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CENTRAL ASIAN REPUBLICS INTERIM REPORT

Sustainability of EPT Potable Water Projects in the Central Asian Republics
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Delivery Order 12, Task 2D2

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Section 1

Introduction

1.1 Background

Under Delivery Orders (DO) 2, 6, 7 and 12 of the Environmental Policy and Technology (EPT) Project, USAID has committed to improve the quality and increase the quantity of water delivered to residents in the Aral Sea disaster zone through rapidly implementable assistance projects and training on environmental health. These activities have a direct impact on water-related health problems while improving the long-term capabilities of local and national governments to provide clean drinking water to their citizens.

In particular, EPT has sponsored major potable water engineering projects in the Aral Sea Basin regions of Turkmenistan, Kazakstan and Uzbekistan. These engineering activities are summarized below.

- Turkmenistan. In Turkmenistan, the EPT Project has designed, constructed and started up a reverse osmosis water treatment plant capable of producing 750m3 per day of clean potable water. An average of 7-10 liters per capita per day (lcd) of the water is intended to be used only for drinking and cooking by approximately 100,000 residents of Turkmenbashi Etrap in the Aral Sea Basin area of Turkmenistan. The water is to be either picked up by trucks or individuals with containers arriving at the plant or delivered by trucks to villages and collective farms.

- Kazakstan. The primary EPT-sponsored engineering activities in the Aral Sea Basin region of Kazakstan have been the rehabilitation of the Kozaman and Berdokyl wellfields and seven transfer pump stations along the Aral-Sarybulak pipeline beginning at those wellfields and ending at Kazalinsk. In the wellfields, wells were tested, chemically redeveloped and well screens, pumps and motors replaced. At the pump stations, pumps, motors and chlorinators were replaced.

- Uzbekistan. EPT has provided a wide range of assistance in rehabilitating selected components of the potable water delivery facilities in the Tuyayumun interregional water supply system. This assistance has included provision of laboratory equipment and supplies; new chlorinators at the Nukus and Urgench treatment plants, pump stations and reservoirs; physical improvements to the clarification and filtration systems at the treatment plants; and related O&M training.

A more detailed description of EPT's work in Central Asia is contained in Appendix A.

1.2 Objectives, Scope and Methodology

DO12 Task 2D2 provides for assessment of financial sustainability of the potable water supply engineering projects installed under the EPT Project in the Aral Sea Basin regions of Uzbekistan, Kazakstan and Turkmenistan. A proposal submitted to USAID in October 1996 expanded Task 2D2 to address overall sustainability of these projects, including institutional as well as financial sustainability, with emphasis on the most problematic sustainability issues. Institutional sustainability includes professional development and training, as well as institutional ownership and capacity. The subtask is intended to sustain the long-term benefits of EPT potable water supply engineering efforts in the Central Asian Republics (CAR) by identifying, developing and promoting policy and other interventions that will facilitate host country financial and institutional support for long-term operation and maintenance. Short-term sustainability will also be evaluated, especially with respect to the applicability of proposed cost recovery techniques in each timeframe.

This initial sustainability assessment has been carried out by an institutional specialist and water resources economist who spent several weeks in CAR during the fall of 1996 identifying long-term sustainability needs and potential interventions to address those needs. This was accomplished through interviews and meetings with EPT, USAID and host country representatives and review of available reports. The specialists then prioritized the identified needs and outlined in more detail the interventions to address the highest priority needs. After the program of sustainability recommendations presented in this interim report is agreed upon with USAID, EPT will present it, in conjunction with USAID/Almaty, to the respective host country officials to obtain their formal commitment to carry out the action items appropriate to them. EPT will then proceed to carry out the remaining action items, collaborating with USAID, other donors and host country officials, as appropriate. A final report will be prepared at the end of the task. Appendix B presents the methodology used, including staffing, approach, typical questions asked in the interviews, persons interviewed and references reviewed.

1.3 Requirements for Sustainability

Review of USAID and other donor literature relating to sustainability of development projects reveals that sustaining the long-term benefits of potable water supply projects requires successful actions at all levels from the facility investment level to the regional water authority through the national government:

- At each water supply project or facility, steps must be taken to provide the capability for effective operation and maintenance. Effective personnel with appropriate training must be obtained to manage and operate the plant. Systematic operation and maintenance procedures must be developed and followed. Necessary equipment and spare parts must be provided. Electric power must be reliably available.

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- At the regional water authority and host country levels, actions must be taken to ensure that the necessary institutional strength and financial resources to support operation and maintenance will be reliably available over time. Some combination of user charge revenues and government subsidies must be developed to support the continued provision of potable water. This requirement is particularly difficult to meet in the Central Asian Republics because mechanisms for water pricing and cost recovery are limited and the economies are presently weak and depressed.

These sustainability factors serve throughout this report as criteria for evaluating the sustainability of EPT's engineering projects in CAR and as a basis for strategies for improving the sustainability of those projects. As a result, there are several common themes that link the recommendations among the three countries, including the introduction or strengthening of water pricing and cost recovery, improvement of billing and collection systems for water charges, provision of initial supplies of expendables, provision of training on management of maintenance and repair, provision of training on water utility management and administration, evaluation of community-based management at the village and collective farm level, improvement of the reliability and quality of power supply and reduction of power usage and cost, and implementation of pilot projects to introduce volumetric measurement and reduce leakage and wastage.

The majortiy of these recommendations are proposed as EPT action items; however, many of them also require active USAID participation. Some of the recommendations involve preparing projects for funding and implementation by the World Bank or other donors. All involve active partnership with the host country governments.

1.4 Organization of Report

Sections 2, 3 and 4 address sustainability of EPT interventions in Turkmenistan, Kazakstan and Uzbekistan, respectively. Each of these sections in turn presents several areas of significant concerns relating to sustainability, presented in order of priority. These discussions include subsections on findings, conclusions and recommendations. The recommendations are presented as a multi-step project for EPT implementation in each area of sustainability concern. Each country section begins with an overview of these projects and a table summarizing project implementation information. Section 5 presents results to date of implementation of the water pricing and cost recovery projects which are given top priority in each country. This discussion includes O&M cost estimates, analysis of problems with the current water pricing strategies, development of pricing scenarios and a spreadsheet model to analyze them and some preliminary recommendations for water pricing and cost recovery in each country.

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Section 2

Turkmenistan

2.1 Overview

In Turkmenistan, the EPT Project has designed, constructed and operated a reverse osmosis water treatment plant capable of producing 750 cubic meters per day of clean potable water. An average of 7-10 liters per capicta per day (lcd) of the water is intended to be used for drinking and cooking only by approximately 100,000 residents of Turkmenbashi Etrap in the Aral Sea Basin area of Turkmenistan. The water is to be either picked up by trucks or individuals with containers arriving at the plant or delivered by government-operated trucks to villages and collective farms. EPT staff are currently still onsite to support plant O&M and train the local operators. Currently, the plant is operating at less than 30% of capacity while the distribution system is planned, tested and implemented. Fifteen new tanker trucks have been supplied by EPT (3) and the World Bank (12). Large site-located tanks and smaller user-specific containers are being procured.

The primary sustainability needs and corresponding recommended initiatives to improve sustainability of the EPT-sponsored potable water interventions in Turkmenistan are summarized below in order of priority for EPT action. Each project summarized below is comprised of several tasks which are presented in step-wise order.

1. To introduce water pricing and cost recovery for O&M. The estimate of annual cost for operation and maintenance of the RO plant and associated distribution system, including contingency and capital replacement funds, has been revised to $347,091, including 76% in foreign exchange which can be reduced over time as local sources of materials are developed. Although the Government of Turkmenistan (GOT) may be willing and able to provide a partial subsidy for plant O&M, the Ministry of Water Resources (MWR) has devolved responsibility for funding and operating this system to the local level. The sum of $347,091 is a significant amount of money relative to the annual local etrap and vilayet budgets and it is unclear they will be able to fully subsidize even the system's annual O&M costs. Therefore, it is critical to both short- and long-term sustainability of the plant and distribution system that an alternative means of financing be developed. The most dependable long-term strategy is that the system be financially self-sustaining based on revenues generated by the sale of water to the users in the etrap. Based on World Bank studies and EPT interviews, there is evidence suggesting residents will be willing and able to pay some price for the water, depending on income, preferences and availability of substitutes. Some remaining sum, depending on prices charged, revenues generated and total O&M costs, may still need to be subsidized by government. At the present time, national policy requires all residents be provided water at no charge. Therefore, as long as residents have access to some other water source provided free of charge, this policy does not preclude charging a price for the RO plant water. In addition, there may be several ways to distinguish the RO plant water from other water, based on the high quality achieved by its treatment and the restrictions placed on its use. And finally, it is al-

O+M costs = $347,091 per year.

① fees to residents ② Subsidy

Which studies? How extensive?

Do they have access to another H_2O source?

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ready standard practice in the etrap to charge for transportation of water. Therefore, users of the water should be charged a price to (1) enable the local operating entity to recover at least a portion of its annual O&M costs and other funds required for long-term sustainability, and (2) distinguish the high-quality potable water from the plant from the lower quality water available from other sources. Based on these sustainability needs, it is recommended that EPT undertake a project to introduce water pricing and cost recovery approaches to fund the RO plant and distribution system, including: developing alternative pricing and allocation strategies, a simple spreadsheet model to evaluate them and a system for billing and collection; providing basic training on water pricing and cost recovery and presenting the pricing strategies, model and billing and collection system to the Hydrogeological Trust, the etrap users/community leaders and MWR to obtain buyin for water pricing; working with the Trust in using the model to select candidate strategies; assisting the Trust in designing a related public education campaign; assisting the Trust in testing the candidate strategies on pilot communities or farms; obtaining Trust and MWR commitment to adopt the strategy found to be most effective, get agreements with other agencies to pay for water used and subsidize O&M costs not funded through water sales; and procuring computers needed for modelling and accounting. Development of preliminary pricing/allocation scenarios and spreadsheet model are complete and a study of local residents' willingness and ability to pay for the water is in progress.

2. To provide a solid foundation for transfer of facility O&M to GOT control. EPT has provided tools, spare parts and supplies and O&M training to the RO plant to facilitate a smooth transition toGOT control. However, for reasons enumerated in no. 3 below, the GOT and Hydrogeological Trust have fallen behind schedule on their action items under the Memorandum of Understanding (MOU), including provision of onsite housing needed for the majority of plant operators and truck drivers who live too far away to commute daily, and completing the testing and beginning full implementation of the distribution system (including paying the drivers) without which the plant is not being run at full capacity on any process train which in turn severely limits the quality of the on-the-job training possible for the local operators. These two items are critical to smooth handoff and near-term sustainability of the plant and distribution system. In addition, a second product water storage tank is needed to allow continued distribution of water to residents while the plant is shutdown for repairs for up to 2 days which is likely to be necessary several times per year. Based on these sustainability needs, it is recommended that EPT undertake a project to complete development of a solid foundation for transfer of O&M and repair to GOT control, including: arranging meetings with GOT and USAID to review status and update the schedule for the GOT to carry out their part of the MOU; extending O&M support to the plant through September 1997; providing two more operator training sessions to cover new staff replacing those who have left due to the long daily commute; obtaining GOT commitment to purchase the first 1-2 year's supply of chlorine and other expendables; and procuring and overseeing installation of a second product water storage tank.

3. To strengthen management and administration of water delivery system. The Hydrogeological Trust in Dashouz, a state-run research and development agency dealing

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mainly in exploration and exploitation of groundwater resources, has been the agency identified by the GOT to work with EPT in designing, building and operating the RO plant and distribution system. There are several issues that need to be addressed and areas that need to be strengthened for the Trust to serve effectively as the long-term manager of the RO plant and distribution system, including: the office in Dashouz is a long way from Turkmenbashi; the Trust is not experienced in water utility operations; it has other pressing responsibilities and priorities; and it is not positioned very high in either the Dashouz Vilayet administration or GOT. The Trust, however, is reputable and strong in its primary mission and may be the organization best positioned to take over O&M of the plant and distribution system in the short-term. However, for both the short- and long-term, it will be beneficial if the Trust were able to hire a full-time water delivery system administrative manager to champion and run the RO plant and its distribution system. In addition, some form of water users or community involvement in the management of the RO plant and distribution system will significantly enhance sustainability by ensuring community support and assistance in the design and implementation of the water pricing, allocation, distribution, billing and collection systems. Another measure which may strengthen the Trust's capability to run the system is to coordinate its operations with those of the consolidated regional (vilayet) water authority that the GOT and World Bank have agreed to in concept; this institution may offer long-term sustainability advantages by serving as a conduit of central government funding and technical and management expertise and by offering some level of cost-effectiveness by allowing more bulk purchasing of expendables. Based on these sustainability needs, it is recommended that EPT undertake water delivery system managment and administration strengthening project, including: assisting the Trust in determining how a full-time water delivery system administrative manager could be funded and in recruiting and providing specialized training to a candidate; studying options for involving water users and the community in the management of the RO plant and distribution system, including appointing an advisory board to work with the Trust that would have representatives from the villages and collective farms in the etrap; and working with the World Bank to determine the nature and timing of the consolidated regional water authority, evaluate how its function and capabilities could be coordinated with those of the Trust and assure that EPT-sponsored management strengthening will be consistent with the planned future of the system.

4. Alternative methods for raising revenue, if necessary. The primary goal of this sustainability task is to recommend measures for increasing the likelihood that the benefits provided by the RO plant to residents of Turkmenbashi Etrap can be maintained, over time. The preferred method for achieving this goal is to implement an appropriate water pricing and allocation program in which revenues from the sale of clean drinking water to residents of the etrap are sufficient to pay for operating and maintaining the facility. Local drinking water users and the community would be involved in management of the plant and the distribution system, and in designing and implementing an appropriate water pricing and allocation program.

The RO plant is a new facility providing clean drinking water to residents of Turkmenbashi City, many villages, and collective farms, where income levels are limited

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and where residents spend a large portion of their current income on food and clothing. Residents of the etrap are likely able and willing to pay somne portion of the cost of producing and delivering clean drinking water, but time and further research are required to determine the extent of their ability and willingness to pay, and the potential impact of alternative water prices on the welfare of local residents. Further work is also required to determine the best means of involving local water users and the community in water policy discussions and management activities.

Given the time and research required to determine the optimal program for operation and maintaining the RO plant, the best water pricing and allocation plan, and the appropriate means of involving local drinking water users, it is useful to examine alternative strategies that may be considered for raising revenue to support operation and maintenance activities. The alternatives listed below are offered in the spirit of supporting the original intent of the USAID/EPT Project, which is the delivery of clean drinking water to residents of Turkmenbashi Etrap:

- Government subsidy of operation and maintenance costs
- Lifeline block-rate pricing program
- Expansion of the service area
- Bottling water for sale inside or outside the service area
- Local water users association
- World Bank funded activity in Turkmenbashi Etrap

Table 2-1 presents the recommendations along with their priority level, donor and implementor, and EPT LOE/equipment cost and schedule estimates. EPT recommends the following steps be taken toward agreeing on a near-term course of action on the above recommendations:

1. USAID/Washington and USAID/Almaty review on this document and return consolidated comments to EPT/Washington and EPT/Almaty by January 10, 1997.

2. EPT/Washington meet with USAID/Washington to review comments and plan strategy on January 13, 1997.

3. EPT Sustainability Task Manager and Economist return to Almaty to meet with EPT/Almaty and USAID/Almaty to complete detailed planning of strategy.

4. EPT Sustainability team, in conjunction with USAID/Almaty, set up meetings or conferences with host country officials to present sustainability findings and recommendations and obtain formal commitment to carrying out action items appropriate to host country.

5. EPT Sustainability team proceed to carry out sustainability recommendations assigned to EPT.

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Table 2-1. Comparison of Sustainability Recommendations for Turkmenistan

Sustainability Project	Priority	Donor (Implementor)	EPT LOE /Cost (Funding Source)	EPT Duration (Timing)
Introduce water pricing and cost recovery	1	USAID (EPT/CH2M)	All tasks--98 person-days (Existing DO12/T2D2 plus mod)	9 months (10/96-9/97)
Provide solid foundation for transfer of facility O&M to GOT	1	USAID (EPT/CH2M) Trust is partner in O&M and installs tank	Commitments from GOT--24 person-days O&M extension 6 mos.--$56,000 Maint. & repair mgmt. training--36 person-days Second product storage tank--$150,000 (Existing DO12/T2B plus mod)	9 months (1/97-9/97)
Strengthen management and administration	1	USAID (EPT/CH2M) WB implements consolidated regional authority & reviews approach to involving users/community in management	Trust system mgr. recruiting & training--24 person-days Users/community mgmt. involvement study/setup--24 person-days Regional authority coord. with WB--12 person-days (Existing DO12/T2B & T2D2 plus mods)	9 months (1/97-9/97)

2.2 Introduce Water Pricing and Cost Recovery for Potable Water System Operation and Maintenance

2.2.1 Findings

1. The RO Plant O&M cost estimate previously prepared by HIID was reviewed and updated. Based on this review, the O&M cost for the plant and water delivery truck fleet has been revised to $220,910 per year. This cost includes includes labor, chemicals, spare parts and membranes. Also included are labor, fuel, lubricants, etc. for truck fleet O&M. O+M $221 K

2. A Contingency and Reserve Fund equal to 20% of the estimated annual operation and maintenance cost, or $44,182, should be included in the annual budget for the RO Plant and the water delivery fleet. The 20% value is recommended during the first 3 years of operation, or until substantial experience is gained in operating and maintaining the plant and delivery fleet. CRF $44 K

3. A Capital Replacement Fund should also be included in the annual budget for the R.O. Plant and delivery fleet, to generate the funds required to replace the plant and trucks when they reach the end of their useful life. A Capital Replacement Fund of $50,000 is recommended for the RO Plant, assuming that the plant will be replaced in 25 years at a current cost estimate of $1.25 million. A Capital Replacement Fund of $32,000 per year is recommended for the delivery fleet, assuming that the 16 trucks will be replaced every 5 years at an average cost of $10,000 per truck. CRF $50 K + $32 K (trucks) =

4. The total estimated annual budget for the Turkmenbashi reverse osmosis plant and water delivery fleet, including the Contingency and Reserve Fund and the Capital Replacement Fund, is $347,091 per year. It is reasonable to expect that the foreign exchange component of this budget should include the Capital Replacement Funds ($82,000); the cost of chemicals, spare parts, membranes, and other materials ($134,588); one-half the cost of truck maintenance ($24,469); and one-half of the Contingency and Reserve Fund ($22,091). The estimated total foreign exchange component of the estimated annual budget is, therefore, $263,147, or 76% of the total annual budget. The estimated local currency component is $83,944 per year (24%), or 419.7 million manat, using an exchange rate of 5,000 manat per dollar. $347 K

5. The total cost of operating and maintaining the Turkmenbashi R.O. Plant and the foreign exchange component can be reduced, over time, as local sources for chemicals and other materials are developed. The current cost estimates include the cost of transporting many of the chemicals and spare parts from countries outside the Central Asian Republics.

6. Based on a meeting with the the GOT Department of Water Resources and Water Management, it is apparent that the Department intends to work closely with the Hydrogeological Trust to calculate the O&M costs of the plant and determine how and at what level of government those costs should be recovered. According to the Chairman of

the Department, the Trust was to submit a distribution plan by November 1 and the Chairman and/or his assistant was to travel to Dashouz in mid-November to work on the costs and cost recovery issues. It is apparently still possible that the central government will subsidize at least a portion of the O&M costs. The central government budget must be submitted before the end of the year and must be formally finalized by February 5, so there is still time to get funding approved for next year.

2.2.2 Conclusions

1. Charging a price for water produced and delivered from the RO plant is essential for two reasons:

   - A positive water price will enable the Trust to recover a portion of the annual operating and maintenance costs and other funds required for long-term sustainability.

   - A positive water price will distinguish the high-quality drinking water produced at the RO plant from lower quality water available from other sources.

2. At the present time, water is provided at no charge to residents of Turkmenistan, but this policy should not be extended to include water produced and delivered from the RO plant. The high-quality water produced at the plant is intended to be used only for drinking and cooking. The plant has been designed to produce only enough water to supply residents with 7 to 10 lcd, which is a small portion of their total water use (approximately 100-200 lcd). Transport by truck maintains the quality, but limits the usage, of the water relative to pipeline or canal delivery.

3. It should be possible to implement a pricing program for water from the RO plant by noting that a price is required to pay for water treatment and transport by truck while the water itself may still be presented as "free" to consumers.

4. The estimated average cost of producing and delivering water, including the contingency and capital replacement funds is $1.42 per cubic meter which is higher than the cost of water delivery in many less developed countries. However, the water is low in total dissolved solids and is much higher quality than drinking water delivered in pipelines or canal systems. Therefore, it is appropriate to charge a price for water from the RO plant, to recover at least some portion of the annual expenditures.

5. It is also likely that residents of the Turkmenbashi Etrap will be willing to pay for the high-quality water for drinking and cooking. The actual level of demand for high-quality water in the Etrap is a function of household income levels, preferences, and the availability of substitutes.

   How was this determined?

6. A partial subsidy may be required by the Government of Turkmenistan or an appropriate local agency, if income levels are not sufficient to support full-cost pricing of water from

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the RO plant. The amount of subsidy required will be a function of the price charged to residents, the revenue generated from water sales, and the total O&M cost.

Why would gov't subsidize when so far it has not shown much interest in supporting the project or plants ~~to date~~

2.2.3 Recommendations for EPT Action

1. Develop alternative potable water pricing and allocation scenarios and a simple spreadsheet model for evaluating them using different assumptions about costs and prices.

2. Design in outline form a billing and collection system to support the pricing and allocation system. One alternative is to develop a coupon system wherein coupons would be purchased conveniently any time from the the RO plant, water delivery truck drivers, or community centers. The coupons would be transferable, so individuals may sell them or barter with them depending on how they value water from the RO plant versus other water sources, food and other necessities they must spend their limited resources on. A precedent for such a system may already exist in Turkmenistan in the form of a food coupon system. Section 5.2.3 describes such a proposal in more detail.

3. With the strong backing and active participation of USAID and the US Embassy, provide basic training on potable water pricing, and present the pricing strategies, model and billing and collection system developed above to relevant Trust and MWR officials and staff. Obtain political buy-in for utilizing water pricing to recover as much of the annual O&M costs as possible and to set prices to generate revenues sufficient to establish an annual repair fund, a contingency fund and a capital reserve fund.

4. Work with those Trust officials and staff in using the water pricing model to evaluate and select the optimal water pricing strategies and assist in refining the billing and collection system for local use.

5. Assist the Trust officials and staff in designing a public education campaign relative to the source, treatment and value of the pipeline water; how it is distributed, priced and allocated; how billing and collection are done; how to care for standpipes, tanks and cisterns; what to use and not use the water for and how to conserve it; and what general health and sanitation practices to follow.

6. Advise Trust officials and staff during testing of one or more proposed candidate water pricing strategies, the proposed billing and collection system and the proposed public education campaign at one or more pilot sites (e.g., at one or more cities or settlements where all three user categories exist).

7. With the strong backing and active participation of USAID and the US Embassy, obtain Trust and MWR commitment to adopt and implement throughout the etrap the candidate water pricing strategy that recovered the greatest proportion of actual O&M costs during the pilot testing described above. Also get commitment to refine, adopt and implement the proposed billing and collection system and public education campaign.

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8. With the strong backing and active participation of USAID and the US Embassy, obtain Trust and MWR commitment to obtain interagency agreements with other GOT agencies that use the water to ensure payments and cost recovery for water delivered and confirm Trust and MWR commitment to provide whatever subsidy is needed to cover O&M costs not funded by water sales using the selected new pricing system.

9. Procure desktop computers needed for accounting of billing, collection and expenditures, as well as for water pricing using the model, and train Trust staff in the use of these.

Implementation of steps 1 and 2 above has already begun. Preliminary pricing and allocation strategies have been developed as part of this task and are described in Section 5.2 below. The strategies are based on careful analysis of: (1) HIID and EPT O&M cost estimates provided to date for the RO plant and distribution system; and (2) water demand data, water use characteristics and other information on socioeconomic needs in Turkmenbashi Etrap and Dashouz Vilayet collected by EPT and the World Bank. The prices are set to recover the maximum possible portion of the estimated actual cost of treating and delivering the water that the various categories of users are willing and able to pay.

Section 5.2 also presents a framework, or simple model, that can be used to analyze water pricing strategies proposed by EPT and host country counterparts. Specifically, the model can be used to test different hypotheses about what annual O&M costs will be (including whether it includes a contingency fund and a capital reserve fund) and what prices each of three groups are willing and able to pay. The model will also help determine what funds, if any, will need to be provided by the government as a subsidy under each strategy. Lastly, Section 5.2 presents a proposed system for billing and collection.

2.3 Provide Solid Foundation for Transfer of Facility Operation, Maintenance and Repair to Host Country Control

2.3.1 Findings

1. Equipment needed to facilitate transfer of O&M of the RO plant to the host country counterparts, inlcuding tools, spare parts, and chemicals, have been procured and delivered. Tanker trucks for delivering the water are already on-site. Other equipment needed to operate the distribution system, including stationary tanks and containers, are being procured.

2. EPT has conducted several O&M-related training programs at the RO Plant. However, many of the operators attending these earlier sessions have left their jobs due to the long commute from their homes to the facility in the absence of onsite housing.

3. The status of further plans and commitments of EPT and its Turkmenistan counterparts relative to takeover of O&M of the Turkmenbashi RO plant and its distribution system are documented in EPT memoranda dated October 17 and July 2, 1996. Implementation of these plans by the Turkmen counterparts has fallen behind schedule. As of late Octo-

ber, the plan for distributing the plant's potable water product had not been tested or implemented, so the plant was not operating at the minimum capacity necessary to simulate normal operations (namely, full capacity on any process train) and only a small portion of the distribution truck fleet had been active. Causes for this include delays in installing onsite housing for the operators and drivers and not yet paying the drivers. This in turn has been caused by several factors, including (1) the Trust office in Dashouz being a long way from Turkmenbashi; (2) the Trust having other pressing responsibilities and priorities; (3) the Trust not being very well positioned in the Vilayet administration or GOT; and (4) the Trust not being experienced in water utility operations.

4. Our interviews at the central government level indicate some knowledge of and interest in the RO plant. However, the Department of Water Resources and Water Management is limited in how actively it can participate in and contribute to the RO plant's sustainability because: (1) they have devolved responsibility to the vilayet for paying for and overseeing O&M of the RO plant; (2) this is the first potable water plant project the GOT has undertaken; (3) it is mostly dedicated to agricultural water managment; and (4) there is a national policy of providing water free of charge to the citizens of the country that the President has publicly committed to.

5. There is one 500 cubic meter product storage tank at the site capable of holding less than one day of product when the plant is operating at full capacity (750 cubic meters/day).

2.3.2 Conclusions

1. The status of GOT implementation of their action items under the MOU should be reviewed and a new schedule and commitments should be obtained, especially for provision of onsite housing and implementation of the distribution system. EPT should support USAID in obtaining the commitments.

2. The plant should have at least one process train operating at full capacity over an extended period to provide adequate on-the-job training and experience to the operators.

3. Additional O&M training is needed to ensure a smooth takeover and enhance near-term sustainability of RO plant O&M by host country counterparts.

4. Sustainability of the plant and distribution system will be improved when the Trust begins its own procurements for the spare parts, chemicals, etc. needed for O&M.

5. If the RO plant had to be shut down for maintenance and repair for more than one day, during full-capacity operations, delivery of clean water to the residents would be interrupted with the limited existing single product water storage tank.

2.3.3 Recommendations for EPT Action

1. Arrange a meeting between GOT, USAID/Almaty and USAID/Ashgabat representatives

as soon as possible to review status of and reconfirm GOT commitment on a specific schedule for fulfilling GOT responsibilities under the existing MOU regarding implementation of the distribution system, provision of operators' housing, and other GOT O&M action items.

2. Extend EPT O&M support until September 1997 to allow extended operation at full capacity for one or more process trains so the operators can have the experience of operating, troubleshooting and membrane cleaning and replacement that is possible only at this operating level.

3. Present two more formal O&M training sessions to refresh and supplement training previously provided to existing staff and to train any new O&M staff hired since the last training session was held.

4. Obtain Trust or MWR commitment to purchase the first 1-2 years' supply of chlorine, as well as other expendables, such as spare parts, fuels and lubricants, etc., and to specify US chlorinators as the GOT standard to facilitate bulk purchases of chlorinators.

5. Procure and oversee installation of an additional 1000 cubic meter tank for storing product water would allow the RO plant to be shut down for major maintenance and repair for 2 full days without interrupting water supply to users.

2.4 Strengthen Management and Administration of Potable Water Delivery System

2.4.1 Findings

1. The Trust has been identified as the local institution to take over O&M of the plant. That agency's main mission, experience and expertise is in exploring, developing and managing groundwater resources; managing a modern potable water treatment and distribution facilities is a new function. In addition, while the Director of the Hydrogeological Trust has been a strong champion of the facility, he is a very busy official and has many other priorities to address. However, the director and his agency represent a reputable and strong local capability in their primary mission.

2. Currently there is little or no existing or planned involvement of the water users or community in the management of the RO plant and distribution system.

3. The GOT and World Bank have agreed in concept to consolidate existing water supply agencies in Dashouz Vilayet into a single regional (vilayet) water authority. The consolidation may require 1-2 years to implement. Existing regional water agencies still operate some water supply systems in Turkmenbashi Etrap.

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2.4.2 Conclusions

1. The Trust may be the best positioned organization to take over the plant in the near-term. In addition, there may be a longer-term role for the Trust in managing the O&M of all groundwater systems used for potable water in the etrap and vilayet in a way that will minimize contamination. However, the Trust will be more effective in running the RO plant and distribution system in the near- and long-term if a full-time potable water specialist, reporting to the Director of the Hydrogeological Trust, can be recruited to manage and champion the system. It would be beneficial to supplement the selected candidate's training with a short study tour in the US through, for example, USAID's NET Project or the Department of Commerce's SABIT Program.

2. Some form of water users or community involvement in the management of the RO plant and distribution system will significantly enhance sustainability by ensuring community assistance in, and support of, the design and implementation of the water pricing, allocation, distribution, billing and collection systems.

3. The Trust's capability to run the RO plant and distribution system may be strengthened if it coordinates its management and administration with that of the consolidated regional (vilayet) water authority; this institution may offer long-term sustainability advantages by serving as a conduit of central government funding and technical and management expertise and by offering some level of cost-effectiveness by allowing more bulk purchasing of expendables.

2.4.3 Recommendations for EPT Action

1. Assist the Trust in recruiting, mobilizing and training a potable water specialist who would report to the Director of the Hydrogeological Trust but be full-time dedicated to managing the Turkmenbashi Etrap potable water system. Assist the Trust in finding ways to fund the position. (If such a position could not be paid for by the Trust, then the MWR or World Bank should be approached.) Procure office equipment needed for operation of the Trust's potable water manager. This equipment would need to include one or two desktop computers for pricing and allocation, billing and collection, cost and revenue accounting, tanker truck routing and scheduling, and tank and container management.

2. Evaluate, and assist the Trust in planning and initiating, the best means of involving the water users and community in the management of the RO plant and distribution system . Options that should be evaluated include having the Deputy Hakim for Dashouz Vilayet appoint an advisory board of water users, with representatives from Turkmenbashi City and each of the collective farms, to work with the Trust in managing the water delivery system. The concept of a water users association at the etrap level should also be evaluated. The water users should be involved particularly in the design and implementation of the allocation, pricing, distribution, billing and collection systems. This work will take advantage of and be coordinated with the work being done by the NIS-EEP Project to introduce pilot irrigation water users associations in Kazakstan. In particular, that pro-

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ject's model agreement, pilot associations program, GOK tax relief and subsidy proposals, and national seminar will be evaluated for applicability to developing a potable water users association in Turkmenbashi Etrap. The output would be a set of recommendations and scope of work for the World Bank to develop one or more pilot water users associations under their water supply and sanitation loan program for Turkmenistan.

3. Work with the World Bank to plan the nature and timing of the consolidated regional (vilayet) water authority they have proposed; determine how the functions and capabilities of the Trust relate to those of the regional authority; and determine how the two could best be coordinated over time.

2.4 Alternative Methods for Raising Revenue, If Necessary

The primary goal of this sustainability task is to recommend measures for increasing the likelihood that the benefits provided by the RO plant to residents of Turkmenbashi Etrap can be maintained, over time. The preferred method for achieving this goal is to implement an appropriate water pricing and allocation program in which revenues from the sale of clean drinking water to residents of the etrap are sufficient to pay for operating and maintaining the facility. Local drinking water users and the community would be involved in management of the plant and the distribution system, and in designing and implementing an appropriate water pricing and allocation program.

The RO plant is a new facility providing clean drinking water to residents of Turkmenbashi City, many villages, and collective farms, where income levels are limited and where residents spend a large portion of their current income on food and clothing. Residents of the etrap are likely able and willing to pay somne portion of the cost of producing and delivering clean drinking water, but time and further research are required to determine the extent of their ability and willingness to pay, and the potential impact of alternative water prices on the welfare of local residents. Further work is also required to determine the best means of involving local water users and the community in water policy discussions and management activities.

Given the timne and research required to determine the optimal program for operation and maintaining the RO plant, the best water pricing and allocation plan, and the appropriate means of involving local drinking water users, it is useful to examine alternative strategies that may be considered for raising revenue to support operation and maintenance activities. These alternatives, described below, are offered in the spirit of supporting the original intent of the USAID/EPT Project, which is the delivery of clean drinking water to residents of Turkmenbashi Etrap.

2.5.1 Government Subsidy of Operation and Maintenance Costs

One alternative for supporting the production and deliver of water from the Turkmenbashi RO Plant is a subsidy from the Government of Turkmenistan to pay for the portion of annual expenditures that cannot be recovered through water sales. Such a subsidy may be required in the near-term, while a water pricing and allocation program is developed for the Etrap, and until

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residents adjust to paying for the clean drinking water. It may also be necessary to provide the subsidy in perpetuity, if the relatively low incomes in the Etrap prevent residents from paying a price that represents the full cost of water production and delivery.

The Government might consider paying for certain components of annual expenditures, while asking residents of Turkmenbashi Etrap to pay for other components in an appropriate water pricing program. For example, the Government might pay for operations and maintenance of the R.O. Plant, including an appropriate contingency and repair fund and a capital replacement collective farms. This sharing of total expenditures may be acceptable to residents of Turkmenbashi Etrap and is consistent with the Government's policy of providing water at no charge to citizens of Turkmenistan. The unit price for water could be stated clearly as the charge for delivery service.

2.5.2 A Lifeline Block-Rate Pricing Program

A partial government subsidy of R.O. Plant production and delivery can be implemented using a lifeline block-rate pricing structure in which the minimum daily requirement for clean drinking water is provided to residents at a very low price, while water purchased in excess of that requirement is sold at a higher price. For example, the unit price for water used to satisfy the minimum daily requirement could be set equal to the per-unit delivery costs, while the price for water in excess of that requirement could include other cost components. The goal of such a plan is to provide all residents with clean drinking water, even if there incomes are very low, while maintaining a price structure that encourages residents to use the water carefully.

Lifeline block-rate pricing structures are used frequently in both developing and developed countries to provide low-income residents with essential services including water, electricity, and communication. For example, in the United States the Rural Electrification Administration was formed to provide electrical service to low-income, rural homeowners who could not afford the capital cost of extending service from urban to rural areas. Many telephone companies in the United States offer lifeline services to low-income residents by charging them a very low price for basic telephone service. The goal of those programs is to ensure that even the poorest residents have access to telephone service for emergencies and other fundamental purposes. This concept is certainly applicable to providing clean drinking water for residents of Turkmenbashi Etrap.

2.5.3 Expansion of the Service Area

The third possibility for raising revenue to support the Turkmenbashi R.O. Plant is to sell a small portion of its production to households, state organizations, and private businesses located outside the Turkmenbashi Etrap. Such a plan must be considered very carefully, however, to ensure that the primary focus of the program remains the delivery of clean drinking water to residents of the Etrap. The only appropriate reason to consider expanding the service area to include other Etraps or Dashouz City is to raise revenue for operating the R.O. Plant and water delivery system in Turkmenbashi Etrap. This goal must be kept in mind when considering expansion of the delivery system or any other activity undertaken to raise revenue.

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2.5.4 Bottling Water for Sale Inside or Outside the Service Area

Another activity that might be implemented to raise revenue is a bottling program for water produced at the R.O. Plant, for sale inside or, if necessary, outside the original service area. Clean drinking water is a very precious resource in the Aral Sea Region, where much of the surface water and groundwater is more saline than desirable and is often contaminated by pollutants or naturally occurring elements. Residents with moderate income levels in villages or cities with water quality problems are likely able and willing to pay for clean drinking water. It may be possible to service those demands with a water bottling plant and distribution system, using a portion of the capacity of the Turkmenbashi R.O. Plant.

The scope of a water bottling and sales program must be limited to marketing only a portion of the output of the R.O. Plant, to ensure that the residents of Turkmenbashi Etrap continue to receive most of the water produced at the Plant. As noted above, the goal should be restricted to raising revenue needed for operating and maintaining the Plant, while sustaining service to Etrap residents. If the sale of water in bottles is successful, there may be pressure to increase the volume of bottled water sold to increase total revenues and reduce the average cost of production. The R.O. Plant has a limited capacity and an increase in the volume devoted to bottled water sales will reduce the volume available for delivery of nonbottled water to local residents who cannot afford bottled water. If Plant operators engage in bottled water sales, they must also ensure that drinking water service to Turkmenbashi residents who cannot afford bottled water is maintained, in order to sustain the benefits envisioned by the USAID/EPT Project.

2.5.5 A Local Water Users Association

A Drinking Water Users Association involving residents of Turkmenbashi City and collective farms in Turkmenbashi Etrap is one alternative method for the water users and community to provide input to the Hydrogeological Trust in Dashouz regarding water production, distribution, and pricing issues. An Association would represent local interests in planning sessions that address local production and delivery issues, and in discussions regarding alternative revenue generation programs. Input from an association that represents Turkmenbashi residents will greatly enhance the likelihood that operational decisions and long-term plans of the Hydrogeological Trust will incorporate appropriate concern for the intended beneficiaries of the EPT Project.

2.5.6 World Bank Funded Activity in Turkmenbashi Etrap

The World Bank and GOT are currently planning to upgrade the existing water supply system in seven of the eight Etraps in Dashouz Velayet, excluding the Turkmenbashi Etrap because the USAID/EPT Project is providing clean drinking water to residents there. We recommend that the World Bank expand its project to include Turkmenbashi Etrap because those residents still use their existing water supply to obtain water for many purposes in addition to drinking and cooking. The Turkmenbashi R.O. Plant has limited capacity and its output must be used only for drinking and cooking. Therefore, residents of the Etrap would benefit from an improved pipeline service that complements their new drinking water supply.

Section 3

Kazakstan

3.1 Overview

EPT has sponsored a wide range of assistance in rehabilitating selected portions of the Aral-Sarybulak regional water supply system in the Aral Sea Basin region of Kazakstan. The primary EPT-sponsored engineering activities have been the rehabilitation of the Kozaman and Berdokyl wellfields and seven transfer pump stations along the pipeline beginning at those wellfields and ending at Kazalinsk. In the wellfields, wells were tested, chemically and mechanically developed and some well screens, sand separators and submersible pumps and motors were added or replaced. At the pump stations, pumps, motors, chlorinators, transformers and controls were replaced. Work rehabilitating the wellfields and pump stations is completed. The engineers are now preparing O&M training courses.

The primary sustainability needs and corresponding recommended projects to improve sustainability of the EPT-sponsored potable water interventions in Kazakstan are summarized below in order of priority for EPT action. Each project summarized below is comprised of several tasks which are presented in step-wise order.

1. To strengthen water pricing and cost recovery for O&M. The EPT improvements are relatively small parts of a much larger existing potable water delivery system and are difficult to separate from the larger system. The estimated annual O&M cost for the Aral-Sarybulak pipeline system is $1.13 million in 1996. Current policy requires that the pipeline authority recover its costs from user fees. In a recent policy change, the authority charges all classes of users the same rate. Previously, the authority charged enterprises many times what it charged state organizations and the general population. This system generated only about 40% of the revenues needed to fund annual O&M costs. However, payment of charges is still the biggest issue as currently no class of users appears able or willing to pay for water. Consequently, the authority is in debt in the amount of over 1 year of O&M costs, has not paid its workers in cash in 1-2 years, has not been able to fund its repair budget and has not been able to pass on 30% of it revenues to the central government as normally required. There is an implicit subsidy of O&M costs from the central or oblast governments, however macroeconomic conditions at the national level may be limiting the central government's ability to provide subsidies. Financial sustainability of the pipeline authority in the short-term, therefore, will depend on some reordering of central government budget priorities and/or support from donors. Over the long-run, assuming systemic problems with the overall national economy are being addressed, water pricing and cost recovery will lead to financial self-sufficiency and therefore to sustainability of the pipeline authority. While the authority has already put in place a pricing strategy that has some economic merit, it will be important to provide additional support on water pricing and cost recovery to the authority to maintain and implement this policy direction. Based on these sustainability needs, it is recommended that EPT undertake a project to strengthen water pricing and cost recovery to fund O&M

of the Aral-Sarybulak pipeline system, including: developing alternative pricing and allocation scenarios, a simple spreadsheet model to evaluate them and a billing and collection system for payment; providing basic training on water pricing and cost recovery and presenting the pricing strategies, model and billing and collection system to the pipeline authority, et al., to obtain buyin for water pricing; working with the pipeline authority in using the model to select candidate strategies; assisting the authority in designing a related public education campaign; assisting the authority in testing the candidate strategies on pilot communities or farms; obtaining authority, et al., commitment to adopt the strategy found to be most effective, get agreements with other agencies to pay for water used and subsidize O&M costs not funded through water sales; and procuring computers needed for modelling and accounting. Development of preliminary pricing/allocation scenarios and spreadsheet model are complete and a study of local residents' willingness and ability to pay for the water is in progress.

2. To address national macroeconomic and institutional obstacles to payment of water charges. National-level macroeconomic and institutional issues currently limit the ability or willingness of retail and wholesale customers to pay for goods and services in the Kzyl-Orda Oblast of Kazakstan. There is a circular set of problems wherein no category of water users can pay its bills, the pipeline authority cannot pay its employees' salaries nor for repair or contingency funds, and the oblast and central governments cannot afford to subsidize the pipeline authority's O&M costs. The relationship between the pipeline authority, the oblast government and the central government is unclear relative to how financial support is provided to the pipeline authority when revenues are not collected from its customers. Based on these sustainability needs, it is recommended that EPT conduct a study of the national-level macroeconomic and institutional factors affecting water payment and examine how the oblast and central governments fund the pipeline authority under these conditions.

3. To provide a solid foundation for facility O&M by the GOK. Early EPT field inspection reports showed the wellfields, pipeline and pump stations to be in poor repair. The repair component in the annual O&M budget is the first to be cut when revenues fall short. There is little or no evidence of formal maintenance and repair training, sheduling or recordkeeping. EPT has provided extra supplies of spare parts and other expendables but there are several additional equipment items that has been approved by USAID and EPT is in the process of procuring that will facilitate O&M by the GOK and enhance near-term sustainability of the pipeline system. Many of these items are relatively inexpensive and can be justified as completing, fine-tuning or facilitating implementation of earlier equipment procurements relating to maintenance and repair. Additionally, it will be critical to near- and long-term sustainability for the GOK to begin establishing the procedures and setting aside funds for procuring many of these expendables themselves. Implementation of the World Bank pilot and full-scale projects for rehabilitation of the Aral-Sarybulak regional pipeline system is also essential to both near- and long-term sustainability of the pipeline system. Based on these sustainability needs, it is recommended that EPT undertake a project to complete the development of a solid foundation for facility O&M and repair by the GOK, including: proceeding with procuring miscella-

neous additional spare parts for the wellfields, backhoes for pipeline repairs, spare parts and non-metric tool kits for the pump stations, and miscellaneous electrical equipment for the pump stations; obtaining GOK commitment to begin procuring supplies of expendables; and providing a comprehensive training program on maintenance and repair management.

4. To strengthen management and administration of water delivery system. The Aral-Sarybulak pipeline authority is an organization being challenged with responsibility for major rehabilitation of its existing facilities and major additions to its distribution network during a difficult transtion to a new economic system when funding from both water sales and government subsidy is absent. Despite these challenges the authority faces, it remains committed to carrying out its mission. Strengthening this institution is critical for its survival in its present circumstances as well as for its successful functioning in the future. In addition, there may be a poor link between the operations of the pipeline authority, which sells water to bulk users, and the bulk and individual users. We need to know more about how the bulk users allocate and distribute their water and what type of billing and collection system, if any, may be used. This is a critical link in developing an effective water pricing and cost recovery strategy for the pipeline authority. Based on these sustainability needs, it is recommended that EPT undertake a project to strengthen the management and administration of the pipeline authority, including: providing a comprehensive program of training on general management and administration of a water utility; using that training program as a means of conducting a brief review of the organization and management of the authority and related agencies and preparing recommendations and a scope of work for strengthening the authority under either EPT, World Bank or other donor or internal funding; and using the community water user training, described earlier under water pricing and cost recovery, as a means of conducting a brief review of the need for and feasibility of establishing some form of community-based management of the allocation, distribution, billing and collection systems at the village or collective farm level.

5. To minimize problems of power supply reliability and quality. Nonpayment for electrical services is one of the causes of interruptions in power supply. In addition, there is only one electrical line into several of the pump stations and no backup system in general which could lead to frequent and lengthy interruptions in the delivery of water in the event of a power outage. Energy fluctuations in both voltage and frequency continue to be problematic due to the local power grid being overloaded with users. Pumps are being run at low frequencies which can reduce their design life and voltage is often erratic. Power outages and the early demise of the pumps threaten the sustainable delivery of potable water to residents of the region. Based on these sustainability needs, it is recommended that EPT undertake a project to minimize problems with power supply reliability and quality, including: utilizing contacts and knowledge gained through USAID's energy program in Kazakstan to facilitate and support negotiations between the pipeline authority (or SCWR) and Ministry of Power relative to voltage and frequency problems; and obtaining clarification from the GOK relative to the need to provide backup power to the pump stations and, if required or desired for contingency reasons, then refer to the World

Bank the procurement of backup generators for the pump stations.

6. To reduce leakage and wastage. There are frequent and serious leaks in the main transmission and local distribution pipelines. In addition, data for bulk water purchases indicates very high per capita usage rates which may be the result of standpipes left running because valves and spigots are missing. Leakage along the pipeline and leakage and wastage by bulk and individual water users are critical problems that raise overall system O&M costs and reduce potential cost recovery, thus affecting sustainability. Based on these sustainability needs, it is recommended that EPT undertake a project to reduce leakage and wastage, including: designing and conducting a pilot project for volumetric measurement (metering) of large bulk and individual water users representing all three user groups; designing and conducting a pilot study for reducing leakage and wastage by representatives of all three user groups; and procuring the water meters and leak detection equipment necessary to carry out these pilot projects.

Table 3-1 presents the recommendations along with their priority level, donor and implementor, and EPT LOE/equipment cost and schedule estimates. The worsening national economic situation in Kazakstan has provided a water system funding situation not anticipated earlier in the project. Because of this, activities previously anticipated to occur without EPT or outside involvement now become questionable and are the subject of many of the sustainability findings and recommendations.

EPT recommends the following near-term steps be taken toward agreeing on a near-term course of action on the above recommendations:

1. USAID/Washington and USAID/Almaty review on this document and return consolidated comments to EPT/Washington and EPT/Almaty by January 10, 1997.

2. EPT/Washington meet with USAID/Washington to review comments and plan strategy on January 13, 1997.

3. EPT Sustainability Task Manager and Economist return to Almaty to meet with EPT/Almaty and USAID/Almaty to complete detailed planning of strategy.

4. EPT Sustainability team, in conjunction with USAID/Almaty, set up meetings or conferences with host country officials to present sustainability findings and recommendations and obtain formal commitment to carrying out action items appropriate to host country.

5. EPT Sustainability team proceed to carry out sustainability recommendations assigned to EPT.

Table 3-1. Comparison of Sustainability Recommendations for Kazakstan

Sustainability Project	Priority	Donor (Implementor)	EPT LOE /Cost (Funding Source)	EPT Duration (Timing)
Strengthen water pricing and cost recovery	1	USAID (EPT/CH2M)	100 person-days (Existing DO12/T2D2 plus mod)	12 months (10/96-9/97)
Address national macroeconomic and institutional obstacles to payment of water charges	1	USAID (EPT/CH2M)	___ person-days (Existing DO12/T2D2 plus mod)	9 months (1/97-9/97)
Provide strong foundation for facility O&M by GOK	1	USAID (EPT/CH2M)	Expendables commitments by GOK--10 person-days Maint. & repair mgmt. training--20 person-days (Existing DO12/T2A plus mod)	9 months (1/97-9/97)

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Sustainability Project	Priority	Donor (Implementor)	EPT LOE /Cost (Funding Source)	EPT Duration (Timing)
Strengthen management and administration	1	USAID (EPT/CH2M) WB implement institutional development & strengthening of community-based organization, pipeline authority, et al.,	EPT management training--20 person-days EPT institutional strengthening review--10 person-days EPT community-based management review--10 person-days (Existing DO12/T2B & T2D2 plus mods)	9 months (1/97-9/97)
Minimize problems related to power supply reliability and quality	2	USAID (EPT/CH2M) & Energy Program Implementor WB procure backup power supply	Power-related commitments--10 person-days Backup power clarification & WB referral--5 person-days (Existing DO12/T2A & T2D2 plus mods)	9 months (1/97-9/97)
Reduce leakage and wastage	2	USAID (EPT/CH2M)	Volumetric measurement--__person-days/$____ Leakage & wastage--__person-days/$ (Existing DO12/T2B plus mods)	9 months (1/97-9/97)

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3.2 Introduce Water Pricing and Cost Recovery for Potable Water System Operation and Maintenance

3.2.1 Findings

1. The estimated annual cost of operating and maintaining the Aral-Sarybulak Pipeline System is determined by examining the actual expenditures for this purpose during the first nine months of 1996, and the budget for the fourth quarter of that year (based on data collected from the the pipeline authority; see Section 5.3 for details). During the first months of 1996, 57.1 million tenge ($815,599) were expended in operating and maintaining the Aral-Sarybulak Pipeline. The budget for operation and maintenance during the fourth quarter of 1996 is 22.3 million tenge, or $318,166. The estimated total expenditure for operations and maintenance in 1996 is 79.4 million tenge ($1.13 million), or an average cost of 36.64 tenge ($0.52) per cm, given the expected delivery of 2,166,100 cm during the year.

2. There is no official subsidy from the central government for O&M costs, so the pipeline authority must recover its costs by charging drinking water consumers. There are three categories of consumers according to the authority's system of water charging. These include general population, state-owned organizations and institutions, and industrial and commercial enterprises. The authority has been trying to offset a subsidy given to two of the three water customer groups (general population and state-owned organizations), that together account for nearly 85% of total water use, by charging the third group (private sector) prices 34 and 7 times the price of the other two groups, respectively. In a recent policy change, the authority charges all classes of users the same rate.

3. Payment of charges is still the biggest issue as currently no class of users appears able or willing to pay for water. The population often are not able to pay or do not pay for their water due to unemployment or delayed wages. The state-owned organizations have difficulty paying due to continuing issues with the national economy. The enterprises often decline to pay their much higher prices to support the other categories when they may be able to get water for less money, although of poorer quality, from ground or surface water sources. The pipeline authority frequently gives preferred rates to consumers who cannot pay the full price and will not cut off the water supply completely even if they do not pay the preferred rates.

4. This system of charging has generated only about 40% of the funds needed for pipeline system O&M in 1996. In particular, the actual expenditures for the first three quarters of 1996 and the budget for the fourth quarter do not include any funds for repairs. Local officials have suggested that repair funds are usually made available when revenues from water sales exceed other planned expenditures. They have also stated that the central government must approve their quarterly budgets and that funding for repairs is not always approved. In particular, repair funds are usually not approved during the winter, when weather conditions prevent repair crews from working on the pipeline system. The absence of repair funds in all of the quarterly budgets for 1996 may indicate that the pipe-

line authority was expecting revenues to be less than other planned expenditures in that year.

5. Due to the poor financial condition of the pipeline authority, the company's workers have not been paid in cash for 1-2 years. In addition, the pipeline authority has not been able to fulfill its obligation to return 30% of its annual revenues to the central government (ostensibly for capital construction and replacement and administration of the State Committee for Water Resources). Overall, the authority is in debt in the amount of over 1 year of O&M budget.

3.2.2 Conclusions

1. The 1996 repair fund situation demonstrates the importance of generating revenues that will pay for operations, maintenance, and repair of the Aral-Sarybulak pipeline system, including the improvements installed by the EPT Project. Sustainable O&M of the improvements to the wellfields and pump stations by the pipeline authority, over time, will depend in large part on the financially viable O&M of the overall pipeline system by the authority. In recent years, water prices and the payment system have not been generating the revenue-necessary to pay for the full cost of operating, maintaining and repairing the pipeline system in all quarters of the year.

2. The outlook for financial sustainability was recently improved when the price structure for water in Kazakstan was modified such that all groups now pay the same rate so no group is subsidizing another. However, while water prices are more consistent with actual production costs, the new structure is not designed to recover costs for a repair fund or contingency fund. In addition, the authority has not analyzed underlying demand conditions and price responsiveness among water customers. The new price structure should generate revenues that will pay for a larger portion of the pipeline authority's operation and maintenance costs. However, systemic problems with the national economy are resulting in nonpayment by all categories of water users (see Section 3.3 below).

3. Apparently, under its current budget authorities, the central government may be unable to provide subsidies to remedy this situation. Financial sustainability of the pipeline authority in the short-term, therefore, will depend on some reordering of central government budget priorities (and/or support from donors) and a careful review of whether improvements in the current billing and collection system could generate additional revenues. Over the long-run, assuming systemic problems with the overall national economy are being addressed, water pricing and cost recovery will lead to financial self-sufficiency and therefore to sustainability of the pipeline authority. Therefore, even though the authority has already put in place a pricing strategy that EPT might support, it will be important to provide additional support on water pricing and cost recovery to the authority to maintain and implement this policy direction.

3.2.3 Recommendations

1. Develop alternative potable water pricing and allocation scenarios and a simple spreadsheet model for evaluating them using different assumptions about costs and prices.

2. Design in outline form a billing and collection system to support the pricing and allocation system.

3. With the strong backing and active participation of USAID and the US Embassy, provide basic training on potable water pricing, and present the pricing strategies, model and billing and collection system developed above to relevant pipeline authority, et al., officials and staff. Obtain political buy-in for utilizing water pricing to recover as much of the annual O&M costs as possible and to set prices to generate revenues sufficient to establish an annual repair fund, a contingency fund and a capital reserve fund.

4. Work with those pipeline authority officials and staff in using the water pricing model to evaluate and select the optimal water pricing strategies and assist in refining the billing and collection system for local use.

5. Assist the authority officials and staff in designing a public education campaign relative to the source, treatment and value of the pipeline water; how it is distributed, priced and allocated; how billing and collection are done; how to care for standpipes, tanks and cisterns; what to use and not use the water for and how to conserve it; and what general health and sanitation practices to follow.

6. Advise authority officials and staff during testing of one or more proposed candidate water pricing strategies, the proposed billing and collection system and the proposed public education campaign at one or more pilot sites (e.g., at one or more cities or settlements where all three user categories exist).

7. With the strong backing and active participation of USAID and the US Embassy, obtain authority commitment to adopt and implement throughout the system's service area the candidate water pricing strategy that recovered the greatest proportion of actual O&M costs during the pilot testing described above. Also get commitment to refine, adopt and implement the proposed billing and collection system and public education campaign based on the results of the pilot tests.

8. With the strong backing and active participation of USAID and the US Embassy, obtain authority commitment to obtain interagency agreements with other GOK agencies that use the water to ensure payments and cost recovery for water delivered and confirm SCWR commitment to provide whatever subsidy is needed to cover O&M costs not funded by water sales using the selected new pricing system.

9. Procure desktop computers needed for accounting of billing, collection and expenditures, as well as for water pricing using the model, and train authority staff in the use of these.

10. Conduct a pilot project for volumetric measurement (metering) as described below under Water Leakage and Wastage.

11. It was previously proposed that EPT reimburse the GOK $150,000 for materials needed to expand Pump Station 7, so that the City of Novokazalinsk can be connected to the pipeline system and discontinue using contaminated water from the Syr Darya River. This would add several tens of thousands of new customers over which to spread the fixed costs of overall pipeline O&M, thereby improving financial sustainability. This will possibly even allow them to lower prices to some categories of users, thus making payment more likely among those users which will also help improve sustainability. If this cannot be accomplished through the EPT Project, then EPT should work closely with USAID, the GOK and the World Bank to ensure that it is done as part of the Bank's upcoming pilot project and then facilitate the Bank's work by providing useful information and advice.

Implementation of these recommendations has already begun. A preliminary pricing and allocation system has been developed as part of this task and is described in Section 5.3 below. The system is based on careful analysis of: (1) host country and EPT cost estimates provided to date for O&M of the overall Aral-Sarybulak Pipeline Authority; (2) the authority's current water pricing structure and prices; and (3) water demand data, water use characteristics and other information on socioeconomic needs in the Aralsk and Kazalinsk Rayons collected by EPT and the World. The preliminary pricing system proposes to improve the financial sustainability of the Aral-Sarybulak system by modifying the current price structure for water in Kazakstan to include water prices that are consistent with actual production costs and with underlying demand conditions and price responsiveness among water customers.

Section 5.3 presents a framework, or simple model, that can be used to analyze water pricing strategies proposed by EPT and host country counterparts. Specifically, the model can be used to test different hypotheses about what annual O&M costs will be (including whether it includes a contingency fund and a capital reserve fund) and what prices each of three groups are willing and able to pay. The model will also help the GOK determine what funds, if any, will need to be provided by the central government as a subsidy under each scenario.

3.3 Address National-level Macroeconomic and Institutional Obstacles to Payment for Water Charges

3.3.1 Findings

1. There is a circular set of problems wherein no category of water users can pay its bills, the pipeline authority cannot pay its employees' salaries nor for repair or contingency funds, and the oblast and central governments cannot afford to subsidize the pipeline authority's O&M costs.

3.3.2 Conclusions

1. National-level macroeconomic and institutional issues currently limit the ability or willingness of retail and wholesale customers to pay for goods and services in the Kzyl-Orda Oblast of Kazakstan.

2. The relationship between the pipeline authority, the oblast government and the central government is unclear relative to how financial support is provided to the pipeline authority when revenues are not collected from its customers.

3.3.3 Recommendations

1. EPT conduct a study of the national-level macroeconomic and institutional factors affecting water payment.

2. EPT examine how the oblast and central governments fund the pipeline authority under the current macroeconomic conditions.

3.4 Provide Strong Foundation for Facility Operation, Maintenance and Repair by Host Country

3.4.1 Findings

1. Several of the EPT field inspection reports submitted early in the program indicated that the equipment and supporting facilities were found in poor condition.

2. The repair fund is apparently the lowest priority category in the authority's budget; it is not funded and repairs are not planned during years of little or no revenues. There is also a contingency fund that can be drawn from.

3. No evidence could be found that the pipeline authority has adequate maintenance and repair training, scheduling, dispatching or recordkeeping systems.

4. The City of Aralsk water department has recently merged into the Aral-Sarybulak Pipeline Authority. The city's distribution system is very old and leaky.

5. EPT is already planning and preparing O&M-related training programs, including pump O&M training and pump station electrical training, to be given to pump station O&M staff.

6. As part of its engineering activities, EPT has procured extra supplies of spare parts, tools, lubricants, chemicals and other expendables that will assist in making a smooth transition from EPT to host country lead on operation and maintenance and enhance the short-term outlook for sustainability of the EPT potable water engineering projects.

7. Several additional equipment items intended to improve maintenance and repair have been approved by USAID and are being procured by EPT, including miscellaneous spare parts for the wellfields; backhoes for pipeline repairs; and additional spare parts, non-metric tool kits, and miscellaneous electrical equipment for the pump stations. Leak detection equipment, piping and miscellaneous equipment for the pipeline were proposed but not approved.

8. The World Bank is currently considering funding a pilot project that would include major rehabilitation of the Aral-Sarybulak main pipeline.

3.4.2 Conclusions

1. It has been apparent from the condition of the pipeline facilities discovered upon inspection at the beginning of the EPT Project, that although the pipeline authority has made valiant and somewhat successful efforts to maintain water delivery under less than optimal conditions, the equipment and supporting facilities have suffered much.

2. The equipment items previously approved by USAID and being procured by EPT are aimed at improving maintenance and repair and thus will improve the sustainability of the EPT-sponsored facility improvements and the delivery of potable water to the residents. The larger items that were proposed but not approved will also improve sustainability, but could be referred to the World Bank for funding.

3. Sustainability could be improved by working with the GOK water management agencies to identify and resolve any problems with procuring necessary spare parts, tools or supplies, such as chlorine, beyond what has been procured by EPT.

4. The pipeline authority's central repair staff could benefit from formal maintenance and repair training and development of formal maintenance and repair scheduling, dispatching and recordkeeping systems.

5. Now that the City of Aralsk water department, with its aging and leaky water distribution system, has merged with the Aral-Sarybulak Pipeline Authority, it is unclear whether the pump stations and wellfields will get sufficient attention by the maintenance crews for necessary regular maintenance and repairs.

6. It is important that the World Bank determine that rehabilitation of the overall pipeline is feasible and that they move forward with and complete that project as rapidly as possible. If not, it is possible that the pipeline authority will focus its limited resources on repairing the main pipeline and defer regular maintenance on the wellfields and pump stations. Also, repairing the pipeline leak-by-leak instead of carrying out a comprehensive rehablitation program will just defer its problems. Therefore, both the pipeline and the wellfields and pump stations would be made more sustainable if the World Bank rehabilitation program goes forward.

3.4.3 Recommendations

1. Proceed with procurement of the equipment items approved by USAID and being procured by EPT that are intended to improve maintenance and repair, including miscellaneous spare parts for the wellfields; backhoes for pipeline repairs; and additional spare parts, non-metric tool kits, and miscellaneous electrical equipment for the pump stations.

2. Working with USAID, obtain commitment from the pipeline authority to purchase the first 1-2 years' supply of chlorine, as well as other expendables, such as spare parts, fuels and lubricants, etc. Also obtain commitment from the pipeline company, et al., to specify US chlorinators as the GOK standard to facilitate bulk purchases.

3. Provide a comprehensive maintenance and repair management training program covering maintenance scheduling, dispatching and recordkeeping; this should be consolidated or coordinated with the O&M training mentioned under Findings above that is currently being planned. Procure desktop computers and relevant software needed for maintenance scheduling and recordkeeping and provide training on how to use them.

4. Refer to the World Bank for funding, under their Aral Sea emergency assistance fund or their pilot study, the equipment items previously proposed but not approved, including leak detection equipment, piping and miscellaneous equipment for the pipeline (see Section 3.4 below for discussion of electrical generators.) Also, confirm with the Bank and GOK that they plan to move forward with the pilot and full pipeline rehabilitation loan programs.

3.5 Strengthen Management and Administration of Water Delivery System

3.5.1 Findings

1. The Aral-Sarybulak Pipeline Authority is an organization being challenged with responsibility for major rehabilitations of its existing facilities through the USAID and World Bank programs, and major new additions to its distribution network with new settlements and Novokazalinsk, in a context of transition to a new economic system, an economic recession and an inability to obtain funding from either revenues or government subsidy.

2. The local Hakims serve as bulk water buyers and apparently control the allocation and distribution of water to residents in their respective settlements.

3. The GOK, with World Bank funding, plans to include a significant institional strengthening component in the Bank's upcoming loan program for water supply and sanitation in the Aral Sea region of Kazakstan.

3.5.2 Conclusions

1. Despite the challenges and economic problems the pipeline authority faces, it remains

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committed to carrying out its mission. Strengthening this institution is critical for its survival in its present circumstances as well as for its successful functioning in the future. Such institutional strengthening is a long-term and expensive effort; however, it is an effort that should begin immediately and there are ways EPT can start the process and prepare the way for other donors.

2. Community-based management systems, such as water users associations, may complement and supplement the functioning and capacity of the pipeline authority in implementing the allocation, distribution, billing and collection systems at the settlement level along the pipeline. Agricultural water users associations are already being developed under the USAID NIS Environmental Economics and Policy Project (EEP Project) that may serve as models.

3.5.3 Recommendations

1. Design a comprehensive program of training on general management and administration of a water utility to the pipeline authority, et al. Initiate the first steps in this comprehensive program. This could be combined with the water pricing and maintenance and repair management training programs described above offered as modules.

2. Use the water utility management training described above as a means of conducting a brief review of the organization and management of the pipeline authority and related agencies. Prepare recommendations and a work scope for improving management and administration that could be implemented in part by EPTor in total by the World Bank under its pilot or full-scale projects.

3. Use the community water user training pilot program, described under Water Pricing and Cost Recovery above, as a means of conducting a brief review of the need for and feasibility of establishing some form of community-based management of the distribution, pricing, billing and collection systems at the village or settlement level. Coordinate with the work being done by the EEP Project to introduce pilot irrigation water users associations in Kazakstan. In particular, evaluate that project's model agreement, pilot associations program, GOK tax relief and subsidy proposals, and national seminar for applicability to developing potable water users associations in Kazakstan. Prepare recommendations regarding the need for and feasibility of setting up water users associations and, if they are both needed and feasible, prepare a work scope and identify candidate villages for developing one or more pilot water users associations by EPT in conjunction with the GOK and EEP (or the World Bank under its pilot or full-scale projects).

3.6 Minimize Problems Related to Power Supply Reliability and Quality

3.6.1 Findings

1. Energy fluctuations in both voltage and frequency continue to be problematic due to the Ikibastuz power grid being overloaded with users. The new pumps are rated at 50 hertz

and 380 volts. Frequency protection devices are set to shut down the pumps if the frequency falls outside of the 52-48 hertz range. At this time, frquency received is often 47 hertz. The wellfield staff have addressed this problem by resetting the devices to accept 47 hertz, as also mandated by the Ministry of Power. Consistently running pump motors at low frequencies can reduce their design life. Transformers can be adjusted to accommodate consistently high or consistently low voltage; however, voltage received at the pump station is often erratic.

2. There is only one electrical line and in general no back-up electrical system for the wellfields and pump stations. National energy supply regulations apparently require a backup power supply system for pump stations. This can be accomplished with either a second power line and transformer or a standby diesel generator. However, it may also be possible to have this requirement waived by the Ministry of Power and SCWR.

3.6.2 Conclusions

1. Nonpayment of electrical services is one of the causes of power interruptions.

2. It would be beneficial for sustaining the pumps through their design life to influence the Ministry of Power and SCWR not to force the pump stations to operate at low frequencies and erratic voltages.

3. It may be possible to have the requirement for power backup systems waived for the pump stations, however it will greatly enhance the sustained delivery of clean water to the population to provide backup systems. It is possible that another donor could supply these items.

3.6.3 Recommendations

1. Working with USAID, obtain commitment from the pipeline authority to resolve problems of power supply reliability, low frequency and erratic voltage with the power providers and Ministry of Power. Provide language for a letter to the Ministry outlining problems with power outages and the effects of low quality power supply on the operation and life of the equipment. Consider suggesting appropriate (lower) pricing of water supplied to the power providers be used as an incentive to the power providers to improve power supply. Work through USAID's energy program for CAR to influence decision-making and policy. Integrate these activities with those relating to macroeconomic and institutional factors at the national level, described in Section 3.3 above.

2. Working with USAID, obtain a decision or clarification from the GOK relative to the need for electric generators, or additional power lines and associated transformers, to provide backup power to the pump stations. If additional major electrical equipment is required, then obtain commitment from the World Bank or other donors to procure it under their Aral Sea emergency assistance fund or their pilot study.

3.7 Reduce Leakage and Wastage

3.7.1 Findings

1. Data and observations of EPT and other donor consultants indicate that frequent and large leaks occur in both the main transmission line and local distribution lines due to the age of the pipeline and its material of construction. These leaks are debilitating to the system in that one transmission leak can depressurize the entire downstream system which must then be closed down until the leak is repaired. This not only results in water not delivered but also loss of revenue in the face of added repair costs.

2. The data for water consumption by residents strongly suggests that a great deal of water is wasted. Observations by EPT and other donor consultants in the field indicate that standpipes are routinely left running because valves and spigots have broken or been stolen and not been replaced due to lack of funding and original sources having been cut off.

3.7.2 Conclusions

1. Leakage along the pipeline and leakage and wastage of water by bulk and individual users are critical problems that raise overall system O&M costs and reduce potential cost recovery, thus affecting sustainability.

2. Volumetric measurement is critical to both water pricing and detection and location of leakage and wastage.

3. World Bank funded activities are targeted at rehabilitation of major portions of the oldest and leakiest segements of the pipelines; this will alleviate much of the problem in the long-term. However, EPT can help significantly in the short-term by facilitating the detection and location of leaks.

3.7.3 Recommendations

1. Design and conduct a pilot project for volumetric measurement (metering) of large bulk water users for one or more settlements and representatives of all three user groups; integrate the design and results with the EPT pilot study on reducing water wastage and leakage (below), the EPT water pricing efforts (above), and the Bank's pilot and full-scale pipeline rehabilitation projects. Procure the necessary water meters. A similar program is underway in Ukraine and lessons learned from this program can be helpful in the program proposed for Kazakstan.

2. Design and conduct a pilot study for reducing water leakage and wastage in one or more settlements and representatives of all three user groups; integrate the design and results with the volumetric measurement pilot study (above), the water pricing efforts (above), and the Bank's pipeline projects. Procure the necessary leak detection equipment.

Section 4
Uzbekistan

4.1 Overview

EPT provided a wide range of assistance in rehabilitating selected components of the potable water delivery facilities in the Tuyayumun interregional water supply system. This assistance has included provision of laboratory equipment and supplies; new chlorinators at the Nukus and Urgench treatment plants, pump stations and reservoirs; physical improvements to the clarification and filtration systems at the treatment plants; and related O&M training.

The primary sustainability needs and corresponding recommended projects to improve sustainability of the EPT-sponsored potable water interventions in Uzbekistan are summarized below in order of priority for EPT action. Each project summarized below is comprised of several tasks which are presented in step-wise order.

1. To strengthen water pricing and cost recovery for O&M. The estimated annual O&M cost for the EPT-installed chlorination and coagulation facilities at Nukus and Urgench is $617,400 or about 7% of the $8.66 million O&M cost for the entire Tuyayumun water supply system (based on data collected from the Ministry of Communal Services or MCS; see Section 5.4 for details). A similar system of potable water pricing exists as described for Kazakstan with the same three user groups and a similar cross-subsidization by enterprises of the other two groups. This has led to a similar result of actual revenues amounting to only about 23% of actual costs. Expected revenues based on the current pricing strategy were multiples of actuals costs, reflecting the difficulty that all three user groups have in paying their water bills at current price levels. The GOU has implemented a policy requiring water prices to rise, over time, until revenues are sufficient to pay for the annual O&M costs, targeted for the year 2000. However, efforts to achieve sustainability should consider both prices and the payment system, to ensure that necessary revenues are generated and collected by the water authorities. Financial sustainability can be improved by modifying the current price structure for water to include prices consistent with actual production costs and underlying demand conditions and price responsiveness among water users. Based on these sustainability needs, it is recommended that EPT undertake a project to strengthen water pricing and cost recovery to fund O&M of the Tuyayumun interregional water supply system, including: developing alternative pricing and allocation strategies, a simple spreadsheet model to evaluate them and a system for billing and collection; providing basic training on water pricing and cost recovery and presenting the pricing strategies, model and billing and collection system to the Tuyayumun water supply system and MCS to obtain buyin for water pricing; working with the system in using the model to select candidate strategies; assisting the system in designing a related public education campaign; assisting the system in testing the candidate strategies on pilot communities or farms; obtaining system and MCS commitment to adopt the strategy found to be most effective, get agreements with other

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agencies to pay for water used and subsidize O&M costs not funded through water sales; and procuring computers needed for modelling and accounting. Development of preliminary pricing/allocation scenarios and the spreadsheet model are complete.

2. To provide a solid foundation for facility O&M by GOU. For a variety of reasons, the Nukus and Urgench facilities were found in poor condition at the beginning of the project. To avoid this problem, the EPT improvements have been accompanied by initial provisions of expendables and several operator training programs. In addition, a recent reorganization at MCS has given more importance and a higher budget priority to the interregional water supply systems so that the outlook is improved significantly relative to payment of salaries and power bills and procurement of expendables. However, there are several items of equipment that will significantly improve sustainability that MCS and the water utility are currently not able to afford. In addition, formal maintenance and repair management training will significantly improve sustainability by reducing maintenance and repair time and costs. And finally, it is important that the World Bank move forward with their overall program of rehabilitating the remainder of the existing treatment facilities at the Nukus and Urgench plants, and provide related training and institutional strengthening. Based on these sustainability needs, it is recommended that EPT undertake a project to complete the development of a solid foundation for facility O&M by the GOU, including: proceeding with procurement of O&M tools, flow meters; leak detection equipment, welding units and backhoes; obtaining or confirming GOU commitment to purchase initial supplies of expendables; providing a comprehensive maintenance and repair training program; and confirming with the World Bank their intention to move forward with their overall program of rehabilitating the remainder of the existing treatment facilities at the Nukus and Urgench plants.

3. To maximize energy efficiency and minimize energy costs. Energy is the most expensive O&M cost item and pumps are the most energy consuming and inefficient equipment items in the Nukus and Urgench water delivery systems. System and financial sustainability could be significantly improved through a program to repair or replace the existing pumps. Based on these sustainability needs, it is recommended that EPT undertake a project to maximize energy efficiency and minimize energy costs in the Nukus and Urgench systems, including: conducting a power use audit, preparing a feasibility study, and providing the results to those involved in World Bank funded work so they may prepare an engineering design and procure and install energy-efficient pumps.

4. To strengthen management and administration of Tuyamuyun water utility. MCS is ready to consider staff reductions and even privatization to improve efficiency and financial sustainability at the Nukus and Urgench water treatment plants. Development and enforcement of potable water standards is deficient; regular inspections by trained personnel followed by adequate fines and penalties for noncompliance are needed. Some form of community-based management of water allocation, distribution, billing and collection at the village and collective farm level may strengthen management of the overall water delivery system. Based on these sustainability needs, it is recommended that EPT undertake a project to support management and administration of the water utility and

strengthen its enforcement capability, including: using the upcoming O&M training program to conduct a brief organization and management audit of at least one of the treatment plants to recommend staff reduction alternatives and provide guidelines for how MCS may make such determinations itself on other facilities in the Tuyayumun system; providing training to MCS and the State Committee on Nature Protection on effective enforcement of potable water quality standards; using the enforcement training to prepare recommendations and a scope of work for improving institutional capacity for enforcement; and using the pilot training of communities recommended under Water Pricing and Cost Recovery to study the feasibility of community-based management of the local side of the water delivery system at the village and collective farm level.

5. To reduce leakage and wastage. There are frequent and serious leaks in the main transmission and local distribution pipelines. In addition, data for bulk water purchases indicates very high per capita usage rates which may be the result of standpipes left running because valves and spigots are missing. Leakage along the pipeline and leakage and wastage by bulk and individual water users are critical problems that raise overall system O&M costs and reduce potential cost recovery, thus affecting sustainability. Based on these sustainability needs, it is recommended that EPT undertake a project to reduce leakage and wastage, including: designing and conducting a pilot project for volumetric measurement (metering) of large bulk and individual water users representing all three user groups; designing and conducting a pilot study for reducing leakage and wastage by representatives of all three user groups; and procuring the water meters and leak detection equipment necessary to carry out these pilot projects.

Table 4-1 presents the recommendations along with their priority level, donor and implementor, and implementation cost and schedule estimates. EPT recommends the following steps be taken toward agreeing on a near-term course of action on the above recommendations:

1. USAID/Washington and USAID/Almaty review on this document and return consolidated comments to EPT/Washington and EPT/Almaty by January 10, 1997.

2. EPT/Washington meet with USAID/Washington to review comments and plan strategy on January 13, 1997.

3. EPT Sustainability Task Manager and Economist return to Almaty to meet with EPT/Almaty and USAID/Almaty to complete detailed planning of strategy.

4. EPT Sustainability team, in conjunction with USAID/Almaty, set up meetings or conferences with host country officials to present sustainability findings and recommendations and obtain formal commitment to carrying out action items appropriate to host country.

5. EPT Sustainability team proceed to carry out sustainability recommendations assigned to EPT.

Table 4-1. Comparison of Sustainability Recommendations for Uzbekistan

Sustainability Project	Priority	Donor (Implementor)	EPT LOE /Cost (Funding Source)	EPT Duration (Timing)
Strengthen water pricing and cost recovery	1	USAID (EPT/CH2M	All tasks--100 person-days (Existing DO12/T2D2 plus mod)	12 months (10/96-9/97)
Provide strong foundation for facility O&M by GOK	2	USAID (EPT/CH2M) WB procure large equipment	Commitments from GOU--20 person-days Maint. & repair managemnt training--40 person-days WB loan program confirmation--10 person-days (Existing DO12/T2C plus mod)	9 months (1/97-9/97)
Maximize energy efficiency and minimize energy costs	3	USAID (EPT/CH2M) WB implement prepare design & procure equipment	Power use audit--40 person-days Feasibility study--20 person-days EPT referral to WB for design & equipment --10 person-days DO12/T2C plus mods	9 months (1/97-9/97)

Sustainability Project	Priority	Donor (Implementor)	EPT LOE /Cost (Funding Source)	EPT Duration (Timing)
Strengthen management and administration	4	USAID (EPT/CH2M) WB implement Community-based organization and consolidated regional authority	Institutional strengthening review--15 person-days Enforecement training--30 person-days Community-based managment review--15 person-days (Existing DO12/T2C & T2D2 plus mods)	9 months (1/97-9/97)
Reduce leakage and wastage vilayet	5	USAID (EPT/CH2M)	Volumetric measurement--__person-days/$____ Leakage & wastage--__person-days/$___ (Existing DO12/T2C plus mods)	9 months (1/97-9/97)

4.2 Strengthen Water Pricing and Cost Recovery for Potable Water System Operation and Maintenance

4.2.1 Findings

1. The estimated cost of operating and maintaining the EPT-installed chlorination and coagulation facilities is a small portion of the estimated annual cost to operate and maintain the entire pipelines. In particular, the estimated cost of operating and maintaining each of the chlorination facilities is $186,600 per year, or about 4% of the cost of operating and maintaining each of the pipelines (based on data collected from EPT and MCS; see Section 5.4 for details). Similarly, the estimated cost of operating and maintaining each of the coagulation facilities is $122,100 per year, or about 3% of the cost of operating and maintaining the pipelines. The estimates include costs for electricity, supplies and lubricants, replacement parts, and chemicals. Labor and equipment are not included because those resources are already available at each site.

2. The estimated annual costs of operating and maintaining the T-Nukus and T-Urgench Pipeline Systems are determined by examining the actual expenditures for this purpose during the first nine months of 1996. During that period, $3.20 million were expended in operating and maintaining the T-Nukus Pipeline, while $3.29 million were expended to maintain the T-Urgench Pipeline. The annual equivalents of these expenditures are $4.27 million for T-Nukus and $4.39 million for T-Urgench. The estimated average annual costs of operation and maintenance are $0.10 (3.61 cym) per cm for the T-Nukus System and $0.07 (2.31 cym) per cm for the T-Urgench System.

3. A similar system of potable water costing and pricing exists in Uzbekistan as is described for Kazakstan above. At present, there are three groups of customers who purchase water delivered through the T-Nukus and T-Urgench Pipeline Systems. Group 1 includes residents of villages, settlements, and cities, who receive water at a subsidized price. Group 2 includes budgetary organizations, self-sustaining sanatoriums, health resorts, medical organizations, and collective farms. This group pays a higher price than Group 1, but a lower price than Group 3, along the T-Urgench System. Group 3 includes self-sustaining enterprises, industrial firms, and private farms. This group pays the highest price for water along the T-Urgench System, while paying the same price as Group 2 along the T-Nukus System.

4. The GOU provides water at a subsidized price to customers in Group 1, while encouraging that higher prices be charged to customers in Groups 2 and 3 to raise revenues foregone by the Group 1 pricing policy. To achieve this goal, the prices charged to customers in Groups 2 and 3 have been established at much higher levels than the prices charged to customers in Group 1. This is due partially to the relative numbers of customers in each group, and partially to the difficulty of collecting revenue from customers in all groups. In both Karakalpakstan (T-Nukus) and in the Khorezm Oblast (T-Urgench), water sales to customers in Group 1 account for more than 40% of total water sales.

5. In 1995, prices for water delivered to customers in Group 1 were 0.50 cym ($0.014) per cm in Karakalpakstan and 0.35 cym ($0.010) per cm in Khorezm. The prices charged to customers in Groups 2 and 3 were 14.22 cym ($0.406) per cm in Karakalpakstan and 6.70 cym ($0.191) and 7.90 cym ($0.226) per cm in Khorezm. These prices are 28 times the price charged to customers in Group 1 in Karakalpakstan and from 19 to 23 times the price charged to Group 1 customers in Khorezm. The prices charged to customers in Groups 2 and 3 are also substantially higher than the estimated average costs of water delivery, which are 3.61 cym ($0.10) per cm in Karakalpakstan and 2.31 cym ($0.07) per cm in Khorezm.

6. It is likely that customers in Groups 2 and 3 will develop alternative sources of water and implement conservation measures to reduce the volume of water purchased from the T-Nukus and T-Urgench Pipeline Systems, in response to the relatively high prices of water. For example, state agencies and industrial enterprises may pump groundwater from local sources or obtain water from local surface canals at average costs that are lower than the prices for water from the pipeline systems. Customers in Groups 2 and 3 may also have difficulty making complete and timely payments for water at the stated prices, leading to a further divergence between expected and actual revenues.

7. The divergence between actual and expected revenues results in a budget deficit that is presently paid for by the Government of Uzbekistan. Actual expenses during the first nine months of 1996 were 112.1 million cym for the T-Nukus Pipeline and 115.1 million cym for the T-Urgench Pipeline, while actual revenues during the period were only 25.0 million cym (22.3%) and 25.7 million cym (22.3%), respectively. The average prices received for water during the period were only 0.81 cym per cm for the T-Nukus Pipeline and 0.52 cym per cm for the T-Urgench Pipeline, compared with average production costs of 3.61 cym per cm and 2.31 cym per cm, respectively. These data suggest that actual revenues are equivalent to about 23% of actual expenditures on each pipeline system.

8. Evidence of price responsiveness is provided by comparing expected revenues at current prices with actual revenues received by the pipeline authorities. In 1995, for example, the expected revenues from water sales are more than sufficient to pay for operation and maintenance costs. The expected revenues are 367.8 million cym in Karakalpakstan and 269.9 million cym in Khorezm, while the estimated annual costs of operation and maintenance are 149.4 million cym and 152.2 million cym, respectively. The expected weighted average prices of water are 7.81 cym ($0.22) per cm in Karakalpakstan and 4.37 cym ($0.12) per cm in Khorezm, or about twice the estimated average costs of production in each region.

9. The population often are not able to pay or do not pay for their water due to unemployment or delayed wages. The state-owned organizations have difficulty paying due to continuing issues with the national economy. The enterprises often decline to pay their much higher prices to support the other categories when they may be able to get water for less money, although of poorer quality, from ground or surface water sources. The water authority frequently gives preferred rates to consumers who cannot pay the full price and

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will not cut off the water supply completely even if they do not pay the preferred rates.

4.2.2 Conclusions

1. It is reasonable to assume that the EPT-installed chlorination and coagulation facilities will be operated and maintained more sustainably by the pipeline authorities, over time, provided that the pipelines are operated in a financially viable manner. At the present time, water prices and the payment system are not generating the revenue necessary to pay for the full cost of operating and maintaining the pipeline systems, and a subsidy is required from the Government of Uzbekistan, each year. The Government has implemented a policy that requires water prices to rise, over time, until revenues are sufficient to pay for the annual costs of operation and maintenance. The current goal of the Government is to achieve financial sustainability of the pipeline systems, through water pricing, by the year 2000. However, efforts to achieve sustainability should consider both prices and the payment system, to ensure that necessary revenues are generated and collected by the pipeline authorities.

2. The outlook for financial sustainability can be enhanced by modifying the current price structure for water in Uzbekistan to include water prices that are consistent with actual production costs and with underlying demand conditions and price responsiveness among water customers. An alternative set of water prices may be more effective in raising necessary revenues than the prices currently charged for water from both pipeline systems. In particular, it may be helpful to raise the price of water charged to customers of Group 1, while reducing the price of water charged to customers in Groups 2 and 3, provided that customers in Group 1 are able and willing to pay a higher price for water. At the same time, it would be useful to enhance the rate of collection of water fees from customers in all groups, so that any increases in water prices can be as small as necessary to pay for system expenditures. In fact, it should be possible to reduce the price of water to customers in Groups 2 and 3, while maintaining the current price of water for customers in Group 1, if revenues are collected in full from all customers.

4.2.3 Recommendations

1. Develop alternative potable water pricing and allocation scenarios and a simple spreadsheet model for evaluating them using different assumptions about costs and prices.

2. Design in outline form a billing and collection system to support the pricing and allocation system.

3. With the strong backing and active participation of USAID and the US Embassy, provide basic training on potable water pricing, and present the pricing strategies, model and billing and collection system developed above to relevant Tuyayumun and MCS officials and staff. Obtain political buy-in for utilizing water pricing to recover as much of the annual O&M costs as possible and to set prices to generate revenues sufficient to establish an annual repair fund, a contingency fund and a capital reserve fund.

4. Work with the Tuyayumun and MCS officials and staff in using the water pricing model to evaluate and select the optimal water pricing strategies and assist in refining the billing and collection system for local use.

5. Assist the Tuyayumun and MCS officials and staff in designing a public education campaign relative to the source, treatment and value of the pipeline water; how it is distributed, priced and allocated; how billing and collection are done; how to care for standpipes, tanks and cisterns; what to use and not use the water for and how to conserve it; and what general health and sanitation practices to follow.

6. Advise Tuyayumun and MCS officials and staff during testing of one or more proposed candidate water pricing strategies, the proposed billing and collection system and the proposed public education campaign at one or more pilot sites (e.g., at one or more cities or settlements where all three user categories exist).

7. With the strong backing and active participation of USAID and the US Embassy, obtain Tuyayumun and MCS commitment to adopt and implement throughout the system's service area the candidate water pricing strategy that recovered the greatest proportion of actual O&M costs during the pilot testing described above. Also get commitment to refine, adopt and implement the proposed billing and collection system and public education campaign based on the results of the pilot tests.

8. With the strong backing and active participation of USAID and the US Embassy, obtain Tuyayumun and MCS commitment to obtain interagency agreements with other GOT agencies that use the water to ensure payments and cost recovery for water delivered and confirm water system and MCS commitment to provide whatever subsidy is needed to cover O&M costs not funded by water sales using the selected new pricing system.

9. Procure desktop computers needed for accounting of billing, collection and expenditures, as well as for water pricing using the model, and train Tuyayumun and MCS staff in the use of these.

10. Conduct a pilot project for volumetric measurement (metering) as described under Reduce Leakage and Wastage below.

Implementation of these recommendations has already begun. A preliminary pricing and allocation system has been developed as part of this task and is described in Section 5.4 below. The system is based on careful analysis of: (1) host country and EPT cost estimates provided to date for O&M of the EPT improvements and overall water system, respectively; (2) the authority's current water pricing structure and prices; and (3) water demand data, water use characteristics and other information on socioeconomic needs in the region collected by EPT and the World. The preliminary pricing system proposes to improve the financial sustainability of the Tuyayumun system by modifying the current price structure for water to include water prices that are consistent with actual production costs and with underlying demand conditions and price responsiveness among water customers.

Section 5.4 presents a framework, or simple model, that can be used to analyze water pricing strategies proposed by EPT and host country counterparts. Specifically, the model can be used to test different hypotheses about what annual O&M costs will be (including whether it includes a contingency fund and a capital reserve fund) and what prices each of three user groups are willing and able to pay. The model will also help the GOU determine what funds, if any, will need to be provided by the central government as a subsidy under each scenario.

4.3 Provide Strong Foundation for Facility Operation, Maintenance and Repair by Host Country

4.3.1 Findings

1. Several of the EPT field inspection reports submitted early in the program indicated that the equipment and supporting facilities were found in poor condition. For example, control features were broken rendering critical processes uncontrollable, the concrete was poorly formed and badly deteriorating, piping systems leaked, equipment was not maintained, and equipment was badly corroded.

2. The EPT Project has procured several items of equipment and supplies that will improve O&M and repair, including O&M tools, spare parts, supplies and lubricants, coagulation chemicals, laboratory equipment and office equipment. Several additional equipment items have been approved by USAID and are currently being procured, including additional O&M tools, magnetic and ultrasonic flow meters, leak detection equipment, diesel and portable electric welding units and backhoes.

3. There has been a recent reorganization in MCS resulting in the formation of a new Committee for Interregional Water System Development which oversees the 12 interregional water supply systems in Uzbekistan. This development gives a higher profile and thus a higher budget priority to the interregional systems. Consequently, both treatment plants have already purchased a 6-month supply of treatment chemicals, and the funding is available to pay salaries, power bills, and all other operating costs for the remainder of 1996.

4. The treatment plant operators do not appear to have been trained in basic water treatment technology. They lack a basic understanding of what the plant is designed to accomplish from a process perspective and concentrate their efforts on hydraulically passing water from one process to the next.

5. The EPT Project has completed several O&M-related training or evaluation programs in Uzbekistan; these include an onsite plant operation evaluation, collaboration with NET water management training in the US, collaboration with NET water operations training in the US, onsite operations training, wiring and training for filter control panels, and a labelling program for improved plant operations. More operator training is being designed now.

6. The MCS requested we consider using any unallocated EPT funds to purchase a mobile laboratory to shuttle between the treatment plants at Nukus and Urgench to perform analyses that are normally performed by laboratories in the cities of Nukus and Urgench which take several hours and often exceed the holding times of the samples for those analyses.

4.3.2 Conclusions

1. It has been apparent from the condition of the potable water delivery facilities discovered upon inspection at the beginning of the EPT Project, that although the interregional water supply system has made valiant and somewhat successful efforts to maintain water delivery under less than optimal conditions, the equipment and supporting facilities have suffered much.

2. Several of the equipment items recently approved by USAID and being procured by EPT are aimed at improving maintenance and repair and thus will improve sustainability.

3. The interregional water supply system's central repair staff could benefit from formal maintenance and repair training and development of formal maintenance and repair scheduling, dispatching and recordkeeping systems.

4. There are two potential problems with MCS' requested assistance in procuring a mobile laboratory. First, such an arrangement may not provide reliable analytical results given the difficulty in operating and maintaining delicate analytical equipment on bumpy and dusty roads. Second, it is not clear who will be responsible for operating and maintaining the mobile laboratory given the plan to share it between two geographic jurisdictions and the current splitting of roles and responsibilities among several water management agencies in the region. This request could be referred to the World Bank and GOU for further study in the context of the Bank-funded institutional consolidation and strengthening plans for the region.

4.3.3 Recommendations

1. Proceed with procurement of O&M tools, magnetic and ultrasonic flow meters, leak detection equipment, diesel and portable electric welding units and backhoes. The flow meters and leak detection equipment will also be necessary for the pilot volumetric measurement project and pilot leakage and wastage project proposed below in Section 4.6.

2. Working with USAID, obtain or confirm GOU commitment to purchase the first 1-2 years' supply of expendables, such as spare parts, fuels and lubricants, etc. (already accomplished for chlorine, but not necessarily in writing), and to specify US chlorinators as the GOU standard to facilitate bulk purchases of chlorinators.

3. Provide a comprehensive maintenance and repair management training program covering scheduling, dispatching and recordkeeping; consolidate or coordinate this with the O&M

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training mentioned under Findings above that is currently being planned. Procure desktop computers and relevant software needed for maintenance scheduling and recordkeeping and provide training on how to use them

4. Confirm with the World Bank and GOU their plans to move forward with the water supply and sanitation loan program in Uzbekistan.

4.4 Minimize Problems Related to Energy Usage and Cost

4.4.1 Findings

1. Energy is the most expensive O&M cost item and pumps are the most energy consuming and inefficient equipment items in the Nukus and Urgench systems.

4.4.2 Conclusions

1. The water agencies could benefit from programs to repair or replace these pumps and generally lower energy uses and costs.

4.4.3 Recommendations

1. Conduct a power use audit and prepare a feasibility study that can be used by the World Bank to prepare an engineering design and procure and install energy-efficient pumps. This recommendation has been detailed in an EPT memorandum dated March 26, 1996. If EPT funds are sufficient, then EPT could also procure and install the pumps.

4.5 Strengthen Management and Administration of Potable Water Delivery Systems

4.5.1 Findings

1. The MCS requested EPT perform a formal analysis of the staffing of the two treatment plants. Apparently, the World Bank and Japanese International Cooperation Agency have recommended large staff reductions at the existing facilities as currently operated and with automation. However, these previous studies did not recommend how to cut staff or what parts of the organizations to focus on. They are also very interested in privatization, i.e. setting up a joint stock company (with at least 51% Ministry ownership) or possibly setting up a private company to perform O&M on a contract basis.

2. Enforcement of potable water quality standards by the relevant ministries is lax. There are not enough trained inspectors and insufficient disincentives for noncompliance.

4.5.2 Conclusions

1. MCS and the regional water authorities are ready to consider staff reductions, privatization and other organizational changes at the treatment plants that will improve both the institutional and financial sustainability of these organizations.

2. Regular and consistent inspections of treatment plants by trained inspectors followed by adequate fines and penalties when standards are not met will provide much of the incentive to operate and maintain properly the potable water treatment and distribution systems.

3. Some form of community-based management of water allocation, distribution, billing and collection may complement and supplement the functioning and capacity of the regional water utilities at the village level.

4.5.3 Recommendations

1. Use one of the upcoming (previously planned) O&M training programs to conduct a brief organization and management audit of at least one of the treatment plants; the output would be recommendations for staff reduction (as per request of MCS) and guidelines for how MCS may conduct such studies itself on other facilities in the Tuyayumun system. Make such recommendations in the context of how these operations could be privatized and prepare a scope of work for a privatization study that could be conducted under the World Bank's loan program.

2. Provide training to improve enforcement of drinking water quality standards for MCS and/or the State Committed for Nature Protection. Use that training to prepare recommendations and a scope of work for improving the institutional capacity for enforcement of the MCS and State Committee for Nature Protection. Work with and through the Resident Policy Advisor for Uzbekistan on implementing this task under DO14.

3. Use the pilot training of communities, recommended under Water Pricing and Cost Recovery above, to study the feasibility of establishing some form of community-based management of the local distribution, pricing, billing and collection systems, e.g. through water users associations. The output would be a set of recommendations, scope of work and identification of candidate settlements for one or more community-based management systems for the institutional strengthening work to be done by the World Bank under its full-scale project.

4.6 Reduce Leakage and Wastage

4.6.1 Findings

1. Data and observations of EPT and other donor consultants indicate that frequent and serious leaks occur in both the main transmission line and local distribution lines due to the age of the pipeline and its material of construction. These leaks are debilitating to the system in that one leak will depressurize the entire downstream system which must then be closed down until the leak is repaired. This not only results in water not delivered but also loss of revenue in the face of added repair costs.

2. The data for water consumption by residents strongly suggests that a great deal of water is wasted. Observations by EPT and other donor consultants in the field indicate that standpipes are routinely left running because valves and spigots have broken or been stolen and not been replaced due to sources for such parts in Russia having been cut off after the Soviet breakup.

4.6.2 Conclusions

1. Leakage along the pipeline and leakage and wastage of water by the bulk and individual users are critical problems that not only reduce water delivered to the population but also raise overall system O&M costs while reducing potential cost recovery, thus affecting sustainability.

2. Volumetric measurement is critical to both water pricing and detection and location of leakage and wastage.

3. Rehabilitatation of the oldest and most poorly maintained segements of the pipelines would alleviate much of the problem in the long-term. Although such a project may be beyond the scope of the EPT Project, EPT can help significantly in the short-term by facilitating the detection and location of leaks.

4.6.3 Recommendations

1. Design and conduct a pilot project for volumetric measurement (metering) of large bulk water users for one or more settlements and representatives of all three user groups, e.g. communal farms and apartment and commercial buildings; integrate the design and results with the EPT pilot study on reducing water wastage and leakage (below), the EPT water pricing efforts (above), and the Bank's rehabilitation program. Utilize the lessons learned from the similar EPT effort in Ukraine and coordinate this effort with the volumetric measurement pilot project in Kazakstan.

2. Design and conduct a pilot study for reducing water leakage and wastage for one or more settlements and representatives of all three user groups; integrate the design and results

with the EPT volumetric measurement pilot study (below), the EPT water pricing efforts (above), and the Bank's rehabilitation program.

Section 5

Water Pricing and Cost Recovery for EPT Engineering Projects in the Central Asian Republics

5.1 Overview

The following three sections present water pricing and cost recovery discussions for Turkmenistan, Kazakstan and Uzbekistan that are based on work to date in implementing the water pricing and cost recovery projects recommended in Sections 2, 3 and 4 above. Each section begins with discussions on current water delivery system O&M cost estimates, water prices charged, revenues collected, subsidies provided and debts incurred; this is followed by analyses of shortfalls in revenues relative to actual annual O&M costs, recommended alternative pricing strategies, a simple spreadsheet model for evaluating those and other strategies, and recommended alternative billing and collection systems.

5.2 Water Pricing and Cost Recovery for Turkmenistan

5.2.1 Water Delivery Cost Estimation

The EPT Project has constructed and brought into operation a reverse osmosis plant for producing high-quality drinking water for about 100,000 residents of the Turkmenbashi Etrap in Dashouz Velayet. The facility includes three groundwater wells that provide water to three process trains with a total design capacity of 750 m3 per day. The goal of the project is to provide residents with an average supply of 7 to 10 liters per capita per day for drinking and cooking. Residents are expected to continue using other water sources for cleaning, bathing, gardening, and livestock watering.

The estimated cost of operating and maintaining the reverse osmosis plant in the Turkmenbashi Etrap and the fleet of water delivery trucks associated with that plant is $220,910 per year (Table 5-1). This cost includes includes the labor, chemicals, spare parts, membranes, and other items required to operate and maintain the plant. Also included are the labor, fuel, lubricants, and other materials required for operating and maintaining the trucks that deliver water from the R.O. Plant to residents of the Etrap.

A Contingency and Reserve Fund equal to 20% of the estimated annual operation and maintenance cost should be included in the annual budget for the R.O Plant and the water delivery fleet. The purpose of this fund is to pay for any unexpected expenditures that arise during the year. The 20% value is recommended during the first three years of operation, or until substantial experience is gained in operating and maintaining the R.O. Plant and delivery fleet. This value can be reduced in the future, if unexpected repairs or other expenses are very small during the first three years. At present, the suggested Contingency and Reserve Fund is $44,182 per year (Table 5-2).

Funds that remain in the Contingency and Reserve Fund at the end of each year should be deposited in a permanent, cumulative reserve fund that will be maintained for as long as the plant remains in operation. The purpose of a permanent, cumulative reserve fund is to pay for any unexpected major repairs or capital expenditures that arise, over time. Such funds are usually maintained by water utilities and other companies that may require unexpected capital expenditures, such as the replacement of a pumping station or the acquisition of additional vehicles for water delivery.

A Capital Replacement Fund should also be included in the annual budget for the R.O. Plant and delivery fleet, to generate the funds required to replace the plant and trucks when they reach the end of their useful life. A Capital Replacement Fund of $50,000 is recommended for the R.O. Plant, assuming that the plant will be replaced in 25 years at a current cost estimate of $1.25 million (Boyd, 1996). A Capital Replacement Fund of $32,000 per year is recommended for the delivery fleet, assuming that the 16 trucks will be replaced every 5 years at an average cost of $10,000 per truck (Boyd, 1996).

The total estimated annual budget for the Turkmenbashi reverse osmosis plant and water delivery fleet, including the Contingency and Reserve Fund and the Capital Replacement Fund, is $347,091 per year (Table 5-2). It is reasonable to expect that the foreign exchange component of this budget should include the Capital Replacement Funds ($82,000), the cost of chemicals, spare parts, membranes, and other materials ($134,588), one-half the cost of truck maintenance ($24,469), and one-half of the Contingency and Reserve Fund ($22,091). The estimated total foreign exchange component of the estimated annual budget is, therefore, $263,147, or 76% of the total annual budget (Table 5-3). The estimated local currency component is $83,944 per year (24%), or 419.7 million manat, using an exchange rate of 5,000 manat per dollar.

The total cost of operating and maintaining the Turkmenbashi R.O. Plant and the foreign exchange component can be reduced, over time, as local sources for chemicals and other materials are developed. The current cost estimates include the cost of transporting many of the chemicals and spare parts from countries outside the Central Asian Republics.

5.2.2 Water Pricing and Allocation Strategies

Charging a price for water produced and delivered from the Turkmenbashi reverse osmosis plant is essential for two reasons:

1. A positive water price will enable the Government of Turkmenistan or the appropriate local agency to recover a portion of the annual operating and maintenance costs and other funds required for long-term sustainability.

2. A positive water price will distinguish the high-quality drinking water produced at the R.O. Plant from lower quality water available from other sources.

At the present time, water is provided at no charge to residents of Turkmenistan, but this policy should not be extended to include water produced and delivered from the Turkmenbashi R.O.

Plant. The high-quality water produced at the plant is intended to be used only for drinking and cooking. The plant has been designed to produce only enough water to supply residents with 7 to 10 liters per capita, per day (lcd), which is a small portion of their total water use, which is likely in the range of 100 to 200 liters per capita, per day (World Bank, 1995, p. 30).

Water produced at the R.O. Plant can be distinguished from other sources of water in Turkmenistan by its high quality and by the delivery system that includes transportation by truck to villages and collective farms. It should be possible to implement a pricing program for water from the R.O. Plant by noting that a price is required to pay for water treatment and transportation. The water, itself, may still be presented as "free" to consumers, but there is a significant cost required to remove salts from the water and transport it to residents of Turkmenbashi Etrap. The Government of Turkmenistan and the local water authority could describe an appropriate water pricing program in this context.

The estimated average cost of producing and delivering water, including the contingency and capital replacement funds is $1.42 per m3 (Table 5-4), which is higher than the cost of water delivery in many less developed countries. However, the water is low in total dissolved solids and is much higher quality than drinking water delivered in pipelines or canal systems. Therefore, it is appropriate to charge a price for water from the R.O. Plant, to recover at least some portion of the annual expenditures. It is also likely that residents of the Turkmenbashi Etrap will be willing to pay for the high-quality water for drinking and cooking. The actual level of demand for high-quality water in the Etrap is a function of household income levels, preferences, and the availability of substitutes.

A partial subsidy may be required by the Government of Turkmenistan or an appropriate local agency, if income levels are not sufficient to support full-cost pricing of water from the R.O Plant. The amount of subsidy required will be a function of the price charged to residents, the revenue generated from water sales, and the total cost of operations and maintenance. A spreadsheet model is useful for analyzing alternative water prices and determining the level of subsidy that corresponds to various water pricing strategies. Such a model is presented in Tables 5-4 and 5-5, and is described in the following paragraphs. The model can be used to examine any number of water pricing alternatives, in addition to those described in this report.

Why would GOT suddenly be willing to do this having shown no interest in it in the past?

One method for examining alternative water pricing scenarios is to suppose that the Government of Turkmenistan decides to pay for some components of the total expenditures, while other components are to be paid for by consumers, through water prices. For example, the Government may decide to pay for the Capital Replacement Fund, while asking residents to pay for the operation and maintenance costs and the Contingency and Reserve Fund. That policy would make water available to residents at an average price of $1.09 per m3, resulting in an average household expenditure of $1.53 per month, or about 6.1% of the average monthly household income in Turkmenbashi Etrap (Table 5-4). By comparison, a full-cost pricing policy would require an estimated average household expenditure of $2.00 per month, or 8.0% of the average monthly income.

In another scenario, the delivered price of water could be reduced to $0.91 per m3 if the Govern-

ment or an appropriate local agency pays for both the Capital Replacement and Contingency Funds. The estimated average household expenditure in this policy scenario is $1.27 per month, or 5.1% of the average monthly income. The delivered price could be reduced even further, if the Government or appropriate local agency pays also for the cost of chemicals, membranes, and spare parts. In this scenario, the Government or local agency would be providing more than half the funding required to operate, maintain, and replace the R.O. Plant, resulting in an estimated average water price of $0.35 per m3, and an estimated average household expenditure of $0.50 per month, or 2.0% of the average monthly income (Table 5-4).

In addition to generating revenues for plant operation, water prices will perform an important role in allocating the limited supply of high-quality drinking water among households in the Turkmenbashi Etrap. Clearly, the quantity of water demanded by households at a zero price would greatly exceed the design capacity of the R.O. Plant (7 to 10 lcd), if the indirect costs of obtaining that water (travel time and opportunity costs) are not excessive. Similarly, a very high price for water from the plant could cause the quantity demanded to fall below the design capacity of the plant. This would reduce the total benefits generated by providing high-quality drinking water to residents of the Turkmenbashi Etrap, and is not a desirable outcome.

The ideal price for water would result in a quantity demanded just equal to the design capacity of the R.O. Plant, while not causing financial harm to residents of the Turkmenbashi Etrap. That price could be determined by examining data describing prices and quantities of water purchased by residents, in recent years. However, such data are not available in the region, because water has always been provided at no charge. Therefore, it will not be possible to determine the best possible price for water at the start of the water pricing program. However, it is possible to design a water pricing and allocation program that will achieve revenue generation and water allocation goals, while also generating information to examine price responsiveness. in the future

Has anyone spoken to GOT re: its role in this?

5.2.3 A Program of Water Prices and Coupons

A program of coupons that enable residents to obtain a specified quantity of water from the R.O. Plant should be implemented in the near-term, to ensure that the total quantity demanded does not exceed the design capacity of the plant. The program will also ensure that all residents have an opportunity to obtain high-quality water for drinking and cooking at the price established by the Government or local agency. For example, if the Government or local agency decides to provide a partial subsidy of the operation and maintenance costs, all residents should be given the opportunity to purchase coupons equivalent to an average supply of 7 to 10 lcd at the subsidized water price. Residents should be required to purchase the coupons at a central location, and to present the coupons in exchange for delivery of water from the R.O. Plant.

All households should be informed that they have an opportunity to purchase coupons pertaining to an average supply of 7 to 10 lcd, but they should not be required to purchase all of their allotted coupons. For example, some households may decide to purchase coupons pertaining to an average supply of less than 7 lcd. Coupons not purchased by the designated households could be sold by the Government or local agency to any willing households for the full-cost water price, presently estimated at $1.42 per m3. It may be desirable to issue water coupons each

month, initially, to enable households to modify their purchase decisions frequently, until they gain experience with the water pricing and allocation program. Those decisions might also change as residents become more familiar with the quality of water produced at the R.O. Plant.

Information regarding the responsiveness of residents to water prices will be gained by observing how many households purchase their full allotment of water coupons each month. If most households decline to purchase their full allotment, then the price of coupons may be higher than demand conditions can support. However, if all households purchase their full allotment and desire more coupons at the current price, then it may be possible/desirable to raise their price.

The economic efficiency of the water pricing and allocation program can be enhanced by enabling residents to buy and sell water coupons from each other, either for cash or for commodities in a bartering framework. A free market for water coupons will enable households willing to sell a portion of their allotment to do so, while households wishing to consume a greater amount of high-quality water than 7 to 10 lcd would be able to obtain additional water at a fair market price for the water. Market transactions will provide additional data describing the true value of high-quality drinking water in the Turkmenbashi Etrap.

5.3 Water Pricing and Cost Recovery for Kazakstan

5.3.1 Water Delivery Cost Estimation

The EPT Project has renovated groundwater wells and pump stations at the Kosaman and Berdykol well fields, located northwest of Aralsk in the Kzyl-Orda Oblast of Kazakstan. The Project has also renovated several pump stations located along the Aral-Sarybulak Pipeline System that delivers water from the well fields to residents and other customers in Aralsk, Kazalinsk, and many settlements located between these twocities. The EPT-installed groundwater pumps and pump stations are major improvements to the Aral-Sarybulak Pipeline System, but the annual costs of operating and maintaining these facilities is likely a small portion of the annual cost of operating and maintaining the entire pipeline.

The estimated annual cost of operating and maintaining the Aral-Sarybulak Pipeline System is determined by examining the actual expenditures for this purpose during the first nine months of 1996, and the budget for the fourth quarter of that year. During the first months of 1996, 57.1 million tenge ($815,599) were expended in operating and maintaining the Aral-Sarybulak Pipeline (Table 5-5). The budget for operation and maintenance during the fourth quarter of 1996 is 22.3 million tenge, or $318,166 (Table 5-5). The estimated total expenditure for operations and maintenance in 1996 is 79.4 million tenge ($1.13 million), or an average cost of 36.64 tenge ($0.52) per m3, given the expected delivery of 2,166,100 m3 during the year (Table 5-5).

The actual expenditures for the first three quarters of 1996 and the budget for the fourth quarter do not include any funds for repairs on the Aral-Sarybulak Pipeline system. Local officials have suggested that repair funds are usually made available when revenues from water sales exceed other planned expenditures. They have also stated that the central government must approve

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their quarterly budgets and that funding for repairs is not always approved. In particular, repair funds are usually not approved during the winter, when weather conditions prevent repair crews from working on the pipeline system. The absence of repair funds in all of the quarterly budgets for 1996 may indicate that the Pipeline Authority was expecting revenues to be less than other planned expenditures in that year. Further inquiry is required to determine if repairs and maintenance were actually conducted during 1996, using funds from another source.

5.3.2 Water Pricing and Allocation Strategies

The 1996 repair fund situation demonstrates the importance of generating revenues that will pay for operations, maintenance, and repair of the Aral-Sarybulak Pipeline System, including the improvements installed by the EPT Project. It is reasonable to assume that those improvements to the groundwater wells and pumping stations will be operated and maintained successfully by the Pipeline Authority, over time, provided that the pipeline is operated in a financially viable manner. At the present time, water prices and the payment system are not generating the revenue necessary to pay for the full cost of operating, maintaining, nd repairing the pipeline system in all quarters of the year, and a subsidy is often required from the Government of Kazakstan.

The Government is currently reviewing its policies regarding water prices for agricultural, domestic, and industrial uses. It is possible that water prices will be increased in the near future to generate revenues that will pay for a larger portion of the operation and maintenance costs. This review of water pricing policy should include consideration of the payment and collection system, to ensure that necessary revenues are generated and collected by the pipeline authority. It is likely that a combination of inappropriate water prices and inadequate payment and collection procedures is contributing to the shortfall of revenues, relative to annual expenditures.

The outlook for financial sustainability can be enhanced by modifying the current price structure for water in Kazakstan to include water prices that are consistent with actual production costs and with underlying demand conditions and price responsiveness among water customers. At present, there are three groups of customers who purchase water from the Aral-Sarybulak Pipeline Authority. Group 1 includes residents of villages, settlements, and cities, who receive water at a subsidized price. Group 2 includes budgetary organizations, self-sustaining sanatoriums, health resorts, medical organizations, and collective farms. This group pays a higher price than Group 1, but a lower price than Group 3, which includes self-sustaining enterprises, industrial firms, and private farms.

The Aral-Sarybulak Pipeline Authority sells water to customers in Groups 1 and 2 at prices that are less than the average cost of production and delivery. In 1996, the prices of water for customers in Groups 1 and 2 were 2.0 tenge per m3 and 10.0 tenge per m3, respectively (Table 5-6). These prices are 5.5% and 27.3% of the estimated average cost of water production and delivery of 36.64 tenge per m3 (Table 5-5). The price of water sold to customers in Group 3 is higher than the average production cost, in an attempt to raise the revenues foregone by selling water to Groups 1 and 2 at subsidized prices. In 1996, the price of water for Group 3 was 68.0 tenge per m3 (Table 5-6.), or 1.86 times the estimated average cost of production and delivery. The Group

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3 price is 34 times higher than the Group 1 price and 6.8 times higher than the Group 2 price.

As noted above, the Pipeline Authority's goal in charging a higher price to Group 3 customers is to raise revenue that will offset the subsidy provided to customers in Groups 1 and 2. However, most of the Authority's customers are in Groups 1 and 2, making it difficult to raise sufficient revenues by charging a higher price to Group 3 customers. In 1996, the Authority delivered 994 million m3 to Group 1 customers and an estimated 845 million m3 to Group 2 customers (Table 5-6). Together, these two groups received 84.9% of the water delivered by the Pipeline Authority in that year. Hence, even if all customers had paid for water at the established prices in 1996, total revenue from water sales would have been 32.7 million tenge (Table 5-6), while the estimated expenditures were 79.4 million tenge. Water sales would have generated only 41% of the funds needed to operate and maintain the system, without considering the additional cost of repairs, and a subsidy of 46.7 million tenge would have been required from the Government of Kazakstan (Table 5-7).

It is often difficult to generate revenues from one group of customers to offset a subsidy provided to other groups of customers, particularly when the subsidy involves a large proportion of the cost of production and delivery. As noted above, the prices charged to customers in Groups 1 and 2 are just 5.5% and 27.3% of the estimated average cost of production and delivery, net of repair costs. Efforts to recover these losses by charging a very high price to Group 3 customers will encourage those customers to develop alternative sources of supply and to implement conservation measures that reduce the volume of water used. For example, state agencies and industrial enterprises may pump groundwater from local sources or obtain water from local surface water canals. In addition, these customers may have difficulty making timely and complete payments for water at the stated prices.

A spreadsheet model can be used to examine the potential revenue impacts of alternative water pricing structures, and to determine the appropriate prices for generating the revenue required to pay for annual expenditures. The model presented in Tables 5-8 and 5-9 maintains the current distinction among residents, state institutions, and private enterprises, to be consistent with current policy in Kazakstan. However, the model can be enhanced to consider any description of water users, including those with more or fewer groups. The model can also be used to examine a full range of water pricing alternatives, in addition to those presented in this report.

The current price structure for the Aral-Sarybulak Pipeline System is depicted by Policy 1 in Table 5-8, in which Group 1 customers are charged a price of 2 tenge per m3, while Group 2 customers are charged 10 tenge per m3, and Group 3 customers are charged 68 tenge per m3. The expected revenue in this scenario is $32,698 per year, which is only 41.2% of the expected annual expenditures (Table 5-8). Policy 2 in Table 5-8 depicts the prices that would be required to generate revenue to pay for operation and maintenance costs, while retaining the price of 2.0 tenge per m3 for Group 1 customers. The price for Group 2 would remain below the average cost of production, while the Group 3 price would be more than four times that cost, and about 2.5 times the price for that group in 1996. This scenario depicts the difficulty in raising revenues for operations and maintenance by raising the price of water substantially for one group of consumers.

Three of the policy scenarios in Table 5-8 (in addition to Policy 1) maintain the 1996 ratio of prices between Groups 2 and 3. As a result, the Group 3 price is much higher than the prices for Groups 1 and 2 in those scenarios, and in scenarios 5 and 6, in which Groups 1 and 2 are charged the same price for water (Figure 5-1). One alternative to this framework is to charge customers in Groups 2 and 3 the same price, while maintaining a lower price for Group 1 customers. This approach would reduce the price charged for customers in Group 3, while raising the price for Group 2 customers, relative to the prices charged in 1996. For example, the current price of 2.0 tenge per m3 could be maintained if both Groups 2 and 3 were charged 66.02 tenge per m3, provided that the volumes of water sold to each group remained the same as in 1996 (Policy 2 in Table 5-9). However, it is likely that a six-fold increase in the price of water sold to Group 2 would motivate those customers to change their consumption pattern significantly.

Policies 2 through 6 in Table 5-9 depict alternative scenarios in which the price of water to Group 1 customers is maintained below the average cost of production, while the price of water for Group 2 and Group 3 customers is established at the level necessary to raise revenues for operations and maintenance. These policies reduce the distance between prices charged to customers in the three groups (Figure 5-2). That distance would be eliminated if all customers were charged a price equal to the average cost of production.

Economic efficiency requires that all customers are charged the marginal cost of water production, so that incremental decisions regarding water consumption equate marginal costs with marginal values. Assuming that the marginal cost is similar to the average cost along the Aral-Sarybulak pipeline, the efficient pricing policy would require that all customers are charged 36.64 tenge per m3. This price would be sufficient to generate a revenue of 79.4 million tenge each year, which is the estimated annual cost of operation and maintenance (Policy 7 in Tables 5-8 and 5-9).

Considerations regarding the ability and willingness to pay among customers in Groups 1 and 2 can be accommodated by charging a price that is less than the average cost of production, while raising the price above that level for Group 3. Policies 1 through 6 in Table 5-9 describe scenarios in which water prices are less than the economically efficient prices for Groups 1 and 2, while the price for Group 3 is higher than the efficient price. Each of these policies can generate sufficient revenue, provided that water deliveries are the same as those observed during 1996, and that all customers pay for actual water deliveries. However, the price that must be charged to Group 3 customers in order to maintain the same revenue level is more than 3 times the average cost of production and almost two times the current price for that group, even when Group 1 is required to pay 80% of the average production cost. It is not likely that Group 3 customers will maintain their current consumption pattern if the price is raised to any of those depicted in Policies 2 through 6 in Table 5-8.

The analysis presented in Tables 5-8 and 5-9 is intended to depict the potential for modifying water prices to generate the revenues needed to pay for operation and maintenance costs. The volumes of water demanded by each group are held constant in this analysis, due to lack of empirical information regarding price responsiveness. However, it is likely that the volume demanded by customers will decrease if the price of water is increased from current levels, and in-

crease if the price is decreased from current levels. Estimates of volumes purchased and the expected revenues in alternative policy scenarios should be revised as data describing actual prices and volumes purchased are developed, over time.

In the near-term, a policy that adjusts water prices in the directions described in Tables 5-8 and 5-9 will improve economic efficiency, with little to moderate impact on equity. The current policy of maintaining an artificially low water price for customers in Groups 1 and 2, while raising the price for Group 3 to a relatively high level, is inconsistent with underlying supply and demand considerations. In particular, customers in Group 3 are likely operating in an elastic portion of their demand curve for water, given the relatively high prices for water and the behavioral responses they have exhibited in recent years. Raising the price of water to customers with elastic demand has resulted in a reduction of revenues received from this group. By contrast, customers in Groups 1 and 2 are likely operating in the inelastic portion of their demand curves, given the relatively low water prices for those group and the fact that water is a necessary resource for many household activities. A small increase in water price will likely increase the revenue received from these groups, with a relatively small reduction in volume demanded. Therefore, it may be desirable to raise the price of water for customers in Groups 1 and 2, while providing protection for the poorest members of this group to ensure that all residents are able to obtain a specified minimum volume of water for household use.

5.4 Water Pricing and Cost Recovery for Uzbekistan

5.4.1 Water Delivery Cost Estimation

The EPT Project has installed chlorination and coagulation facilities along the Tuyamuyun-Nukus (T-Nukus) and Tuyamuyun-Urgench (T-Urgench) Pipeline Systems. Annual costs of operation and maintenance include the costs for electricity, supplies and lubricants, replacement parts, and chemicals. The estimated cost of operating and maintaining the EPT-installed facilities is a small portion of the estimated annual cost to operate and maintain the entire pipelines. In particular, the estimated cost of operating and maintaining each of the chlorination facilities is $186,600 per year (Table 5-10), or about 4% of the cost of operating and maintaining each of the pipelines. Similarly, the estimated cost of operating and maintaining each of the coagulation facilities is $122,100 per year (Table 5-10), or about 3% of the cost of operating and maintaining the pipelines. Labor and equipment are not included in the cost estimates for the chlorination and coagulation facilities because those resources are already available at each site.

The estimated annual costs of operating and maintaining the T-Nukus and T-Urgench Pipeline Systems are determined by examining the actual expenditures for this purpose during the first nine months of 1996. During that period, $3.20 million were expended in operating and maintaining the T-Nukus Pipeline, while $3.29 million were expended to maintain the T-Urgench Pipeline. The annual equivalents of these expenditures are $4.27 million for T-Nukus and $4.39 million for T-Urgench. The estimated average annual costs of operation and maintenance are $0.10 (3.61 cym) per m3 for the T-Nukus System and $0.07 (2.31 cym) per m3 for the

T-Urgench System (Table 5-11).

5.4.2 Water Pricing and Allocation Strategies

It is reasonable to assume that the EPT-installed chlorination and coagulation facilities will be operated and maintained successfully by the pipeline authorities, over time, provided that the pipelines are operated in a financially viable manner. At the present time, water prices and the payment system are not generating the revenue necessary to pay for the full cost of operating and maintaining the pipeline systems, and a subsidy is required from the Government of Uzbekistan, each year. The Government has implemented a policy that requires water prices to rise, over time, until revenues are sufficient to pay for the annual costs of operation and maintenance. The current goal of the Government is to achieve financial sustainability of the pipeline systems, through water pricing, by the year 2000. However, efforts to achieve sustainability should consider both prices and the payment system, to ensure that necessary revenues are generated and collected by the pipeline authorities.

The outlook for financial sustainability can be enhanced by modifying the current price structure for water in Uzbekistan to include water prices that are consistent with actual production costs and with underlying demand conditions and price responsiveness among water customers. At present, there are three groups of customers who purchase water delivered through the T-Nukus and T-Urgench Pipeline Systems. Group 1 includes residents of villages, settlements, and cities, who receive water at a subsidized price. Group 2 includes budgetary organizations, self-sustaining sanatoriums, health resorts, medical organizations, and collective farms. This group pays a higher price than Group 1, but a lower price than Group 3, along the T-Urgench System. Group 3 includes self-sustaining enterprises, industrial firms, and private farms. This group pays the highest price for water along the T-Urgench System, while paying the same price as Group 2 along the T-Nukus System.

The Government of Uzbekistan provides water at a subsidized price to customers in Group 1, while encouraging that higher prices be charged to customers in Groups 2 and 3 to raise revenues foregone by the Group 1 pricing policy. To achieve this goal, the prices charged to customers in Groups 2 and 3 have been established at much higher levels than the prices charged to customers in Group 1. This is due partially to the relative numbers of customers in each Group, and partially to the difficulty of collecting revenue from customers in all Groups. In both Karakalpakstan (T-Nukus) and in the Khorezm Oblast (T-Urgench), water sales to customers in Group 1 account for more than 40% of total water sales (Table 5-12).

In 1995, prices for water delivered to customers in Group 1 were 0.50 cym ($0.014) per m3 in Karakalpakstan and 0.35 cym ($0.010) per m3 in Khorezm (Table 5-12). The prices charged to customers in Groups 2 and 3 were 14.22 cym ($0.406) per m3 in Karakalpakstan and 6.70 cym ($0.191) and 7.90 cym ($0.226) per m3 in Khorezm (Table 5-12). These prices are 28 times the price charged to customers in Group 1 in Karakalpakstan and from 19 to 23 times the price charged to Group 1 customers in Khorezm. The prices charged to customers in Groups 2 and 3 are also substantially higher than the estimated average costs of water delivery, which are 3.61 cym ($0.10) per m3 in Karakalpakstan and 2.31 cym ($0.07) per m3 in Khorezm (Table 5-11).

It is likely that customers in Groups 2 and 3 will develop alternative sources of water and implement conservation measures to reduce the volume of water purchased from the T-Nukus and T-Urgench Pipeline Systems, in response to the relatively high prices of water. For example, state agencies and industrial enterprises may pump groundwater from local sources or obtain water from local surface canals at average costs that are lower than the prices for water from the pipeline systems. Customers in Groups 2 and 3 may also have difficulty making complete and timely payments for water at the stated prices, leading to a further divergence between expected and actual revenues.

Evidence of price responsiveness is provided by comparing expected revenues at current prices with actual revenues received by the pipeline authorities. In 1995, for example, the expected revenues from water sales are more than sufficient to pay for operation and maintenance costs. The expected revenues are 367.8 million cym in Karakalpakstan and 269.9 million cym in Khorezm (Table 5-12), while the estimated annual costs of operation and maintenance are 149.4 million cym and 152.2 million cym, respectively (Table 5-11). The expected weighted average prices of water are 7.81 cym ($0.22) per m3 in Karakalpakstan and 4.37 cym ($0.12) per m3 in Khorezm, or about twice the estimated average costs of production in each region.

The divergence between actual and expected revenues results in a budget deficit that is presently paid for by the Government of Uzbekistan. Actual expenses during the first nine months of 1996 were 112.1 million cym for the T-Nukus Pipeline and 115.1 million cym for the T-Urgench Pipeline, while actual revenues during the period were only 25.0 million cym (22.3%) and 25.7 million cym (22.3%), respectively (Table 5-13). The average prices received for water during the period were only 0.81 cym per m3 for the T-Nukus Pipeline and 0.52 cym per m3 for the T-Urgench Pipeline, compared with average production costs of 3.61 cym per m3 and 2.31 cym per m3, respectively (Table 5-11). These data suggest that actual revenues are equivalent to about 23% of actual expenditures on each pipeline system.

An alternative set of water prices may be more effective in raising necessary revenues than the prices currently charged for water from both pipeline systems. In particular, it may be helpful to raise the price of water charged to customers of Group 1, while reducing the price of water charged to customers in Groups 2 and 3, provided that customers in Group 1 are able and willing to pay a higher price for water. At the same time, it would be useful to enhance the rate of collection of water fees from customers in all groups, so that any increases in water prices can be as small as necessary to pay for system expenditures. In fact, it should be possible to reduce the price of water to customers in Groups 2 and 3, while maintaining the current price of water for customers in Group 1, if revenues are collected in full from all customers.

A spreadsheet model is useful for examining alternative water pricing structures and describing the potential revenue effects of alternative prices for members of the three user groups. The model presented in Tables 5-14 and 5-15 maintains the current distinction among residents, state institutions, and private enterprises, to be consistent with current policy in Uzbekistan. However, the model can be enhanced to consider any description of water users, including those with more or fewer groups. The model can also be used to examine a full range of water pricing alternatives, in addition to those presented in this report.

A pricing policy that maintains the current price of water for customers in Group 1, while reducing the price charged to customers in Groups 2 and 3 should generate sufficient revenues in each pipeline system. For example, revenues equal to expected annual expenditures of 149.1 million cym could be generated if the price charged to Groups 2 and 3 is reduced from 14.22 cym per m3 to 6.34 cym per m3, while maintaining the Group 1 price of 0.50 cym per m3, provided that all groups pay for actual water deliveries, and that quantities demanded are the same as those delivered during 1996 (Policy 2 in Table 5-14). Similarly, the prices charged to Groups 2 and 3 in Khorezm could be reduced to 3.44 cym per m3 and 4.04 cym per m3, respectively, while maintaining the current Group 1 price of 0.35 cym per m3 (Policy 2 in Table 5-15).

Prices charged to Groups 2 and 3 can be reduced further if the price charged to customers in Group 1 is increased in each region. The analysis presented in Tables 5-14 and 5-15 describes the range of prices that can be charged to customers in each group, while generating sufficient revenue to pay for expected annual expenditures. For example, if residents are asked to pay 20% of the full cost of production, the price for Group 1 would be 0.72 cym per m3 in Karakalpakstan and 0.46 cym per m3 in Khorezm. The prices for Groups 2 and 3 could be reduced to 6.14 cym per m3 in Karakalpakstan, and to 3.36 cym per m3 and 3.95 cym per m3, respectively, in Khorezm (Policy 3 in Tables 5-14 and 5-15).

Economic efficiency requires that all customers are charged the marginal cost of water production, so that incremental decisions regarding water consumption equate marginal costs with marginal values. Assuming that the marginal cost is similar to the average cost in each region, the efficient pricing policy would require that all customers in Karakalpakstan are charged 3.61 cym per m3, while all customers in Khorezm are charged 2.31 cym per m3 (Policy 7 in Tables 5-14 and 5-15). This policy would require a departure from the current policy of charging different prices to the three groups of customers. However, such a policy is necessary to achieve an efficient allocation of water among the groups.

Considerations regarding the ability and willingness to pay among customers in Group 1 in each region can be accommodated by charging those customers a price that is less than the efficient price, while charging customers in Groups 2 and 3 a price that exceeds the efficient price (such as Policies 2 through 5 in Tables 5-14 and 5-15). Each of these policies can generate sufficient revenue, provided that water deliveries are the same as those observed during 1996, and that all customers pay for actual water deliveries. Any one of the Policies numbered 2 through 5 in Tables 5-14 and 5-15 will begin to reduce the distance between water prices among the three user groups, while Policy 1 would result in equal prices for all groups, as shown in Figures 5-3 and 5-4.

The analysis presented in Tables 5-14 and 5-15 is intended to depict the potential for modifying water prices to generate the revenues needed to pay for operation and maintenance costs. The volumes of water demanded by each group are held constant in this analysis, due to lack of empirical information regarding price responsiveness in the two regions. However, it is likely that the volume demanded by customers in Groups 2 and 3 will increase as the price of water is reduced, while the volume demanded by customers in Group 1 will decrease as the price of water for that group is increased. Estimates of volumes purchased and resulting revenues should be

revised as data describing actual prices and volumes purchased are developed, over time.

In the near-term, a policy that adjusts water prices in the directions described in Tables 5-14 and 5-15 will improve economic efficiency, with little to moderate impact on equity. The current policy of maintaining an artificially low water price for customers in Group 1, while raising the prices for Groups 2 and 3 to relatively high levels, is inconsistent with underlying supply and demand considerations. In particular, customers in Groups 2 and 3 are likely operating in an elastic portion of their demand curve for water, given the relatively high prices for water and the behavioral responses they have exhibited in recent years. Raising the price of water to customers with elastic demand has resulted in a reduction of revenues received from these groups. By contrast, customers in Group 1 are likely operating in the inelastic portion of their demand curve, given the relatively low water price for that group and the fact that water is a necessary resource for many household activities. A small increase in water price will likely increase the revenue received from this group, with a relatively small reduction in volume demanded. Therefore, it may be desirable to raise the price of water for customers in Group 1, while providing protection for the poorest members of this group to ensure that all residents are able to obtain a specified minimum volume of water for household use.

5.5 Comparison of Water Pricing Strategies Among the Countries

All of the facilities constructed or improved by the EPT project in Kazakstan, Turkmenistan, and Uzbekistan can be sustained, over time, if the water treatment and delivery facilities are operated in a financially viable manner. In addition, local water agencies and central governments must place a high priority on performing necessary repairs and maintenance on a regular schedule, to prevent the facilities from falling into disrepair. Some of the funds needed to pay for proper operation and maintenance can be generated by charging residents and industries for water they purchase from local water authorities. In all three countries, however, it is likely that some level of financial subsidy from the central government will be required until the income of residents and industries increases, over time, to levels that will enable these customers to pay the full cost of water production and delivery.

The average cost of operation and maintenance varies among the three countries, according to the characteristics of each water supply system. The average cost per m3 is lowest in Uzbekistan, where water is delivered to residents of Urgench and Nukus through a pipeline from the Tuyamuyun Reservoir. The large volume of delivered in these pipelines results in a relatively low average cost. In Kazakstan, the Aral-Sarybulak Pipeline System delivers groundwater pumped from below the former lake-bed of the Aral Sea to residents of Aralsk and Kazalinsk. A smaller volume is delivered in this system, than in Uzbekistan, and all of the water must be pumped uphill from the Aral Sea basin. A large proportion of the estimated operation and maintenance cost is for annual service of the groundwater wells and pumping stations.

The EPT-installed reverse osmosis plant in Turkmenistan produces clean drinking water for about 100,000 residents of the Turkmenbashi Etrap. The average cost of operation and maintenance includes the cost of replacing membranes that remove salt from the water and the cost of other water treatment chemicals. A fleet of trucks is maintained for delivering water to village

centers and collective farms. The average cost of water produced and delivered from this plant is higher than the cost of typical pipeline or canal delivery systems that may include chlorination and other basic water treatment. However, the goal of the Turkmenbashi project is to provide very clean water for drinking and cooking, with an average delivery rate of 7 to 10 liters per capita per day. It is reasonable to expect that such a specialized facility will have a higher average cost of production than a larger, more general water supply system.

Table ~~1~~ 5-1
Estimated Annual Operation and Maintenance
Costs for the Turkmenbashi R.O. Plant

Item	Estimated Cost ($)
Chemicals	90,188
Spare Parts, Membranes, And Other Materials	44,400
Labor	6,672
Fuel for Trucks	30,713
Truck Maintenance	48,938
Total Annual Cost	220,910

Source: Estimates prepared by Pervez Shaikh and other EPT Project personnel in Almaty, Kazakstan and in Turkmenbashi, Turkmenistan.

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Table ~~12~~ 5-2
Estimated Annual Cost of Water Production
And Delivery at the Turkmenbashi R.O. Plant,
Including a Contingency and Reserve Fund
And a Capital Replacement Fund

Item	Estimated Cost ($)
Estimated Annual Operation And Maintenance Cost	220,910
Contingency and Reserve Fund (At 20% of Annual O&M)	44,182
Capital Replacement Fund	
For the R.O Plant (Assuming a 25-year period)	50,000
For the Delivery Trucks (Assuming a 5-year period)	32,000
Total Annual Cost	347,091

Sources: Estimated Annual O&M Costs are From Pervez Shaikh, EPT Project, Almaty, Kazakstan. Capital Replacement Funds are From Boyd, 1996.

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Table ~~D3.~~ 5-3
Estimating the Foreign Exchange Component of the Extimated Annual Operation and Maintenance Costs, the Contingency and Reserve Fund, and The Capital Replacement Fund for the Turkmenbashi R.O. Plant

Item	Estimated Total Cost	Estimated Foreign Exchange	Estimated Local Currency	
			Dollars	Manat
	($)	($)	($)	(million)
Chemicals	90,188	90,188		
Spare Parts, Membranes, And Other Materials	44,400	44,400		
Labor	6,672		6,672	33.4
Fuel for Trucks	30,713		30,713	153.6
Truck Maintenance	48,938	24,469	24,469	122.3
Sub-Total of Annual Costs	220,910	159,056	61,853	309.3
Contingency and Reserve Fund	44,182	22,091	22,091	110.5
Capital Replacement Fund	82,000	82,000		
Total of Annual Costs and Funds	347,091	263,147	83,944	419.7

Source: Total cost estimates prepared by Pervez Shaikh and other EPT Project Personnel in Almaty, Kazakstan and Turkmenbashi, Turkmenistan.

Notes: The exchange rate used in this table: 5,000 Manat per Dollar.

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Table ~~IX~~ 5-4
Alternative Cost Allocation Scenarios Involving the Government of Turkmenistan
And Water Users in Turkmenbashi Etrap

Cost Allocation Scenario	Estimated Annual Cost to G.O.T.		Estimated Annual Cost to Water Users		Estimated Monthly Cost Per Household	
	Total	Per m3	Total	Per m3	Total	% Of Income
	($)	($/m3)	($)	($/m3)	($)	(Percent)
1 Water users pay full cost of production and delivery, including the contingency and replacement funds	0	0	347,091	1.42	2.00	8.0
2 The Government pays for the Capital Replacement Fund	82,000	0.34	265,091	1.09	1.53	6.1
3 The Government pays for the Capital Replacement Fund and the Contingency Fund	126,182	0.52	220,910	0.91	1.27	5.1
4 The Government pays for the Capital Replacement Fund, the Contingency Fund, and the Cost of Chemicals, Membranes, and Spare Parts	260,769	1.07	86,322	0.35	0.50	2.0

Parameters used in this Analysis:			**Notes:**
Daily demand for drinking and cooking:	6.68	liters per capita per day.	[Production / population]
Average population per household:	7	persons.	[World Bank and other sources]
The total volume of water sold annually:	243,750	cubic meters.	[750 m3/day for 325 days/year]
Total population in the Etrap is:	100,000	persons.	[World Bank population data]
Number of households in the Etrap:	14,286	households.	[Population / average per household]
Average monthly income per household:	25	dollars.	[World Bank and other sources]

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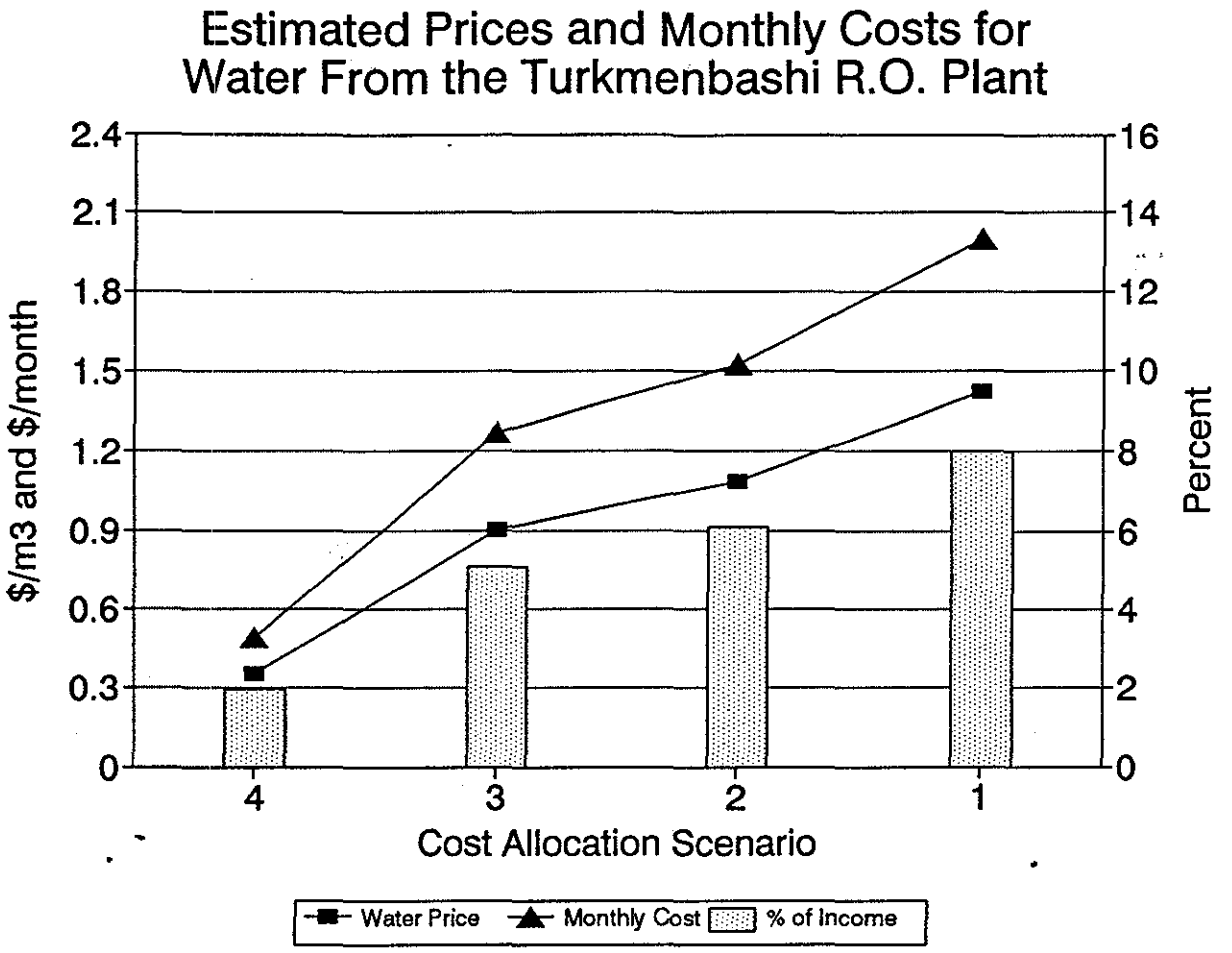
Estimated Prices and Monthly Costs for
Water From the Turkmenbashi R.O. Plant
$/m3 and $/month
2.4
2.1
1.8
1.5
1.2
0.9
0.6
0.3
0
16
14
12
10
8
6
4
2
0
Percent
4
3
2
1
Cost Allocation Scenario
Water Price
Monthly Cost
% of Income

Figure ~~I-1~~ 5-6

Table ~~1~~ 5-5
Estimated Annual Operation and Maintenance Costs
For the Aral-Sarybulak Pipeline System in Kazakstan, For
The First Nine Months and the Fourth Quarter of 1996

Item	Actual Expenses for 9 Months		Budget for Fourth Quarter		Estimated Annual Budget	
	Tenge	Dollars	Tenge	Dollars	Tenge	Dollars
Salary	13,537,500	193,393	6,338,700	90,553	19,876,200	283,946
Social Insurance	4,061,200	58,017	1,901,600	27,166	5,962,800	85,183
Electricity	11,494,100	164,201	5,263,000	75,186	16,757,100	239,387
Fuel and Lubricants	2,614,400	37,349	993,000	14,186	3,607,400	51,534
Materials	1,394,500	19,921	200,000	2,857	1,594,500	22,779
Depreciation	16,197,300	231,390	4,370,200	62,431	20,567,500	293,821
Repair Fund	0	0	0	0	0	0
Transportation	622,100	8,887	200,000	2,857	822,100	11,744
Other Expenses	577,700	8,253	200,000	2,857	777,700	11,110
Deductions:						
Road Fund	615,000	8,786	201,400	2,877	816,400	11,663
Employment Fund	270,800	3,869	126,700	1,810	397,500	5,679
Geological Processing	5,707,300	81,533	2,477,000	35,386	8,184,300	116,919
Total	57,091,900	815,599	22,271,600	318,166	79,363,500	1,133,764
Cost per cubic meter	36.69	0.52	36.51	0.52	36.64	0.52

Note: The exchange rate used in this table is: 70 tenge/dollar.
The volume delivered in the nine months is: 1,556,100 cubic meters.
The volume planned for the Fourth Quarter is: 610,000 cubic meters.

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Table ~~D2~~. 5-6
Estimated Water Prices and Volumes Delivered From the Aral-Sarybulak Pipeline System, By User Group, 1996

User Group	Volume	Proportion Of Sales	Average Water Price	Expected Revenue
	(cubic meters)	(percent)	(tenge/m3)	(tenge)
Group 1	994,042	45.9	2.0	1,988,084
Group 2	844,667	39.0	10.0	8,446,675
Group 3	327,391	15.1	68.0	22,262,554
Total	2,166,100	100.0	15.1	32,697,313

Note: The volume delivered to Group 1 is from data provided by the Pipeline Authority. The volumes delivered to Groups 2 and 3 are estimated using the proportions of water delivered to these Groups in Karakalpakstan.

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Table ~~B3~~. 5-7
Estimated Expenses, Revenue, and Budget Deficit for
The Aral-Sarybulak Pipeline System for 1996

	Estimated Revenue and Costs	
	(Tenge)	(Dollars)
Actual Expenses	79,363,500	1,133,764
Expected Revenue	32,697,313	467,104
Budget Deficit	46,666,187	666,660

Note: The exchange rate used in this this analysis is: 70 tenge per dollar.

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Table ~~K4~~. 5-8
Evaluating Alternative Water Pricing Scenarios for the Aral-Sarybulak Pipeline System, Using Actual Costs and Deliveries for January through September 1996, And the Expected Deliveries for October Through December 1996

Water Pricing Policy Scenario	Water Prices Required to Raise Revenue to Recover Annual Costs			Expected Total Revenue
	Group 1	Group 2	Group 3	
	(tenge per cubic meter)			(1000 tenge)
1 Current price structure in which residents pay 5.5% of full cost and others pay a higher price.	2.00	10.00	68.00	32,698
2 Residents pay only 5.5% of full cost. Other groups are charged a price higher than full cost.	2.00	25.19	171.35	79,364
3 Residents pay only 20% of full cost. Other groups are charged a price higher than full cost.	7.33	23.46	159.62	79,364
4 Residents pay only 40% of full cost. Other groups are charged a price higher than full cost.	14.66	21.09	143.49	79,364
5 Residents pay only 60% of full cost. Other groups are charged a price higher than full cost.	21.98	21.98	118.95	79,364
6 Residents pay only 80% of full cost. Other groups are charged a price higher than full cost.	29.31	29.31	77.80	79,364
7 All water users are charged the average cost of water delivery	36.64	36.64	36.64	79,364

Notes: The following water deliveries are estimated for 1996, based on data for Jan. to Sept.:

Group 1	994	thousand m3
Group 2	845	thousand m3
Group 3	327	thousand m3
Total	2,166	thousand m3

The average cost of water delivery in the Aral-Sarybulak Pipeline System is taken to be: 36.64 tenge per cubic meter.
Total annual costs are assumed to be: 79,364 thousand tenge.
This program sets the price for Group 2 at 14.7 % of the price charged to water users in Group 3, in Policies 1 through 4.

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Table ~~IX~~ 5. 5-9
Evaluating Alternative Water Pricing Scenarios for the Aral-Sarybulak Pipeline System, Using Actual Costs and Deliveries for January through September 1996, And the Expected Deliveries for October Through December 1996

Water Pricing Policy Scenario	Water Prices Required to Raise Revenue to Recover Annual Costs			Expected Total Revenue
	Group 1	Group 2	Group 3	
	(tenge per cubic meter)			(1000 tenge)
1 Current price structure in which residents pay 5.5% of full cost and others pay a higher price.	2.00	10.00	68.00	32,698
2 Residents pay only 5.5% of full cost. Other groups are charged a price higher than full cost.	2.00	66.02	66.02	79,364
3 Residents pay only 20% of full cost. Other groups are charged a price higher than full cost.	7.33	61.50	61.50	79,364
4 Residents pay only 40% of full cost. Other groups are charged a price higher than full cost.	14.66	55.28	55.28	79,364
5 Residents pay only 60% of full cost. Other groups are charged a price higher than full cost.	21.98	49.07	49.07	79,364
6 Residents pay only 80% of full cost. Other groups are charged a price higher than full cost.	29.31	42.85	42.85	79,364
7 All water users are charged the average cost of water delivery	36.64	36.64	36.64	79,364

Notes: The following water deliveries are estimated for 1996, based on data for Jan. to Sept.:

Group 1	994	thousand m3
Group 2	845	thousand m3
Group 3	327	thousand m3
Total	2,166	thousand m3

The average cost of water delivery in the Aral-Sarybulak Pipeline System is taken to be: 36.64 tenge per cubic meter.
Total annual costs are assumed to be: 79,364 thousand tenge.
This program sets the price for Group 2 at 100 % of the price charged to water users in Group 3.

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Estimated Water Prices for Groups of Water Users in Aral-Sarybulak System

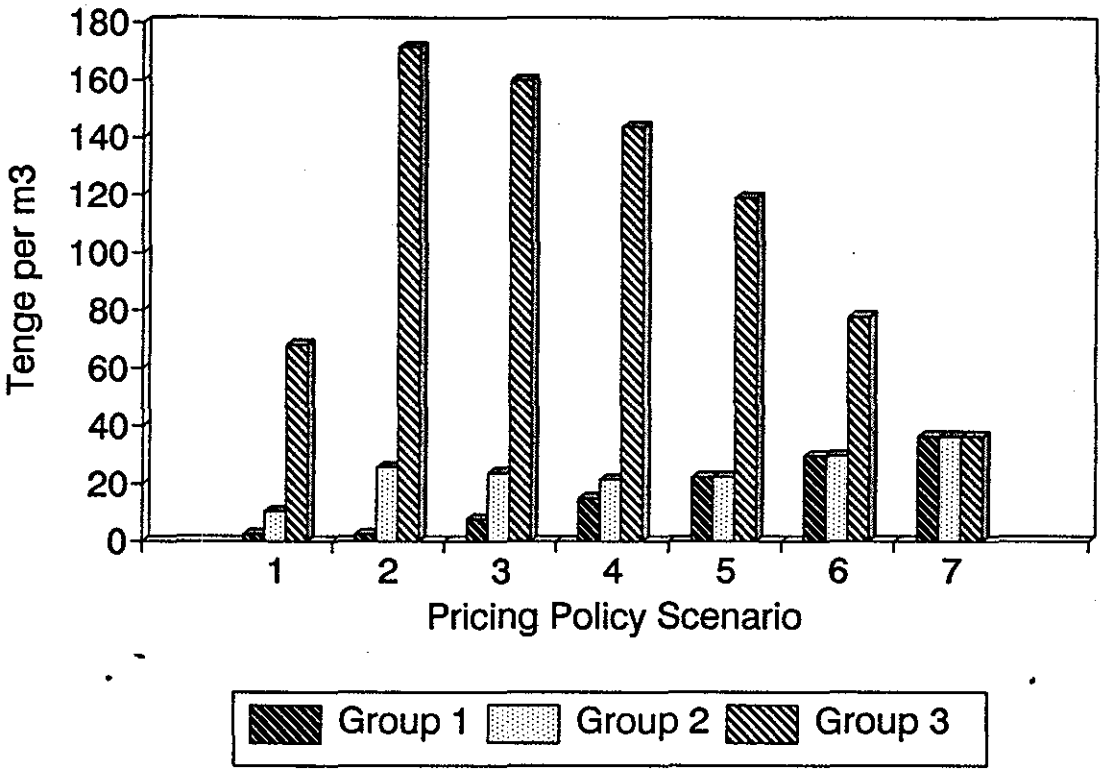

Figure ~~K.1~~. 5-1

Estimated Water Prices for Groups of Water Users in Aral-Sarybulak System

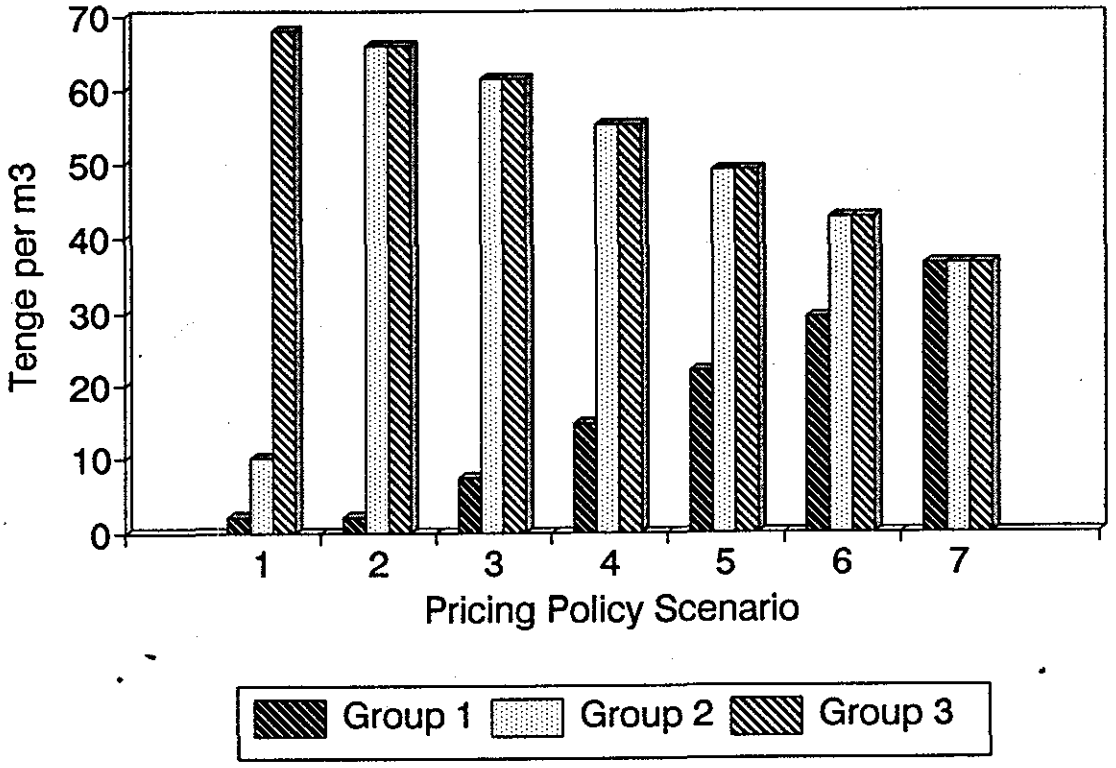

Figure ~~B.2~~.5-2

Table ~~D.0.~~ 5-10
Estimated Operation and Maintenance Costs for the Chlorination and Coagulation Systems Installed by the EPT Project on the Tuyamuyun-Nukus And Tuyamuyun-Urgench Pipeline Systems in Uzbekistan

	Chlorination		Coagulation		Total	
Item	($)	(Cym)	($)	(Cym)	($)	(Cym)
Electricity	600	33,000	7,000	385,000	7,600	418,000
Supplies and Lubricants	1,000	55,000	2,500	137,500	3,500	192,500
Maintenance Labor	0	0	0	0	0	0
Equipment	0	0	0	0	0	0
Replacement Parts	5,000	275,000	12,500	687,500	17,500	962,500
Chlorine	165,000	9,075,000	n/a	n/a	165,000	9,075,000
Coagulation Chemicals	n/a	n/a	100,100	5,505,500	100,100	5,505,500
Total for Each Pipeline	171,600	9,438,000	122,100	6,715,500	293,700	16,153,500
Total for Both Pipelines	343,200	18,876,000	244,200	13,431,000	587,400	32,307,000

Note: The exchange rate used here is: 55 cym / dollar.
The labor and equipment required to maintain these facilities is already available at each site. There is no incremental cost for labor or equipment.

Source: Cost data provided by R. Hoffman of CH2M-Hill in Moscow, October, 1996.

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Table ~~D1~~. S-11
Estimated Annual Operation and Maintenance Costs
For the Tuyamuyun-Nukus and Tuyamuyun-Urgench
Pipeline Systems in Uzbekistan, January to September, 1996

Item	Tuyamuyun-Nukus		Tuyamuyun-Urgench	
	Cym	Dollars	Cym	Dollars
Labor Payments	13,078,000	237,782	12,267,000	223,036
Labor Surcharges	5,232,000	95,127	4,906,000	89,200
Electricity	64,141,000	1,166,200	70,485,000	1,281,545
Fuel	3,513,000	63,873	3,822,000	69,491
Chemicals	3,162,000	57,491	9,935,000	180,636
Depreciation	9,335,000	169,727	6,412,000	116,582
Repair Fund	5,204,000	94,618	3,056,000	55,564
Overhead and Workshop Operations	5,946,000	108,109	1,804,000	32,800
Other Expenses (non-operational)	2,463,000	44,782	2,457,000	44,673
Total	112,074,000	2,037,709	115,144,000	2,093,527
Annual Equivalent	149,058,420	2,710,153	153,141,520	2,784,391
Cost per cubic meter	3.61	0.07	2.31	0.04

Note: The exchange rate used in this table is: 55 cym / dollar.
The volume delivered in the Nukus system is: 31,040,000 cubic meters.
The volume delivered in the Urgench system is: 49,835,000 cubic meters.
The annual equivalent cost is obtained by multiplying the nine-month cost estimates by 1.33 to approximate full-year expenditures.

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Table ~~D2.~~ 5-12
Water Prices and Volumes Delivered in Karakalpakstan and Khorezm Oblast, By User Group, 1995

Volume of Water Delivered				
	Karakalpakstan	Khorezm	Karakalpakstan	Khorezm
	(1000 cubic meters)		(proportion of sales, %)	
Group 1	22,015	26,571	46.7	43.0
Group 2	18,093	14,586	38.4	23.6
Group 3	7,001	20,621	14.9	33.4
Total	47,109	61,778	100.0	100.0

Water Prices				
	Karakalpakstan	Khorezm	Karakalpakstan	Khorezm
	(cym per cubic meter)		(dollars per cubic meter)	
Group 1	0.50	0.35	0.009	0.006
Group 2	14.22	6.70	0.259	0.122
Group 3	14.22	7.90	0.259	0.144

Expected Revenue From Water Sales				
	Karakalpakstan	Khorezm	Karakalpakstan	Khorezm
	(1000 cym)		(1000 dollars)	
Group 1	11,008	9,300	200	169
Group 2	257,282	97,726	4,678	1,777
Group 3	99,554	162,906	1,810	2,962
Total	367,844	269,932	6,688	4,908

Expected Weighted Average Prices				
	Karakalpakstan	Khorezm	Karakalpakstan	Khorezm
	(cym per cubic meter)		(dollar per cubic meter)	
Average	7.81	4.37	0.14	0.08

Note: The exchange rate used here is: 55 cym/dollar.

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Table ~~D.3.~~ 5-13
Estimated Costs, Revenues, and Budget Deficit for the
Tuyamuyun-Nukus and Tuyamuyun-Urgench Pipeline Systems
During January Through September, 1996

	Tuyamuyun-Nukus		Tuyamuyun-Urgench	
	Cym	Dollars	Cym	Dollars
Actual Expenses	112,074,000	2,037,709	115,144,000	2,093,527
Actual Revenue	24,985,000	454,273	25,712,000	467,491
Budget Deficit	87,089,000	1,583,436	89,432,000	1,626,036

Note: The exchange rate used here is: 55 cym/dollar.

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Table ~~D4~~. 5-14
Evaluating Alternative Water Pricing Scenarios for the Tuyamuyun-Nukus Pipeline System, Using Actual Costs and Deliveries for January through September 1996, And the Actual Distribution of Sales Among Groups for 1995

Water Pricing Policy Scenario	Water Prices Required to Raise Revenue to Recover Annual Costs			Expected Total Revenue
	Group 1	Group 2	Group 3	
	(cym per cubic meter)			(1000 cym)
1 Current price structure, in which residents pay 13.8% of full cost and others pay a higher price.	0.50	14.22	14.22	322,321
2 Residents pay only 13.8% of full cost. Other groups are charged a price higher than full cost.	0.50	6.34	6.34	149,058
3 Residents pay only 20% of full cost. Other groups are charged a price higher than full cost.	0.72	6.14	6.14	149,058
4 Residents pay only 40% of full cost. Other groups are charged a price higher than full cost.	1.44	5.51	5.51	149,058
5 Residents pay only 60% of full cost. Other groups are charged a price higher than full cost.	2.17	4.88	4.88	149,058
6 Residents pay only 80% of full cost. Other groups are charged a price higher than full cost.	2.89	4.24	4.24	149,058
7 All water users are charged the average cost of water delivery	3.61	3.61	3.61	149,058

Notes: The following water deliveries are estimated for 1996, based on data for Jan. to Sept.:

Group 1	19,292	thousand m3
Group 2	15,856	thousand m3
Group 3	6,135	thousand m3
Total	41,283	thousand m3

The average cost of water delivery on the Tuyamuyun-Nukus Pipeline System is taken to be: 3.61 cym per cubic meter.
Total annual costs are estimated to be: 149,058 cym.
This program sets the price for Group 2 at 100 % of the price charged to water users in Group 3.

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Table ~~D5~~. 5-15

Evaluating Alternative Water Pricing Scenarios for the Tuyamuyun-Urgench Pipeline System, Using Actual Costs and Deliveries for January through September 1996, And the Actual Distribution of Sales Among Groups for 1995

Water Pricing Policy Scenario	Water Prices Required to Raise Revenue to Recover Annual Costs			Expected Total Revenue
	Group 1	Group 2	Group 3	
	(cym per cubic meter)			(1000 cym)
1 Current price structure, in which residents pay 15.0% of full cost and others pay a higher price.	0.35	6.70	7.90	289,508
2 Residents pay only 15% of full cost. Other groups are charged a price higher than full cost.	0.35	3.44	4.04	153,142
3 Residents pay only 20% of full cost. Other groups are charged a price higher than full cost.	0.46	3.36	3.95	153,142
4 Residents pay only 40% of full cost. Other groups are charged a price higher than full cost.	0.92	3.04	3.58	153,142
5 Residents pay only 60% of full cost. Other groups are charged a price higher than full cost.	1.39	2.73	3.21	153,142
6 Residents pay only 80% of full cost. Other groups are charged a price higher than full cost.	1.85	2.41	2.84	153,142
7 All water users are charged the average cost of water delivery	2.31	2.31	2.31	153,142

Notes: The following water deliveries are estimated for 1996, based on data for Jan. to Sept.:

Group 1	28,508	thousand m3
Group 2	15,649	thousand m3
Group 3	22,124	thousand m3
Total	66,281	thousand m3

The average cost of water delivery on the Tuyamuyun-Urgench Pipeline System is taken to be: 2.31 cym per cubic meter.
Total annual costs are estimated to be: 153,142 cym.
This program sets the price for Group 2 at 85 % of the price charged to water users in Group 3.

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Estimated Water Prices for Groups of Water Users in the T-Nukus System

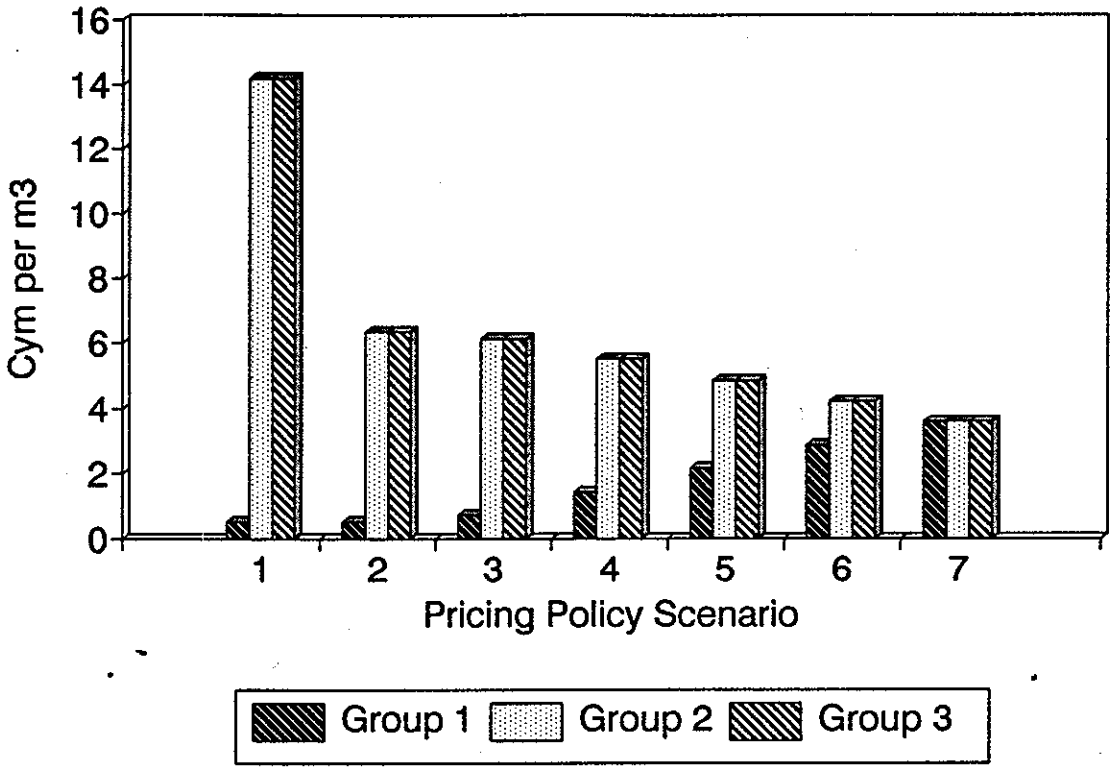

Figure ~~4.1~~ 5-3

Estimated Water Prices for Groups of Water Users in the T-Urgench System

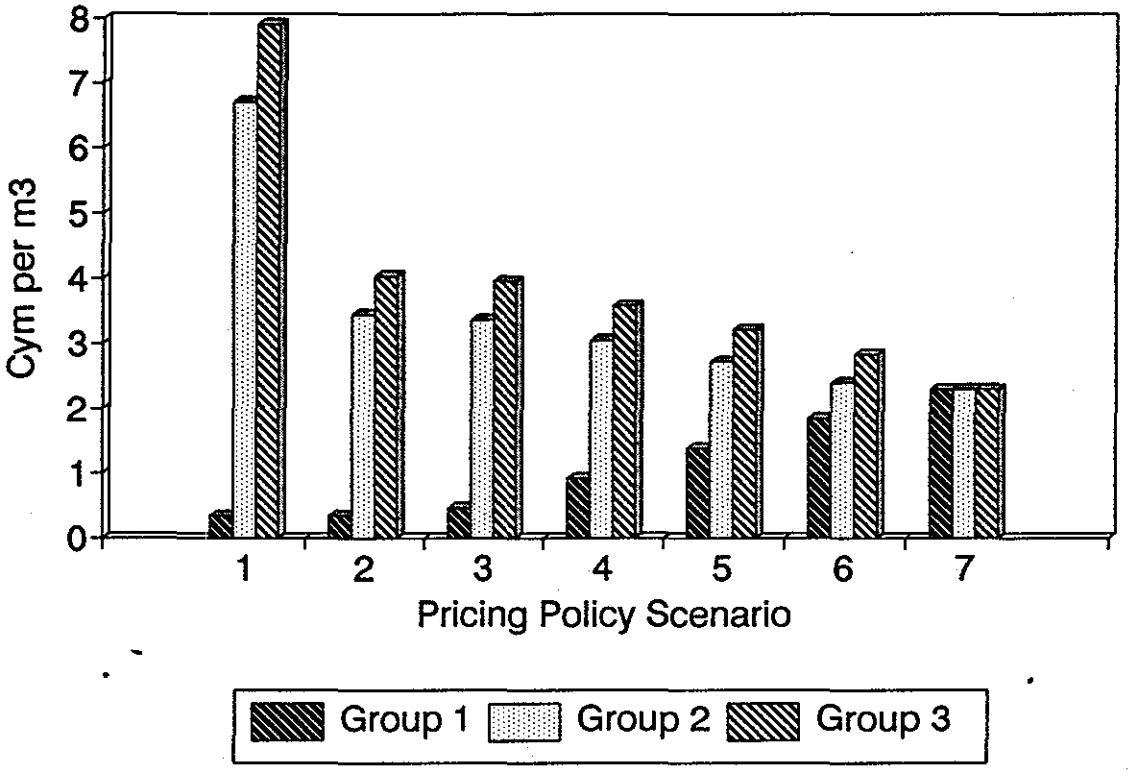

Figure ~~4.2~~ 5-4

Appendix A

Descriptions of EPT Engineering Projects in the Central Asian Republics

ENVIRONMENTAL POLICY AND TECHNOLOGY PROJECT
Central Asian Regional Office

OVERVIEW OF THE U.S. ARAL SEA PROGRAM

Special area - Alleviate human suffering caused by the ecological disaster in the Aral Sea.
Program objective - Reduce environmental risks to public health.
Geographical area - Five countries in the Amu Darya and Syr Darya basins in Central Asia.

WATER SYSTEM ACTIVITIES

* Improve the water quality and reliability of water supply facilities.
  - Kazakstan:
    - wellfield rehabilitation and well system equipment replacement, and
    - transmission pump system equipment replacement.
  - Turkmenistan:
    - demineralized water treatment plant design and installation, and
    - water distribution program for truck delivery.
  - Uzbekistan:
    - technical operations assistance at two major water plants, and
    - selected equipment replacement for improved operations.

PUBLIC HEALTH ACTIVITIES

* Improve water quality monitoring and public health education.
  - Kazakstan:
    - laboratory equipment and training at five selected laboratories, and
    - interagency health education program and demonstration projects.
  - Turkmenistan:
    - laboratory equipment and training at one selected laboratory, and
    - health education and sanitation program and demonstration projects.
  - Uzbekistan:
    - laboratory equipment and training at three selected laboratories, and
    - interagency health education program and demonstration projects.

REGIONAL WATER POLICY ACTIVITIES

* Increase regional cooperation in water management.
  - Central Asian Republics:
    - series of interrelated workshops on water policy and pricing;
    - promote systemic policy and institutional strengthening for water management;
    - facilitate regional agreements on water use and energy generation;
    - leverage donor resources to support integration of policy activities; and
    - develop and fund applied demonstration projects and partnerships in related water management and policy issues, such as decision support, environmental assessment of damages, water pricing, and allocation.

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ENVIRONMENTAL POLICY AND TECHNOLOGY PROJECT
Central Asian Regional Office

SUMMARY OF THE U.S. ARAL SEA PROGRAM

The Aral Sea is a major environmental disaster in Central Asia which directly affects Kazakstan, Uzbekistan, and Turkmenistan; and indirectly the Kyrgyz Republic and Tajikistan. Thirty years ago, the Aral Sea was the fourth largest inland lake in the world; today, the sea level has fallen 15 meters, the surface area has been reduced by one-half and the salinity levels have tripled. The effects include: destroyed ecosystems, an end to commercial fishing, and drastic declines in health levels for people in the region. The disaster stems directly from huge diversions of water from the Amu Darya and Syr Darya which formerly fed the Aral Sea. Inefficient irrigation practices, excessive use of chemicals and fertilizers, lack of adequate drainage, and contaminated groundwater all combined to create an environmental disaster as a result of decisions to focus primarily on the production of cotton and rice for the former Soviet Union.

In March 1993, the five Central Asian presidents met in Kyzl-Orda, Kazakstan and established an Inter-state Council for the Aral Sea (ICAS) pledgeding one percent of the GDP in each country to be devoted to addressing the problems of the Aral Sea. This commitment was reaffirmed by the presidents with the execution of the Nukus Declaration in September 1995. In addition, the World Bank hosted Donors' Meetings to mobilize international resources to address the problems of the Aral Sea. There is little chance that the Aral Sea can be "saved" over the short term; therefore, initial assistance focuses on the most serious human impacts of the disaster, as well as setting the stage for addressing water policy issues in a more systematic manner. The World Bank's Aral Sea program consists of two phases: (1) analysis, design and pilot activities valued at more than US$40 million; and (2) a second phase with the implementation of the planned projects estimated to cost US$470 million over three to four years. Other donors, such as the European Union and the Swiss Government, are also implementing projects in the region.

Based on an initial commitment made by Secretary of State Warren Christopher in October 1993, the USG has provided more than US$22 million in humanitarian assistance in the Aral Sea disaster area. The U.S. Aral Sea Program is being implemented for USAID by the Environmental Policy and Technology (EPT) project which is a NIS program managed by CH2M Hill International, Inc. USAID is the first international donor providing concrete assistance and has completed local projects addressing water supply and health needs of the affected populations in three countries near the Aral Sea. Specific benefits from this program include: (1) greater access to safe water through water system reliability improvements, (2) reduced bacterial contamination through improved water quality improvements, (3) improved public health through health education programs and sanitation demonstration projects in three countries, and (4) water management policy improvements through regional cooperation. These activities include:

Kazakstan - These activities focus on the western area of Kyzl-Orda Oblast and include: water supply improvements at wellfields and transmission system improvements for system reliability, water quality monitoring equipment and training, and public health education programs that provide training and support for community-based sanitation projects. It is estimated that 200,000 people will benefit from the water system improvements and 300,000 will benefit from the public health education programs. Laboratory equipment was provided to five laboratories in February 1995, several wells were rehabilitated in August 1995, and chlorination equipment was installed

at eight pump stations in September 1995. Detailed designs for pump station improvements were completed and the replacement equipment is being installed and will be completed late 1996. These efforts include the collaboration with the World Bank program for complementary activities such as the repair of the main water transmission line and selected municipal system improvements that are beyond the funding limit of the USAID program.

Turkmenistan - These activities focus on the Turkmenbashi area in Dashhovuz Velayat near the Aral Sea. and include: the installation of a demineralized water treatment plant; water quality monitoring equipment; and public health education programs. The water treatment plant will benefit 100,000 people and the public health education programs will benefit about 200,000 people. The water treatment plant began operations in August 1995 and full scale testing was completed in March 1996. Continued plant operations and maintenance training and support is being provided by the EPT project until December 1996. The public health program began with field assessments followed by training seminars in April 1995. Demonstration health projects will be implemented in late 1996.

Uzbekistan - These activities focus on Karakalpakstan and Khorezm Oblast in the delta of the Amu Darya near the Aral Sea and include: equipment and training at two water treatment plants, and public health education programs. Operations training was conducted in the summer of 1995, and new chlorination equipment was installed at two large water treatment plants in August 1995. Additional chlorination equipment was installed in the cities of Nukus, Urgench, kegeili, and Chimbai in the summer of 1996. Also, chemical feed and metering equipment is being installed at the two plants and will be completed in late 1996. In addition, extended operations training will be provided at these facilities after installation of the equipment. A public health education seminar was conducted in April 1995 and included the identification of health demonstration projects. A least 1,000,000 people will benefit from operational improvements at the water treatment plants and about 400,000 will benefit from the public health education programs.

Regional Cooperation - The Aral Sea disaster represents a policy failure on the part of the former Soviet regime due to efforts to make Central Asia a cotton growing area regardless of the environmental costs. The Regional Cooperation program provides policymakers from all five countries opportunities to discuss common concerns and develop a rational, policy-based strategy for dealing with the cause of the disaster. A water management study tour was conducted in April 1994 to the western United States for 22 senior policymakers from the five countries to define the critical policy issues and see how U.S. agencies address common water issues. As a result. additional workshops were conducted: (1) in December 1994 in Tashkent, Uzbekistan on information management issues; (2) in May 1995 in Ashgabat, Turkmenistan on water policy issues: and (3) in November 1995 in Bishkek, Kyrgyz Republic on water pricing issues. A joint-donor water quality standards seminar was also conducted in Tashkent in August 1995. These activities highlighted the importance of coordinated approaches to rational water policies. This regional approach is producing results: 1) a water sharing agreement was executed in Shymkent, Kazakstan in April 1995 by the water ministers from all five Central Asian Republics; 2) water pricing is being developed in the CAR; and 3) agreements are being facilitated for water quality and a major hydroelectric facility.

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ENVIRONMENTAL POLICY AND TECHNOLOGY PROJECT
Central Asian Regional Office

TURKMENISTAN ACTIVITIES
WATER SYSTEM IMPROVEMENTS PROGRAM

GENERAL DESCRIPTION

This is a summary of the field activities conducted by CH2M Hill as part of the EPT program in Turkmenistan. This assistance is provided by the United States Agency for International Development based on a Memorandum of Understanding executed on February 17, 1994 between the Government of the United States and the Government of Turkmenistan. The U.S. Aral Sea Program is intended to provide technical support "to cooperate in a mutual effort to help meet critical potable water needs of the rayon ... and to promote improved environmental health."

A water treatment facility was planned to provide the critical water needs for the population of Turkmenbashi Etrap in Dashhovuz Veleyat near the Aral Sea. The Turkmenbashi Water Treatment Plant was designed to treat saline groundwater from wells and provide an improved water quality source for almost 100,000 people in the area. The capacity of the facility is based on the concentration of total dissolved solids (TDS) in the groundwater and the hours of operation. The rated capacity of the facility is approximately 750 cubic meters per day. The plant processes remove 99 per cent of the TDS and organic compounds in the well water. The water produced exceeds the World Health Organization (WHO) guidelines for potable water. A blending option of well and treated water was provided to reduce the production costs.

The treatment processes include sand separation, filtration, chemical adjustment, membrane desalting, corrosion control, and disinfection. The potable water produced will be stored in a reservoir on site for truck distribution to cisterns or through a dispensing facility at the plant for individual containers. The facilities at the site include: a building with the plant processing equipment; a building that contains a dispensing area, an office, a laboratory, and a maintenance and storage area; and an underground water storage reservoir. Construction began in late 1994 and plant operations were initiated by the President of Turkmenistan in August 1995. Plant operations were completed with a full-scale performance test completed in February 1996, and the facility was received by the Government of Turkmanistan in March 1996.

PROCESS DESCRIPTION

The treatment process is divided into three parallel "trains" which consist of supply wells, sand separator, bag cartridge, filter cartridge, high pressure pump and reverse osmosis membrane units. Each process train can be operated individually and has one-third the plant rated capacity, or about 250 cubic meters per day. Water is pumped from six deep wells on the site that are about 60 meters deep with two wells for each process train. Each well has a capacity of about 2 liters per second. The well water is processed through a cyclone sand separator to remove sand and course particles in the water. This is followed by bag filters to remove fine particles greater than 20 microns that may clog the membranes. Pressure gages are located at the inlet and outlet of the filters to determine when the filters should be cleaned.

Pretreatment chemicals are added to the water to prevent scaling in the reverse osmosis units. For example, sulfuric acid is added to prevent carbonate scaling while an anti-scalant is used to prevent other chemicals from being deposited. The pH of the water is then adjusted prior to passing to the membranes. Cartridge filters are used as safety filters to remove any fine particles larger than 5 microns that pass through the bag filters.

High pressure pumps operating at about 20 kilograms per square centimeter pump the filtered water to the spiral wound semi-permeable membranes. Product water, or permeate, passes through the membranes and is followed by chemical treatment. Sodium hydroxide is added for pH control, sodium hypochlorite is added for disinfection, and a corrosion inhibitor is added to prevent corrosion in the piping. The concentrate, or waste water that is high in contaminants, is discharged to the canal and represents about 25 per cent of the plant flow. The treated water is pumped to the 400 cubic meter reservoir prior to being pumped to the distribution trucks. Two truck loading stations are provided and water can also be pumped to the dispensing system by a hydropneumatic system.

EXTENDED OPERATIONS PLAN

The plant operations is presently constrained by the vehicle delivery system. The World Bank provided twelve 3.9 cubic meter capacity trucks in August 1996 and USAID provided three 5.4 cubic meter capacity trucks in September 1996. The Government is begining to use these vehicles in addition to private vehicles from the collective farms. During plant operations it is intended that: (a) one operator is responsible or process control and operation and maintenance, (b) the second operator is responsible for the truck loading delivery system, and (c) the third operator would assist in the container dispensing system. The laboratory technician conducts periodic analyses of the product water to ensure the water quality. The plant manager is responsible for the overall facility operations and the plant records.

Preliminary training was conducted by the manufacturer in the United States in November 1994 at a similar facility for ten participants from Turkmenistan. Training was conducted until February 1996 when a full-scale plant performance test was completed and the Government of Turkmenistan accepted the responsibility for the facilities. At that time, a transition was made from the manufacturer of the equipment to EPT plant operations personnel. An EPT plant manager is responsible for process operations and chemical control, and an EPT deputy plant manager is responsible for the electrical, mechanical, and instrumentation functions. Three EPT senior operators have been trained and are assisting in the operation of the facility. An engineering advisor is providing oversight and visits the plant on a monthly basis. Additional detailed training will be provided for the government personnel on site until December 1996.

More than two years of treatment and cleaning chemicals for normal operation were provided by USAID with spare parts. A financing report was completed that included recomendations for budgeting the recurring costs of the facility. A distribution plan was also provided to the government and an enlarged service area is being considered. These extended operational services are being provided at the facility by EPT personnel until December 1996. At that time, it is anticipated that full plant operations will be assigned to the plant personnel from the Dashhovuz Veleyat.

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ENVIRONMENTAL POLICY AND TECHNOLOGY PROJECT
Central Asian Regional Office

TURKMENISTAN ACTIVITIES
SUMMARY OF EQUIPMENT INSTALLED

I. TURKMENBASHI WATER TREATMENT PLANT

A. Water Supply System -

1. Six Water Supply Wells and Well Houses
   - Capacity of 2 lps each provided and installed by the GOT, and
   - Well pump motor starters and control equipment.
2. Wellfield Transmission Pipe
   - 1790 meters of pipe provided and installed by the GOT.

B. Treatment System -

1. Two Metal Buildings
   - Each building (21m x 10.5 m) is completed with insulation, partition panels, doors, lights, backup heating, lightning protection, finish flooring, laboratory, and office. Materials for building slabs were purchased locally. Primary heating (hot water) was provided and installed by the GOT.
2. Pretreatment Equipment
   - manifold skid with pipe, control valves, and gauges;
   - sand separator skid with three centrifugal separators and piping and valves;
   - bag filter skid with three bag filters with piping and valves;
   - pretreatment chemical skids with acid and antiscalant feed pumps, storage tanks with piping and valves; and
   - cartridge filter skid with three cartridge filter with piping and valves.
3. Desalination Equipment
   - three membrane skids each with a high pressure pump, six fiberglass pressure vessels containing semipermeable membranes, control valves, control panel, and associated piping.
4. Post Treatment Equipment
   - three post treatment chemical skids with sodium hydroxide, sodium hypochlorite, and corrosion inhibitor each with three chemical feed pumps, storage tanks and associated piping and valves.
5. Ancillary Equipment:
   - cleaning system skid with storage tank, pump, heater, and mixer;
   - power system with main disconnect switch, main motor control center, galvanized steel conduits, and power supply wires;
   - control system with common control panel and local control equipment and lighting panels;
   - lighting protecting and grounding system;
   - safety equipment with two safety showers and safety clothing; and
   - laboratory equipment including conductivity, pH, and colorimeter meters with chemical reagents.

C. Water Storage and Distribution Systems

1. Concrete storage reservoir
   - precast reservoir (21m x 6m x 3.6m high) with a storage volume of 400 m3 designed and installed by GOT. Materials were purchased locally.

D. Water Distribution System

1. Truck Loading Equipment
   - two truck loading pumps, associated piping and valves;
   - hydropneumatic pump, tank, and air compressor; and
   - dispensing bench with piping and valves.
2. Delivery Vehicles (Sep. 1996)
   - three 5 cubic-meter diesel trucks, spare parts, and operations manual.

E. Site Sanitary and Drainage Systems

1. Site Sanitary Facilities
   - two compartment pit privy designed and installed by the GOT.
2. Site Drainage
   - gravity drainage system with manholes to the drainage canal provided and installed by the GOT.

F. Additional Plant Materials

1. Treatment and Cleaning Chemicals
   - supply for more than two years at normal plant operations.
2. Miscellaneous Tools and Spare Parts
   - assortment of operation and maintence tools, and
   - variety of spare parts needed for operation.

G. Operations Training

1. Collaborated with NET for operations training in the US (November 1994),
2. Preliminary training at the site (November 1995),
3. Final operations and maintenance manual (February 1996), and
4. Extended operations and training (continuous until December 1996).

H. Office Equipment

1. Office furniture including a desk, two file cabinets, and chairs (1995);
2. Record Drawings of all facilities (September 1996);
3. computer, printer. software, and accessories (October 1996); and
4. Two-way radios for local communications (October 1996).

II. DASHHOVUZ HEALTH CENTER

A. Health Education Materials (April 1995)

1. Miscellaneous training materials.

B. Office Equipment (June 1995)

1. Desk copier, cartridge, and paper.

III. SANITARY AND EPIDEMOLOGICAL SERVICES

A. Turkmenbashi Laboratory Equipment (October 1996)

1. Basic water quality laboratory;
2. portable laboratory, pH meter, and accessories; and
3. Related materials, reagents, and training.

IV. PARTNERSHIPS, APPLIED DEMONSTRATION PROJECTS, WORKING COMMITTEE

A. Office Equipment

1. Ministry of Nature Use and Environmental Protection
   - one computer, one printer, and software (October 1996).
2. Ministry of Melioration and Water Management
   - one computer, one printer, and software (July 1996); and
   - one facsimile machine (May 1996).
3. Turkmengiprovodhoz
   - two computers, one printer, and software (September 1996); and
   - one facsimile machine (October 1996).
4. Turkmenhydromet
   - one computer, one printer, and software (September 1996).
5. Scientific Information Center for ICAS
   - one computer, one printer, and software (October 1996).

Note: All materials identified were provided by USAID through the EPT project except those noted which were provided by the Government of the Turkmenistan (GOT).

SUM.T1A October 1996

ENVIRONMENTAL POLICY AND TECHNOLOGY PROJECT
Central Asian Regional Office

KAZAKSTAN ACTIVITIES
WATER SYSTEM IMPROVEMENTS PROGRAM

GENERAL DESCRIPTION

This is a summary of a series of field investigations conducted in the Aral Sea area of Kazakstan since the summer of 1994 by CH2M-Hill field teams as part of the EPT program activities. The purpose of these visits were to define the scope of work and implement the activities which are included in the Memorandum of Understanding executed on 18 March 1994 between the Government of the United States and the Government of Kazakstan. The U.S. Aral Sea program is intended to provide technical support to improve water quality, address immediate public health needs, and develop effective regional water management.

The activities included in the Memorandum of Understanding were negotiated to provide a staged program of water supply improvements. Three of the elements have been implemented, i.e., water quality monitoring improvements (provision of laboratory equipment), water quality improvements (provision of chlorination equipment), and health education improvements (public health training.)

The field teams have made site inspections of all facilities in the water system which includes wellfields, transmission pipeline, pumping stations, and distribution systems in Aralsk, NovoKazalinsk, and some rural areas. The field teams interviewed government officials at federal, oblast and rayon levels. Detailed technical information was compiled for each facility which were used for the implementation program. Detailed technical reviews were conducted periodically by the Kazakstani representatives and detailed recommendations were made. A hands-on improvements program was initiated in the summer of 1995 beginning at the wellfields and continuing along the transmission line and pump stations. In May 1996, the Minister of Finance allocated almost $2 million to the State Committe on Water Resources to support the EPT activities which will continue in the summer of 1996 with a major implementation program.

RECOMMENDATIONS

Recommendations were made to the Kazakstan State Committee on Water Resources for a series of priority projects based on the results of the field investigations, and include a detailed technical assistance program, with the following elements:

1. Provision of water monitoring equipment at five locations in the cities of Aralsk and NovoKazalinsk laboratories and the Sanitary and Epidemiological Services laboratories in Aralsk, NovoKazalinsk and Kzyl Orda.

2. Provision of water chlorination equipment and training at the following eight locations:
   * Pump stations 1 and 2 in the two wellfields,
   * Pump station 3 near the city of Aralsk.

* Pump stations 4, 5 and 7 near the rural settlements,
* the city of Aralsk pump station, and
* the city of NovoKazalinsk water treatment plant.

3. Provision of equipment and training to improve the reliability of the water supply from the wellfields that included an on-site testing program and the replacement of submersible pumps and motors in three wells. The preparation of a comprehensive program of wellfield improvements is being completed to continue these activities after the winter.

4. Provision of equipment and training to improve the reliability of the main transmission system by replacing equipment at six pump stations serving the main pipeline and one pump station serving the City of Aralsk, including pumps, motors, fittings, selected piping, motor control centers,and power transformers.

5. Provision of equipment and training to improve the operations and maintenance with six diesel welding units for the wellfields, transmission line, and the cities of Aralsk and NovoKazalinsk.

6. Development of a public health education and training program to address the critical health issues of the population with a focus on water and sanitation activities, and the development of grass-roots demonstration projects by the local agencies for practical training.

7. Recommendations for institutional improvements to ensure the sustainability of the technical assistance, including the following:
   * chlorine supply requirements for the continued operation of the equipment installed,
   * local budgetary support for all systems for proper operation and maintenance, and
   * development of interagency agreements to ensure payments and cost recovery for water.

Additional priority projects will be implemented as funding is available from USAID or other donors. The World Bank may provide funding for complementary projects, such as the following:

8. Provision of materials and equipment for the replacement of selected distribution piping in the cities of Aralsk and NovoKazalinsk to reduce leakage and improve service in the urban areas. The replacement of piping will be implemented on a phased construction basis by the local authority, and includes 1000 meters of plastic pipe and fittings for each city.

9. Replacement of a portion of the main transmission line between the wellfields and Aralsk, with the possibility of a second stage between Aralsk and NovoKazalinsk, as necessary.

10. Construction of a new pump station for the city of NovoKazalinsk which will provide for the phase-out of the water treatment plant using contaminated water from the SyrDayra as a water source.

October 1996

ENVIRONMENTAL POLICY AND TECHNOLOGY PROJECT
Central Asian Regional Office

KAZAKSTAN ACTIVITIES
SUMMARY OF EQUIPMENT INSTALLED

I. SANITARY AND EPIDEMOLOGICAL SERVICES

A. Kzyl Orda Laboratory Equipment
1. spectrophotometer, reagents and training (February 1995),
2. final laboratory operations manual, (July 1996) and
3. follow-on laboratory assessment and training (October 1996).

B. Kzyl Orda Health Center
1. desk copier, cartridge, and materials (April 1995);
2. health education materials (April 1995),
3. materials for health demonstration projects (October 1996), and
4. audio-visual training equipment (October 1996).

C. Aralsk Laboratory Equipment
1. basic water quality laboratory (February 1995);
2. Spectrophotometer, turbidimeter, pH meter, reagents and training (Feb. 1995);
3. final laboratory operations manual (July 1996), and
4. follow-on laboratory assessment and training (October 1996).

D. Aralsk Health Center
1. desk copier, cartridge, and health education materials (April 1995); and
2. audio-visual equipment (October 1996).

E. NovoKazalinsk Laboratory Equipment
1. basic water quality laboratory (February 1995);
2. spectrophotometer, turbidimeter, pH meter, reagents, training (February 1995);
3. final laboratory operations manual (July 1996), and
4. follow-on laboratory assessment and training (October 1996).

F. NovoKazalimsk Health Center
1. desk copier, cartridge, and health education materials (October 1995); and
2. audio-visual equipment (October 1996).

II. ARALSK ADMINISTRATION FOR WATER AND SEWERAGE

A. Aralsk Laboratory Equipment
1. portable pH meter, turbidimeter, and colorimeter (February 1995);
2. conductivity meter, MEL/MF laboratory, and training (February 1995);
3. final laboratory operations manual (July 1996); and
4. follow-on laboratory assessment and training (October 1996).

B. Aralsk Pump Station Chlorination Equipment

1. chlorination system (45 kg/day), and gas detection system (November 1995);
2. breathing apparatus, emergency kit, and training (November 1995); and
3. final chlorination operations manual (August 1996).

C. Aralsk Welding Equipment (April 1996)

1. one welding unit, mounted on a trailer powered by a 3kw diesel engine;
2. electric grinders, cutting saws, spare parts, and miscellaneous hand tools; and
3. operations and maintenance manual, and training.

D. Aralsk Pump Station Pumping Equipment

1. one 95 lps and two 57 lps pump systems with flow meters (September 1996);
2. electrical equipment, piping equipment, and spare parts (September 1996); and
3. tools, training, and operations manual (September 1996).

III. NOVOKAZALINSK ADMINISTRATION FOR WATER AND SEWERAGE

A. Laboratory Equipment

1. portable pH meter, turbidimeter, and colorimeter (February 1995);
2. conductivity meter, MEL/MF laboratory, and training (February 1995);
3. final laboratory operations manual (July 1996); and
4. follow-on laboratory assessment and training (October 1996).

B. Novokazalinsk Water Treatment Plant Chlorination Equipment

1. chlorination system (45 kg/day), and gas detection system (October 1995);
2. breathing apparatus, emergency kit, and training (October 1995); and
3. final chlorination operations manual (August 1996).

C. Novokazalinsk Welding Equipment (April 1996)

1. one welding unit, mounted on a trailer powered by a 3kw diesel engine;
2. electric grinders, cutting saws, spare parts, and miscellaneous hand tools; and
3. operations and maintenance manual, and training.

IV. BERDYKOL AND KOSAMAN WELLFIELDS OF THE FEDERAL PIPELINE

A. Chlorination Equipment at Pump Stations Nos. 1 and 2

1. chlorination system (45 kg/day), and gas detection system (September 1995);
2. breathing apparatus, emergency kit, and training (September 1995); and
3. final chlorination operations manual (August 1996).

B. Wellfield Pumping Equipment

1. three submersible pumps, motors, and related materials (September 1995);
2. twenty-nine submersible pumps, motors, and related materials (September 1996);
3. fourteen sand seperators and fittings (September 1996); and
4. final wellfield operations manual (October 1996).

C. Pumping Equipment at Pump Stations Nos. 1 and 2 (September 1996)
1. three 210 lps and three 310 lps pumping systems with flow meters;
2. electrical equipment, piping, and spare parts; and
3. tools, training, and operations manual.

V. ARALSK-SORBULACK FEDERAL PIPELINE

A. Chlorination Equipment at Pump Stations Nos. 3, 4, 5, and 7
1. chlorination system (45 kg/day), and gas detection system (October 1995);
2. breathing apparatus, emergency kit, and training (October 1995); and
3. final chlorination operations manual (August 1996).

B. Welding Equipment (April 1996)
1. four welding units, mounted on a trailer powered by a 3kw diesel engine;
2. electric grinders, cutting saws, spare parts, and miscellaneous hand tools; and
3. operations and maintenance manuls, and training.

C. Pumping Equipment at Pump Stations Nos. 3, 4, 5, and 7 (under construction)
1. nine 132 lps and three 63 lps pumping systems with flow meters (Oct. 1996);
2. electrical equipment, piping, and spare parts (October 1996); and
3. tools, training, and operations manual (October 1996).

D. Pumping Equipment for Settlement Areas
1. five 25 lps, two 32 lps, and four 44 lps pumping systems with flow meters (October 1996);
2. electrical equipment, piping, and spare parts (October 1996); and
3. tools, training, and operations manual (October 1996).

VI. PARTNERSHIPS, APPLIED DEMONSTRATION PROJECTS, WORKING COMMITTEE

A. Office Equipment
1. Center for Observation of Pollution of the Environment, KazGidroMet
   - one computer, one printer, and software (July 1996).
2. Interstate Council of Kazakstan, Kyrgyz Republic, and Uzbekistan.
   - one computer, one printer, and software (September 1996).
3. KazNIIMOSK, KazGidroMet
   - four computers, four printers, and software (July to September 1996).
4. KazGidroMet
   - one computer, one printer, and software (October 1996).
5. Ministry of Ecology and Bioresources
   - one computer, one printer, and software (October 1996).
6. State Committee on Water Resources
   - two computers, two printers, and software (August and September 1996); and
   - one facsimile machine (June 1996).
7. Zhetisai District Administration, South Kazakstan Oblast
   - one computer, and printer, and software (October 1996).

VII. ARALSK AND NOVOKAZALINSK HEALTH DEMONSTRATION PROJECTS

A. Water System Materials

1. pipe, fittings, and related materials (October 1996).

B. Health Education Materials (October 1996)

1. computer at the national level;
2. camcorder and TV/VCRs at the oblast level; and
3. overhead projectors and flip charts at the rayon level.

Note: All materials identified were provided by USAID through the EPT project.

SUM.KIA October 1996

ENVIRONMENTAL POLICY AND TECHNOLOGY PROJECT
Central Asian Regional Office

UZBEKISTAN ACTIVITIES
WATER SYSTEM IMPROVEMENTS PROGRAM

GENERAL DESCRIPTION

This is a summary of a series of field investigations conducted in the Aral Sea area of Uzbekistan since the summer of 1994 by CH2M-Hill field teams as part of the EPT program activities. The purpose of these visits were to define and implement the activities which are included in the Memorandum of Understanding executed on 20 April 1994 between the Government of the United States and the Government of Uzbekistan.

The U.S. Aral Sea program in Uzbekistan is intended "to provide water quality improvements and a complementary environmental education programs for critical populations in selected areas of Uzbekistan", as well as promote effective regional water management.

The Nukus and Urgench water treatment plants are well designed, conventional water treatment plants that use the surface water from the Tuyamuyun Reservoir on the AmuDarya. The plants were constructed in 1985 and each plant can produce 200,000 m^3/day of potable water. The state of repair of the plants is generally good; however, some systems need upgrading with new equipment at both plants. Finished water is pumped through long transmission lines to the city and rural areas. Expansion of both plants is being considered by the Government of Uzbekistan.

The plants are not producing potable water by international standards, i.e., the World Health Organization (WHO) guidelines. This is due to out-dated local standards that allow highly turbid and poorly disinfected finished water in the transmission system. Microbiological contaminants such as bacteria may be present in the finished water which may cause acute (infectious) health problems to the population served by these plants. Both plants have the unit processes and operations (i.e., clarification, filtration, and chlorination) needed to achieve these standards. Facility improvements needed for microbiological treatment include new chlorination (disinfection) equipment and upgraded laboratory equipment. Improved operational methods and selected equipment are also needed to optimize clarifier and filter performance, and extensive operator training is being implemented.

To assess the potential health impacts on the people receiving the treated water, the concentration of contaminants in the raw water needs to be established. Once these concentrations are established, comparative risk assessment studies can be conducted to establish the threat to public health. In May 1996, EPT and the Centers for Disease Control began collaboration on a demonstration health evaluation in Nukus to determine the reduction in diareheal disease from provision of adequately disinfected water. Installation of new and upgraded treatment processes at the existing water treatment plants is not advised until risk assessment and treatment feasibility studies are completed.

IMPROVEMENTS PROGRAM

The following recommendations have been developed based on the EPT field investigations:

* The Government should adopt WHO guidelines for potable water. These guidelines should be carried out in a phased approach with Phase I improvements based on: (a) eliminating contaminants such as bacteria that cause acute health problems, and (b) conducting engineering and risk assessment studies as leading to overall improvements to the regional water systems.

* Specific improvements relate to the reduction of contaminants causing acute health problems should be based on reducing turbidity to 1.0 NTU and increasing disinfection to provide a "free" chlorine residual of 0.2 mg/l in the finished water, and the following tasks have been completed:
  - Installed new chlorination systems (900 kg/day) at both plants that includes scales, evaporators, chlorinators, injectors, associated piping and valves, venting systems, alarm systems and safety equipment with the associated training in August 1995;
  - Provided new laboratory equipment and reagents to ensure that plant processes are operating properly and efficiently in February 1995, and additional reagents and materials were provided in August 1996;
  - Installed chlorination systems (900 kg/day) at the Nukus and Urgench water distribution reservoirs in August 1996;
  - Installed chlorination systems (90 kg/day) at the Chimbai and Kagieli Pump Stations in Karakalpakstan in August 1996; and
  - Installed filter valve control panels at both plants and a labeling program for improved plant operations in May 1996.

* Provide limited equipment for physical immprovements to the clarification and filtration systems at both plants, that include the following scheduled for late 1996:
  - Coagulant transfer and feed pump systems,
  - Polymer feed pump systems, and
  - Flow measuring devices at the radial clarifiers.

* Provide operator training to optimize the clarifiers, filters and other unit processes in order to meet the proposed new standards. Operator training was provided during 1995 and 1996, and extensive operations training will be provided in early 1997.

* The Government should institute an annual budget to ensure adequate operation and maintenance of the plants including a reliable supply of chemicals and repair parts. Based on these interventions, the Government of Uzbekistan is provided increased support for chemicals.

* Conduct a risk assessment and advanced treatment feasibility study to determine if exposure levels from contaminants, such as pesticides and metals, in the raw water are great enough to justify adding advanced treatment processes at the plants.

* Conduct an engineering study of the distribution system to determine how finished water from the plants is managed both in the transmission pipelines and in the distribution systems.

ENVIRONMENTAL POLICY AND TECHNOLOGY PROJECT
Central Asian Regional Office

UZBEKISTAN ACTIVITIES
SUMMARY OF EQUIPMENT INSTALLED

I. MAIN ADMINISTRATION FOR HYDROMETEOROLOGY

A. Computer Equipment for Workshop
1. computer, printer, software, and accessories (November 1994).

II. NUKUS SANITARY AND EPIDEMIOLOGICAL SERVICES

A. Laboratory Equipment
1. spectrophotometer, reagents and training (February 1995);
2. final laboratory operations manual (July 1996); and
3. follow-on laboratory assessment and training (August 1996).

B. Office Equipment
1. desk copier, cartridge, and materials (September 1995).

III. TUYAMUYUN-NUKUS WATER TREATMENT PLANT

A. Laboratory Equipment (February 1995)
1. water quality laboratory, and spectrophotometer;
2. portable and laboratory turbidimeter and pH meter;
3. conductivity/TDS meter, and MEL/MF laboratory; and
4. related materials, supplies, reagents and training.

B. Additional Laboratory Equipment (August 1996)
1. laboratory operations manual;
2. conductivity meter, portable turbidimeter, and pocket colorimeter;
3. regent sets for chlorine, chloride, hardness, zinc, and other parameters;
4. extensive supply of laboratory materials; and
5. follow-on laboratory assessment and training.

C. Chlorination Equipment (August 1995)
1. three chlorinators (900 kg/day), two ejectors, and chlorination piping;
2. chlorine emergency units, two self-contained breathing apparatuses; and
3. alarm systems, spare parts, accessories, and training.

D. Plant Equipment
1. eighteen control panels for filter operation (April and May 1996);
2. six alum pumps for chemical addition (October 1996);
3. two polymer pumps for treatment (October 1996); and
4. related materials. piping, accessories, and supplies.

E. Operations Training

1. on-site plant operation evaluations conducted (July and August 1994),
2. collaborated with NET Water Management training in the US (March 1995),
3. collaborated with NET Water Operations training in the US (July 1995),
4. on-site operations training conducted (July and August 1995),
5. wiring and training for filter control panels (April 1996), and
6. labeling program for improved plant operations (May 1996).

F. Office Equipment (purchased and held pending training)

1. one computer, printer, software, and accessories;
2. copy machine, and facsimile machine; and
3. overhead projector, slide projector, camcorder, and TV/VCR.

IV. TUYAMUYUN-URGENCH WATER TREATMENT PLANT

A. Laboratory Equipment (February 1995)

1. water quality laboratory, and spectrophotometer;
2. portable and laboratory turbidimeter and pH meter;
3. conductivity/TDS meter, and MEL/MF laboratory; and
4. related materials, supplies and reagents and training.

B. Additional Laboratory Equipment (August 1996)

1. final laboratory operations manual;
2. conductivity meter, portable turbidimeter, and pocket colorimeter;
3. reagents sets for chlorine, chloride, hardness, zinc, and other parameters;
4. extensive supply of laboratory materials; and
5. follow-on laboratory assessment and training.

C. Chlorination Equipment (August 1995)

1. three chlorinators (900 kg/day), two ejectors, and chlorination piping;
2. chlorine emergency units, two self-contained breathing apparatuses; and
3. alarm systems, spare parts, accessories, and training.

D. Plant Equipment

1. eighteen control panels for filter operation (April and May 1996);
2. six alum pumps for chemical addition (October 1996);
3. two polymer pumps for treatment (October 1996); and
4. related materials, piping, accessories, and supplies.

E. Operations Training

1. on-site plant operation evaluations conducted (July and August 1994);
2. collaborated with NET Water Management training in the US (March 1995);
3. collaborated with NET Water Operations training in the US (July 1995);
4. on-site operations training conducted (July and August 1995);
5. wiring and training for filter control panels (April 1996); and
6. labeling program for improved plant operations (May 1996).

F. Office Equipment (purchased and held pending training)
   1. one computer, printer, software, and accessories;
   2. copy machine, facsimile machine, and accessories; and
   3. overhead projector, slide projector, camcorder, and TV/VCR.

V. CITY OF NUKUS WATER DISTRIBUTION SYSTEM

A. Chlorination Equipment at the Nukus Reservoir (August 1996)
   1. two chlorinators (900 kg/day), related equipment and piping;
   2. chlorine emergency kits, self-contained breathing apparatus; and
   3. alarm systems, spare parts, accessories, and training.

B. Chlorination Equipment at the Chimbai and Kagieli Pumping Stations (August 1996)
   1. two chlorinators (90 kg/day), related equipment and piping;
   2. chlorine emergency kits, self-contained breathing apparatus; and
   3. alarm systems, spare parts, accessories, and training.

VI. CITY OF URGENCH DISTRIBUTION SYSTEM

A. Chlorination Equipment at the Urgench Reservoir (September 1996)
   1. two chlorinators (900 kg/day), related equiment and piping;
   2. chlorine emergency kits, self-contained breathing apparatus; and
   3. alarm systems, spare parts, accessories, and training.

VII. URGENCH OBLAST HEALTH CENTER

A. Office Equipment (April 1995)
   1. desk copier, cartridge, and materials.

B. Health Education Materials (April 1995)
   1. miscellaneous training materials.

VIII. SANITARY AND EPIDEMOLOGICAL SERVICES

A. Office Equipment (September 1995)
   1. desk copier, cartridge, and materials.

B. Health Education Materials (September 1995)
   1. miscellaneous training materials.

IX. PARTNERSHIPS, APPLIED DEMONSTRATION PROJECTS, WORKING COMMITTEE

A. Office Equipment

1. Institute of Bioecology, Academy of Sciences, Nukus
   - two computers, one printer, and software (September 1996).

2. Institute of Engineers of Irrigation and Mechanization of Agriculture
   - two computers, one printer, and software (March and May 1996).
3. Institute for Water Problems, Academy of Sciences
   - one computer, one printer, and software (September 1996).
4. SANIGMI (Central Asian Hydrometeorological Research Institute)
   - two computers, two printers, one scanner, and software (September 1996).
5. State Committee for Nature Protection
   - two computers, two printers, and software (July and August 1996); and
   - one facsimile machine (May 1996).
6. State Committee for Statistics and Forecasting
   - one computer, one printer, and software (October 1996).

X. NUKUS AND URGENCH HEALTH DEMONSTRATION PROJECTS

A. Water System Materials (October 1996)

1. pipe, fittings, and related materials.

B. Health Education Materials (October 1996)

1. computer at the national level;
2. camcorder and TV/VCR at the oblast level; and
3. overhead projectors and flip charts at the rayon level.

Note: All materials identified were provided by USAID through the EPT project.

Appendix B
Methodology

Approach

Task 2D2 is being carried out using a six-step approach, as follows:

Step1--Identify Long-term Sustainability Needs. Hold individual consultations with EPT Project staff in Washington and Almaty and then an initial team planning meeting in Almaty with EPT/Almaty and USAID/Almaty to plan the task work and collect readily available information. These meetings will cover preliminary identification of long-term sustainability needs, potentially applicable policies and other interventions to address them, and an itinerary for host country visits and meetings. Then visit Kazakstan, Turkmenistan, and Uzbekistan to interview representatives of selected host country institutions that are or may be responsible for long-term financing, ownership, and operation and maintenance of the EPT/CAR engineering projects in those countries. Based on the above, list each EPT/CAR engineering project's long-term sustainability needs and the corresponding applicable policies and other interventions that can address them. Exhibit B-1 presents a list of questions typically asked during the interviews. Exhibit B-2 contains a list of the persons interviewed for the task and Exhibit B-3 contains a list of references reviewed.

Step 2--Prioritize Needs and Design Interventions. Hold additional meetings with EPT and USAID staff to review the results of Step 1, and use this feedback to help prioritize the identified long-term sustainability needs, select potential policies and other interventions to address the highest priority needs, and discuss approaches to promoting those interventions to the host country counterparts and collaborating with them to implement the interventions. Present preliminary findings and outline the proposed interventions and promotion plans in trip reports.

Step 3--Prepare Interim Report on Project Sustainability. Prepare an interim report presenting task objectives, methods, and results obtained in the preceding tasks, including a summary of sustainability needs and priorities, a description of the policies and other interventions designed to address them, and country-specific plans for continuing promotion of the selected interventions. The promotion plan will include identification of longer-term resources for promotion during the period of the EPT Project, a contingency plan in case adoption does not occur before the end of the EPT Project, and a plan for periodic monitoring and evaluation of the sustainability of project benefits over the long-term. Submit the interim report to EPT/Almaty for distribution to USAID/Almaty and Washington and the relevant host country counterparts and allow time for review and comment prior to Step 4 below.

Step 4--Promote/Collaborate on Selected Interventions. Assist in the startup of the promotion of the policies and other interventions designed in Step 2. Present and invite discussion of the interim report water pricing and cost recovery findings at the Executive Policy Retreat planned under DO8 and to be held in Almaty in December. Solicit comments of the other host country counterparts who have participated in the sustainability evaluation but who are not participating in the retreat. Adjust the proposed interventions and promotion plan according to the comments.

Step 5--Prepare Final Report on Project Sustainability. Prepare a final report based on the review comments received under Step 4 above and submit it to EPT/Almaty for distribution to USAID/Almaty and Washington and the relevant host country counterparts.

Step 6--Followup and Implementation. Provide continuing support, as feasible with the remaining subtask budget, to efforts to promote the proposed policies and other interventions and to collaborate with host country counterparts to implement them.

Staffing

Subtask 2D2 has been carried out by an Institutional Specialist, who also serves as Task Leader, and a Utility Financing Economist. The Task Leader/Institutional Specialist reports to the DO12 Manager.

The Institutional Specialist focuses on institutional buy-in and professional capacity building. The Utility Financing Economist addresses the economic sustainability of these projects. The two specialists jointly developed and are jointly executing a plan for achieving these objectives in concert with an advisory group in EPT/Almaty. The advisory group consists of the Regional Policy Coordinator, Regional Engineering Coordinator, and Regional Director. The specialists also consulted with the Project Director and Deputy Project Director in EPT/Washington, the EPT/CAR Country Managers, USAID/Almaty and USAID/Washington.

The Institutional Specialist is also the primary interface with the Regional Engineering Coordinator and CAR Country Managers responsible for obtaining their input on CAR engineering activities and for ensuring that the results of this task are reflected in remaining CAR engineering activities and deliverables. He is also the primary interface with the Regional Policy Coordinator and other CAR policy specialists responsible for obtaining their input on CAR regional policy activities and for ensuring that the results of this task are reflected in remaining CAR regional policy activities and deliverables.

Exhibit B-1. Standard List of Questions Asked in Interviews

The following questions are intended for each of the different levels of organizations or agencies involved in managing drinking water in CAR. The questions apply mainly to the EPT drinking water facilities, therefore please specify whether your answers apply only to the improvements provided by EPT, or to the entire facility, or to the entire system of well fields, pump stations and pipelines and treatment facilities. Please answer what you can and indicate if you can provide answers to the other questions later or if some other agency would be better and, if so, which one. Either way we hope to be able to meet with each organization in person and will review your responses to these questions then. It is our intent to help you plan for long-term O & M of the EPT drinking water facilities, so we will make recommendations where appropriate.

1. Please provide as much information as possible on the estimated costs of operation and maintenance for the deep wells, pump stations, pipelines and treatment facilities supported by the EPT Project that provide clean drinking water in the Aral Sea Basin. You may fill in the attached tables or use them as a guide to the cost components for each type of facility.

2. How has your agency budgeted and allocated funds to operate and maintain these facilities in the past--before and after the break up of the former Soviet Union? How much funding has been budgeted and allocated? What changes in funding do you anticipate needing for O & M given the EPT improvements? What plans or ideas do you have for making the funding changes?

3. Has your agency already budgeted or allocated funds for a capital replacement fund (or "sinking fund") to replace the entire facilities when they have reached the end of their design life? If so, how much and what do you still lack? If not, why? What plans or ideas do you have for providing a capital replacement fund?

4. Do you have any plans or ideas to recover O & M costs by charging users for water delivered to them? What techniques are being considered? If so, what portion of the O & M costs do you believe you will be able to recover in that way? What needs to happen for water pricing to be accepted in your agency? Who would decide? Are any new laws, regulations or policies needed or are any changes needed in existing laws, regulations or policies? Who or what agency would administer the water pricing system and how?

5. How is your agency organized and managed to provide O & M services to these facilities? What procedures are used? Are any changes needed and, if so, what are they? What plans or progress has been made in implementing the changes?

6. What types of staff and how many of each are currently used for O & M of these facilities? What formal O & M training do they have? Are any changes needed and, if so, what are they? What plans and progress have been made in implementing the changes?

7. Does your agency monitor and evaluate the O & M performance of these facilities? If so, how? If not, why and what plans or ideas do you have for monitoring and evaluation of O & M?

Exhibit B-2. List of Persons Interviewed

Kazakstan

EPT Interview Participants

Tim Van Epp, Task Leader/Institutional Specialist
Dennis Wichelns, Ph.D., Utility Financing Economist
Marat Nauryzbekov, Senior Engineer
Elmyra Shaimerdenova, Interpreter

Persons Interviewed

Znalil Zalgadaro, State Committee on Water Resources
Adrian Hutchens, Sheladia Consultants, Asian Development Bank Project
Esen Mikeev, Chief Engineer of Kzylordaselkhozvodoprovod Kzylorda
Vitali Sheck, Director of ODSP Aral Kzyl-Orda
Amantai Taskinbaev, Chief Engineer, Aral-Sarybulak Aralsk Pipeline Company
Jamshid Malakouti, EPT Senior Engineer
Edward Couch, Representative of Pump Manufacturer

Turkmenistan

EPT Interview Participants

Tim Van Epp, AICP, Institutional Specialist
Dennis Wichelns, Ph. D., Utility Financing Economist
Marat Nauryzebekov, Senior Engineer
Luba Podgochaya, Interpreter

Persons Interviewed

Gurbansakhat Babaev, Chairman, and Bashkovsky, Assistant to the Chairman, Department of Water Resources and Water Management
Dr. Omar Niyazovich Niyazov, Deputy Head of Hydrogeological-Reclamation Field Studies and Projects

Uzbekistan

EPT Interview Participants

(Same as for Turkmenistan)

Kazakstan

EPT Interview Participants

Tim Van Epp, Task Leader/Institutional Specialist
Dennis Wichelns, Ph.D., Utility Financing Economist
Marat Nauryzbekov, Senior Engineer
Elmyra Shaimerdenova, Interpreter

Persons Interviewed

Znalil Zalgadaro, State Committee on Water Resources
Adrian Hutchens, Sheladia Consultants, Asian Development Bank Project
Esen Mikeev, Chief Engineer of Kzylordaselkhozvodoprovod Kzylorda
Vitali Sheck, Director of ODSP Aral Kzyl-Orda
Amantai Taskinbaev, Chief Engineer, Aral-Sarybulak Aralsk Pipeline Company
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Turkmenistan

EPT Interview Participants

Tim Van Epp, AICP, Institutional Specialist
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Luba Podgochaya, Interpreter

Persons Interviewed

Gurbansakhat Babaev, Chairman, and Bashkovsky, Assistant to the Chairman, Department of Water Resources and Water Management
Dr. Omar Niyazovich Niyazov, Deputy Head of Hydrogeological-Reclamation Field Studies and Projects

Uzbekistan

EPT Interview Participants

(Same as for Turkmenistan)

Persons Interviewed

Komildgan Saidov, General Director of the Republic Industries Union for Maintenance and Development of Regional Water-Suppliers, Ministry of Municipal Services, and Fakhritdin Miryusupov, Main Engineer, RWA Maintenance and Development of Regional Water Supply Systems, Ministry of Municipal Services

Ekrin Yuldashev, Deputy Minister, Ministry of Communal Services and Fakhritidin Miryusupov, Main Engeneer, RWA Maintenance and Development of Regional Water Supply Systems, Ministry of Communal Services

Albert Rafikov, Chief of Department for the Coordination of Socioeconomics, Research and Investment, Interstate Council on the Problems of the Aral Sea Basin Executive Committee

Alexander Mironenkov, Head of Agroindustrial Investments Department, State Committee on Forecasting and Statistics of the Cabinet of Ministers, and Pulat Zakirov, Manager of Project Implementation Group, Water Supply, Sanitation and Health Project

Exhibit B-3. List of References Reviewed

Note: References are divided into the following categories: Regional and Sustainability Issues, Kazakstan, Turkmenistan and Uzbekistan.

Regional and Sustainability Issues

Anderson, Robert. "Water Policy and Pricing in Central Asia." USAID EPT Project. Trip Report. June 1996.

Asian Development Bank. "Staff Guidelines on Institution Development." Washington, D.C.: Asian Development Bank. January 1987.

Bamberger, Michael and Shabbir Cheema. "Case Studies of Project Sustainability, Implications for Policy and Operations from Asian Experience." Economic Development Institute of The World Bank, EDI Seminar Series. Washington, D.C.: The International Bank for Reconstruction and Development/The World Bank. 1990.

Browning, Rick. "Water Policy and Pricing in Central Asia." USAID EPT Project. Trip Report. June 1996.

Esselman, Jim. "Sustainability, Sustainable Development and the Health Sector." Issue Paper No. 1. Sustaining the Vision: Lessons for USAID's Move Toward Sustainability and Sustainable Development, A Series of Issue Papers. USAID Center for Development Information and Evaluation. Research and Reference Services Project, Sustainability Working Group. Washington, D.C.: USAID. October 1994.

Frederiksen, Harald D. "Water Resources Institutions, Some Principles and Practices." World Bank Technical Paper Number 191. Washington, D.C.: The International Bank for Reconstruction and Development/The World Bank. 1992.

Frederiksen, Harald D., Jeremy Berkoff and William Barber. "Principles and Practices for Dealing with Water Resources Issues." World Bank Technical PapA Compendium of Donor Experience." A.I.D. Program Evaluation Discussion Paper No. 24. Washington, D.C.: USAID. November 1988.

USAID EPT Project. "Guidelines for Competitive Grant Proposals in Water Resources Policy and Management." Central Asian Republics Regional Office. May 1995.

USAID EPT Project. "Guidelines for Workgroups, Research Proposals and Partnerships." Regional Cooperation in Water Manage 1996.

Narayan, Deepa. "Participatory Evaluation, Tools for Managing Change in Water and Sanitation." World Bank Technical Paper Number 207. Washington, D.C.: The International Bank for Reconstruction and Development/The World Bank. 1993.

Pezzey, John. "Sustainable Development Concepts, An Economic Analysis." World Bank Environment Paper Number 2. Washington, D.C.: The International Bank for Reconstruction and Development/The World Bank. 1992.

Russell, Diane. "Sustainability in Agriculture and Natural Resource Management." Sustaining the Vision: Lessons for USAID's Move Toward Sustainability and Sustainable Development, A Series of Issue Papers. USAID Center for Development Information and Evaluation. Research and Reference Services Project, Sustainability Working Group. Washington, D.C.: USAID. December 1994.

Russell, Diane. "Theory and Practice in Sustainability and Sustainable Development." Sustaining the Vision: Lessons for USAID's Move Toward Sustainability and Sustainable Development, A Series of Issue Papers. USAID Center for Development Information and Evaluation. Research and Reference Services Project, Sustainability Working Group. Washington, D.C.: USAID. January 1995.

Serageldin, Ismail. "Toward Sustainable Management of Water Resources." Directions in Development. Washington, D.C.: The International Bank for Reconstruction and Development/The World Bank. 1995.

The President's Council on Sustainable Development. *Sustainable America, A New Consensus for Prosperity, Opportunity, and a Healthy Environment for the Future*. Washington, D.C." U.S. Government Printing Office. February 1996.

United Nations Development Programme. "Description of Sub-Project, Aral Sea Basin Capacity Development RER/94.041, Preparation of Training Modules for Water Supply and Sanitation (International Training Network - ITN). Undated.

USAID. Brief Bibliography of USAID Documents on Sustainability. Nick Wedeman, Research Analyst. Washington, D.C. 1996.

USAID. "How Important is Sustainability in Evaluating Projects?" Washington, D.C.: USAID. 1988.

USAID. "Sustainability of Development Programs: A Compendium of Donor Experience." A.I.D. Program Evaluation Discussion Paper No. 24. Washington, D.C.: USAID. November 1988.

USAID EPT Project. "Guidelines for Competitive Grant Proposals in Water Resources Policy and Management." Central Asian Republics Regional Office. May 1995.

USAID EPT Project. "Guidelines for Workgroups, Research Proposals and Partnerships." Regional Cooperation in Water Management Information Management Workshop, Tashkent, Uzbekistan, Nov. 28-Dec. 2, 1994. November 30, 1994.

USAID EPT Project. "Proposal Recommendations from Water Information Management Workshop, December 1994." Central Asian Republics Regional Office. April 1995.

USAID EPT Project. "Regional Cooperation in Water Management Information Management Workshop, Tashkent, Uzbekistan, Nov. 28-Dec. 2, 1994." Final Report. Central Asian Republics Regional Office. December 1994.

USAID EPT Project. "Regional Cooperation on Water Policy and Management Workshop, Ashgabad, Turkmenistan, May 2-6, 1995." Field Report. Central Asian Republics Regional Office. January 1996.

USAID EPT Project. "Summary of Rationale, Selection Process and Awards, Applied Demonstration Projects, Regional Cooperation Activities." Central Asian Republics Regional Office. December 1995.

USAID EPT Project. "Summary of the Seminar on Water Pricing in Central Asia." New Independent States Field Report. May 1996.

USAID EPT Project. "Work Plan for Delivery Order 8, Regional Cooperation in Water Resources Management for Central Asia." July 1995.

USAID EPT Project. "Workshop Report, Regional Cooperation on Water Policy and Management, May 2-6, 1995." Central Asian Republics Regional Office. May 1995.

Turkmenistan

Boyd, Michael L. "Turkmenbashi Water Treatment Plant, Water Financing Report." Turkmenistan Technical Report. USAID EPT Project. June 1996.

Dreyer, Paul. "Sustainable Water Management Activities, Background Materials for Turkmenistan." Memorandum to Tim Van Epp, USAID EPT Project. October 18, 1996.

Shaikh, Pervez. "RO Plant O&M Cost Estimates." Memorandum to Dennis Wichelns, USAID EPT Project. November 8, 1995.

The World Bank. "Proposed Water Supply and Sanitation Project." Investment Project, Initial Project Information Document: Republic of Turkmenistan. March 23, 1995.

The World Bank. "Turkmenistan Water Supply and Sanitation Project, Project Identification Mission, February 11-March 1, 1995: Background Notes." Rita Klees, Task Manager.

The World Bank. "Turkmenistan Water Supply and Sanitation Project, Project Identification Mission, February 11-March 1, 1995: Needs Assessment." Rita Klees, Task Manager. November 1995.

USAID EPT Project. "Engineering Report: Water, Wastewater, and Sanitation Improvements for the City of Dashowuz and the Turkmenbashi Etrap, Turkmenistan." Delivery Orders 2 and 12. January 1996.

USAID EPT Project. "Turkmenbashi Water Treatment Plant Water Financing Report." Turkmenistan Technical Report. November 1995.

Kazakstan

Daane, Janelle. "Summary Report on CAR Projects and Trip Report." Memorandum to Carl Mitchell. USAID EPT Project. October 22, 1996.

Dreyer, Paul. "Sustainable Water Management Activities, Background Materials for Kazakstan." Memorandum to Tim Van Epp. USAID EPT Project. October 7, 1996.

Dreyer, Paul. "Sustainable Water Management Activities, Background Materials for Kazakstan." Memorandum to Tim Van Epp. USAID EPT Project. October 10, 1996.

USAID EPT Project. "EPT Project Summary: U.S. Aral Sea Program Overview, EPT Activities Completed." October 1996.

USAID EPT Project. "Field Report, Implementation Status of the Water Distribution System Improvements, Kzyl-Orda Oblast, Kazakstan." Almaty, Kazakstan: Central Asia Regional Office. August 1995.

USAID EPT Project. "Interim Field Investigations in Kazakstan: Regional Water Systems in Kzyl-Orda Oblast." Almaty, Kazakstan: Central Asia Regional Office. October 1994.

USAID EPT Project. "Investigation of Water Distribution Systems in Aralsk, Novokazalinsk and Kazalinsk, Kazakstan." Kazakstan Field Report. April 1996.

USAID EPT Project. "Proposed Rehabilitation Program for the Kosaman and Berdykol Wellfields, Field Research: June-July & September 1995." Almaty, Kazakstan: Central Asia Regional Office. March 1996.

Van Epp, Tim. "DO12/Task 2D2 – Meeting with Natalia Beisenova, Economist, Kazakstan Resident Mission, World Bank – November 1, 1996." Memorandum to Dennis Wichlens. USAID EPT Project. November 2, 1996.

Uzbekistan

Dreyer, Paul. "Sustainable Water Management Activities, Background Materials for Uzbekistan." Memorandum to Tim Van Epp. USAID EPT Project. October 18, 1996.

Hoffman, Randy. "Policy Intervention Victory." Memorandum to Barry Primm, Paul Dreyer et al. USAID EPT Project. March 27, 1996.

Hoffman, Randy. Trip Report on activities in Urgench, Nukus and Tashkent, Uzbekistan, March 7-28, 1996. USAID EPT Project. March 1996.

The World Bank. "Project Information Document, Update – Republic of Uzbekistan." Washington, D.C. November 1, 1996.

The World Bank. "Staff Appraisal Report, Republic of Uzbekistan – Pilot Water Supply Engineering Project." Report No. 15434-UZ. Washington, D.C.: Infrastructure, Energy and Environment Division, Country Department III, Europe and Central Asia Region. August 15, 1996.

USAID EPT Project. "Uzbekistan Activities, Water System Improvements Program." Almaty, Kazakstan: Central Asia Regional Office. October 1996.

USAID EPT Project. "Uzbekistan Activities, Summary of Equipment Installed." Almaty, Kazakstan: Central Asia Regional Office. October 1996.

USAID EPT Project. "Field Report: Assessment Report in the Republic of Uzbekistan: Water and Sanitation Health Education Program in Nukus and Urgench, November-December 1994." Almaty, Kazakstan: Central Asia Regional Office. December 1994.

USAID EPT Project. "Field Report Summary, Republic of Uzbekistan, Interim Field Investigations, Nukus and Urgench Water Treatment Plants." Almaty, Kazakstan: Central Asia Regional Office. Undated.

USAID EPT Project. "Proposed Chlorination System Improvements at Water Treatment Plants: Nukus and Urgench, Uzbekistan." Almaty, Kazakstan: Central Asia Regional Office. February 1995.

USAID EPT Project. "EPT Field Report: Interim Field Investigations in Uzbekistan: Nukus and Urgench Water Treatment Plants." Almaty, Kazakstan: Central Asia Regional Office. September 1994.

Wichelns, Dennis. "Revised Draft Text for Uzbekistan." Memorandum to Tim Van Epp. USAID EPT Project. November 27, 1996.

Japan International Cooperation Agency and Ministry of Public Utilities, State Committee of Uzbekistan for Nature Protection, Republic of Uzbekistan. "The Study on Water Supply System in Six Cities (sic) of The Aral Sea Region in Uzbekistan." Draft Final Report, Main Report – Part I, Basic Plan. October 1996.

Japan International Cooperation Agency and Ministry of Public Utilities, State Committee of Uzbekistan for Nature Protection, Republic of Uzbekistan. "The Study on Water Supply System in Six Cities (sic) of The Aral Sea Region in Uzbekistan." Draft Final Report, Main Report – Part II, Feasibility Study. October 1996.

Japan International Cooperation Agency and Ministry of Public Utilities, State Committee of Uzbekistan for Nature Protection, Republic of Uzbekistan. "The Study on Water Supply System

in Six Cities (sic) of The Aral Sea Region in Uzbekistan." Progress Report (2), (Main Report). October 1995.

Commission of the European Communities. "TACIS 1992 Action Programme – Uzbekistan." Brussels, Belgium. July 17, 1992.

Kudat, Ayse, et al. "Social Assessment of Urban Water Supply, Uzbekistan: Water Supply, Sanitation and Health Project, Urban Component." The Uzbek Social Science Network. August 15, 1996.

Kudat, Ayse, et al. "Needs Assessment for the Proposed Uzbekistan Water Supply, Sanitation and Health Project." June 23, 1995.

Dreyer, Paul. "Sustainable Water Management Activities, Background Materials for Uzbekistan." Memorandum to Tim Van Epp and Dennis Wichelns. October 18, 1996.

State Committee on Forecasting and Statistics of the Cabinet of Ministers of the Republic of Uzbekistan. "Aral Sea Program 5, Project No. 1: Uzbekistan Water Supply, Sanitation and Health Project; Interim Report, Assessment of Desalination Facilities." May 1996.

Aral Herald, Central Asian Scientific Tribune. Issue 1., Water Resources. Tashkent, Uzbekistan: Issued with the collaboration of the Aral Sea Basin Capacity Development Project of UNDP. Spring 1996.

Aral Sea Basin Monitor. Tashkent, Uzbekistan: Published jointly by EC-ICAS and the Aral Sea Basin Capacity Development Project (ASBCD). Autumn 1996.

Van Epp, Tim. Report on Operations and Maintenance at Costs in Uzbekistan. Memorandum to Randy Hoffman. October 11, 1996.

Van Epp, Tim. "DO 12/Task 2D2 – Proposed Itinerary for Trip to Turkmenistan and Uzbekistan." Memorandum to Paul Dreyer, et al. October 10, 1996.

Hoffman, Randy. "Draft Proposal for DO 12 Activity Modification, Uzbekistan Task 2C1." Memorandum to Jim Westfield, et al. March 26, 1996.