various species of breeding stock and hand-fertilization of roe from known donor species; and (d) dust control measures and worker training to minimize exposure. Details on the environmental impacts are in the environmental review for the sturgeon hatchery.

13. Onshore Oil Cleanup. This component would finance two sub-components: (a) the development of pilot tests to determine the effectiveness, costs, and financial viability of different onshore oil cleanup technologies, including sediment/sludge mechanical washing, thermal treatment, and land farming/bio-remediation; and b) cleanup and restoration of an 11-ha test site using the technology selected by the pilot tests. This component was subject to an environmental review by the State Oil Company with the assistance of international oil cleanup consultants. The review concluded that cleanup would have long-term positive benefits and the potential negative impacts of the cleanup are not significant. However, the quantities and qualities of the oil sludge are no well defined, and further information on the nature of the oil contamination would be determined during detailed project design and the potential environmental impacts of the component reassessed.

14. Environmental issues associated with the onshore oil cleanup include: (a) worker safety in the oil field cleanup; (b) disposal of oil field wastes; (c) handling of recovered oil; and (d) increased dust from oil field cleanup operations.

15. To mitigate these impacts the project would include: (a) providing training and equipment for oil field cleanup workers as part of a work safety plan; (b) testing and categorizing of oil field wastes by contaminants and severity for disposal in appropriate facilities; (c) adequate on-site storage facilities for recovered waste; and (d) using anti-dusting measures such as watering in the oil field. Details on the environmental impacts are in the environmental review done by the State Oil Company (SOCAR).
16. **Strengthening Environmental Management.** This component would support the Government of Azerbaijan, and the State Committee for Ecology, in addressing high-priority environmental management issues identified during the NEAP process. The component would include two sub-components: an environmental management subcomponent which would undertake a complete review of the institutional system and structures for environmental management in the national government; and a hazardous waste management subcomponent which would develop the framework for a cradle-to-grave management system for hazardous waste. Both subcomponents would be developed in close cooperation with local experts and would support activities developed under the mercury cleanup component. There are no environmental issues associated with this component.

17. **Project Management and Supervision Support.** This component would support the existing PIU with technical assistance, office equipment, training, procurement assistance, supervision and management support, operating costs, vehicles, communications facilities, and rehabilitation of offices. There are no environmental issues associated with this component.

18. Because of the nature of the proposed mercury cleanup operations, a greater level of detail for this component is included below.

19. **Mercury Cleanup.** Sumgait is a city of 350,000 inhabitants located 30 km northwest of Baku on the northern side of the Abseron peninsula. The city is heavily industrialized and was one of the major sites for chemical industry in the former Soviet Union. Today, production has decreased largely due to economic recession causing a lowered demand for the products. Lack of funds has led to a deterioration of the industrial facilities and production is now closed or continuing at a limited level. The industrial activities have caused severe environmental contamination of the Sumgait region including the Caspian Sea. Human health indicators such as child mortality are significantly higher in Sumgait than the rest of the Republic.

20. Chlorine gas and caustic soda have been produced in the city of Sumgait using a mercury amalgam process since 1958. The original chlorine plant ceased operation in 1981 when a new chlorine plant was opened nearby and is continuing to operate at very low efficiency and production rate. While it was operating, the old chlorine plant used large amounts of mercury, some of which were lost in the sludge by-product or due to evaporation, liquid spills and mishandling. A map of the site is provided in the Appendix 4.

21. There are an estimated 65,000 tons of mercury-rich (in the form of organic compounds of mercury) waste sludge that have been inadequately stored at the site as well as 40,000 tons of mercury-contaminated soil (in the form of elemental mercury) and building debris under the old plant. These wastes pose a likely risk for ground water contamination, wind-borne contamination, and leakage into the Caspian Sea. Preliminary investigations indicate elevated concentrations in the marine ecosystem including fish for human consumption.

22. The project is aimed at demonstrating efficient clean up and environmentally safe disposal of the mercury-rich sludges and mercury contaminated soils at the chlorine plant site. The main features of the on-site activities are as follows:

23. **Sludge Dewatering and Stabilization.** Pilot tests will be carried out during the design phase of the operation to determine the most cost effective and least environmentally damaging method of dewatering and stabilizing the large volume of waste sludges that are stored in temporary
basins on the plant site. This is aimed at finding the most efficient method for dewatering and/or stabilizing the mercury-rich sludge making it suitable for transport and disposal. The alternative methods to be considered are: atmospheric drying on specially constructed open air drying beds, addition of and mixing with dry inert materials (for example, dry clays from the landfill site) and dewatering/stabilization by mixing with materials that remove water in chemical processes (for example, calcined lime (CaO) and cement).

24. Developing and Applying a Low-Technology Method for Mercury Recovery. The soils at the old factory site are contaminated with mercury in the liquid elemental form which makes mechanical separation using low-technology feasible. Twenty-six technologies were reviewed which were considered as applicable to the remediation of mercury contaminated soils. Technology selection was based on those technologies that were determined to be technically feasible as stand-alone or individual options and had the greatest potential to:

- reduce exposure to surface receptors (site workers, area residents, and ecological resources) and aquatic receptors (surface water resources and the Caspian sea)
- recover mercury as a recyclable product for resale
- provide a cost effective strategy which maximizes the local work force
- provide a technology that can be supported and implemented considering the local technology and support infrastructure

25. The project could use several options for mercury remediation in parallel. Two principal options were considered for the mercury remediation:

- remediation to levels suitable for replacement as excavation fill
- remediation to levels suitable for disposal in a hazardous waste landfill

26. Option 1 would require recovery and treatment resulting in soil concentrations of from 5-20 ppm depending upon soil background concentrations. Concentrations in the order of 10 ppm in soil are considered as hazardous to human and ecological health (7 ppm in Sweden, 3 ppm in USA). These levels would require excavation and recovery by a thermal retort and distillation process. A unit capable of treating approximately 4-5 tons of soil per day should cost approximately US$500,000 to US$700,000 depending on the sophistication of the mercury emission control and monitoring equipment.

27. Option 2 would be a substantial refinement of the crude soil washing /gravity separation process currently being used at the site. It would include a rotary mechanical sluice to separate the mercury from the coarse soil particles followed by a fluidized bed washing system to clean the recovered mercury of fine particles, as well as a closed loop water recirculation system and final treatment of excess water before discharge to the canal to remove traces of dissolved mercury. Settling basins would recover the treated soil and clay particles and these would have to be dewatered (using the technology as described above) prior to transport to the hazardous waste landfill. Capital cost for the system is expected to be approximately US$350,000 to US$400,000.

28. Core drilling on the old plant site revealed substantial concrete foundations which complicate the removal of contaminated soils. It is proposed to extract the soils using high pressure hoses and a slurry sump pump so that the material to be processed will be in the form of
a liquid slurry that is not suited to treatment using heat treatment methods as proposed under Option 1. Thus Option 2 was selected which is also the least cost method and provides the best occupational health protection for the workers involved in the operation.

29. **Transporting Wastes.** The dewatered sludges would be transferred to the hazardous waste landfill using covered trucks along a designated route which avoids inhabited areas and roads with heavy traffic. Roads along the proposed route would be strengthened and periodically maintained. Bridges crossing canals along the route would be temporarily lined and sealed. Trucks would be inspected to assure they meet operational and safety requirements on a regular basis. Accident mitigation and emergency response would be included in the transport system design and training of operators. Trucks would be washed before leaving both the work site and the landfill and the resulting waste waters treated to remove contaminants.

30. **Construction of a Safe Hazardous Waste Landfill.** A hazardous waste landfill meeting international standards would be designed for final disposal of the excavated soils, building debris, and sludge. The landfill site has been selected following an evaluation of seven different potential sites identified in a preliminary geological screening process and evaluated according to a set of topographical, geological, hydrological, climatic and ecological criteria. Following the initial screening, two sites were selected for more detailed geological, hydrological and topographical investigation. The results of these surveys were used to identify the preferred site which would fully comply with the international environmental standards. The selected landfill site is in a remote area away from human habitation with very low rainfall and barren conditions with gently sloping natural topography, groundwater table at least twenty meters below the surface, and in an area with a high clay content soil that has no hydrological links to the Sumgait or Baku watersheds.

31. Work would begin with clearing top soil and sparse vegetation from the site for the landfill. The base clay should be terraced in accordance with the specified elevations, and if needed, compacted. To achieve a satisfactory base for the following construction, the compacted clay must be made smooth. The prepared clay base would then be covered with a needle-punched geotextile of polyester, polyethylene or polypropylene having a mass per unit area of at least 400 g/m². To minimize joining, the geotextile should be at least 4 m wide. The geotextile should be laid smooth and in the longitudinal direction of the landfill. The geotextile should have overlapping joints at least 0.5 m wide. These would follow the "roofing tile" principle, i.e., the second strip is laid under the first when joining strips, so that the drainage material does not lift the overlap.

32. A 0.3 m layer of coarse draining material (e.g. sandy gravel with stones) should be continuously deposited on the geotextile during laying. The material would be taken from a borrow pit which would be opened for this operation, and should be laid in place with care so that the geotextile is neither damaged nor moved. A second impermeable geotextile with the same specifications as above is then laid on top of the drainage layer using the same procedure.

33. In general, large items of scrap, wire cables, timber, etc. should be removed from the contaminated material prior to deposition. Concrete debris or blocks should not be larger than 0.4 m in diameter. Reinforcing rods should not project from the concrete rubble. Owing mainly to the risk of wind erosion, the landfill would be divided into three parts of approximately equal
size. Deposits would start in the northernmost part of the landfill and proceed in a southerly direction, in accordance with the dominating wind direction. After part has been built up to its final height, it should be provided with a sealing and covering layer. This would be carried out at the same time as the second part of the landfill progresses.

34. The main principle for deposit of material in the landfill is that non-compressible material is placed centrally, while more compressible material, such as sludge, is laid at the edge. The purpose is to maintain a dome shape landfill, even after the looser compressible material has dried out or has decomposed. The landfill process would begin with placing a 0.4 m layer of fine-grained material from the factory site on the geotextile. Coarser material (e.g. concrete debris) would be deposited on top of the fine material layer, placed centrally and in a continuous line along the longitudinal axis of the landfill. There should be no unfilled pockets. The landfill would then be built up successively with about 0.4 m layers to its full height, each layer being compacted. The degree of compaction will be decided during laying and will depend on the type of material. It may also be necessary to stabilize the uppermost layer of the sludge (with cement or bentonite). The extent of the measures will be determined in detail during laying and will depend on the nature of the material and other circumstances such as weather conditions at the time of laying. The final layer should be evened out to provide a smooth surface suitable as a base for laying a plastic membrane.

35. The covering layer on the landfill would consist of a plastic membrane that prevents infiltration by precipitation. Installation should be performed in such a way as to meet the normal European/North American design specifications. An installation engineer with verified experience, who will also be responsible for cutting, welding and control of welded joints, should lay the membrane in place. The membrane should be of UV-stabilized 1.5 mm HDPE (High Density Poly-Ethylene) and should be laid smooth. The membrane must withstand laying on slopes corresponding to 1:3 without extra anchoring.

36. Both the sludge and the excavated material from the fabric area have a content of organic material. This will create gas when disposed, which might result in lifting effects on the membrane and also in rare occasions explosion risk. Therefore, the gas has to be ventilated through circular holes of 1 m in diameter with CC 10 m in the membrane, on top of the landfill. A coarse material (sand) with a diameter of about 2 m shall cover the hole. As the membrane is laid, an approximately 0.4 m layer of fine grained, non-contaminated material from the burrow pit should be added. This material should be spread as one layer and with great care so that the membrane is not damaged or moved. As soon as possible a "dig proof" layer of approximately 0.2 m concrete should be cast above the covering layer. The aim with this layer is to prevent future accidental digging or drilling in the landfill. It will also serve as a second erosion protection layer if the main protection on top of the landfill fails. The "dig proof" layer should be cast in 10 by 10 m panels, with concrete quality Grade 25. The layer should then be further covered with approximately 0.2 m of fine grained material. To finish off the landfill an erosion protection layer, with possibilities for vegetation to root, should be placed on top. This is recommended to consist of precast concrete bricks. As the erosion layer will be fully exposed to the weather, a minimum of grad 30 concrete quality with reinforcement should be used. The thickness should be at least 50 mm and the bricks should have a hole area of about 20-30 % to
facilitate establishment of vegetation. The shape of the bricks may be Z-formed, square or any other shape, which is cheap to manufacture and easy to place.

37. The dome shape of the landfill together with the covering plastic membrane will result in nearly 100 % of the precipitation to run-off as surface water. To prevent this water from infiltrating the lower parts of the landfill, a drainage system would be needed. The system would consist of an outer and an inner drain pipe, which both discharge at the lower end of the disposal area. The inner drain would collect run-off water from the covering plastic membrane, and the outer drain would collect and draw off surface water. It is essential that especially the outer drain is dimensioned and laid in a way that it will not be clogged with sediments. Otherwise, this will result in a continuous need for maintenance in the future.

38. Monitoring Program for Mercury Emissions to Air, Land and Water from the Cleanup operations. The workers involved in this operation will be at greatest risk from mercury and other toxic emissions. Workers will be provided where necessary with suitable protective clothing and breathing equipment to protect them from any such exposures. The atmospheric concentrations of potential contaminants would be monitored on a regular basis to ensure their safety. Regular monitoring of water discharges for mercury would also be carried out to determine the efficacy of the treatment plant for excess water from the mercury recovery process. Surface water run-off and ground waters on the clean up and landfill sites will also be monitored for possible mercury contamination. Yearly environmental surveys of soils, river sediments and the coastal marine environment will be carried out starting immediately the Association credit becomes effective. In parallel the most sensitive members of the neighboring population, namely women of child bearing age and young children would be surveyed to determine the extent of mercury in their hair as a key indicator of mercury exposure.

39. The project includes a significant component of training of local staff in modern hazardous waste clean up and landfill construction technologies as well as hazardous waste management generally. Significant efforts will be made in the training of local staff in environmental monitoring and survey techniques as well as analytical procedures and analytical quality control. This includes state-of-the-art techniques for sampling and analysis of mercury in the environment which can be used in future operations dealing with similar problems or for general monitoring of the environment and human health in the future.

D. Baseline Data - Present Environmental State

Physical Environment

40. Geology and Topography. Sumgait is located in the north-western part of the Abseron peninsula, close to the northern coast of the Caspian Sea. The Abseron peninsula lies within the southeastern part of Greater Caucasus. Sediments of Cretaceous up to modern periods are present in the geological profile of the peninsula. The northwestern slopes, facing the Caspian Sea, have in some places been terraced by the abrasion of the sea of the Quaternary period. Intensive wind-erosion occurs due to the predominance of fine-grained soil, lack of vegetation and also tectonic conditions. This results in wash down of slopes and emergence of ravines.

41. The investigation area lies within the western Abseron anticline, which includes the Yunusdag anticline. The relief of the investigation area was formed in the younger Pliocene
period and has changed largely by the denudation processes. Denudation, however, did not entirely level the surface. The layering of the soil thus reflects both tectonic and denudation processes.

42. The seismic activity in the area have to be considered in order to estimate the safety of the constructions. The site was selected because there are no geological fault lines in the area which would be potential lines of failure in the event of seismic activity. The clay layer at the proposed site is a minimum of 25 meters thick and would provide a measure of seismic protection. As an additional precaution, the detailed design of the landfill will take into account the frequency and severity of likely seismic events. For the detailed design, further information on the potential for seismic activity will be obtained from the Geophysical and Seismic Institute in Baku.

43. Climate. The climate of the area is typical for half-desert and dry steppe regions with hot summers and cold winters. The maximum summer temperatures is 42°C, and the winter minimum is -21°C. Precipitation is on average only 185 mm/year and the main precipitation volume (60-70 percent of the total annual) occurs during the cold season. The evaporation rate is high (over 1000 mm annually). The average relative humidity of the area is 17.4 percent. The predominant wind directions are northern, north-western, southern and south-western winds. Annual average wind velocity is 7.2 m/sec. Regardless of the season, northerly storms are frequent with wind velocities of 20-35 m/sec.

44. In Tables 1 and 2 long-term average data on the main climate properties obtained from the Sumgait meteorology station are presented.

### Table 1: Long-Term Annual Average Climate Data

<table>
<thead>
<tr>
<th>Month</th>
<th>I</th>
<th>II</th>
<th>III</th>
<th>IV</th>
<th>V</th>
<th>VI</th>
<th>VII</th>
<th>VIII</th>
<th>IX</th>
<th>X</th>
<th>XI</th>
<th>XII</th>
<th>Annual</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average air temperature °C</td>
<td>2.7</td>
<td>3.3</td>
<td>5.9</td>
<td>10.3</td>
<td>16.5</td>
<td>21.1</td>
<td>24.3</td>
<td>24.7</td>
<td>20.8</td>
<td>15.9</td>
<td>10.6</td>
<td>5.9</td>
<td>13.5</td>
</tr>
<tr>
<td>Precipitation, mm</td>
<td>18</td>
<td>13</td>
<td>18</td>
<td>20</td>
<td>9</td>
<td>6</td>
<td>6</td>
<td>11</td>
<td>24</td>
<td>30</td>
<td>24</td>
<td>185</td>
<td></td>
</tr>
<tr>
<td>Evaporation, mm</td>
<td>38</td>
<td>30</td>
<td>47</td>
<td>77</td>
<td>105</td>
<td>135</td>
<td>164</td>
<td>168</td>
<td>122</td>
<td>80</td>
<td>52</td>
<td>46</td>
<td>1064</td>
</tr>
</tbody>
</table>

### Table 2: Relative Frequency of Wind Directions, Average Calm Rate (%), and Annual Wind Speed (AWS)(m/sec)

<table>
<thead>
<tr>
<th>Season</th>
<th>Wind directions, %</th>
<th>Calm</th>
<th>AWS m/sec</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>N</td>
<td>NE</td>
<td>E</td>
</tr>
<tr>
<td>Winter</td>
<td>24</td>
<td>5</td>
<td>4</td>
</tr>
<tr>
<td>Spring</td>
<td>32</td>
<td>7</td>
<td>3</td>
</tr>
<tr>
<td>Summer</td>
<td>38</td>
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</tr>
<tr>
<td>Autumn</td>
<td>28</td>
<td>7</td>
<td>4</td>
</tr>
<tr>
<td>Annual</td>
<td>30</td>
<td>8</td>
<td>4</td>
</tr>
</tbody>
</table>

45. Air Quality. Large cities in Azerbaijan have suffered from air pollution levels considered unsafe for human health. Closure and considerably reduced production at major industrial facilities in Sumgait have contributed to substantial improvements in air quality. Air quality is monitored in Sumgait for sulfur dioxide (SO₂), nitrogen oxides (NOₓ), particulates, carbon monoxide (CO), hydrogen fluoride (HF), and other compounds. Data from 1991-95 show that monitored pollutants in Sumgait reach levels 5 times higher than those allowed by Azerbaijan's air quality standards (Maximum Permissible Concentrations).
46. Water Resources. Due to the low rainfall and high evaporation, there are very limited fresh water resources in the area. The only stream of any size is the Sumgait river which passes through the industrial area and is highly contaminated with industrial pollutants from direct discharges and surface water run off and discharges into the Caspian Sea near the large industrial/domestic effluent treatment plant. The mercury sludge piles are located adjacent to the river and much of the waste has washed into it over a period of time. Both the Sumgait river and the sewage treatment facility have been and continue to be sources of pollution contributing to the “dead ecological zone” which extends a considerable distance off-shore and along this northern section of the Abseron peninsula coast line. A man-made water source, the Samur-Abseron canal runs in a NW-SE direction, approximately 5 kms inland from the industrial area and provides freshwater to the Abseron peninsula, including Baku and Sumgait as well as other smaller settlements. The canal discharges into the Yeyran-Batan fresh water reservoir from which water is also used for irrigation purposes on the Abseron peninsula.

Biological Environment

47. The Caspian Sea, because of its peculiar geologic history, contains a unique, but highly productive flora and fauna. The top of the food chain is characterized by an endangered seal, numerous bird species, and several sympatric species of sturgeon, the most well known being Acipenser gueldenstaedti. The sturgeon and a variety of other fishes are important in the regional economy as a food source, and the caviar produced by the sturgeon is exported world-wide with high revenue potential.

48. A rich literature exists on the fauna and flora of the Caspian. The most comprehensive English summary of the living marine resources in question prior to more recent industrialization by the Soviet Union has been given by Zenkevitch (1948; revised and translated from the Russian in 1961, “The Seas of the USSR,” Wiley, New York), in his monograph on all the seas of the Soviet Union. A more recent volume has been produced by Prof. Abdul Kasymov of the Institute of Zoology of the Azerbaijan Academy of Sciences. Already published in Russian with the assistance of the Azerbaijan State Committee for Ecology, this book has been revised and translated into English and is being prepared for publication in the USA at present. This book's emphasis is on the effects of pollution on the biota of the Caspian, specifically on the central region where most of the oil production has occurred. A comparison is made in the book on a wide variety of Caspian Sea species encountered around habitats near (former Soviet) oil production sites and experimental results on the physiological effects of oil and oil production waste products. Neither work has considered the effects of the Sumgait chemical industrial wastes on the marine environment and its living resources however. Open disclosure of problems with industrial chemical contaminants was not encouraged prior to Azerbaijan’s independence.

49. Fisheries around the Caspian Sea have traditionally played an important role in the economies of the surrounding states. While several species of sturgeon, and the caviar they produce, are considered the principal living renewable resources, numerous other fishes and the Caspian seal are also important both as food and as integral components of regional biodiversity. The biological communities have had to survive side-by-side with fossil fuel production and an untold number of natural hydrocarbon seeps. The build-up of the chemical industry in the city of Sumgait has contributed additional burdens on the Caspian ecosystems. Damming of rivers has
inhibited natural breeding migrations by the sturgeon. Since the disintegration of the USSR, little control has been possible on fishing effort and catch rates, thus further threatening the sturgeon.

50. A peculiar strategy in the Soviet Union was to seed seas such as the Caspian with alien species that could potentially increase the productivity of the food chain from lower levels up through fisheries products. Such "invasions" are regarded with much trepidation by contemporary environmentalists, as well as ecologists, but many of the introductions into the Caspian are prospering.

51. The production of caviar ranks second behind fossil fuel as Azerbaijan's most valuable natural resource. Caviar is available for home consumption and export, and thus the "health" of the Caspian is of importance to a diversified free-market economy in Azerbaijan.

52. A "dead zone" exists in the sediments just off the Sumgait industrial district. It stretches in a wide band along the shore for an unknown distance. Most likely mercury is not solely responsible for this lack of life but other contaminants emitted from the Sumgait industries. Mercury is a potent toxin for micro-organisms but likely not at this level. The exact cause of the azoic nature of the sea floor is not known. It is anticipated that as the pollutant export to the Caspian abates, the region will once again become more hospitable to fisheries resources.

Mercury in Sumgait and the Caspian Sea

53. In the NEAP, mercury pollution has been identified as the most severe industrial problem in Sumgait. The mercury pollution emanates from the chlor-alkali production plant located in the Sumgait industrial area. One plant is currently in operation while the plant formerly situated on the project site was closed down in 1981 and dismantled. Accurate figures of the leakage of mercury from the chlor-alkali plants are not available. However, it is estimated that mercury losses to waste, air, soil and water have at times been as high as 1 kg per ton of chlorine produced and is currently (1997) estimated at around 300 g/ton. In the currently active plant, chlorine production has varied between 60 to 70,000 tons per year during the last decades, indicating annual losses in the order of tens of tons. Production has dropped considerably over the last 5-6 years with lowered mercury losses as a consequence.

54. Based on available descriptions on amounts of mercury accumulated at the factory area a rough estimation of accumulated mercury (Hg) can be made: first considering the Hg used during the period 1987-1997, second the estimated number from 1981, third the estimation from production in the new factory, and fourth from production figures and the two measurements of Hg that are available (1981 and 1987). This gives a total of between 893 and 2,341 tons of consumed mercury during the production process.

55. It is not known to what extent this mercury has entered the Caspian Sea or how it has affected human health in Sumgait. A major part of the unaccounted mercury is most likely contained in the process sludge and as elemental mercury in the concrete foundations and the soils under the factory building. The extent of leakage to the Caspian Sea is not known, but mercury in soils and the sludge will be a continuing source of toxic contaminants to the Caspian Sea, if measures are not taken to safely dispose of the contaminated materials.

56. The major risk associated with mercury emissions to the Caspian Sea is bioaccumulation in the marine food chain.
57. In the preparatory environmental baseline survey that was carried out for this project, high levels of mercury were found in sediments of the Sumgait river and to a lesser extent in marine sediments. This survey also indicates that mercury is accumulating in the marine ecosystem (algae, mussels and fish) and that toxic levels of methyl-mercury may be present in fish. A summary of the results are given in the attached figure. The marine survey was carried out by marine biologists from Texas A & M University and scientists from the Baku Institute of Zoology to specifically investigate the environmental impact of mercury releases to the Caspian Sea. The survey found that mercury in the fish and their food chain is predominately methyl-mercury with a large bio-accumulation factor, as shown in the attached diagram. It is of public health concern that the highest concentrations of methyl-mercury are found in the beluga sturgeon sample (1,200 parts per billion (ppb)) purchased in the Baku market, with a level of methyl mercury exceeding the limiting values for fish in North America and Europe (generally in the range 500 to 1,000 ppb). This fish is a common source of protein in the coastal areas of Azerbaijan. The only exceptions in this diagram are mercury in mussels (6,700 ppb), which are filter feeders extracting fine particles from the passing currents containing non-methylated mercury and algae (900 ppb) attached to the jetty, which are also filtering particles from the water column. In comparison, fluvial sediments from the Sumgait river contain 8,000 ppb of mercury.
Diagram of Mercury Transfers in the Environment with Levels of Mercury for Those Items Tested

- MERCURY SOURCE TERM
- RIVER EFFLUENT
  - FLUVIAL SEDIMENTS 8,000 PPB
  - LONGSHORE CURRENTS
  - COASTAL SEDIMENTS 200 PPB

- PHYTOPLANKTON
  - KILKA 30 PPB
- ZOOPLANKTON 320 PPB

- MULLET
- STurgeON 1,200 PPB

- MUSSELS 6,700 PPB

- ATTACHED ALGAE 900 PPB

- HUMANS

- BIRDS
Survey of Mercury in Human Hair

58. As part of the project’s baseline environmental survey, a survey of hair mercury levels for 174 residents of Sumgait was performed by the Institute of Prophylactic Medicine (IPM) in Baku under the supervision of the Swedish Environmental Research Institute (IVL). In order to facilitate the evaluation of the results, a questionnaire was prepared where each person was asked information on age, gender, location of home in relation to the chlorine plant, employment in the chlorine plant, frequency of fish consumption, and swimming habits. The sampled individuals were subdivided for analysis into groups of workers at the chlorine plant, their families, inhabitants of Sumgait (three groups based on distance from the chlorine plant) and persons with residence outside Sumgait.

59. Mercury in human hair is mainly used as an indicator of methyl-mercury intake via consumption of contaminated food. Ingested methyl-mercury is accumulated in the brain tissue and can lead to damage of the central nervous system. Methyl-mercury is also capable of crossing the blood - placenta barrier to human fetuses which are more sensitive to exposure than adults.

60. In unexposed populations, background values of mercury in hair are generally below 1000 ppb, whereas levels above 5,000 ppb have been measured in individuals with a high consumption of fish containing elevated levels of methyl-mercury. WHO guidelines for mercury in hair give a value of 6-10,000 ppb as an indicator of exceeding the maximum tolerable intake of methyl-mercury. Recent studies have indicated that this level is high, and that negative effects occur in the human fetus in a mother with hair mercury level below 5,000 ppb.

61. In order to determine the accuracy of the results of the local laboratory, 20 split samples were analyzed by IVL. The results are presented in the following table which shows the average, median, maximum and minimum values of mercury in hair in ppb obtained by the two institutes, with "n" representing the number of samples.

<table>
<thead>
<tr>
<th></th>
<th>Average</th>
<th>Median</th>
<th>Maximum</th>
<th>Minimum</th>
<th>N</th>
</tr>
</thead>
<tbody>
<tr>
<td>IPM</td>
<td>270</td>
<td>250</td>
<td>5,200</td>
<td>0</td>
<td>173</td>
</tr>
<tr>
<td>IVL</td>
<td>920</td>
<td>560</td>
<td>3,350</td>
<td>60</td>
<td>20</td>
</tr>
</tbody>
</table>

62. The average and median values of the results reported by IPM are considerable lower than the results reported by IVL. Testing of mercury in hair is a highly technical process, and the actual instrumentation and techniques used by IPM are unknown. Although both the average and median values reported by IPM are heavily influenced by the large number of samples where mercury was below the analytical detection limit, it can be concluded that the IPM results are substantially underestimated.

63. The average mercury concentrations for all the samples reported by IPM is 270 ppb, which is well below levels considered by WHO to pose a threat to human health. Given the uncertainty of the obtained analytical results and the indication of a large underestimation of the true values, this should not be taken as an indication of an overall low exposure in the Sumgayit region. In comparison, the average of the IVL results is 920 ppb which is also not considered to be high. However, the maximum levels found by IPM and IVL, 5.2 and 3.35 mg/kg, respectively, are
high enough to approach levels that may represent a potential health risk to human fetuses. Further analysis of the IPM results into groups that live varying distances from the chlorine plant and eat fish with more or less frequently, shows that those who live close to the plant and those who are workers or relatives of workers at the plant, as well as those who eat fish more than once per week have elevated levels of mercury in their hair.

64. The results of the two environmental baseline surveys indicate that there is a need to carry out follow-up surveys prior to the start of the mercury cleanup operations to determine more thoroughly the routes and extent of bio-accumulation of methyl-mercury in the marine ecosystem and to further test mercury in the hair of critical members of the community, in particular women of child bearing age and young children. TACIS has agreed to immediately fund these follow up surveys and funds have been allowed in the financing of the project to carry out yearly surveys during the implementation of the project to check that the controls on further releases of mercury to the environment are effective. If these follow-up surveys indicate excessive exposures of methyl-mercury, then public health warnings will be issued to the sensitive members of the population to reduce their consumption of mercury contaminated fish.

Socio-Economic Environment

65. Sumgait was an industrial production center in the former Soviet Union with large-scale chemical and petrochemical enterprises. Today, Sumgait suffers from the related problems of an industrial base in steep decline and large-scale environmental pollution. Much of the Soviet capital infrastructure and technology is beyond its useful life, and investments during the last decade have been minimal. Productivity of industrial enterprises has declined, workers have been laid off, and plants have closed. The Sumgait area is one of the most economically depressed regions of the Abseron peninsula. The chemical industry continues to be an important source of employment, and the Mayor of Sumgait expressed concern that measures taken to reduce the environmental impact of the chemical industry could result in inhabitants of Sumgait losing a primary source of income.

66. The environmental problems in Sumgait are also extensive. Soviet industrial practices often ignored environmental impacts in an effort to increase output. Consequently, Sumgait suffers from large-scale environmental pollution with significant negative impacts. Health indicators show that infant mortality in the Sumgait area is six times that of the surrounding areas, and the incidence of cancer is significantly higher than in the rest of Azerbaijan.

67. The mercury baseline study found that mercury contamination has already occurred in the nearby Caspian Sea and preliminary survey results indicated toxic levels of methyl-mercury in fish and other aquatic organisms. The planned follow-up survey would provide the data needed to prepare a program of public warning and education on the relative risk of consuming certain species of fish.

E. Environmental Impact

68. The major environmental impact of the mercury cleanup is the removal and safe disposal of a large amount of toxic mercury containing waste in Sumgait. In its present state, the waste is a source of emissions to air and water with risk of exposure to both humans and the surrounding ecosystems. Exposed contaminated media will be distributed to adjacent surface soils and to the
Caspian sea by wind blown particles, vapor and surface water runoff. These contaminates will continue to be transported into the Caspian Sea impacting the terrestrial and marine ecology as well as the residents of the area that utilize the Caspian for food sources and recreation. Virtually all of the mercury in the contaminated media has the potential to migrate to adjacent area lands and ultimately will find its way into the Caspian Sea. This volume of mercury flowing into the Caspian will continue to contaminate the area ecosystem for centuries.

69. The overall environmental and public health benefit of the project is expected to be highly positive in both short and long-term perspectives. The major expected positive impacts for the mercury cleanup are:

- Reduced emissions of mercury to land, air and water from the contaminated chlorine plant site and sludge basins
- Long-term removal and safe storage of mercury-containing material
- Potentially reduced human exposure to methyl-mercury from eating fish—in the short term through public health warnings and education programs and in the longer term by reducing further losses of mercury to the environment
- Local training in modern hazardous waste management and operation, environmental and monitoring techniques for mercury, and occupational safety

70. An analysis of these impacts and any potential negative impacts and proposed mitigation is given below for the various parts of the mercury cleanup.

71. The main overall potential negative impacts are associated with occupational exposure to mercury and other potentially toxic contaminants during the cleanup process and further possible losses of these toxic materials to the environment. Mitigation plans for these potential impacts are given below. A special case in regard to occupational safety is the operating chlorine-alkali plant adjacent to the contaminated site. During the preparatory work for this project, it became apparent that leaks of chlorine gas from this plant constitute a more serious risk to cleanup workers' health and safety on the contaminated site than the mercury itself. The currently operating plant is in a very poor state of repair and experiences frequent shut-downs because of chlorine leaks. In a letter from Prime Minister Rasi-zade sent to the World Bank on May 18, the Government of Azerbaijan stated that it has decided to close the chlorine-alkali plant.

**Mercury Recovery**

72. It is possible to recover mercury in the liquid elemental form from the soils under the old chlorine plant site, for which a low technology wet mechanical separation technology has been selected that is the most suited to the conditions on the site and for the protection of workers. After the mercury recovery, the soil will be dewatered/stabilized as discussed below and then transported to the landfill for safe disposal. Excess water from the mercury recovery process will be treated to remove mercury before discharge to the Caspian Sea.

**Positive Impact**

73. Being a highly dense liquid metal, elemental mercury has the property that it will migrate in the soil laterally as well as vertically wherever it finds even the smallest of cracks or voids. This has been observed in the results of the geological survey on the old chlorine plant site where the
mercury spilled on the concrete floor of the plant has migrated down to more than 6 meters and has spread even outside the boundary of the plant. If the mercury is not removed from this soil before it is deposited in the landfill it would also migrate and any imperfections in the containment barrier would result in further migration into soils outside the containment structure. Using a wet process for mercury recovery rather than a high temperature distillation process greatly reduces the potential for mercury losses to the air and, therefore, the risk of occupational exposure to the clean up personnel.

Negative Impact
74. Potentially negative impacts are associated with unexpected events causing leakage and/or spillage such as failure to implement safety rules and quality control procedures.

Mitigation Measures
75. The proposed mercury recovery technology is common in the gold mining industry worldwide and is currently in use in Europe and the USA for mercury cleanup operations along the lines that are proposed for this site. The same precautions to prevent mercury releases to the environment have been built into the design and operation of the facility that would meet even the strictest European and US standards. A water recycling system is proposed so that it is only necessary to treat excess water to remove mercury before discharge to the Caspian Sea. Further surveys of the soils in and around the plant site will be carried out during the cleanup operation to ensure that the full extent of contamination is defined and excavated accordingly. During the process, the groundwater table around the plant site will be drawn down potentially capturing any contaminated ground waters and preventing further escape to the environment. The operation will be designed and implemented by an experienced international contractor under a project management contract. The contractor will be responsible for preparing detailed work plans including environmental and occupational safety protection measures that will have to be followed during implementation. Workers will be provided with personal protective equipment and training in occupational safety and environmental protection. On-site showers and dressing rooms will be provided for the site workers as well as protective overalls, boots, and gloves. A health monitoring plan which will include monthly medical check-ups will be implemented to assure that the personal protective equipment is being used and is effective. The currently operating chlorine plant will be shut down prior to the start of cleanup operations because of the high risk of accidental releases of toxic chlorine from this plant.

Sludge Treatment Operation
76. The mercury-rich waste sludge and the wet soils from the mercury recovery plant will have a high moisture content which makes them difficult to handle and transport safely. Therefore, it will be necessary to dewater/stabilize them before transport and disposal in the safe landfill.

Positive Impact
77. The process will reduce the potential loss of contaminated materials to the environment through leakage especially during transport. In addition it will also make the materials more stable for landfilling.

Negative Impact
78. Potentially negative impacts are risk of occupational exposure to mercury and chlorinated hydrocarbons during handling and treatment of sludge and spills during the treatment process.
Mitigation Measures

79. During the first phase of the mercury cleanup, pilot scale testing of different sludge treatment alternatives will be made. These tests will focus on finding the optimal method for dewatering/stabilization of the sludge. Workers safety and avoidance of leakage/spills as well as fugitive dust emissions will be important criteria in this work. Furthermore, detailed analysis of the sludge will be made to identify other potential toxins which may require special precautions for worker occupational exposure. Workers will be provided with the necessary protective clothing and safety equipment and will be instructed in occupational health and safety procedures.

Transport of Sludge and Contaminated Soils to Safe Disposal Site

80. The treated sludge will be transported by dump trucks to a purpose-built hazardous waste landfill.

Positive Impact

81. Removal of large quantities of mercury from the Sumgait industrial area will lead to reduced occupational exposure and reduced emissions to air and water. Long-term benefit would be a reduction of mercury in the Caspian Sea and reduced human exposure via fish consumption.

Negative Impact

82. Potentially negative impacts are associated with risks for site workers exposure during transportation and accidental leaking and spills may cause additional environmental exposures. Diversion of these loads for other uses or simply for sake of convenience to the drivers to dump locally in uncontrolled landfills or on the side of the road is also a risk. Increased road traffic will occur during the transport of the sludge and contaminated soils to the landfill site. Fugitive dust emissions during transport is another potential source of environmental contamination. Of particular importance is to make sure that no spillage or fugitive dust blow off occurs on the short bridge over the freshwater canal transferring water to the Yeyran-Batan reservoir which supplies water for the whole Abseron peninsula.

Mitigation Measures

83. Fugitive dust controls will be implemented during truck loading at the plant site following the process of stabilization. All trucks used to transport these materials will have specially fitted covers to prevent dust blow off during transport. Before leaving the site a special truck chassis and wheel washing system will be operated to remove any contaminated materials. The waste disposal site has been specially selected to minimize the transport distance (some 18 kms) from the industrial area of Sumgait and to avoid built-up areas along the selected route to the site. The route passes through old waste dumps and uninhabited lands. Sections of the route will be improved by better paving and strengthening as needed, and the small bridge over the fresh water canal will also be strengthened and sealed so that there is no chance of accidental spillage into the canal. Drivers will be instructed in traffic safety and will be regularly monitored to ensure that they are following safe driving practices. A hazardous waste manifest system will be introduced to control all loads leaving the clean up site and to ensure that all of the waste generated is transported to the safe landfill where each load will be inspected and the manifests recorded.
Construction of Hazardous Waste Landfill

84. A hazardous waste landfill would be built in an area with a high clay content soil that is not hydrologically linked to either the Sumgait or Baku watersheds and is remote from human habitation. The hazardous waste landfill will be designed and constructed to meet or exceed international and local environmental and safety standards.

Positive Impact

85. The construction of the hazardous waste landfill will encapsulate the toxic mercury contaminated materials and keep them permanently separated from the environment. A substantial amount of mercury containing wastes that otherwise could have resulted in further ecological damage and negative human health impacts will thus be safely isolated. The disposal site that has been set aside for the mercury waste has an area of 50 hectares and is large enough to handle other hazardous wastes generated in future cleanup operations or from future industrial operations on the Abseron peninsula. As a result, local experts will be trained in modern hazardous waste management techniques and technical operations for continuing application with other waste streams.

Negative Impact

86. The main potential problem for the construction and maintenance of the landfill is considered to be the wind erosion caused by the frequent high winds and general absence of a vegetation cover. A small amount (less than 5 hectares) of land will be disturbed during the construction and operation of the mercury landfill site. Larger areas will be needed if other hazardous waste deposits will be constructed. The options for other types of land use will be restricted.

87. The proposed site can be characterized as a heavily overgrazed range land with extensive erosion loss of topsoil. No sensitive species or habitat are known in the area. Topsoil will be stockpiled for reuse in the rehabilitation of the surface once the landfill is covered. However, due to the dry windy conditions there is a risk of fugitive dust emissions during the layering of the waste material in the landfill. As in all such landfill operations, the major concern is to prevent leakage of toxic materials from the deposit. In addition, the trucks that return for depositing waste in the landfill can have waste material clinging to their tires or chassis, which if not removed will contaminate the transport routes and the environment.

Mitigation Measures

88. The landfill will be designed and constructed on a natural clay deposit of considerable thickness which will act as a geological barrier underneath the waste and will prevent leakage into the biosphere. Moreover, the landfill design incorporates an internal drainage system and is enclosed in a plastic membrane cover which prevents seepage of rainfall into the waste deposit. Provision is also made for gas venting to prevent build up of gas and possible gas explosions. The plastic membrane will be adequately protected by a concrete layer and special provisions will be made to reduce wind erosion and facilitate surface stabilization of a vegetative cover on the deposit. Fugitive dust emissions will be controlled during construction of the landfill by careful application and compaction of the waste layers (with possible use of water sprays), as well by the technology selected for waste stabilization/dewatering. The landfill would be monitored for five years after completion and any leaks repaired under the contractor's five year
guarantee. The site will, if possible, be re-vegetated with native species and will serve as a demonstration of waste landfill site rehabilitation. Vehicles leaving the site will be sprayed with water to remove wastes attached to their tires or under their chassis. Construction workers will be given safety training and construction practices will conform to international standards of safety. Personal protective equipment and training will be provided to site workers.

F. Analysis of Alternatives

89. An analysis of alternatives were considered for the following: (a) remediation of the old chlorine plant site; (b) remediation of the sludge basins; (c) landfill siting; and (d) landfill cover construction; and (e) traffic route to the landfill. In all cases the no action alternative was the base condition for which to judge the environmental benefits and risks of the various actions that were proposed.

Remediation of the Old Chlorine Plant Site

90. The following alternatives were evaluated in determining the best method of preventing further releases of mercury from the old chlorine plant site:

- Recovery of mercury and cleaning of soil to acceptable levels for backfilling into the excavation;
- Excavation of contaminated soil and recovery of the mercury, dewatering/stabilization of the treated soil and transport to a safe landfill, then backfilling of the excavation with clean fill;
- On-site remediation with encapsulation of contaminated soil in situ; and
- Excavation of soil and transfer to a safe landfill without mercury recovery.

No Action Alternative

91. Currently workers from the factory have set up a very crude sluice to recover mercury from soil under the old plane site. Some of the cement flooring has been removed and shallow excavations have been made to collect soil for washing and removal of the mercury. In one of the areas sampled it was found that they were able to reduce the mercury content of the soil from 13 percent to 3 percent, which is an appreciable level of recovery considering the low level of technology, but leaves the soil in a condition that would require further treatment even for landfiling. There are no occupational safety protection measures for the workers and the water from the operation drains untreated into the Caspian Sea. The area is characterized by a high water table level and the geological survey indicates that the mercury is spreading laterally as well as vertically. Hence, under the no action alternative, mercury is continuing to escape into the environment and in particular the Caspian Sea and workers are being exposed to occupational health risks.

Other Alternatives

92. As indicated above, several alternatives have been evaluated for preventing mercury releases to the environment from the old chlorine plant site. Investigations of this site show that a large amount of concrete footings from the old building are present, extending as far as 3.6 m below surface. The soil is also mixed with asphalt, gravel, concrete and debris such as bricks. The concentrations of mercury in the soil at the old factory site are extremely high and at some points
exceed 100 g of Hg/kg dry weight (i.e., 10%). The investigated area covers about 9000 m² but contamination extends beyond this area as shown by the results of the core drilling. Surface groundwater is prevalent at the site with the groundwater level about 0.5 m below the soil surface. This could partly be man-made groundwater since drainage conditions at the site are insufficient and drainage tubes have been partly corroded by the aggressive water. The mercury concentrations in the groundwater are several ug/liter compared to typical values for Dutch groundwater (0.01–0.05 ug/L) or Swedish (0.0006–0.05 ug/L) values.

93. Alternatives with advanced mercury removal to levels that would allow backfilling into the excavation were rejected because: (a) with the high soil moisture content due to the high groundwater levels at the site, this type of advanced treatment is considered unrealistic as it requires a high temperature technology to vaporize the mercury from the soil and recovery of the mercury in water cooled condensers; (b) expensive environmental monitoring and mercury emission controls have to be installed adding to the already high capital and operating cost of the equipment and level of sophistication of the technology; and (c) the heterogeneity (concrete foundations, bricks, water, building debris, asphalt, etc.) of the soil requires that it be extracted using a wet process which is unsuited to the thermal mercury recovery technology.

94. Excavation and direct disposal of the contaminated soils and debris in a safe landfill is probably the most economic alternative, although excavation would be complicated by the large concrete foundations. However, due to the extremely high concentrations of metallic mercury in the soil, mercury would remain in a mobile state and would create major problems in the landfill even to the extent of eventually finding paths for leaching into the biosphere. Hence this alternative was not considered to be environmentally acceptable.

95. Isolation of the contaminated site by in situ methods of containment depend on the existence of a sound clay base under the site and effective methods of forming an impenetrable barrier to prevent further migration of the mercury and ground waters from the site in a lateral direction. However, there was insufficient evidence of a suitable clay layer under the plant site from the geological survey to consider this alternative any further. Moreover, the corrosive nature of the ground waters on the site would require special precautions to protect the sealing material to be used in forming the barrier.

96. For the mercury recovery operation, some 20 technologies were evaluated to select those that were technically feasible and had the greatest potential to:

- reduce mercury exposure to site workers, area residents, and the environment;
- recover mercury as a recyclable product for reuse;
- provide a cost effective strategy which maximizes use of the local work force; and
- provide a technology that could be maintained and operated effectively under the constraints of the local economy and infrastructure.

97. Experience in Europe and the USA indicate that it is preferable to set up the mercury recovery equipment on-site rather than transport the contaminated soil to a processing facility at another site, either in-country or overseas. The costs of transporting large volumes of waste for long distances become prohibitive. Thus the preferred alternative is to install a simple robust
method for mercury recovery on-site followed by subsequent transport and disposal of the treated waste to a safe landfill.

98. Following an evaluation of the different technologies, it was decided to use a combination of processing steps to produce a mercury product which would have a good market value in order to offset some of the costs of the operation. The proposed approach uses complementary technologies in the following steps:

- Excavation of high concentration mercury contaminated soils using high pressure water hoses and a slurry sump pump to extract the washings from the excavated pit.
- Separation and recovery of elemental mercury from the slurry using a rotary sluice or other suitable gravity separation devise common to the mining industry. The recovered mercury would be cleaned in a water fluidized bed extractor to produce a readily saleable product.
- Settling of the suspended soil particles from the sluicing and washing operations to produce a wet slurry and dewatering/stabilizing of the slurry to meet the requirements of the hazardous waste landfill operation.
- Recycle of settling basin overflow water to the excavation operation and treatment of excess water by chemical precipitation to levels safe for disposal to the environment.
- Leaving large concrete foundations in place and backfilling the excavation with clean fill material.

**Sludge Basins**

*No Action Alternative*

99. The mercury-contaminated sludge has been stored in brick-lined basins located on the banks of the Sumgait river, which passes through the industrial area. Some of the basins have been overfilled and as a result during rain storms sludge is washed into the river and into the Caspian Sea. High winds also erode the surface of the sludge piles distributing the toxic waste over a wide area including the Sumgait river. Hence under existing conditions the sludge piles create a severe environmental and health impact and because of their location must be excavated and redeposited in a safe landfill. The only question remains as to the method of dewatering and stabilizing the wet slurry so that it is suitable for transport and disposal.

*Other Alternatives*

100. Several technologies for reducing the water content have been considered such as:

- Draining of the material on specially constructed open air filter beds with under drains to facilitate dewatering. While the method is low cost it involves two stages of materials handling with increased possibilities for spillages and worker occupational exposure. The beds would also be subject to wind erosion and increased risk of generating fugitive dust emissions. The process is also slow requiring a larger area to operate. Filtrate water drained off the beds would have to be treated before discharge to the environment.
- Use of mechanical dewatering devises (on e.g., centrifuges, vacuum-suction units, hydraulic presses, etc.) would overcome some of the disadvantages of the simple drying beds indicated above, but would be costly to set up on site and would need regular maintenance and possible
costly repairs if not operated according to manufacturer specifications. One problem would be building and other debris in the sludge which would increase the risk of mechanical failures.

- Other means to reduce the water content of the material is to mix the sludge with a dry inert (with respect to water) material in a suitable mixing device (i.e., a rotary drum mixer or batching plant as used in the cement industry. This will increase the amount of material that has to be transported but the technical problems with fine material (which tend to block filtering devices) and handling of filtrate water will be avoided. Overall though this would be a low cost method with good environmental benefits. It could be set up as a continuous operation to minimize materials handling and losses of material to the environment.

- Solidification of the sludge by mixing it with, for example, cement, calcined lime or bentonite. This will reduce the hydraulic conductivity (permeability) in the sludge which is positive feature in the landfill. Other advantages are that fugitive dust emissions would be virtually eliminated in the processing and transport of the material. However, the cost of the additives are high which makes this alternative less financially attractive than the use of locally available dry inert material. Another disadvantage is that the amount of material that has to be transported and disposed off will increase.

101. At this point of time it is not possible to determine which is the best alternative. Further investigations have to be performed and pilot test carried out to see which one provides the best long term environmental and worker protection at the lowest cost.

Landfill Site Selection

102. Initially seven sites were selected from geological and topographical maps of the area near Sumgait for siting the proposed hazardous waste landfill. Following on-site inspections by geological and environmental experts two of the sites were selected for more detailed topographical, geological and hydrogeological investigation. Both sites are situated in uninhabited areas about 15 km from Sumgait and shallow alluvium sediments cover the surface with deep dense clay layers underneath. Site 1 is located 15 km. to the south-west of Sumgait. The area has a mainly flat surface with a gentle slope from north-west to south-west. Ground waters are below a depth of 25 m from the surface. Site 2 is located 4 km away from site 1 (to the north-west). Absolute heights are 100-115 m sloping from north-north-west to south-south-east. Sediment composition here is basically similar to that of site 1, but the soil contains more water.

103. The choice of site 1 for the proposed hazardous waste disposal facility was based on the following:

- The transport distance and conditions of road were more favorable than at site 2
- The slopes are lower at site 1, decreasing the risks of erosion
- The available area for potentially other hazardous waste deposits were larger at site 1

Landfill Cover Construction

104. Different options for the top sealing material for the landfill were considered, including:

- Clay from the deposit area
- Bentonite mixtures
• Cement mixtures
• HDPE-membranes

105. Since the clay in the deposit area has a limit of plasticity due to its limited water content, it can only be used if for this purpose if more water is added to it before construction starts. However, mixing water with this clay under the conditions on this site would be a major difficulty and may not even be feasible.

106. Bentonite mixtures are an alternative if they are properly compacted. The costs for local bentonite are, however, high. Furthermore, the mixtures would have to achieve a sufficiently low hydraulic permeability, and absorption of water would have to be sufficient to withstand the arid conditions in the area.

107. The problem with cement mixtures are similar to those with bentonite mixtures.

108. HDPE-membranes have been evaluated as the most economic alternative for this purpose. The supplier of the membrane will carry out the cutting, welding of splices and quality control of the installation to ensure that the material is water tight. The material is sustainable under arid conditions and its use, as well as experiences with its sealing performance, are wide-spread.

Selection of Traffic Route to Landfill

109. Several routes from the industrial area to the landfill site were considered. The final choice of route was made to minimize the number of crossings (to just one) of the Samur-Abseron canal and to avoid any area of human habitation. The selected route is paved until it leaves the highway where it becomes an earth road for about 2 km until it reaches the landfill. The standard of the unpaved roads will be improved with locally available construction material.

G. Mitigation Plan

Sludge Treatment

<table>
<thead>
<tr>
<th>Code</th>
<th>Mandatory Precaution Measures</th>
</tr>
</thead>
<tbody>
<tr>
<td>1, 2</td>
<td>The waste water from the dewatering processes must be treated at the site and the treatment residue must be disposed of in the safe landfill.</td>
</tr>
<tr>
<td>1, 2</td>
<td>Analysis of the sludge with respect to mercury and other contaminants must be done frequently.</td>
</tr>
<tr>
<td>1, 2</td>
<td>All waste spillage from the process must be collected immediately and properly disposed of in the safe landfill.</td>
</tr>
<tr>
<td>1, 2</td>
<td>A washing facility must be installed at the site. The waste water has to be treated at the site and the treatment residue has to be properly disposed of in the safe landfill.</td>
</tr>
<tr>
<td>1, 2</td>
<td>Facilities to combat dusting by water sprinkling must be installed and used whenever needed.</td>
</tr>
<tr>
<td>1</td>
<td>Workers must for their personal protection wear safety helmets, rubber boots, gloves and other protective clothes. They should also have at hand a gas mask to be used at extensive dustings. Clothes and boots etc. must be properly cleaned whenever the personnel leaves the area for the day or for lunch etc.</td>
</tr>
</tbody>
</table>

1 = Health and safety precautions
2 = Environmental control measures
### Mercury Recovery

<table>
<thead>
<tr>
<th>Code</th>
<th>Mandatory Precaution Measures</th>
</tr>
</thead>
<tbody>
<tr>
<td>1, 2</td>
<td>A detailed work plan must be developed and approved to ensure that recovery operations do not conflict with other activities on the site.</td>
</tr>
<tr>
<td>1</td>
<td>A health and safety plan must be produced.</td>
</tr>
<tr>
<td>1</td>
<td>A health monitoring plan must be implemented to assure that appropriate personal equipment is used and is effective.</td>
</tr>
<tr>
<td>1, 2</td>
<td>A fugitive dust and mist program will be developed and implemented to reduce the contaminant dispersal on and off site.</td>
</tr>
<tr>
<td>1</td>
<td>Workers must for their personal protection wear safety helmets, rubber boots, gloves and other protective clothes. They should also have at hand a gas mask to be used at extensive dustings. Clothes and boots etc. must be properly cleaned whenever the personnel leaves the area for the day or for lunch etc.</td>
</tr>
</tbody>
</table>

1 = Health and safety precautions
2 = Environmental control measures

### Excavation and Loading of Contaminated Material

<table>
<thead>
<tr>
<th>Code</th>
<th>Mandatory Precaution Measures</th>
</tr>
</thead>
<tbody>
<tr>
<td>1, 2</td>
<td>The site and all internal access roads and possible evacuation roads must be defined and clearly marked.</td>
</tr>
<tr>
<td>1, 2</td>
<td>Vehicles are only allowed along the official and marked roads.</td>
</tr>
<tr>
<td>2</td>
<td>The site must be well drained. External (clean) runoff water shall be diverted by cut off ditches etc.</td>
</tr>
<tr>
<td>1</td>
<td>All vehicles must have gas masks easily available for the driver and helpers and any other person riding with the vehicle.</td>
</tr>
<tr>
<td>1, 2</td>
<td>All waste spillage from loading activities must be collected immediately from all areas outside the excavation/loading area and the waste deposit.</td>
</tr>
<tr>
<td>1, 2</td>
<td>A washing facility must be installed at the site with the capacity to remove all contaminated material that sticks to the vehicles used. The waste water has to be treated at site and the treatment residue has to be properly taken care of.</td>
</tr>
<tr>
<td>2</td>
<td>The face of the excavation must be covered during rain to prevent excess water content in the waste and minimize the erosion risk. This can be achieved by a special arrangement of geomembranes or tarpaulins.</td>
</tr>
<tr>
<td>1, 2</td>
<td>Facilities to combat dusting by water sprinkling must be installed and used whenever needed.</td>
</tr>
<tr>
<td>1</td>
<td>Workers must for their personal protection wear safety helmets, rubber boots, gloves and other protective clothes. They should also have at hand a gas mask to be used at extensive dustings. Clothes and boots etc. must be properly cleaned whenever the personnel leaves the area for the day or for lunch etc.</td>
</tr>
</tbody>
</table>

1 = Health and safety precautions
2 = Environmental control measures
Transport and Unloading

<table>
<thead>
<tr>
<th>Code</th>
<th>Mandatory Precaution Measures</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>All necessary traffic regulations/diversions must be made for all roads that are used for the transport of polluted waste. Special attention should be paid to interference with public roads.</td>
</tr>
<tr>
<td>2</td>
<td>Roads and bridges leading to the landfill site must be strengthened.</td>
</tr>
<tr>
<td>1</td>
<td>All transport trucks must be in good and safe conditions to avoid traffic incidents. This should be regularly checked.</td>
</tr>
<tr>
<td>1, 2</td>
<td>The loading trucks (carriers) to be used must be equipped with a cover on the load that prevents dusting.</td>
</tr>
<tr>
<td>1, 2</td>
<td>A special area must be arranged and marked for unloading of transported waste. No waste is allowed to be tipped or stockpiled outside this area and only loaders are allowed to traffic the area and collect waste to be disposed of.</td>
</tr>
<tr>
<td>1, 2</td>
<td>All waste spillage must be collected immediately from all areas outside the marked area.</td>
</tr>
<tr>
<td>1, 2</td>
<td>A washing facility shall be installed at the landfill site with the capacity to remove all contaminated material that sticks to the vehicles used. The waste water has to be treated at site and the treatment residue has to be taken care of.</td>
</tr>
<tr>
<td>2</td>
<td>Placing of waste in the landfill shall be arranged according to a plan that ensures that there is place enough in the unloading area.</td>
</tr>
<tr>
<td>1, 2</td>
<td>All stockpiled waste shall be sufficiently covered to avoid over saturation and/or dust erosion.</td>
</tr>
<tr>
<td>1</td>
<td>Workers must for their personal protection wear rubber boots, gloves and other protective clothes. They should also have at hand a protection mask to be used at extensive dustings. Clothes and boots etc. must be properly cleaned whenever the personnel leaves the area for the day or for lunch etc.</td>
</tr>
</tbody>
</table>

Landfill

<table>
<thead>
<tr>
<th>Code</th>
<th>Mandatory Precaution Measures</th>
</tr>
</thead>
<tbody>
<tr>
<td>1, 2</td>
<td>Facilities to combat dusting by water sprinkling must be installed and used whenever needed.</td>
</tr>
<tr>
<td>2</td>
<td>The final coverage of the deposit must be immediately applied when the specific unit of the deposit is filled up and approved. The coverage must comply with the technical specifications.</td>
</tr>
<tr>
<td>1</td>
<td>Workers must for their personal protection wear rubber boots, gloves and other protective clothes. They should also have at hand a protective mask to be used at extensive dustings. Clothes and boots etc. must be properly cleaned whenever the personnel leaves the area.</td>
</tr>
</tbody>
</table>

1 = Health and safety precautions  
2 = Environmental control measures
H. Monitoring Plan

110. The main purpose of the monitoring plan is to monitor the current environmental conditions in and around the old factory site and how these conditions improve during the implementation of the project. The main objectives of the monitoring plan are to:

(a) monitor potential releases of mercury to land, air and sea before, during and after the cleanup operation;

(b) determine the impact of mercury in the Caspian Sea offshore from the Sumgait industries on fisheries and the marine environment;

(c) set up a monitoring program to monitor potential releases of mercury from the selected disposal site; and

(d) determine and monitor exposure routes of mercury in the Caspian Sea and the potential health impact on the population of Sumgait.

111. Detailed descriptions of proposed monitoring plans can be found in the supporting documents. A brief summary is given here of the objectives.

112. A1. Definition of a relevant strategy for monitoring of mercury releases via air, groundwater and effluent water at the contaminated site and the sludge basins. The monitoring should cover a three-year period commencing before the recovery and cleanup activities are started and continuing for an additional five years after the landfill is closed.

113. A2. Installation of necessary sampling equipment and monitoring of mercury in air, groundwater and effluent water at the contaminated site and around the sludge site following the proposed sampling strategy.

114. B1. Definition of a relevant strategy for monitoring of mercury in the marine environment. The strategy should include measurements of mercury in water, sediments and biota (fish and benthic organisms) in the coastal area of the Caspian Sea. Specific measurements of methyl-mercury should be considered in some cases. Sampling sites should be selected directly adjacent to the outlet from the Sumgait industrial site as well as at background sites not directly affected by the industrial effluents. The selection of background sites should be based on prevailing currents and transport pathways in the Caspian Sea.


116. C1. Definition of a relevant strategy for monitoring of mercury releases from the waste disposal site. The strategy should include monitoring of releases to air, drainage water and groundwater over a period of five years after the completion of the landfill.

117. C2. Installation of necessary sampling equipment and monitoring of mercury following the proposed monitoring strategy.
118. D1. Perform human hair surveys for mercury in the population of Sumgait. Surveys should be performed at one occasion before the mercury cleanup operation is started and two times after the completion of the mercury cleanup operation.

I. Environmental Management and Training

119. The project will contain an extensive program for training of local staff in areas related to the cleanup of the site and operation of the landfill. For all training activities, support from local authorities and institutions is critical. The major areas of training are:

- Environmental monitoring
- Workers' safety
- Management of hazardous waste landfill

Environmental Monitoring Training

120. The training in environmental monitoring will include strategies and techniques for monitoring of mercury releases from the industrial site and the landfill area as well as monitoring of the marine environment and human health impact. The training will follow all the major issues outlined above. Training should be started as soon as the project is commenced in order to allow an increasing transfer of responsibility to local expertise during the progress of the work.

121. The main components of the training in environmental monitoring are:

- environmental fate of mercury, its transport and effects on human health
- sampling strategies and available techniques for mercury in the environment
- techniques for analysis of mercury and its compounds in the environment
- evaluation of data and risk assessment

122. The training in environmental monitoring will run in parallel with a significant transfer in technology and investments in order to allow the completion of the project with significant local participation.

Workers' Safety

123. The result and quality of the whole project will to a great extent depend on that all involved personnel understand the precautions and why they are needed. Therefore, all personnel have to be informed and trained. The training must include:

- information about personal protection such as safety helmets, rubber boots, gloves and other protective clothes. They should also have at hand and know how to use a gas mask to be used at extensive dustings or as protection against chlorine gas leaks. Clothes and boots etc. must be properly cleaned whenever the personnel leave the area for the day or for lunch etc.

- information about the toxicity of mercury and how it affects the human body and the environment. It is recommended that all senior staff have extensive training in this.

124. It should also be noted that all visitors to the old factory site, sludge basins and the landfill area have to be informed about the necessary precautions for their personal safety.
Hazardous Waste Landfill Management

125. Since there is a lack of elaborated disposal strategies concerning hazardous waste in the Republic of Azerbaijan, the landfill in the current project may serve as a guideline for the future. The chosen disposal strategy for the new landfill is based on the recently formulated Swedish regulations and the European Union's proposal for landfill directives.

126. To understand the construction of the landfill and its different precaution layers, a course in disposal strategy is proposed. This course is aimed at governmental and regional staff members as well as key personal in the project.

J. Consultation and Reviews

127. Local experts have been involved in the data collection, interpretation and review of this EA. The State Committee on Geology collected geologic data at the old factory site and the proposed landfill site. The Institute of Prophylactic Medicine conducted hair and demographic data collection on mercury contamination. The Mayor of Sumgait, the deputy to the mayor on environment, and the chlorine plant manager were consulted on all aspects of the project.

128. An Environmental Assessment workshop was held in Sumgait on April 28 to which representatives of ministries and state organizations, local authorities and municipalities, non governmental organizations, scientific research institutes, industrial enterprises and the press were invited. At the workshop, the project plan was presented and participants were given the opportunity to question the representatives of the World Bank, State Committee on Ecology, local authorities, and the World Bank consultants on various aspects of the project. A draft EA was presented to the participants prior to the workshop. A summary of the workshop presentations and the discussion is given in Appendix 2.

K. Appendices

Appendix 1. List of Environmental Assessment Preparers and Organizations.
Appendix 2. Record of the Consultation Meeting.
Appendix 4. Map of Mercury Cleanup Site and Landfill.
Appendix 1

List of Environmental Assessment Preparers and Organizations

John Munthe, Swedish Environmental Research Institute (IVL), Gothenburg, Sweden

Jan Sundberg, Karsten Håkansson, Bertil Nord and Jan Rogbeck, Swedish Geotechnical Institute (SGI), Linköping, Sweden

Gilbert T. Rowe and William J. Rogers, Texas A&M University, Texas, USA

Professor Alekoerov, State Committee on Geology and Natural Resources, Baku, Azerbaijan

Professor Namik Aliyev, Institute of Phrophylactic Medicine, Baku, Azerbaijan
Appendix 2

Minutes of the EA Assessment Workshop Held by the World Bank, State Committee on Ecology and Control of Natural Resources Utilization and Sumgait Executive Authority to Discuss the “Mercury Cleanup and Construction of Hazardous Waste Landfill” Project

April 28, 1998

Participants: WB experts, representatives of the ministries and state organizations, local municipalities, non-government organizations, scientific-research institutes, industrial enterprises, press (the list of the participants attached).

Agenda: Discussion of the EA on the “Mercury Clean Up and Construction of the Hazardous Wastes Landfill” Project.

Listened to:

1. Arif Islamzadeh - Ecology Advisor to the Sumgait Mayor. A. Islamzadeh welcomed the participants and briefed them on the workshop objectives and tasks.

2. Aloyev H.B. - Sumgait -city Deputy Mayor. He mentioned the project implementation importance for Sumgait. Sumgait -city is one of the most heavily industrialized cities of the Azerbaijan Republic and consequently a well developed industry production in line with inadequate ecological protection under the soviet policy severely affected the environment. Linked to the foregoing serious factors, the future landfill project should duly consider both mercury and other hazardous wastes disposal.

3. Muradov R.B. - (NEAP Coordinator in Azerbaijan). The Project in question is included into NEAP priorities list, approved by the Government of the Azerbaijan Republic on January 8, 1998. WB and State Committee on Ecology and Control of Natural Resources Utilization (hereinafter SCECNRU) experts in cooperation with scientific research institutes and non-governmental organizations (hereinafter NGO) representatives started developing Mercury Clean Up Project including NEAP document. According to the Provision “NEAP Process in Azerbaijan” a NEAP document need to be developed before Project Implementation, be
discussed with community and be thoroughly examined by the experts of SCECNRU. Muradov R.B asked the participants to be active during the discussion of the document and suggest constructive proposals.

4. Mamedov Ch. F.- (WB NEAP Coordinator) - Mamedov CH. F.explained where is a basic difference between World Bank acting as Development Bank and normal investment banks. The task of the WB comprises project development, technical and financial support to the projects important for the perspective progress of the country. This workshop is held to provide a full transparency, which is one of the basic components required by the WB in respect to the projects having high ecological impact and importance.

5. John Munthe (WB Project Expert) mentioned that the document in question is developed in co-operation with WB, SCECNRU, State Committee on Geology, Zoology Institute and Ministry oh Health’s Epidemiology and Hygiene Centre. This document duly considers all the possible implementation impacts on the environment. For the purpose of this project including EA a number of studies have been carried out to determine present soil, ground water, coastal zones, flora and fauna of the sea bottom state including mercury content in the human hair within Sumgait -city population. In addition, engineering research surveys have been conducted within two sites of the Apsheron peninsula. One of the sites is completely consistent with both geological and ecological requirements needed for the project implementation and due to the features mentioned was selected for the purpose of hazardous wastes landfill construction. Jh. Munthe informed the participants on the mercury contamination accumulated within the old chlorine producing plant and sludge basins. Monitoring will be required to be carried out within the area once the landfill construction is accomplished.

6. Bertill Nord - WB Project Expert presented the participants feasibility studies results of this Project and told about the construction of identical landfills in other countries. The landfill site selection was based on the ecological safety.

7. Adishirin Alekperov- Geology and Hydrogeology Department Manager under State Committee on Geology mentioned that geological tests proved that mercury is accumulated not only at the 6m depth within old factory area but also is accumulated outside the old plant territory. In regards to the site selected for the landfill its location and features are consistent
with geological and technical conditions, taking into account that lithology of this site represents an area with a high clay content soil and reserves of ground water at 25m depth. This site would meet the requirements needed for the construction of the hazardous wastes landfill.

8. Mamedova A.P.- Department Manager of the Epidemiology and Hygiene Centre. She informed the participants on the results of the studies carried out to determine mercury content in the human hair. The studies proved correlative dependency between mercury content in human hair and their working activity in the factory. The highest mercury level was representative for the workers of the plant, then family members of the workers and the nearby population. High mercury content was determined in the hair of the people most frequently using fish. This result is consistent with data reflecting mercury content in marine products including fish and first of all beluga-fish most often used by the local population.

The floor was also given to the representatives of ministries and state organizations, local municipalities, NGO-s, scientific-research institutes, industrial enterprises and political parties. The representatives such mentioned in line with some questions put their proposals (questions, answers and proposals are provided below).

The participants of the workshop highly and unanimously appreciated and approved WB policy, State Committee on Ecology and Sumgait Executive Authority (Municipality). These organizations and institutions contributed tremendous efforts and willingness to generate public awareness on the project progress. They mentioned that Project importance and urgency is dictated by complicated ecological situation in Sumgait, hazardous wastes landfill lack in Azerbaijan including hazardous impact of the mercury to the human health. The participants of the workshop expressed their willingness and readiness to render a required assistance to make the Project possibly soon to be implemented.

Chairman

Islamzadeh Arif
List of People and Organizations Represented
Urgent Environmental Investment Project

1. Sh. Abushova - Deputy Chairman of the “Sevil” Women Organisation.
2. N. Amahanova - Education Department, methodologist
3. H. Aloyev - Sumgait Executive Authority Head Deputy
4. A. Efendiyev - AP EA Director of the “Polymer Materials” Institute, Professor
5. M. Salahov - AP EA “Polymer materials” Institute, Professor
6. J. Yuzbekov - Industrial Institute of the Azerbaijan Republic, Director of Studies, Doctor of technical sciences
7. R. Ismaylov - Industrial Institute of the Azerbaijan Republic, Professor, Pro-rector
8. N. Nazarov - “Azerkimya” State Enterprise
9. M. Mamedov - Sumgait Ecology Committee Chairman
10. S. Jamalov - Sumgait Ecology Committee, Chief of Department
11. T. Fayrushin - Sumgait Ecology Committee, Chief of Department
12. A. Humbatov - Sumgait Ecology Committee, Chief of Department
13. G. Jalilov - Sumgait Ecology Committee, Inspector
14. F. Hassanov - State Technical Inspectorate, Senior Inspector
15. B. Askarov - Sumgait Municipality, Department Manager
16. I. Mamedov - “Sinteskauchuk” factory Director, Candidate of technical sciences
17. T. Ibragimov - “Sinteskauchuk” factory, Manager of the “Environment Protection” Department
18. N. Tagiyev - Sumgait, Senior Psychiatrist, Candidate of Medical Sciences
19. J. Agayev - “Kimyachi” polyclinic, Senior medical doctor, Candidate of medical sciences
20. R. Taptigov - “Maslek” newspaper, Editor
21. R. Piriyev - ADP Inspection Committee Chairman
22. H. Abdullayev - National Scientific Research Health Prophylaxis Institute (NSRHPI), Referent on science, Professor
23. T. Nabiyev - NSRHPI, Department Manager, Candidate of medical sciences
24. M. Aliyeva - NSRHPI, Department Manager
25. A. Mamedova - NSRHPI, Department Manager, Candidate of medical sciences
26. S. Halilova - Vocational Diseases Polyclinic, Chief Physician
27. I. Hajiyeva - MSF (Belgium) Representative
28. B. Agayeva - “Taffakur” Lyceum Director
29. Z. Gasimova - N32 Lyceum, Biology Teacher
30. M. Maharramov - Sumgait Municipality, Department Manager
31. B. Alamshahov - Sumgait Municipality, Senior Advisor
32. D. Ashurov - Industrial Institute of Azerbaijan, Professor
33. J. Israfilov - “Uzvi Sintez” factory, Director, Candidate of Chemical Sciences
34. V. Jafarov - AP EA “Polymer Materials” Institute, Deputy Director, Candidate of Chemical Sciences
35. E. mamedov - Sumgait, “Ekho Sumgaita” newspaper, Chief Editor
36. H. Kuliyeva - Sumgait, Health Department, Senior Pediatrician
37. A. Mamedova - NSRHPI, Laboratory manager, Candidate of medical sciences
38. A. Nasirov- Superphosphate factory, Senior Metrologist Deputy
39. F. Allahverdiyev- “Uzvi Cynthez” factory, Engineer
40. R. Huseynov- “Uzvi Cynthez” factory, “Environment Protection” Department Manager Deputy
41. T. Ibragimov- “CK” factory, Social and Environment Protection Department Manager
42. R. Heydarov- Aluminium factory, Health department, Senior Doctor
43. V. Levdina- “Taffakur” Lyceum, Teacher
44. J. Jalilbiyev- AP EA “Polymer Materials” Institute, Doctor of chemical sciences, Professor
45. M. Muradov- Industrial Institute, post-graduate
46. R. Turabhanoglu- Azerbaijan Democratic Independence Party Chairman
47. D. Bayramov- Sumgait branch of the Azerbaijan Popular Front Party, branch’ deputy-chairman
48. A. Allahverdiyev- Sumgait Senior Sanitary Inspector
49. A. Agashirin- Geology Department, Expedition Manager
50. K. Aliyeva- “Internews” NGO
51. M. Suleymanov- Wild Nature Fund, NGO
QUESTIONS AND ANSWERS SESSION

1. R. Alekberova - Have mercury analysis been taken from the 65th facility of “Organic Synthesis” plant that we work in?

2. John Munthe - In initial tests we did not use much analysis, it will be implemented mainly through MONITORING system to be applied.

3. C. Mamedov - For your information I would like to say that one sample test costs US $38.

4. Samir - Lawyer - What aspects have been considered when choosing a disposal site nearby Sumgait city, and how the control over technical safety rules observation by workers will be carried out?

5. R. Muradov - Landscape was considered when choosing the disposal site and this selected disposal site is the best option, and regarding observation of the safety rules I can say that it is fully reflected in the project.

6. A. Islamzade - I can add that seven sites had been proposed for the disposal site, and this selected area is the most optimal area.

7. Doctor Tagiyev - In terms of medical norms, how far is the disposal site to be constructed is located from the residential area?

8. B. Nord - Since there are various types of disposal sitess in the world, distances are also different, and especially from the transportation considerations, 15 km distance was accepted. Also I want to mention that the disposal site’s life should be long-term and it is isolated by a waterproof membrane.

9. M. Salakhov - In 2nd paragraph 10th item of the project it is shown that dioxim analysis will be implemented. How will the analysis be carried out through Monitoring system?

10. John Munthe - Sludge sample will be used, and sludge with an excess dioxim concentration will be disposed of.

11. M. Salakhov - I would like to inform you that in 1989 dioxim analysis were carried out through “Tayfun” Monitoring system in the Institute I work for.

12. A. Efendiyev - I appeal to the project authors as well as to the World Bank representative. 15 science doctors and professors, and 80 science candidates are working at the Polymer Metals
Institute under Azerbaijan Academy of Sciences. Do not forget to use this scientific potential. No one applies to us. I request that in your future activity you would attract our scientists as well.

13. R. Ismaylov - There are specialists in the areas of chemistry, physics, mechanics, automatics working in our Institute. Currently problems lab is functioning. Can any problem arise in future regarding rise of the Caspian level?

14. R. Muradov - The selected disposal site is located 100 m higher than the sea level accordingly to the landscape, and it will not face any problems in future.

15. B. Asgerov - 115th facility of the plant started its operation in 1982. While being in the work regime, how is mercury clean-up to be implemented in this facility?

16. A. Islamzade - “Azerkimya” State Company has promised to shut down this facility at “SAM” plant.

17. D. Bayramov - The project envisaged termination of production. I wonder, how much mercury is in wastes and what methods will be used for the clean-up?

18. A. Islamzade - This issue was taken into account in the previous projects. Report on 1750 tons of mercury clean-up was received from Moscow. Accordingly to standards, quantity of mercury in each ton is about 5-10 grams, but it is at 250 grams level in our production wastes. 62 technological clean-up schemes exist in the world. With the allocated credit it is possible to implement only the mercury clean-up works. That’s why available financial resources should be efficiently used. Tests will be continued afterwards too.

19. I. Mammedov - As you know, there are several calcination methods: cement method, bentonite method, etc. These are beneficial methods. In what composition and to what condition will the ground waters be cleaned? How much is water concentration?

20. John Munthe - Additional substances in great concentrations will be received as a result of calcination. Mercury will be mainly separated in sediment form. Received mercury sediment will be transported and disposed of. Mercury concentration should be 1 microgram in 1 liter of water.

21. R. Piriyev -

a) What is the difference between the World Bank and other banks? What are the credit conditions of the World Bank?

b) How far from residential area should the disposal site be located? What can be results of natural disasters?
c) Under what conditions will local specialists be attracted to work in project implementation?

22. C. Mamedov - The World Bank covers 129 countries. This project is implemented based on IDA credit. Grace period for this credit is 10 years. After 10 years annual interest will accrue at 0.75%. This is the best option and we have to efficiently use this credit resources.

23. John Munthe - There is no usual standard for how far should disposal sites be from residential areas. Geology Committee may answer on natural disasters. Area selected for the disposal site is located above the sea level. Regarding attraction of local specialists, it will be done in full. Project preparation was carried out in very short period in terms of time. Since now, connection with local institutions will be maintained in project implementation area.

24. Y. Yuzbeyov - How will mercury be separated from wastes? As you know, mercury formations, particularly, evaporated mercury are dangerous. How will you prevent this on the disposal site?

25. John Munthe - we completely share your opinion. We will minimize the mercury evaporation in the disposal site. Disposal site will be kept in full isolation by special membrane. Gases will be cleaned through filters by ventilation pipes.

26. A. Humbatov - Quantity of mercury in the project is shown to be 65,000 tons. But based on information received from enterprises, this number is 180,000 tons.

27. This number was received from the Geology Committee, and was determined based on the tests conducted on contaminated and sludge territories. This number was taken from initial information.

28. D. Bayramov - If mercury content will exceed the one specified in the project, will it be possible to proportionally increase the project amount?

29. C. Mamedov - If suppose mercury content is twice higher, it does not mean that project amount will increase so much.

30. Kh. Guliyeva - I would like to emphasize two things. First, especial attention should be paid to woman and children. Second, personnel involved in clean-up procedures, should get especial food, including milk and milk products.
Appendix 3

Cost Estimate and Time Plan for the Proposed Project.

<table>
<thead>
<tr>
<th>Project component</th>
<th>Estimated cost (1000 US$)</th>
<th>Start</th>
<th>End</th>
</tr>
</thead>
<tbody>
<tr>
<td>Excavation of sludge basins, dewatering, transport to landfill</td>
<td>881.5</td>
<td>99-06-15</td>
<td>01-05-31</td>
</tr>
<tr>
<td>Mercury recovery, disposal of treated soils and backfill</td>
<td>813.1</td>
<td>99-06-15</td>
<td>01-05-31</td>
</tr>
<tr>
<td>Sludge pump, tanks for recovery process</td>
<td>679.9</td>
<td>99-03-31</td>
<td>99-05-31</td>
</tr>
<tr>
<td>Landfill construction</td>
<td>978.9</td>
<td>99-03-31</td>
<td>01-09-30</td>
</tr>
<tr>
<td>Geotextile for landfill, installation</td>
<td>698.8</td>
<td>99-10-30</td>
<td>01-07-31</td>
</tr>
<tr>
<td>Landfill operation</td>
<td>504.2</td>
<td>99-05-30</td>
<td>01-09-30</td>
</tr>
<tr>
<td>Road and bridge construction and improvements</td>
<td>446.6</td>
<td>99-03-31</td>
<td>01-09-30</td>
</tr>
<tr>
<td>Environmental monitoring and control, equipment, training, site testing</td>
<td>1204.7</td>
<td>98-03-31</td>
<td>01-12-31</td>
</tr>
<tr>
<td>Site testing, engineering services</td>
<td>117.5</td>
<td>98-09-30</td>
<td>99-06-30</td>
</tr>
<tr>
<td>Project management, technical support, training landfill and safety management, technical supervision</td>
<td>1 930.1</td>
<td>98-09-30</td>
<td>01-12-31</td>
</tr>
</tbody>
</table>
Appendix 4

Map of Mercury Contaminated Area and Proposed Site for Landfill