



# The Hashemite Kingdom of Jordan

## Reuse for Industry, Agriculture and Landscaping (RIAL) Project

### Overview of Task 3- Water Reuse, Conservation and Pollution Prevention in Industries

#### Completion Report -

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CDM International Inc.



*For:*

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RIAL Task 3 Report

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# 1. Introduction

The primary aim of the United States Agency for International Development (USAID) 'Reuse for Industry, Agriculture and Landscaping' (RIAL) project (Contract No. LAG-I-00-98-00034-00 Task Order 816) was to further develop the sustainability of water reuse activities in Jordan. RIAL Task 3 - Water Reuse, Conservation and Pollution Prevention in Industries - activities were designed to assist the Government of Jordan (GOJ) in developing a national strategy that would demonstrate acceptable and "implementable" approaches to improving water management and environmental performance in industry.

Specific Task 3 objectives included:

- Grow industry interest and adoption of best practices and technologies for improved water conservation, recycling and reuse, environmental management and pollution prevention
- Improve centralized industrial wastewater treatment project capacity and operations
- Devise financing approaches to support industry investment in water conservation and pollution prevention
- Build institutional capacity that supports improved industry environmental performance
- Develop a strategy to promote sustained water conservation, recycling and reuse and environmental management in industry

In this RIAL Task 3 Completion Report we provide a summary of activities undertaken, results achieved and performance indicators stemming from the above objectives. This report is comprised of the following sections:

Section 1 - Introduction

Section 2 - Industrial Wastewater Treatment Project Strengthening

Section 3 - Integrated EMS/P2 Implementation

Section 4 - Institutional Capacity Building

Section 5 - Industry National Strategy

Section 6 - Conclusions and Deliverables

## 2. Industrial Wastewater Treatment Project Strengthening

Industry in Jordan, representing nearly 15% of the Gross Domestic Product (GDP), is a significant and important user of water. Many Jordanian industrial enterprises use significant quantities of water in their manufacturing processes and few have access to advanced wastewater treatment technologies. Water that is reclaimed within industries is generally not of high enough quality to be reused; water that is reused is generally not often recycled efficiently.

The absence of industrial wastewater treatment options may contribute in some cases to improper and illegal disposal of industrial wastewaters. At the same time the regulatory infrastructure and environmental standards have been slow to develop in Jordan. The lack of a strict regulatory enforcement and monitoring program has contributed to the poor environmental performance of certain industries, particularly small and medium size enterprises (SME).

### 2.1 Objectives

The RIAL project team activities related to strengthening industrial waste treatment projects were initially focused on the Zarqa region but expanded over the course of our work to include Al Hassan and Ad Dulayl Qualified Industrial Zones (QIZ). These three industrial areas comprise significant concentrations of industries which consume substantial quantities of water and generate large quantities of wastewater. Our specific objectives aimed at improving industrial wastewater treatment in these areas included:

- Perform comprehensive survey of industries and wastewater quantity and quality that could be used in feasibility study and preliminary design
- Identify qualified users of a potential centralized industrial wastewater treatment plant (CIWWTP) in terms of effluent quality, peak and daily average sewer discharges anticipated, sewer effluent amounts and loadings that could be used in process design
- Devise appropriate metrics to be used as a basis for cost-benefit evaluations for pre-treatment investments by industry stakeholders, to guide enforcement and establish user fees for regulators and the IWWTP authority, and to assist in final design and cost projections for the CIWWTP
- Develop a set of recommendations for targeted areas of regulatory enforcement and identify analytical capabilities that are needed both by industry stakeholders and regulators to cooperatively work to improve environmental performance and reduce wastewater generation.

### 2.2 Activities Undertaken

The RIAL project team, working with GOJ and industry stakeholders in Zarqa, Al Hassan and Ad Dulayl completed the following activities.

- Developed survey questionnaire for collection of information on industry water use, wastewater generation and management approaches.
- Lead walk-through surveys with MoE and WAJ staffs of each enterprise and completed survey forms by conducting interviews on site with the environmental and plant managers of each enterprise.
- Established a baseline of level of environmental compliance for industry based on survey of industry enterprises.
- Constructed MicroSoft (MS) Excel spreadsheet database containing field survey information.
- Integrated database of industry information with GIS base map.
- Conducted a data collection effort aimed at obtaining independent verification and historical effluent quality data for each enterprise was undertaken with the WAJ's Central Water Quality Laboratory.
- Assessed the numbers of enterprises and types of industry sectors most likely to rely on a newly constructed CIWWTP.
- Identified alternative treatment and compliance options and ranges of costs for industry stakeholders.
- Determined the specific metrics that are drivers for industry stakeholders in the selection of compliance options and technologies.
- Established a cost for transport for disposal to the CIWWTP.
- Assessed the suitability of sites for the proposed IWWTP and suggested alternatives.
- Assessed the cost of water by geographic area and type of industry.
- Assessed cost of wastewater disposal by geographic area and type of industry.

We summarized the results of our work is summarized in feasibility studies and preliminary design reports for the Zarqa Region, Al Hassan Industrial Estate and Ad Dulayl Industrial Park.

### **2.3 Results Achieved**

The RIAL project team working with industry stakeholders and MoE and WAJ staff were able to develop a comprehensive understanding of water use and wastewater management issues faced by industries in Zarqa Region, Al Hassan Industrial Estate (QIZ) and Ad Dulayl Industrial Park (QIZ). Through this work approaches for treatment of wastes were devised

and implemented resulting in environmental improvement in industry in all three regions of focus.

### 2.3.1 Zarqa Region

The Zarqa region is comprised of more than 3,000 small and medium size enterprises (SMEs) plus two major industrial water consumers, the Jordan Petroleum Refinery and a power generating utility plant.

In 2001 a survey of Zarqa Region industries was conducted as a part of the World Bank Organization (WBO) funded study to evaluate interest on the part of industry stakeholders in participating in a centralized wastewater treatment plant (CIWWTP) project. Information was gathered from selected enterprises on wastewater quantities and characteristics, as well as their willingness to rely on the CIWWTP as a dedicated facility for the management of industrial wastewater effluents. Twenty six industrial enterprises showed full interest in using the proposed CIWWTP. The daily wastewater outflow from these industries varied between 1 and 200 cubic meters (m<sup>3</sup>) with a total daily flow of 746 m<sup>3</sup>. The Total Dissolved Solids (TDS) of the effluents varied between 1,000 and 80,000 milligrams/litre (mg/l) with an average of 8,860 mg/l. In addition, seventeen industrial enterprises showed partial interest in using the proposed CIWWTP. Daily wastewater outflow from these enterprises varied between 1 and 200 m<sup>3</sup> with a total sum of 645 m<sup>3</sup> and TDS values of these wastewaters varied between 1,000 and 10,000 mg/l with an average of 4,385 mg/l.

Based on the wastewater loadings and quantities identified from among the industry populations sampled the design basis for the CIWWTP was established by the consultant DORSCH. The design basis recommended for the IWWTP was based on both the quantities and general composition of wastewaters identified from the WBO data base. WBO issued a Feasibility Report and Environmental Impact Assessment (EIA) for the proposed CIWWTP in 2002. The Dorsch report included a recommendation to finalize the design and the prepare bid documents for the Zarqa CIWWTP under the RIAL Project.

The RIAL project team identified a number of technical concerns with the information contained in the World Bank Organization (WBO) and the Mediterranean Assistance Program funded reports (Dorsch<sup>1,2</sup>). We started by developing an enhanced and refined the database which served as the basis for performing a critical assessment of the design case. After reviewing the Dorsch studies and identifying data gaps we conducted a pre-assessment aimed at identifying those industry sectors that are most likely to participate in using the proposed CIWWTP.

The RIAL Project Team worked with Ministry of Environment (MoE) and the Water Authority of Jordan (WAJ) staff to define the industrial zones “worst

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<sup>1</sup> Dorsch. 2002. “Feasibility Study for the Treatment of Industrial Wastewater in the Zarqa Governorate: Final Feasibility Report and Environmental Impact Assessment” Dorsch Consult Ingenieuresellschaft mbH, Amman, Jordan.

<sup>2</sup> Dorsch. 2003. Feasibility Report and Environmental Impact Assessment (November 2003) and Final Tender Document (January 2003).

polluters” --- those who consistently violated water effluent standards. MoE and WAJ staff also helped us identify those segments of the industrial community who were using pre-treatment technologies and discharging their effluents legally to the municipal sewer system. Those enterprises in compliance with wastewater management standards were not considered viable CIWWTP stakeholders. Some of these were however erroneously identified as potential participants in the Dorsch design recommendation.

The total annual water demand calculated for the paper and sanitary, construction, textile, engineering and food sectors included in the RIAL Task 3 Zarqa feasibility study is over 12 million cubic meters (m<sup>3</sup>). The proposed treatment plant was designed for a capacity of 1450 m<sup>3</sup>/day, or 529,250 m<sup>3</sup>/yr. Without accounting for water losses, recycling, reuse, or product forms which consume water, the facility meets less than 5% of the needs of the industry stakeholders in the Zarqa Governorate.

In addition to the above findings concerns of project sponsors about the design basis were heavily influenced by a yeast manufacturing plant. The facility was issued a permit to discharge its wastewater to a land farming application. In this case the enterprise was not found by the RIAL Project Team to be a viable candidate for discharge to the CIWWTP and the originally proposed design was deemed to be inadequate. Furthermore, the operating costs for the plant based on the requirement of using best available technologies to comply with meeting current effluent discharge standards for land irrigation made the plant among the most costly in the world per unit volume of reclaimed water. A review of land farming applications showed that cost recovery through land farming was not attractive based on flows and value-added crop options. Additional concerns were identified regarding inadequate access and egress routes to the proposed site at Al Ghabawi site and potential negative impacts to traffic and air pollution problems from proposed waste hauling operations.

Based on the above the design was deemed infeasible. Further, since the CIWWTP was limited by both a capital ceiling of \$5 million and at best could only address up to 5% of the wastewater issues in the governorate. On the basis of our technical and financial analysis, four alternatives to the proposed project are recommended for consideration:

1. Add industrial pre-treatment at Ein Ghazal - Specified pre-treatment units would be designed and installed at this existing wastewater receiving station with discharge to the sewer flowing to As Samra WWTP.
2. Add industrial pre-treatment at As Samra - Specified pre-treatment units would be designed and installed adjacent to the newly constructed As Samra WWTP.
3. Re-design IWWTP for Zarqa Free Zone - Centralized treatment facility designed specifically for industries in the Free Zone (and select industries outside the zone) with direct connections between industries and the IWWTP.
4. Re-design IWWTP for Ad Dulayl Qualified Industrial Zone - Centralized treatment facility designed specifically for industries in the QIZ (and select industries outside the zone) with direct connections between industries and the IWWTP.

We recommend that any advancement of industrial wastewater management infrastructure in Jordan be done in parallel with the implementation of a strategic program that provides incentives to industry for improved water management and systematically eliminates access to inappropriate or illegal effluent discharge options. The recommended strategy calls for the strengthening of the Ministry of Environment's current practices of monitoring and enforcement coupled with financial incentives through a revolving loan program available to industry stakeholders. This dual enforcement and incentive approach will help to motivate industry to seek one of two alternatives to meet their regulatory obligations: (1) making investments into either cleaner and/or pre-treatment technologies to meet compliance obligations, or (2) committing to the use of a planned industrial wastewater treatment facility.

The overall assessment of the Zarqa Industrial Wastewater Treatment Plant yields the conclusion that indeed centralized wastewater treatment will be the best option for certain industries in Zarqa. However, stakeholder participation within the framework of an enhanced enforcement environment and on-site investment incentives must be confirmed before finalizing the treatment location and process design. Subsequent studies that have gone further than the analysis and conclusions reported herein have confirmed these recommendations to be valid.

### 2.3.2 Al Hassan Industrial Estate (QIZ)

Al Hassan Industrial Estate (QIZ) contains 96 operating facilities distributed over 10 industry sectors (Services, Food, Pharmaceutical, Engineering, Plastic & Rubber, Chemicals, Textile & Garment, Wood, Leather & Packaging industry) as illustrated in Table 2-1.

Nearly 45% of these are textile industries which are in turn responsible for generating the bulk of the industrial wastewater (which is known as "blue water" in the garment trade) at Al Hassan Industrial Estate. Some other industries generate a small amount of industrial wastewater but with significant concentration. The remaining factories generate only domestic sewage in addition to solid waste such as fabric scraps and used packaging material.

**Table 2-1: Number of existing wet industries vs. total number of industries registered and operating at Al Hassan Estate**

No.	Industry Category	Year 2006			No. of Wet Industries
		No. of Factories Registered	Operating	No. of Workers	
1	Services	64	24	151	0
2	Food	1	1	8	1
3	Pharmaceutical	9	7	261	3
4	Engineering	12	9	575	0
5	Plastic & Rubber	8	6	230	0
6	Chemical	5	5	160	1

7	Textile & Garment	61	43	20765	6
8	Wood	1	0	0	0
9	Leather	1	0	0	0
10	Packaging	2	1	30	0
<b>Total</b>		<b>164</b>	<b>96</b>	<b>22,180</b>	<b>11</b>
Textile/Cyber City		1	1		1
<b>Total Surveyed</b>					<b>12</b>

The main objective of the study was to support the MoE in solving the overall problem of industrial wastewater generated in north of Jordan and specifically the problem associated with disposal at Al Ekaider through the development within the estate an environmentally sound system to manage the industrial wastewater generated from both Al Hassan Industrial Estate and Cyber City.

Cyber City is an industrial estate located approximately 7 kilometres southwest of Al Hassan. It is a combined Qualified Industrial Zone (QIZ) and Special Free Economic Zone located in the north of Jordan. It occupies more than 4,000 dunums of land, with 1000 dunums in the first running stage and it will be the largest QIZ to data once completed.

A detailed survey and engineering feasibility study was prepared under RIAL/Task 3 in order to define the industrial wastewater quantities and qualities generated at Al Hassan Industrial Estate from these industries (so-called "wet" industries) and a centralized WWTP was designed to treat all wastes generated at Al Hassan Industrial Estate.

After the handover of the study, the private sector took over and have signed with the Jordan Industrial Estate Corporation (JIEC) on March 19, 2007 a MOU for building and constructing a Centralized Industrial Wastewater Treatment Plant to treat and recycle 1200 m<sup>3</sup>/day of industrial wastewater "blue water" generated from Al Hassan Industrial Estate and Cyber City textile factories in North Jordan.

The plant will be a model for other industrial estates and QIZ as it will be the first of its type in Jordan and will solve the problem of industrial wastewater disposal and improve the overall environmental performance of the industries in the region. Construction of the plant will started in April 2007.

### 2.3.3 Al Dulayl Industrial Park

The project was initiated between the Ministry of Environment (MoE), the USAID and Ad Dulayl QIZ as part of the overall initiative work aimed to solve the problem of Al Ekaider disposal site and to help develop an environmentally sound system to manage the industrial wastewater generated at Ad Dulayl Industrial Park (QIZ).

Ad Dulayl Industrial Park (QIZ 1) is a privately owned public sharing company with a capital of (\$20 million). The Park is located in Ad Dulayl town within the municipality boundaries on a main road 45 km northeast of Amman.

The total area of the park is 718,000 m<sup>2</sup> with available net area of 660,000 m<sup>2</sup> after deducting the roads. The Industrial Parks are designated for light, medium and large industries with plot areas provided ranges from 4,000 m<sup>2</sup> to 50,000 m<sup>2</sup>.

The primary objective of the feasibility study was to develop a database on the industrial wastewater and quantities and characteristics which could serve as a basis for designing a centralized IWWTP for Ad Dulayl QIZ Industrial Park.

The Ad Dulayl QIZ contains 21 facilities all of these industries are textile (garment companies). Of the 21 industries, 4 were found to be dry industries that generate no industrial wastewater, 14 are considered wet industries and the remaining 3 were found closed permanently.

All these industries generate also domestic sewage at the factories and from there residential areas and dormitories (where all experts and non Jordanian employees live). In addition a solid waste such as fabric scraps and used packaging material is generated.

The survey result revealed that the source of the wastewater generated at Ad Dulayl QIZ is produced from 6 wet industries including the Regional Washing House. The total average industrial wastewater generated at Ad Dulayl Industrial Park QIZ is found to be approximately 841 m<sup>3</sup>/day with a peak of 1268 m<sup>3</sup>/day.

The industrial wastewater management practices at Ad Dulayl Industrial Park as identified from the survey are summarized in Table 2-2

The survey conducted and the analytical analysis revealed that no need for new standalone centralized industrial wastewater treatment plant. However, it supported the need for an Industrial Wastewater Treatment Plant from the existing individual wastewater treatment plants to accept and treats the small amount of industrial wastewater that is currently disposed at Al-Ekaider disposal site.

**Table 2-2. Current Industrial Wastewater Management Practices**

<b>No.</b>	<b>Name of Enterprises</b>	<b>Industry Sector</b>	<b>Industrial WW Management Practices</b>
1	UNITED CREATIONS L.L.C	TEXTILE & GARMENTS	N/A
2	CASUAL WEAR APPAREL L.L.C (PETRA)	TEXTILE & GARMENTS	N/A
3	RAINBOW TEXTILES L.L.C.	TEXTILE & GARMENTS	N/A
4	BEELINE LTD	TEXTILE & GARMENTS	N/A
5	HI-TECH TEXTILE L.L.C. (1)	TEXTILE & GARMENTS	TO AL EKAIDER
6	HI-TECH TEXTILE L.L.C.(2)	TEXTILE & GARMENTS	N/A
7	EAM MALIBAN TEXTILES CO	TEXTILE & GARMENTS	TO AL EKAIDER (WWTP UNDER CONSTRUCTION)
8	THIRD DIMENSION ( SEDENA)	TEXTILE & GARMENTS	ON SITE WWTP IN OPERATION, 60% TREATED & RECYCLE, 40% BRINE TO AL EKAIDER
9	MUSTAFA & KAMAL ASHRAF TRADING	TEXTILE & GARMENTS	TO AL EKAIDER
10	SUN JORDAN TEXTILE LTD (3)	TEXTILE & GARMENTS	TO AL EKAIDER
11	MEDITERRANEAN RESOURCES APPAREL INDUSTRY	TEXTILE & GARMENTS	MANAGED BY RTEX
12	NEEDLE CRAFT L TD	TEXTILE & GARMENTS	TO AL EKAIDER
13	FINE APPAREL LTD	TEXTILE & GARMENTS	MANAGED BY RTEX
14	SUN JORDAN TEXTILE LTD (1)	TEXTILE & GARMENTS	MANAGED BY RTEX
15	SUN JORDAN TEXTILE LTD (2)	TEXTILE & GARMENTS	MANAGED BY RTEX
16	AL-QADIR GARMENT CO	TEXTILE & GARMENTS	MANAGED BY RTEX
17	MF TEXTILES MIDDLE EAST (JORDAN)	TEXTILE & GARMENTS	MANAGED BY RTEX
18	REGIONAL TEXTILE SUPPORTIVE INDUSTRIES (RTEX)	TEXTILE & GARMENTS	WWTP, REUSE FOR AGRICULTURE
19	RELIANDCE CO. (PANORAMA)	TEXTILE & GARMENTS	CLOSED PERMANENTLY
20	ROBINA APPAREL COMPANY	TEXTILE & GARMENTS	CLOSED PERMANENTLY
21	ARABELLA APPAREL COMPANY	TEXTILE & GARMENTS	CLOSED PERMANENTLY

\* N/A = NOT APPLICABLE

From the survey results and the flows and strength of waste in the data collected, assumed that the wastewater treatment plant of the largest industry in the QIZ (Eam Maliban Co.) starts operation as planned January 2008, the remaining industrial wastewater flows that will require treatment are:

1. 40.5 m<sup>3</sup>/day from Hi Tech Textile L.L.C (1) and from Hi Tech (2) when start the washing process.
2. 88.85 m<sup>3</sup>/day from Mustafa and Kamal Ashraf Trading
3. 3.85 m<sup>3</sup>/day from Needle Craft Ltd.

Therefore, only textile industrial wastewater treatment plant was required and the total amount of industrial waste which requires treatment is approximately 135 m<sup>3</sup>/day. Eam Maliban onsite treatment plant and RTEX treatment plant were the two existing treatment plants and the available options that could accept treating the above quantities in addition to their existing waste.

The first option with Eam Maliban was rejected by the company owners and the option of treating the remaining amount of industrial wastewater at RTEX wastewater treatment plant was accepted by the QIZ owners. RIAL/Task 3 scope was to evaluate the existing plant capability for treatment to the recycling stage and identify the required upgrading.

The industrial wastewater plant design included a pre-treatment system and reverse osmosis system to reduce the TDS of the effluent to an acceptable level that can be recycled and reused at the washing house. This will help also to reduce the overall cost of water use at the facility. The total design flow proposed is 225 m<sup>3</sup>/day as long term average and 300 m<sup>3</sup>/day for the peak day.

#### **2.4 Indicators of Success**

As a result of the RIAL Task 3 activities the following successes were achieved:

- Established database of water and wastewater management information for industries in Zarqa Region (2005), Al Hassan Industrial Estate (2006) and Al Dulayl Industrial Park (2007)
- Prepared CIWWTP feasibility studies and preliminary design for Zarqa Region, Al Hassan Industrial Estate and Ad Dulayl Industrial Park.
- Averted a \$5 million environmental infrastructure investment that would have had minimal impact on improving the environmental performance of the industrialized Zarqa Governorate
- Engaged private investment in Zarqa
- The Al Hassan Industrial Estate private sector has commissioned the construction of a dedicated industrial wastewater treatment plant which will service more than 90 enterprises.

- Reduced the amount of textile wastes being disposed at the Al Ekaider landfill as CIWWTP capacity is being developed through the private sector lead efforts to construct and fully fund the Al-Hassan CIWWTP

## 3. Integrated EMS/P2 Implementation

### 3.1 Overview and Objectives

The RIAL project team focused effort on the application of pollution prevention (P2) by applying elements of the ISO 14001 Environmental Management System (EMS). By reducing pollution, waste and inefficiencies at the source, less energy, materials and water are consumed in manufacturing, and a less of a dependence on end-of-pipe treatment technologies is achieved. Reducing raw material consumption per unit of production and simplification or elimination of end-of-pipe controls translates into lower operating costs for enterprises. Hence, enterprises can improve their financial bottom line performances.

Specific objectives:

1. Established a dedicated Pollution Prevention (P2) program as a part of the existing EMS.
2. Developed elements of an Environmental Management Information System (EMIS) to facilitate compliance and reporting requirements to ASEZ (Aqaba Special Economic Zone) agency, which is the local environmental regulatory body. The same EMIS was later applied by the Corporate Environmental Manager to track EH&S performance at the different mining locations.

### 3.2 Activities Implemented

The RIAL project team screened and select industrial enterprises from which direct consulting and Partner Enterprise relations were created.

Activities were implemented at the following Partner Enterprises: the Aqaba Fertilizer Complex, Eshidiya Mines, Jordan Potash Co., Jordan Refinery Co., Jordan Industrial Estate Corporation, Jordache Apparel, the Industrial Estate. Pepsi and Hammoudeh Dairy and Cheese as Partner Enterprises.

The RIAL project team also provided P2 consulting within the Qualified Industrial Zones (QIZ), which produce large quantities of wastewater from textile industries with a negative impact on the surrounding environment; the Amman Slaughterhouse; and the Potash and Cement industrial sectors.

### **3.3 Results Achieved**

The accomplishments are detailed in specific reports that were prepared, reviewed and then condensed into small workshops and seminars that were widely distributed. RIAL then conducted a series of industry-specific workshops on P2 tools and practices. These workshops made effective use of P2/EMS Sector Notebooks created for this purpose and which were later incorporated in the Knowledge Center for wide access by all stakeholders. Industry Sector Notebooks were created for the Food Processing and Rendering Industry, the Dairy Industry, and the Beverage Industry.

In the cases of the Jordan Industrial Estate Corp. and the Ad Dulayl Industrial Park (QIZ), baseline practices for wastewater management were extensively studied and recommendations were made for large-scale treatment technology investments. These are briefly described in the next section.

A focus on Zarqa (Sub Task 3.2.1) was made by first conducting a Workshop to serve as a kick-off, and then providing core information on EMS and P2. The initial workshop was used as a final screening in the selection of Partner Enterprises. Presentations were made to senior management from the Aqaba Fertilizer Complex, Eshidiya Mines, Jordan Potash Co., Jordan Refinery Co., the Jordan Industrial Estate Corporation, QIZ representatives, ASEZA, and the Zarqa, Sahab, and Irbid Industrial Zones. Break-out discussions with individual enterprises from among the recommended list of Partner Enterprises identified under Sub-Task 3.1 were conducted to ensure that the proper selection and level of commitment was shared by these organizations.

The Workshop was extended to a series of two-day programs for technical personnel. These provided in-depth information on how an integrated EMS/P2 program is supposed to function; information on how to conduct P2 audits and to prepare cost/benefit analyses for the purpose of identifying P2 investment opportunities; case studies and group discussions whereby enterprises shared technical challenges; and on the use of Internet resources.

After the final selection of the Partner Enterprises was made, Memorandum of Understandings (MOUs) were developed between the RIAL Project Team and each specific partner. The purpose of these agreements was to obtain senior management commitment for manpower resources in identifying and evaluating P2 opportunities that result in water reductions. These commitments extended to establishing P2/EMS teams comprised of technical staff members, and for testing, sampling, and plant trials. Partner Enterprises committed to implementing no-cost/low-cost P2 opportunities and to develop and establish written Corporate Environmental Policy statements. Partner Enterprises published their Corporate Environmental Policy statements on web sites and newspapers.

Kick off-meetings, planning and scheduling meetings, audit protocols, and targeted areas for the audits were discussed in detail with each of the Partner Enterprise EMS/P2 teams. At the completion of each P2 audit and assessment, a joint presentation was made by the enterprise team and RIAL Project Team to enterprise senior management. The presentations covered the costs/benefits for

each of the three P2 cost categories; provided an implementation schedule for the low-cost/no-cost investments; and defined the resources and preliminary estimated costs needed for the medium and high cost P2 investments.

The low-cost/no-cost P2 recommendations were largely implemented by the enterprises and the exact financial and water savings quantified. The CDM technical assistance team audited the improvements to verify that the recommendations had been implemented and savings captured.

The teams also developed feasibility assessments and detailed C/B assessments for the medium and high-cost P2 investments. At one point Task 3 purchased an ultrasonic flow meter to facilitate measurements needed for P2 assessments. This constituted subsidized technical assistance to implementing P2 measures through USAID.

In several cases such as Jordache and Ad Dulayl QIZ Task 3 defined and attempted to secure financing for medium and large P2 projects through USAID's DCA program. However, DCA rejected these investments on the basis that they did not meet the full criteria for their type of support.

As a part of the EMS/P2 programs implemented at Partner Enterprises, the RIAL Project Team introduced metrics for environmental performance tracking. This was accomplished by implementing a series of workshops and training programs as well as enterprise-specific consulting on the application of Environmental Management Information Systems (EMIS). As an example, the RIAL Project Team assisted IT personnel at the

**Jordan Phosphate Mining Co. (JPMC)** developed an internal waste tracking database which they now use to chart waste on a weekly basis. The RIAL Project Team also assisted JPMC in upgrading their email communications through the use of an automatic calendar which circulates email notes on corrective actions for environmental aspects that their EMS/P2 committee has identified.

As another example, the RIAL Project Team also trained and then facilitated conference call training with Essential Software Solutions Inc. (ESS), a leading EMIS supplier of database management systems for the

**Jordan Petroleum Refinery Company.** This led to the refinery contracting additional training of staff on their own and site visits to refineries in Saudi Arabia where the commercial EMIS software platforms were being applied. These efforts fostered the exchange of information and networking which allowed the enterprise to make appropriate decisions regarding investments in the most appropriate metrics and tracking system for their situation.

With other enterprises the activities focused on identifying P2 opportunities aimed at reducing wastewater loadings and sewer and off-site discharges. Working with each enterprise's EMS/P2 team that we helped to form, the project developed a comparative costs/benefits analysis between P2 and pre-treatment technology options. Summary reports with lessons learned and performance-tracking data were published and then distributed to the enterprises, the WAJ, the MoE, and then placed on the web site of the MoE's Industry Knowledge Center (IKC).

### **3.3.3 Phosphate Fertilizer Industry**

RIAL and the USAID Mission have considered Jordan Phosphate Mining Co. (JPMC) a strategic Partner Enterprise because of its size, the fact that it represents a multi-national corporation, and the economic importance of the industry sector to Jordan. JPMC is the second largest industrial facility in Jordan. It operates three mines each extracting phosphate rock, and a downstream fertilizer and chemicals plant, the Aqaba Fertilizer Complex at Aqaba. The fertilizer complex manufactures phosphoric acid, diammonium phosphate ("DAP"), sulphuric acid and aluminium fluoride. Jordan is the sixth largest phosphate rock producer in the world, the fourth largest exporter of phosphate rock in the world. JPMC is the largest exporter in terms of revenue in the Jordanian economy.

The initial RIAL Project scope of work called for technical assistance to be provided to the Eshidiya Mining location. This technical assistance was to be in the form of a leak detection and repair (LDAR) program aimed at saving water in the ore beneficiation plant.<sup>3</sup> The 2003 "Environmental Aspects of the Eshidiya Mining Operation" report identifies and documents approximately 6 million JD in annual water savings and recycling opportunities.<sup>4</sup> At the time the original scope of activities for the RIAL Project was written, the partner enterprise expressed interest in the LDAR program, which included a 50,000 USD line item for equipment procurement.

At the initiation of the RIAL Project several visits were made to the Eshidiya Mining location and follow up meetings were conducted with corporate management in Amman. JPMC's management explained that the enterprise was in the process of undergoing privatization and a process of modernization of the Eshidiya ore beneficiation plant was underway which incorporated many of the recommendations included in the 2003 PA report.

Based on several visits and meetings with the Corporate Environmental Manager at the Aqaba Fertilizer Complex, a modified technical assistance program was devised. The revised program focused on strengthening JPMC's existing EMS program. By strengthening the existing program, benefits to the enterprise's overall EMS will be achieved and eventually reach operational levels at the mining locations.

## **Training and Tools**

To achieve maximum benefit and widespread adoption of best practices and technologies, reinforcement through targeted training was implemented at each of the Partner Enterprises and in roll out activities. Among the activities implemented was a two-day workshop at the end of Year 1. The workshop reviewed progress and accomplishments and provided enterprises with additional

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<sup>3</sup> USAID Reuse for Industry, Agriculture and Landscaping (RIAL) Project, Contract No. LAG-I-00-98-00034-00, Task Order 816. See Page 3-26, Task 3.3.3: Focus on Phosphate Fertilizer Industry, Revised Work Plan. September 1, 2004.

<sup>4</sup> Environmental Aspects of the Eshidiya Mining Operation, PA Government Services Jordan Project Office, USAID Contract No. LAG-I-00-99-00019-00. October, 2003.

tools to facilitate financing P2 investments. Partner Enterprises participated by making presentations of their work as a part of the workshop. Enterprises from other industrial zones were invited to attend which allowed dissemination of information.

A one-day workshop was also implemented at mid-point of Year 2. This workshop focused on approaches, resources and tools for integrating P2 into full EMS programs. Strategies and approaches to financing large-scale P2 investments were covered.

### 3.4 Results Achieved

At each of the Partner Enterprises elements of ISO 14001 were established along with dedicated P2 programs that identified and captured several million dollars in savings in the forms of energy, raw materials, water reuse and reduced pollution fees. More than 700,000 cubic meters in water savings or reuse opportunities were identified. Detailed reports published throughout the program document the P2 opportunities, the technical solutions arrived at by each of the Partner Enterprise EMS/P2 teams, and the C/B analyses prepared in justification of investments.

The RIAL Project Team determined that all of the low-cost P2 opportunities were implemented, however due to time and limited resources a detailed auditing of each facility could not be conducted to assess whether the medium and high-cost opportunities were captured. Table 3-1 provides a summary of the savings, including those achieved with Partner Enterprises during the second year roll-out activity.

**Table 3-1. Summary of Water Savings and Financial Savings**

No.	Name of Enterprise	Total Materials Savings	Total Financial Savings
		Tons/year (most is water)	JDs
1	Jordan Petroleum Refinery Co. (JPRC)	277,739	1,034,237
2	Jordan Phosphate Mines Co. (JPMC) - AQABA Fertilizer Complex	109,802	1,044,604
3	American - Jordanian Co. for Apparel, (JORDACHE)	126,390	147,929
4	Jordan Aerated Ice Co. - Pepsi Cola	252,252	443,059
5	Hammoudeh Food Industries Co.	Requires further Assessment	
	Total in JD's	766,183	2,669,829
	Total in US\$		3,760,323

The results achieved at Partner Enterprises extended beyond immediate P2 opportunities. Each of the enterprises underwent a corporate-wide reorientation in which water resources and environmental performance became strategic objectives of policies. At several of the facilities structural reorientations were

made in which formal EH&S (Environment, Health & Safety) managers and supporting staff were created for the first time.

P2 activities at the Partner Enterprises helped to create case studies that demonstrate how voluntary actions can achieve financial rewards and save or reuse reclaimed water effectively. These same activities helped to quantify and better define baseline wastewater management practices and options for some of the larger water users. These poor practices were found not to be unique for the enterprises, but rather typified the practices at many other enterprises. This in part helped to develop a base-line understanding of industry practices.

When the efforts were extended to training and auditing large estates (the Irbid Industrialized and Ad Dulayl QIZ) a quantifiable baseline of wastewater management practices emerged. This information enabled RIAL to develop the basis for a national strategy.

### **3.5 Indicators of Success**

- The RIAL Project Team has developed a feasibility study for Ad Dulayl QIZ on the design and operation of a CIWWT plant of its own. These are testimonies to the rationalized approach devised under RIAL for environmental infrastructure investments.
- More than 500,000 cubic meters of water and 3,000,000 USD in P2 savings were achieved at Partner Enterprises during the first year of the program.
- Jordache created a formal technical position of a full-time environmental manager.
- The Jordan Petroleum Refinery Company created a formal environmental policy statement and created an environmental management plan.
- The Jordan Petroleum Refinery Company engaged Lloyds of London to implement independent auditing in order to become registered under ISO 14001.

## **4. Institutional Capacity Building**

Work with key industry partners to develop incentives and to implement pilot demonstrations that support the concept that financial rewards and sound water management are synonymous thereby creating a marriage between the reliance on an end-of-pipe treatment technology and pollution prevention.

### **4.1 Overview and Objectives**

The RIAL project also focused on technical and institutional capacity building in government and industry. The RIAL project team provided industry exposure to the benefits of an integrated P2/EMS program, while at the same time to created tools and transfer skills that would benefit a range of stakeholders. The stakeholders were industries, the MoE, NGOs and the general public including academic institutions that have a focus of their own on environment and water conservation from an industrial viewpoint.

### **4.2 Activities Implemented**

Environmental and water authority regulators throughout the world play an important role in the management of a nation's water resources. Modern regulatory bodies do not focus solely on enforcement. They also serve as a resource that has the charter of assisting industry to improve their environmental performance.

#### **Government of Jordan Capacity Building**

RIAL organized a Water Management Task Force (WMTF). The WMTF consisted of a Steering Committee and three working groups. The Steering Committee was comprised of representatives from industry, the Ministry of Industry, the Zarqa Chamber of Industry, the Municipality Authority, the Ministry of Water and Irrigation, the Water Authority of Jordan, the Ministry of Environment, the Royal Scientific Society, Academics from Universities and Technical and Financial representatives from the Industrial Development Bank of Jordan. The Committee met several times to oversee and guide the activities of the working groups.

One of the technical working groups helped to review the technical design for the CIWWTP. This group evaluated the proposed treatment processes, existing and future Jordanian standards (893/2002, 202/2003), expected influent and effluent flows and characteristics, reliability, operational flexibility, staffing and reuse components (including opportunities for productive use of reclaimed water). The group investigated reuse options (e.g., selling reclaimed water in the Industrial Zone) and quality and quantity requirements of those options. The group also helped to review the Dorsch design and several effective industrial wastewater treatment plants worldwide including plants in Tunisia, Cyprus, Europe and USA. Treatment plant alternatives were also considered for application and a recommended strategy developed.

As a part of the technical review, the group implemented an Environmental Impact Assessment (EIA) developed as a part of the design basis for the IWWTP in compliance with USAID Regulation No. 216.

The second group formed was the Sustainability Working Group. The duties of this group were to aid in reviews of the construction schedule, the cost estimate (including capital and O&M costs), and assess and recommend viable financial options that incorporate contributions from industry stakeholders. This group worked closely with the RIAL Project Team in evaluating the use of fee structures to promote water conservation and reuse by participating firms, and further helped to assess potential options for the utilization of the USAID Development Credit Facility to mobilize local lending. This group also helped to develop guidelines for procurement and contract methods, including design/build, design/build/operate, etc., and management contracts, e.g. Greater Amman management contract.

Finally a Strategy Working Group was formed. This group worked on selection criteria for Partner Enterprises from within the ZCI for industry-specific EMS/P2 pilot programs under Sub-Task 3.2, along with a list of Partner Enterprises subject to USAID review and approval. The Group monitored progress and tracked performance of both Sub-Tasks 3.2 and 3.3.

The Strategy Working Group provided guidance on establishing criteria for evaluating the costs/benefits of proposed projects. Three categories of projects were comprised of low-cost/no-cost which was implemented by enterprises alone; medium cost projects, which require subsidies but should be cost-shared by enterprises some of which were implemented; and, large-scale investments that were beyond the present financial means of the enterprise and therefore require financing.

The Strategy Working Group also helped to evaluate the use of economic instruments as a part of devising recommendations for a national strategy that will encourage and help to catalyze industry stakeholder investments into water reuse, recycling, and low water demand technologies. Among the economic instruments assessed were access to USAID's Development Credit Authority (DCA), bonds, pooled financing and community based finance models, and the establishment of an Environmental Fund. Models used in other countries were examined as a part of the Group's activity.

## **Industry Knowledge Center**

RIAL worked primarily with the MoE, incorporating suggestions and ideas from the WAJ, Ministry of Trade and Industry, and Chambers of Industries to develop a Web-based resource for water conservation and P2. The objective was to create a Web-based library with links to international programs and tools on EMS and P2.

A strategy for widely publicizing this resource to industry was devised by helping to create a Knowledge Center that is managed by the MoE. The strategy for dissemination is based on new activities under the USAID Manifest Project will

link the web site and toolkits created for the center to a cradle to grave wastewater management system. In the follow-on work after RIAL, industry stakeholders will be required to file year end waste generation reports and to apply for waste generator licenses. In this manner the tools for P2 practices can be accessed thus providing industry stakeholder's alternative approaches to reducing wastes and improving water reuse. This approach places regulators in the role of advisors to industry thus providing alternatives to end-of-pipe controls and further affording enterprises tools for reducing the costs for compliance.

Among the tools provided at the center are Jordanian enterprise P2 case studies implemented by Partner Enterprises, Industry Sector Ps/EMS Sourcebooks, links to international case studies on P2, EMS/ISO 14001 toolkits, links to sites for software downloads for performing C/B analyses, links to web sites for international symposiums on P2 and sources of funding from financial institutions. In addition the site will eventually provide information on the Jordan Environmental Fund and a National Recognition Award which was initiated under RIAL and is continuing under a working group established by the MoE.

Finally, the center contains the starting point for a database for industry performance. Enterprise data on wastewater, enterprise-specific demographics, as well as waste management and current reporting practices are contained in a GIS database. As this database system is enhanced/refined, and populated and regulatory elements are added to it under the USAID Manifest Project, the tool will become accessible to the general public. This will allow the public and NGOs to benchmark industry performance in wastewater management and reuse of reclaimed water.

### **4.3 Results Achieved**

Tools and skills have been transferred to the MoE. The specific tools housed in the Knowledge Center places the MoE in a modern-day role of being both regulator and advisor/consultant to industry. The nature of the tools is such that they are likely to be accessible to a broad range of stakeholders, not just industry.

Over the course of the project more than 200 industry personnel have been benefited from workshops, seminars and on-site consulting on P2, EMS, and EMIS tools, with approximately 15% being female.

#### **Industry Knowledge Center Website**

Hosted under the Ministry of Environment website with the following content:

1. Ministry of Environment/Jordan - Link to the main website page of the MoE.
2. Home - Main page of KC website
3. About us - it will contain information on the Knowledge Center objective, Mission and Vision
4. Contact Us - The KC address, phone number and fax number
5. Services - What the KC provides to customers
6. Industry By Sector - the page will include information on waste management and pollution prevention for industry
7. Workshop & Training - Workshops and training materials delivered under the Industry Component of RIAL Project.

8. Local Case Studies – Contains RIAL Partner Enterprises case studies / reports
9. International Case studies – Links to international website on waste management and pollution prevention
10. Environmental Score Board Entry Screens - Dynamic pages that allow for entering and viewing information about industry water use and wastewater disposal.

The following is a list of equipment procured and now housed at the MoE Industry Knowledge Center:

#### **Office Furnishings**

- 3 Office Desks, 3 movable office chairs and 3 Office side disk
- One meeting table with 6 movable meeting chairs
- 2 Glass front book cases / cabinet
- Telephone
- Water Dispenser

#### **Computer Hardware and Peripherals**

- 3 Personal Computers (hp 7500)
- Colored Printer (hp 1280 ink jet)
- Digital Camera (hp).
- Computer Hub
- Multi function (Fax, Copier, Printer and Scanner)

#### **Computer Software**

- Microsoft XP Operating System
- Microsoft Office Software
- Arc GIS Software

#### **Computer Applications**

- “Industry wastewater database” (MS - Excel sheet).
  - Contains information on wastewater quantities and disposals practices for approximately 100 industries across Zarqa Region.

## **4.4 Indicators of Success**

- Pepsi created a full time position for an environmental manager and has adopted a wastewater tracking system which their IT personnel developed from tools introduced under the RIAL program.

- The Aqaba Fertilizer Complex (JPMC) invested in a simplified EMIS software platform based on additional consultations with the RIAL project team in year 2.
- The MoE has engaged a full time advisor on cleaner production.
- The Industry Knowledge Center has been established and furnished.
- MoE staff has been trained on use of knowledge center software and computer applications.
- The MoE has assigned a full time director to the Industry Knowledge Center.
- The Industry Knowledge Center Website was developed and launched
- The MoE has engaged an outside contractor with funding support through USAID to develop an electronic waste tracking program that will constitute the USAID Manifest Project system for wastewater management.
- The Environmental Recognition Award program has been devised and the first recipients were identified and awards were distributed.
- The problem of off-site disposal of industrial wastes to undisclosed locations and the Ein Ghazal municipal receiving station were identified and highlighted and became the focus of monitoring and enforcement.

# 5. Industry Strategy

## 5.1 Overview and Objectives

RIAL activities have yielded sustainable water recycling, reuse and conservation projects from technical, institutional and socio-economical perspectives.

The development of a national strategy that would further develop the sustainability of water conservation, recycle and reuse in industry was envisioned at the outset of the RIAL Project to be best accomplished through direct interaction with specific industries, simultaneous with the provision of technical assistance to key government agencies responsible for industrial water use and wastewater discharge. The approach taken had three distinct elements:

**1. Demonstration of Benefits to Industries** - Direct interventions were used to demonstrate to industries the financial and operational benefits of water recycling, reuse and conservation in their day-to-day processes. The technical interventions were developed within an Environmental Management System/Pollution Prevention (EMS/P2) framework to emphasize direct financial and indirect environmental benefits of water conservation and recycling activities. Where appropriate, specific economic and financial tools were applied to aid in the demonstration of benefits. Emphasis was initially placed on the Zarqa area due to the relatively high density of industrial development there, and a Centralize Industrial Wastewater Treatment Plant proposed at the start of the project.

**2. Training of Industry Stakeholders** - To enhance sustainability of the direct interventions, focused training of industry employees was implemented. This training will serve to reinforce concepts passed on through direct EMS/P2 intervention. Training was aimed at all levels of industry employees (workers, managers and executives).

**3. Institutional Capacity Building** - Specific capacity building activities were performed to ensure that the EMS/P2 approach and the resultant national strategy had continued support from the Government of Jordan including the Ministry of Environment after the completion of the project.

## 5.2 Activities Undertaken

The creation of a national strategy for industrial water management was an important RIAL Project Team activity. Its development and adoption was considered at the onset of the project to be best accomplished through direct interaction with specific industries, simultaneous with the provision of technical assistance to key government agencies responsible for industrial water use and wastewater discharge.

On the whole, the RIAL Project Team learned that the industrial sectors' environmental performance is poor and below the general standard of care practiced in North America and throughout the European Union. The RIAL project team visited and audited many more enterprises than the Partner Enterprises. These visits in most cases were tantamount to rapid in-plant assessments on water use and wastewater management.

On-site interviews revealed that facility managers oftentimes provided irrational answers to basic questions such as how much wastewater is generated how is it managed, and what happens to the solid waste (sludge) streams generated from on-site treatment? In many instances, industry representatives reported they had no sludge from on site treatment, yet inspections of the operations either showed sludge generation from pre-treatment operations, or responses simply made little sense based upon the nature of their processes.

Additionally, we found many enterprises to report between 1/10th to less than half the amount of wastewater generated than the regulators have reported from past inspections and on permit applications.

A significant number of industry stakeholders did not know where their wastewaters were disposed and some did not appear to be concerned about off-site disposal practices. A large number of industry representatives understood that their companies were in fact illegally disposing of their wastes at Ein Ghazal, which currently only accepts municipal wastes unless a special permit is issued. Some industry representatives did not appear concerned about applying for proper disposal permits because they believed that their liabilities end when they pay a transporter to accept the waste for disposal.

These factors enabled the RIAL project team to develop recommendations for a rational strategy aimed at not only meeting regulatory compliance, but one that encourages practices and investments on the part of industry to sustain limited water resources.

The recommended strategy is defined in the December 2007 "Strategy for Improving Water Conservation, Pollution Prevention, and Environmental Performance in Jordanian Industry".

- Jordan's standards with regard to wastewater management are comparable to other countries, including the U.S. The current regulatory practices for enforcement are, however inadequate.
- The central laboratory of the WAJ only monitors 18 facilities within Zarqa on a regular basis, and only for sewer discharge violations. Among these 18 facilities, one is the thermal power station and the other is the petroleum refinery. This means that out of nearly 3800 enterprises which comprise the SME population, less than 1 % (0.4 % to be exact) are aggressively monitored for violations and only for exceeding sewer discharge standards. Land irrigation using industrial wastewater and off-site transport and disposal are not monitored by the WAJ.

- The MoE has the responsibility of monitoring and enforcement of all other standards related to wastewater management. The MoE does not have any monitoring infrastructure but contracts the Royal Scientific Society (RSS) to perform monitoring. The RSS typically only randomly monitors 6 enterprises within the Zarqa Governorate with spot measurements of certain wastewater effluent quality parameters.
- Fines and penalties are an inadequate deterrent to intentional violations. Facilities that are found to be out of compliance are given citations. Three consecutive citations typically will result in a shutdown with a modest lien attached to the assets of the company until compliance is demonstrated. Shutdowns are either overturned through enterprise lobbying efforts with the GOJ, or compliance is met, but not monitored to ensure continued enforcement. There are no criminal penalties imposed for intentional violations.
- The country lacks environmental enforcement capabilities. The consequence of this is that unless the general area of enforcement is improved, there are no guarantees that any environmental infrastructure investment will be sustained and improve industry's management practices for wastewater.

### 5.3 Results Achieved

The following strategy has been recommended with elements already underway:

**Cradle-to-Grave Waste Management System** - A Cradle-to-Grave Waste Management System should be implemented and supervised by the MoE. The Cradle to Grave Management System that forms the basis for the U.S. Resource Conservation and Recovery Act (RCRA) can serve as the model. This is a waste-trip-ticket system that makes the entire life cycle of an enterprise's waste transparent to the regulator. Enterprises would be required to have a permit to generate waste, a permit to maintain untreated wastes in temporary storage on site, a permit to discharge within legal limits. While the WAJ maintains monitoring and enforcement over sewer discharges, the MoE could begin careful monitoring and enforcement of off-site disposal practices. The transporter would have a permit to transport. The disposal facility would have a permit to receive certain types of wastes. By creating a paper trail for waste at the point of generation to off-site transit to final destination, the quantities and characteristics of wastes that are being generated by each generator becomes transparent. The RCRA trip ticket management model provides the regulator with an independent verification of how much wastewater is generated, how much of it leaves a generator's site, and how much of it is actually received by the disposal facility. This transparency will make it clearer to the regulator whether or not a generator or waste transporter is taking a waste to an unlicensed area. This will trigger an enforcement action on the part of the MoE.

The only current major off-site disposal facility is Ein Ghazal. This municipal pre-treatment facility is permitted to accept industrial waste under an existing permit

system, but only one industrial facility is permitted. The survey has confirmed that enterprises are disposing their wastes illegally to the station.

**Technical Assistance to Ein Ghazal** - Part of the strategy included technical assistance to equip the Ein Ghazal waste receiving station with resources that will enable it to monitor and apply enforcement tools to curtail illegal discharges of industrial wastes. This was approved by the MoE who requested and has received support from USAID through a 2-year technical support program aimed at developing a formal cradle to grave wastewater management program based on the U.S. model manifest system.

Initial enforcement actions recommended under the strategy call for forcing the violators to apply for a formal permit to discharge to the Ein Ghazal facility. Again this is being addressed through a newly funded manifest system project. Under this new activity the MoE has begun developing a database that identifies violators that should be targeted under enforcement actions, and establishes a basis for estimating the quantities and characteristics of wastes streams that are being sent to Ein Ghazal.

The above constitutes the “stick.” The strategy can be strengthened by devising and imposing significant fines and penalties for intentional violations. Overhead costs for the MoE to manage the permit system and data base should be derived in part if not entirely from fees for licensing and permits. Heavy fines for violations will help to pay for aggressive monitoring.

**Environmental Fund** - The RIAL project team has recommended establish a Revolving Fund for Pre-Treatment and Clean Technologies. Discussions with the MoE showed that this approach is best supported through the Jordan Environment Fund. A separate report detailing recommendations and approaches was published. The MoE has formed a working committee that is developing this over time. RIAL has continued to provide support and guidance by facilitating meetings and through proposed models for financing and sustaining a fund program.

As a part of the strategy the RIAL project team recommended examining the feasibilities of Jordanian investments into CIWWTP in regions where the industrial population of users is better defined. This recommendation was followed up and a separate feasibility assessment and full design resulted for the Irbid Industrial Estate. In this case the investment made good business sense because the estate services more than 90 enterprises which are already dependent on an on-site sanitary treatment plant. In P2 assessments at the estate RIAL learned that industrial wastes were being managed by a combination of discharges to the sanitary system which overloaded the system and sacrificed operational integrity, off-site disposal to undesignated areas causing environmental damages, and disposal to the Al Ekaidar landfill which is an environmentally damaging practice because wastes were combined with municipal wastes in unlined pits in close proximity to residential communities.

This recommendation has resulted in a final design which the industrial estate managers have committed funds, contracted an engineering firm and have begun

breaking ground to construct a centralized industrial wastewater treatment unit within the fence line of the estate. In addition, under the Manifest project which has been requested by the MoE and approved by USAID, a separate contractor is developing an environmental management plan that is based on P2 which will ensure that the new treatment works will be sustained.

**Institutional Strengthening** - The recommended strategy calls for a strengthening of the Ministry of Environment's current practices of monitoring and enforcement (a "Stick") coupled with financial incentives through an environmental fund program that may be established through the Jordan Environmental Protection Fund. Coupling these components with the P2 tools created in the Knowledge Center offers a sustainable approach to improving water use and overall environmental performance among industry stakeholders.

**National Strategy** - The results of the work related to a national strategy were documented in the December 2007 Task 3 Report entitled "Strategy for Improving Water Conservation, Pollution Prevention and Environmental Performance in Jordanian Industry." The specific recommended actions were reviewed with over 30 representatives of industry, government, funding agency and interested stakeholders in a workshop held in Amman on January 14, 2007. The final strategy for further developing the sustainability of water conservation in industry was documented in a January 2008 National Strategy for Industry Overview memorandum report.

- The MoE was reoriented and recognized the need for a formal cradle to grave industrial wastewater management system and more focused enforcement.

## 6. Summary and Conclusions

Specific RIAL Task 3 project objectives included:

- Achieve growing industry interest and adoption of best practices and technologies for efficient water use in industrial production
- Improve water quality and environmental performance
- Develop a strategy and a management program that promotes and helps sustain water conservation and reuse of reclaimed water
- Develop recommendations for a long-term strategy for the management and sustainability of the planned Zarqa Centralized Industrial Wastewater Treatment Plant (CIWWTP); and,
- Assist in developing financing approaches for achieving required investments in water efficiency improvement.

Deliverables developed under RIAL Task 3 are listed in Table 6 -1  
**Table 6-1. RIAL Task 3 Deliverables.**

<b>RIAL PROJECT Reports - ( Task 3 )</b>		
<b>NO.</b>	<b>TITLE</b>	<b>DATE</b>
3.01	<a href="#"><u>Industry Workshop on Pollution Prevention and Water Management Strategies ( Le Royal Hotel )</u></a>	28 Sep. 2004
3.02	<a href="#"><u>SUMMARY REPORT ON AL HASSA</u></a>	30 Sep. - 2004
3.03	<a href="#"><u>Preliminary Assessment of Reclaimed Water Use From the Wadi Shelala Wastewater Treatment Plant Investment by Irbid's Industry</u></a>	1 Nov.2004
3.04	<a href="#"><u>Revision of Jordanian Standard 202/ 2004</u></a>	21 Feb.- 2005
3.05	<a href="#"><u>Guidance Document for Design of Worker Safety Training Program for the Jordan Petroleum Refinery Co.</u></a>	28Feb.- 2005
3.06	<a href="#"><u>Interim Report on Basiline Industry Wastewater Management Practices in the Zarqa Governorate</u></a>	21 Mar. - 2005
3.07	<a href="#"><u>Guidance Document for ISO 14001 Development and Implementation for the Jordan Petroleum Refinery Co.</u></a>	5 May - 2005
3.08	<a href="#"><u>Training Report: EMS/P2 and ISO 14001 Training Course for JPMC (11 AND 12 July 2005)</u></a>	21 Aug.- 2005
3.09	<a href="#"><u>Training Report: Pollution Prevention Training Course for WAJ &amp; MOE (15 and 16 August 2005)</u></a>	30 Aug.- 2005
3.10	<a href="#"><u>EMS/P2 Assessment Report Jordan Petroleum Refinery Company</u></a>	6 Sep.- 2005
3.11	<a href="#"><u>Assesment of a Proposed Centralized Industrial Wastewater Treatment Plant for the Zarqa Region (Final)</u></a>	1- Dec. 2005
3.12	<a href="#"><u>Year 1 Industry Workshop Report</u></a>	18-19 Sep. 2005
3.13	<a href="#"><u>EMS/P2 Assessment Report American Jordanian Company for Apparel-JORDACHE</u></a>	1-Mar-06
3.14	<a href="#"><u>Training Report: EMS/P2 and ISO 14001 Training Course for Hammoudeh Dairy (March 5- 7,2006)</u></a>	8-Mar-06
3.15	<a href="#"><u>EMS/P2 Guidance Document</u></a>	30-Mar- 06
3.16	<a href="#"><u>EMIS Training Aqaba 27&amp;28 February 2006 EMIS Trainings for JPMC in 27 &amp; 28 Feb 2006</u></a>	30-Mar- 06
3.17	<a href="#"><u>Initial Environmental Review and Pollution Prevention Audit at the Jordan Phosphate Mining Co.</u></a>	7-May- 06

## RIAL PROJECT Reports - ( Task 3 )

NO.	TITLE	DATE
3.18	<a href="#">Year 2 Industry Workshop Report</a>	15 Aug.- 06
3.19	<a href="#">Initial Environmental Review and Pollution Prevention Audit of the Jorda Areated Ice Co. (Pepsi Cola)</a>	30 Oct. - 06
3.20	<a href="#">..\7.0 Reports\7.3 Task 3\Industrial Study Tour II\Ind study Tour Summary Report USA Aug. 20-28-06, October 1,06.pdf</a>	30 Oct. - 06
3.21	<a href="#">Al Hassan Industrial Estate Feasability Study for an industrial Wastewater Treatment Plant</a>	Jan. 07
3.22	<a href="#">Industry Sector Worshop Report</a>	Mar-07
3.23	<a href="#">Jordan Environmental Protection Fund (JEPF) Program- Program Concept and Development Approach</a>	May-07
3.24	<a href="#">Task 3 Industry Completion Report - Final</a>	Jun-08
3.25	<a href="#">Strategy for Improving Water Conservation, Pollution Prevention, and environmental Performance in Jordanian Industry Report</a>	Dec. - 07
3.26	<a href="#">MOE Industry knowledge Center IKC Report</a>	Dec. - 07
3.27	<a href="#">Ad Dulayl Industrial Park (QIZ) Feasability Study</a>	Jan. - 08
3.28	<a href="#">Strategy for Improving Water Conservation, Pollution Prevention, and Environmental Performance in Jordanian Industry</a>	Jan. - 08