Industrial Wastewater Management Options in Hebron

Prepared for the United States Agency for International Development
under Contract #HNE-C-00-96-90027-00

James W Morris
Mohammad M Abu-Orf
Nader Al-Khateeb
Said A Assaf
Alexander A Friedman

September 1998

Development Alternatives Inc
7250 Woodmont Ave Suite 200
Bethesda Maryland 20814

FORWARD

Collaborative Approaches for Resolving Water Issues

A

The FORWARD Team

Development Alternatives, Inc , Bethesda MD (Prime Contractor)
Arab Scientific Institute for Research and Transfer of Technology Ramallah West Bank/Gaza
Camp Dresser & McKee International Inc , Cambridge MA
CDR Associates, Boulder CO
Conflict Management Group, Cambridge MA
EnviroConsult Office, Amman Jordan
Environmental Quality International Cairo Egypt
HDR Engineering, Inc , Austin TX
Jordan Institute of Public Administration, Amman Jordan
Jouzy & Partners, Amman Jordan
Marketing Research Organization, Amman Jordan
Management Planning and Research Consultants, Beirut Lebanon
National Center for Middle East Studies, Cairo Egypt
RESOLVE, Inc , Washington D C
Training Resources Group, Alexandria VA
Water and Environment Research and Study Center, Amman Jordan

TABLE OF CONTENTS

EXECUTIVE SUMMARY vii

1 INTRODUCTION 1

2 APPROACH 5

3 OVERVIEW OF INDUSTRIAL WASTE GENERATION IN HEBRON 7

On-site Observations 10
Interviews and Available Information 12

4 INDUSTRY-SPECIFIC FINDINGS AND RECOMMENDATIONS 15

Stone Cutting Industries 15
Impacts of Tanning Industry on the Hebron Wastewater System 25
Car/Truck Washes 29
Food Processing 30
Chemical, Metal, and Miscellaneous Industries 31
Solid Wastes 32

5 EDUCATIONAL OPPORTUNITIES AND OPTIONS 35

Stone Cutting Industry 35
Tanning Industry 36
General Industrial and Public Educational Needs 36
Proper Reuse of Treated Wastewater 36

6 REGULATORY AND INSTITUTIONAL CONSIDERATIONS 39

7 ACTION PLAN 41

General Wastewater Data Collection 41
Industry Specific Actions 42

REFERENCES 45

APPENDICES

A SITE VISITS 47

B DOCUMENTS GATHERED 81

C PEOPLE INTERVIEWED AND CONTACT INFORMATION 87

D LICENSED FACTORIES AND SMALL INDUSTRIES IN HEBRON MUNICIPALITY 95

E POTENTIAL COOPERATING EDUCATIONAL RESOURCES FOR TRAINING 101

F PHOTOGRAPHS 105

LIST OF TABLES AND FIGURES

TABLES

2 1	Industrial Facilities Survey	5
3 1	Qualitative Impact of Industries Investigated on the Wastewater Management System	8
3 2	Estimated Relative Impact of Industries Investigated on the Wastewater Management System	9
3 3	Site Visit Log	10
3 4	Distribution of Industries Registered at the Chamber of Commerce, 1995-1996	12
4 1	Stone Cutting Facilities in Hebron City and District	15
4 2	Generalized Tanning Process Used in Hebron	26
4 3	Estimated 1998 Equalized Hebron Tannery Loads to the Sewer	27

FIGURES

3 1	Location of the Industrial Sites Visited	11
4 1	Schematic Diagram Describing Water Usage in a Typical Medium/Large Stone Cutting Industry Facility	16
4 6	Schematic Diagram Describing Typical Dimensions of Elevated Tanks in Medium/Large Facilities	18
7 1	Hypothetical Sections of the City and Conceptual Schematic of Wastewater Collection System	43

Photographs (found in Appendix F)

1 2	Raw Sewerage Discharge from the City of Hebron to the Wadi Al-Samen	107
1 3	Noticeably Bright Grayish, White Raw Sewerage Flowing Southward Down the Wadi Al-Samen	108
3 2	Multiple Bay Building	108
4 2	Continuous Water Usage for Stone Sawing	109
4 3	Slurry Settling after 10 Minutes	110
4 4	Polymer Mix and Dosing Tank	111
4 5	Close-up of Polymer Tank	112
4 7	Typical Stone Cutting Process Water Settling and Recycle System Tanks	113
4 8	Agricultural Test Plot at Al Arroub Field Demonstration Station	114
4 9	Rotating Wooden Drums Used in the Tanning Process	114
4 10	Light Grayish Blue Hides after Completion of the Tanning Step Showing the Characteristic Through the Blue" Color	115
4 11	Photograph of Tannery Drum Showing the Large Hinged Door through which all Materials Pass	115

4 12 Wastewater Discharge from a Typical Tannery in Hebron 116
4 13 Hand Application of Diesel Fuel to Truck Surfaces 116
4 14 High Pressure Water Spray Removes the Dissolved Materials and Fuel 117
4 15 Overflow Sump Photograph 117
4 16 Waste Tile Crusher 118
4 17 On-site Settling Pond 118
4 18 Ready-mix Recycle Pond Overflow 119
4 19 Clay Processing in Open Water Filled Basins 120
4 20 Pottery in a Storage Area Awaiting Firing 120
4 21 Modern Electroplating Facility in Hebron 121
4 22 Ground Surface Area Receiving Discharged Spent Solvents from Electroplating Facility 121
4 23 Randomly Dumped Piles Burning at the Hebron Solid Waste Dump 122
4 24 Area Setting View of the Hebron Open Burn Solid Waste Dump 122

LIST OF ACRONYMS

ANE	Asia and Near East Bureau (USAID)
ASIR	Arab Scientific Institute for Research and Technology of Transfer
BOD_5	Five Day Biochemical Oxygen Demand - bioassay for organics
CAMP	Coastal Aquifer Management Project (Gaza)
COD	Chemical Oxygen Demand - chemical measure of organics present
Cr	Chrome
CWES	Center for Water and Environmental Studies
EAWMP	Eastern Aquifer Water Management Project
L/capita-d	daily flow in liters per person
MEPP	Middle East Peace Process
mg TSS/L	concentration of total suspended solids, mass per volume in liters
m3/facility-d	daily flow volume produced at one factory or industrial installation
NGO	Nongovernmental Organization
NH_4-N	Nitrogen present in the ammonia/ammonium form
NIS	New Israeli Shekel
pH	measure of acidity
PVO	Private Voluntary Organization
S^{2}	Sufides
$SBOD_5$	Soluble Biochemical Oxygen Demand – dissolved portion of BOD_5
SCOD	Soluble Chemical Oxygen Demand – dissolved portion of COD
TDS or salinity	Total dissolved salts, substances in solution
TKN	Total Kejheldal Nitrogen, nitrogen in organic forms
TSS	Total Suspended Solids – material present in solid particulate form
TVSS	Total Volatile Suspended Solids – organic portion of TSS
UNDP	United Nations Development Programme
USAID	United States Agency for International Development
Visit No	Industrial facility site interviews and tours (number designation for reference)

EXECUTIVE SUMMARY

The Municipality of Hebron contains a large and diverse industrial sector relative to the city's population of approximately 200,000 people in an area of about 29 km^2 (2) Many of these industries are important to the entire West Bank region At present the majority of the city is connected to a sewage collection system that is intended to serve over 95 percent of the potential clients by September, 1998 and close to 100 percent of the population shortly thereafter At present, the collection system discharges untreated, raw wastewater into the Hebron Wadi which flows in a southerly direction from the south end of the city

The purpose of the work described in this report was to support the development of a conceptual design for wastewater treatment and disposal options for Hebron The core objectives were to determine and classify the existing the industrial wastewater generation and characteristics information available, gather information to identify and describe the industries that will have the greatest impact on a comprehensive wastewater management system design, and determine how to gather additional critical information needed to complete a successful conceptual system design This activity is part of an Integrated Water Resources Management Program designed to protect and enhance the use of the scarce water resources of the Eastern Aquifer Basin for Palestinians in the West Bank Program components will identify wastewater aquifer recharge and agricultural reuse opportunities, stormwater harvesting potential, develop plans to protect the aquifer from point and non-point pollution, establish a flow conservation program, as well as, the impact of industrial activities on wastewater management and reuse as addressed in this effort

Based on 32 industrial interviews and more than twelve meetings with key governmental and industrial water-use authorities to obtain critical information, it appears that hard data for water consumption and wastewater generation and their associated engineering characteristics do not exist for either industrial or domestic sources in Hebron The data obtained from the industrial interviews were judged to be inconsistent due to attempts to favorably impress the interviewer, because key information and data was not systematically or accurately collected, and/or since political perspectives or imperatives appeared to influenced the data recorded or responses given

Findings must be interpreted in the context of the limited resources available to the team and the potential for politically motivated withholding of information by interviewees, data bias, or the team's failure to understand and find potential resources for available information However, two resident Palestinian team members with extensive experience and expertise in water and environmentally related issues assured that to the extent reasonable the data readily available was obtained

It must also be emphasized that many of the water scarcity problems faced by Hebron industries are magnified by the fact that water and power are simply not available on a dependable and consistent basis from the municipality Typically dependable municipal water supplies are available for industrial use only during the three wet months of the year A new municipal water source and supply developed with USAID resources will shortly help to address this industrial problem However, based on the findings of this initial effort, it is apparent that if the current industrial practices continue and no

corrective actions are taken for the proposed wastewater treatment system design, the following serious impacts will occur

- A substantial flow and suspended solids load from the stone processing industries will substantially increase the size and complexity of the wastewater treatment system The collection system will require frequent flushing and more than typical levels of maintenance due to plugging and abrasion Handling and disposal of excessive sludge generated from this source will substantially increase construction, operation and maintenance costs for the wastewater treatment facility

- Tanning industry wastewaters will require that pipes in the service drainage areas be protected or replaced with corrosion resistant materials to cope with very high sulfide levels and the rapidly alternating swings in pH expected Excessive levels of either can lead to substantial corrosion and system failure Sulfides could require special design considerations to protect treatment system headworks and equipment from extensive corrosion In addition, special oxygen transfer provisions may be required beyond those considered normal for municipal wastewater treatment facilities

- Wastewater characterization is recommended for the truck/car wash facilities prevalent throughout Hebron determine if their impact is as substantial as anticipated and to recommend options to reduce flow, oil, grease and total suspended solids loadings

- Significant treatment plant impacts will be exerted by contributions from dairy processing and animal slaughterhouse facilities These effects may be substantially increased seasonally for olive oil production and for many other food production activities during Ramadan

- With the extremely low water usage in general in Hebron and the industries that predominate, careful attention must be paid to wastewater salinity High salinity can potentially restrict many resource options including irrigation reuse and groundwater recharge Salinity issues may dictate separate treatment and disposal for high salinity streams This concern may ease with higher wastewater generation rates anticipated as water becomes more available to Hebron

Key options enumerated for industrial waste minimization, reuse and recharge based upon team observations and industrial experience include

Stone Processing On-site or preliminary treatment to reduce solids in the sewered wastewaters and to enhance all reuse and recharge alternatives

Tanneries Alter existing tanning processes to dramatically reduce costs for production while maintaining high quality At the same time the amounts of troublesome sulfides and other materials released to the wastewater treatment system can potentially be reduced significantly

Food Processing Use of efficient high pressure washing systems to significantly reduce wastewater generation Also potential exists to reduce the mass of pollutants discharged by adopting dry cleaning techniques

Other Industries Close attention is advised for understanding and controlling the unexpected impact of the truck/car washing bay's wastewater generation At several industrial operations the disposal of potentially harmful substances directly onto or into the ground was practiced posing a direct threat to precious groundwater In many instances throughout Hebron's industrial community, the generation and handling of solid wastes pose real concerns for environmental and public health protection

Regulatory The industrial operations in Hebron discharge materials to the sewer with little or no oversight or restrictions This practice poses an on-going threat to the region's water resources Political authority in the region is fragmented with overlapping responsibilities and little true enforcement capabilities A strong local industrial sewage pretreatment authority could potentially safeguard reuse and recharge options, protect treatment system components and operation, provide municipal and industrial operation guidance and training, and potentially fund operations through appropriate sewer use charges

The absence of adequate data prevented economic or technical feasibility of the waste reduction alternatives identified from being determined Data characterizing the quantity and quality of both industrial and domestic/commercial wastewater from Hebron are essential before a proper treatment plant options plan may be completed

Plan of Action for Obtaining Needed Information

Additional information on Hebron wastewaters as currently generated and after the water supply is enhance in the future is necessary to develop a viable, meaningful conceptual design for the Hebron wastewater treatment system These data can be obtained by a stepwise wastewater characterization survey The results from each step or phase in the proposed characterization study will determine, or inform, the specific needs of each following step This will minimize the overall efforts required by collecting only relevant data directly needed and help assure a cost effective final design A traditional engineering comprehensive source and wastewater generation study is not recommended in order to save time and resources Major steps in such a focused stepwise program include

1 Location of sewers and facilities to determine the sources of wastewater generated from the major geographic and demographic areas of Hebron Services, laterals and mains collecting wastewater should be entered into a master plot with each major industrial client identified It may be possible to group collection system drainage areas that predominately serve major industries, domestic areas, and mixed domestic/commercial/industrial areas

2 Limited wastewater flow measurement and sampling program

   A Isolate a large, predominately domestic area for sampling to determine current typical per capita loading rates for Hebron At the same time measure the wasteflow characteristics at the municipal outfall as it discharges into the wadi With population estimates and industrial/commercial facility information gather previously, a reasonable estimate may be obtained for the true impact of industrial contributions

B Next, based on initial data evaluations, select subdrainage areas serving specific industrial categories to determine the general importance of each These data will then be used with sampling data collected at specific industrial installations for accurate characterization The industries to be sampled may then be selected based upon the importance of their contribution and the potential impacts on the collection, treatment and reuse system

3 Based upon the above, the relative impact of each industry can be evaluated and determinations concerning the economic feasibility and advantages obtained for all practical pretreatment, reuse, recharge, or discharge options identified This would be a preliminary economic feasibility study comparing the impacts of pretreatment, preliminary treatment, and collection system operation and maintenance costs to the impacts and costs of the overall wastewater treatment system The focus will be on the cost or value to the industries served compared to the impact and cost savings for wastewater treatment and handling These investigations must carefully consider and evaluate all alternatives in relation to the discharge quality required for specific recycle, reuse, recharge or surface discharge options Each of the proposed end uses of the treated wastewater will directly effect the treatment train required and resultant system cost

4 Once feasible treatment system options are identified then potential on-site demonstration projects or pilot treatment studies should be considered These projects should only be pursued when the treatment system effectiveness goals have been addressed

These steps are not all purely sequential and portions may rationally overlap Conceptual design may be well underway concurrently with steps 3 and 4 but should not proceed before steps 1 and 2 have been accomplished

Solid Waste Issues

Solid waste disposal at the Hebron open burn-dump threatens all three key environmental media, air, land and water Serious consideration should be given to converting or replacing the current operations to a controlled sanitary landfill There are also possibilities for using the waste as refuse derived fuel for converting the $CaCO_3$ waste stone cutting slurry solids to lime, a product used in tanning and cement/concrete manufacturing Dried stone cutting slurries could also be considered for use as landfill cover material for solid waste management operations due to its slow hydraulic conductivity

Educational Opportunities

Educational efforts should focus on two areas demonstrations and training of more efficient and less polluting industrial practices, and informing the industry owners, workers, and citizens of threats to their precious environmental resources and how to avoid contamination and waste

CHAPTER 1

INTRODUCTION

The Municipality of Hebron contains a large and diverse industrial sector relative to the city's population of approximately 200,000 people in an area of under 29 km^2 These industries are important to the entire West Bank region At present the majority of the city is connected to a sewerage collection system that is planned to serve over 95 percent of the potential clients by September, 1998 and close to 100 percent shortly thereafter The collection system currently discharges untreated, raw wastewater into the Hebron Wadi or Wadi Al-Samen which flows in a southerly direction

The purpose of the work described in this report was to support the development of a conceptual design for wastewater treatment and disposal options for Hebron The core objectives were to determine and classify the existing the industrial wastewater generation and characteristics information available, gather information to identify and describe the industries that will have the greatest impact on a comprehensive wastewater management system design, and determine how to gather additional critical information needed to complete a successful conceptual system design This activity is part of an Integrated Water Resources Management Program designed to protect and enhance the use of the scarce water resources of the Eastern Aquifer Basin for Palestinians in the West Bank Program components will identify wastewater aquifer recharge and agricultural reuse opportunities, stormwater harvesting potential, develop plans to protect the aquifer from point and non-point pollution, establish a flow conservation program, as well as, the impact of industrial activities on wastewater management and reuse as addressed in this effort

An understanding of water and wastewater concerns for Hebron's industrial base are only possible if the extreme scarcity of this valuable resource is realized Most industries can not rely on the municipal distribution system because for most of the time there is no water in the system for delivery The exception is that water is usually available to meet industrial needs during the three month annual wet season Otherwise the supply can not be depended upon Thus, at most industries with significant water demands, needed water is trucked to on-site reservoirs When water is available industries, commercial establishments and homeowners pump water for storage and use later Even this technique can fail as the electrical supply grid often fails and shuts down for significant periods during these high demand episodes When water is available in the supply system, it is very expensive Municipal water supplied through the distribution system costs 4 NIS per m^3 or approximately $4 20 U S per thousand U S gallons By comparison typical U S water costs are about $1 00 U S per thousand gallons Industries pay from 10 to 16 NIS per m^3 or $10 40 to $16 60 U S per thousand gallons

Water usage by the people of Hebron reflects this long-term scarcity They have an estimated average daily water consumption rate of about 30 L/capita-d, half the recommended allowance for proper sanitation set by the United Nations As new water well come on-line and water becomes more available, projections of future water usage in Hebron first goes to 60 L/capita-d then to a range of between 120 to 135 L/capita-d

For comparison water usage in the United States and Europe typically falls between 300 and 400 L/capita-d

Industrial operations in Hebron vary widely in both size and sophistication For example, the time honored art of pottery making is practiced in a way that is not significantly different from the methods used centuries ago In comparison very modern, "state-of-the-art" equipment prevails at the many stone processing and related industries The products of Hebron industries are also very diverse They include specialty welding electrodes used throughout the Middle East and Mediterranean, and only available from a single Hebron factory Also produced are fluid milk and processed milk products, the pasta and a variety of footwear The manufacturing of each of these products and the varied size and number of operations assures a wastestream unique to Hebron

Raw wastewater flowing from Hebron has the characteristic odor of raw sewage but appears very different Instead of the typical dark brownish gray color associated with a mixed domestic, commercial, industrial or municipal wastewater, Hebron's discharge is a bright white flow with a tinge of gray as seen in Figure 1 2 The strong color is due to the heavy load of suspended white limestone solids, $CaCO_3$, discharged from the thriving stone processing industries of Hebron Figure 1 3 shows that the white color persists as the flow winds down the wadi and it remains highly colored for many kilometers downstream Untreated open channel waste-flow of this type pose hazards to public health, prevent the flourishing of natural environmental habitats, and are deleterious to agricultural reuse and groundwater recharge It is the intent of USAID to provide treatment of this discharge with an appropriate wastewater treatment system

The treatment system to be developed with USAID resources may consist of many separate component facilities or could be a single large centralized facility As used in this report the term wastewater treatment or wastewater management "system" includes on-site modifications to existing industrial waste generation practices, the municipal wastewater collection and conveyance network, a modern, cost effective municipal wastewater treatment facility including regional or centralized pretreatment operations, and facilities for agricultural or industrial reuse and/or groundwater recharge

The best combination of unit processes and operation will be determined by the amounts of wastewaters generated, their independent and aggregate characteristics, and the eventual desired use of the treated effluent Critical to all future treatment system design work is the integration of findings from other activities aimed at protecting the area's water resources The quality required from the treatment system depends on where the product or treatment system effluent is discharged and how it will be used or incorporated into the surface and groundwater resources These reuse, recycle, discharge, and recharge utilization paths place specific system effluent quality requirements that must be carefully determined and serve as the driving force for treatment system performance criteria

This report describes the potential industrial impact on the system and details the information needed to develop a conceptual design for a cost effective, operable treatment system that will meet Hebron's needs into the future Information has been gathered by direct on-site investigations of industrial operations, and by gathering existing data and reports describing the industrial components of the Hebron's wastewaters Suggestions are provided for potential wastewater recycle, reuse, and recharge options and an educational/technology transfer/demonstration outline is

Previous Page Blank

offered Finally, a plan of action is provided for the next activities required to prepare a meaningful conceptual design

This activity is technical support by FORWARD to reach agreement on important water issues in West Bank and Israel through collaborative problem solving In this region of the world, water use and availability conflicts are highly political and require careful work to foster peace and prosperity

CHAPTER 2

APPROACH

The approach taken was to use available industry and municipal data to estimate flows then quantify amounts discharged from key industrial sectors Data enumerating industrial installations and identifying the products produced was key Then this information would be combined with existing wastewater composition data or literature derived values to identify the contributions to system loading that would cause the greatest concerns Since the stone cutting and tanning industries were known significant contributors to the sewage collected, the core data gathering efforts were pursued with initial visits to representative facilities in those industries The entire team visited these first two businesses This allowed the interview and data gathering guidelines to be refined by the team into an industrial facility survey guideline used for the entire field effort The guideline was then used at all 32 facility visits (referred to individually as Visit No or Visit Nos) to assure thoroughness and consistency The resulting guideline is presented in Table 2 1

Table 2 1 Industrial Facilities Survey

Industrial category
Facility name, location, addresses and phone number
Owner s name
Responsible individual(s) interviewed and phone numbers
Major product(s), units of production
Production capacity (number of units per day/week/year)
Production rate (current)
Future growth plan, (near term long term)
Was production system itself visited? Describe visit
Raw materials and chemicals used Quantity relative to production if relative
Energy sources and cost
Number of employees
Production flow scheme, describe with a diagram
Water source(s), amount used, cost purpose, metered (tie data to production), is flow seasonal or strongly diurnal
Water flow scheme diagram (try to use the diagram in #13)
Opportunities for recycle, reuse or minimization
Quality requirements for potential on-site reuse, recycle
On-site treatment requirements for reuse or pretreatment prior to discharge
Waterborne pollutants of concern and quantity (if possible)
Access to public sewers at present or near future
Attitude towards reuse/recycle (buy, sell or reuse)
Pollution
- Potential impact on wastewater treatment plant
- Potential impact on groundwater for recharge
- Potential air pollution
- Solid waste problems
- Public health concerns

Name other facilities like yours that are important water users/wastewater dischargers Get contact information

Initial visits to Hebron municipal officers, mayor, assistants, water and sanitation department heads, the Hebron Chamber of Commerce, Palestinian Water Authority, Palestinian Environmental Agency, and Ministry of Industry allowed the team to collect information used to evaluate the level of industrial activity in Hebron An information base was thus established portraying the approximate numbers of operating industrial units, the significant industrial categories or sectors, and location and contact data Though not comprehensive, of questionable accuracy and in some ways incomplete, the Hebron Chamber of Commerce and Industry's, *Commercial Industrial Guide – 1995 to 1996* [2] was a key resource The Hebron Ministry of Industry provided a listing of registered industries, presented in Appendix D, which was also used though it was obviously far from a complete listing of industrial operations in the municipality

Then the information first collected was used to identify industries for visits Industrial categories and specific facilities were selected for interview visits based on the team's collective industrial wastewater treatment expertise and experience The expected value of the data to the conceptual design effort and the anticipated impact of the facilities led to the formation of a prioritized list of installations for visits

After each day of visits the team would review the notes taken and reduce them to a summary site visit report for each facility As part of the review process opportunities for minimization, recycle, reuse, and recharge implications were vigorously discussed Resulting ideas and recommendations were captured Then any modification to industries prioritized or new information to seek was used to order the next day's/days' interviews

The team divided into two groups or subteams for all but a few visits to allow more sites to be seen during the limited time available Each subteam would have a member fluent in both Arabic and English A typical visit started with a meeting with a key manager or the business owner and often several support personnel in the facility office area or conference room During these sessions the points of inquiry listed on the industrial facilities survey (Table 2 1) were covered and notes were taken

From this interview session key elements of the facility's production processes with potential for minimization and or recycle were identified and discussed In addition those operations discharging materials with potential impact on the wastewater management system, including reuse and recharge, were noted The facility's production areas were then toured focussing on the critical areas and functions identified Often additional important points were discovered during these tours At the end of each visit an understanding of the production processes from a waste generation and water use perspective had be gained and the broad characteristics of the wastewater produced obtained

During the interviews information was often obtained that led to the identification of additional potentially beneficial visits Also during the course of going from site to site, chance observations led to selecting additional industrial sites It is noteworthy that several industries visited with the expectation that they potentially might have had significant impacts were judged to have no significant impact on the future treatment system Though as a category similar industrial sectors produce significant wastewaters, the practices and technologies employed in Hebron were found to generate less substantial waste loads These segments will need less attention in subsequent work and are detailed in this report

CHAPTER 3

OVERVIEW OF INDUSTRIAL WASTE GENERATION IN HEBRON

Based on 32 industrial interviews and more than twelve meetings with key governmental and industrial water-use authorities to obtain critical information, it appears that hard data for water consumption and wastewater generation and their associated engineering characteristics do not exist for either industrial or domestic sources in Hebron The data obtained from the industrial interviews were judged to be inconsistent due to attempts to favorably impress the interviewer, because key information and data was not systematically or accurately collected, and/or since political perspectives or imperatives appeared to influenced the data recorded or responses given

It must also be emphasized that many of the water scarcity problems faced by Hebron industries are magnified by the fact that water and power are simply not available on a dependable and consistent basis from the municipality Typically, dependable municipal water supplies are available for industrial use only during the three wet months of the year A new municipal water source and supply developed with USAID resources will shortly help to address this industrial problem However, based on the findings of this initial effort, it is apparent that if the current industrial practices continue and no corrective actions are taken for the proposed wastewater treatment system design, the following serious impacts will occur

- A substantial flow and suspended solids load from the stone processing industries will substantially increase the size and complexity of the wastewater treatment system The collection system will require frequent flushing and more than typical levels of maintenance due to plugging and abrasion Handling and disposal of excessive sludge generated from this source will substantially increase construction, operation and maintenance costs for the wastewater treatment facility

- Tanning industry wastewaters will require that pipes in the service drainage areas be protected or replaced with corrosion resistant materials to cope with very high sulfide levels and the rapidly alternating swings in pH expected Excessive levels of either can lead to substantial corrosion and system failure Sulfides could require special design considerations to protect treatment system headworks and equipment from extensive corrosion In addition, special oxygen transfer provisions may be required beyond those considered normal for municipal wastewater treatment facilities

- Wastewater characterization is recommended for the truck/car wash facilities prevalent throughout Hebron determine if their impact is as substantial as anticipated and to recommend options to reduce flow, oil, grease and total suspended solids loadings

- Significant treatment plant impacts will be exerted by contributions from dairy processing and seasonal olive pressing activities, and animal slaughterhouse facilities These effects may be substantially increased seasonally for olive oil production and for many other food production activities during Ramadan

- With the extremely low water usage in general in Hebron and the industries that predominate, careful attention must be paid to wastewater salinity High salinity can potentially restrict many resource options including irrigation reuse and groundwater recharge Salinity issues may dictate separate treatment and disposal for high salinity streams This concern may ease with higher wastewater generation rates anticipated as water becomes more available to Hebron

Despite the extensive effort in conducting the interviews with key governmental and industrial contacts described in this section and in Appendix A, it should be understood that hard data for water consumption and wastewater generation, along with the relevant wastewater characteristics necessary for a cost effective wastewater management system development do not appear to exist at the present time

The importance of key industrial sectors on a proposed wastewater treatment system may be summarized by looking at the broad qualitative effects that might be expected due to their waste contributions Table 3 1 details the impacts that would potentially be expected to occur As may be seen, the stone cutting, tannery, car washing and food processing industries all potentially have a significant impact on any wastewater treatment system but not all to the same degree Though stone cutting could exert a heavy influence on recharge options, sludge management, TSS load and sediment in the collection system if not pretreated, if appropriate on-site pretreatment is used all these concerns become minor and more water will be available for reuse There are cases that need special attention These would include sulfide and corrosion issues for tannery wastestreams and solids control for stone cutting

Table 3 1 Qualitative Impact of Industries Investigated on the Wastewater Management System

Treatment Level	Potential Impact									
	Sewers		Treatment Plant						Reuse	Recharge
	Sediment	Corrosion	TSS	BOD	Oxy Trnsfr	Sldg Mass	TKN	Sulfide		
Stone Cutting & Processing										
None	XXX#	X	XXX#	n/a	n/a	XXX	n/a	n/a	XX	XXX
On site	X	X	X	n/a	n/a	X	n/a	n/a	X	X *
Prelim	XXX#	X	X	n/a	n/a	XXX	n/a	n/a	X**	X
Tanning										
Current	XX	XXX#	XX	XXX	XX	XXX	XXX#	XXX	XXX	XXX
Pretreat	X	X	X	XX	XX	XX	XX	XX#	XX	XX
Car Washes										
Current	XXX	XX	XXX	XX	XXX	XXX	X	X	XXX	XXX
On site	X	X	X	X	X	X	X	X	XX	XX
Food Processing										
Current	XX	X	XX	XXX	XX	XX	X	X	X	XX

X Low or no potential adverse impact on wastewater management system
XX Significant potential for adverse impact on wastewater management system
XXX Potential for substantial adverse impact on wastewater management system
Special attention required
More water for reuse
n/a not applicable

Another broad indication of the importance of a given wastewater load may be obtained by comparing the estimated amounts of waste produced by an industry to that produced by the general domestic contributions of people discharging to the same system If the population required to produce a similar load to that of an industry, or the industry's population equivalence, is significant, then the wastestream warrants consideration Table 3 2 presents the results of such a comparative or relative waste load estimate for the industrial sectors deemed significant by this activity

Table 3 2 reveals that if an estimated population equivalent of 10,000 people or more is considered to pose a significant system design concern, all the major industrial sectors addressed by this activity have aspects that conceptual designers of a wastewater treatment system must pay careful attention too As expected some estimated impacts are very substantial For a city of 200,000 people the potential impact of the stone cutting industry on system solids handling equivalent to more than 2 million people is undoubtedly substantial

Table 3 2 Estimated Relative Impact of Industries Investigated on the Wastewater Management System

Treatment Level or Type	Relative Impact							
	Current Flow		TSS		BOD		Nitrogen, Phosphorous, O&G	
	m3/d	PE	Mass, kg/d	PE	Mass, kg/d	PE	Mass, kg/d	PE
Stone Cutting & Processing								
NONE	500 1,200	17,000 40 000	25 000 180,000	290 000 2 100,000	0	0	0	0
Pretreat	0	0	0	0	0	0	0	0
Tanning								
NONE	120	4 100	976	11 000	120	1 400	120 S	31 000 S
Car Washes								
NONE	300	10 000	530	6 200	420	4 800	520 O&G*	13 000 O&G*
Food Processing								
Dairy	80	2 700	1 100	12 000	2 100	25 000	210 N	15 000 N
Slaughter			120 800	1,400 9 300	120 800	1 400 9 300	10 66 N	710 4 700 N
Olive Oil[a]	75	2,500			900	10,500		
Chemical Metal Miscellaneous								
No significant impact on wastewater treatment system								

a = 45 day season

PE = Population equivalent or number of people required to contribute the same amount of the parameter cited Used standard U S per capita data from M&E [32] and UNDP report [2] For comparison use a current population for Hebron of 200 000 people

* O&G Oil and grease from petroleum sources are often very difficult to degrade and thus may cause treatment problems

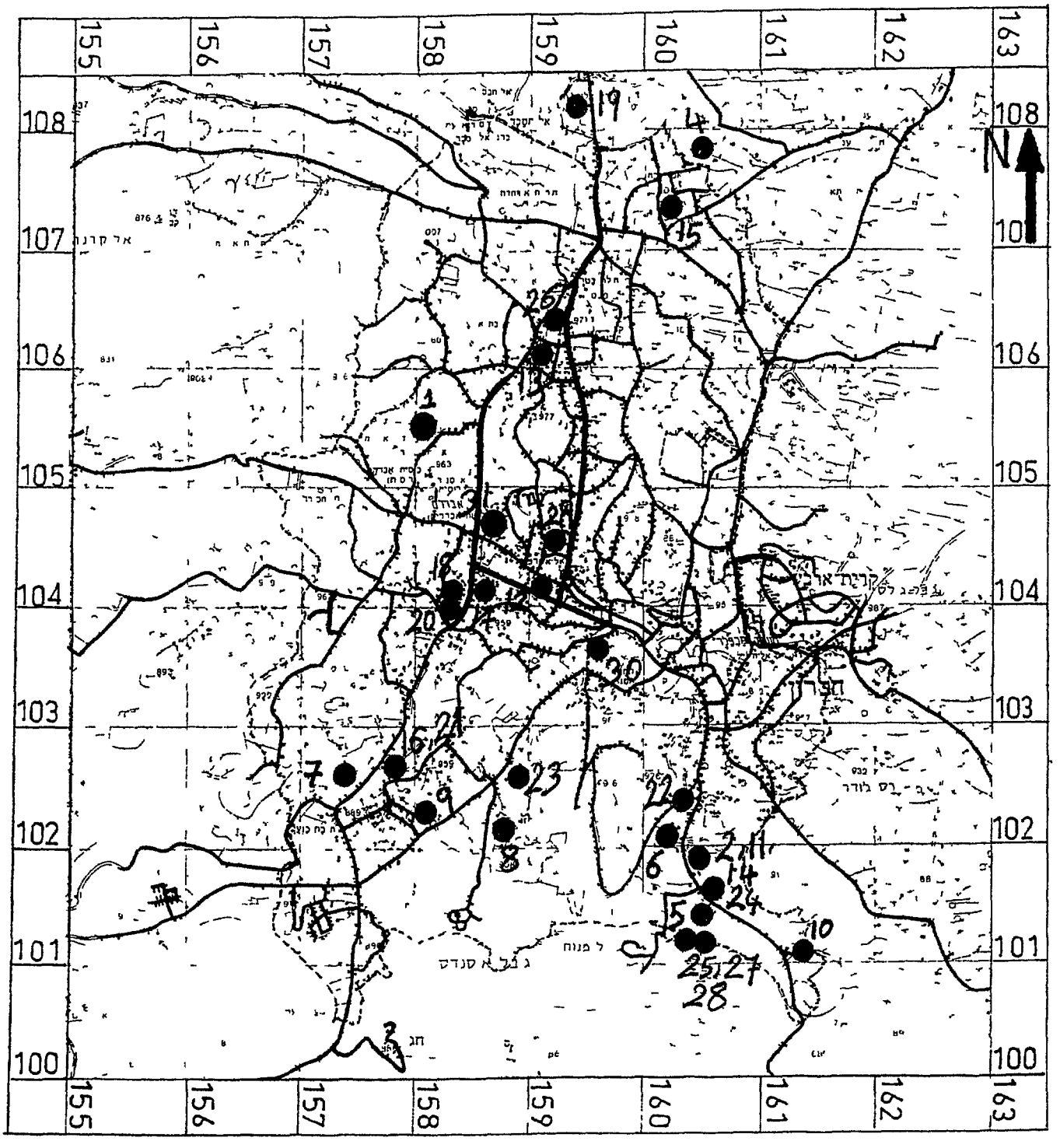
On-site Observations

The industries shown in Table 3 3 were visited and evaluated for water use and wastewater generation data by the whole team or subteams Each site was selected due to their suspected potential significant impacts on a wastewater treatment and reuse system for Hebron Figure 3 1 shows the location of the facilities visited The visit numbers shown in Table 3 3 correspond to the site visit descriptions presented in Appendix A and referred to in this report

Table 3 3 Site Visit Log

Visit No	Date	Industry	Facility Name
1	6/23/98	Dairy	Al Junaidi Dairies & Food Products
2	6/23/98	Tannery	Palestine Tanning Factory
3	6/23/98	Municipality of Hebron	Solid Waste/Refuse Burn Dump
4	6/23/98	Milk Farm	Juneidi
5	6/23/98	Stone Cutting	Monzer Facility for Marble and stone cutting
6	6 /24/98	Olive Press	Al Haramin Press
7	6/24/98	Food Product Macaroni Repeat visit on 6/30	KAR for Macaroni & Food Stuff MFG
8	6/24/98	Metal Working	Solar Boiler
9	6/24/98	Light Metal Mnftr	Neiroukh Scales & Metallic Furniture
10	6/23/98	Stone Cutter	Al Anwar Marble Company
11	6/25/98	Tannery	National Leather Co
12	6/29/98	Vegetable Cannery	Agricultural Industries Co
13	6/29/98	Ice Cream	Petra Foods
14	6/29/98	Tannery	Modern Tannery Co
15	6/29/98	Detergents Cosmetics	Hassounech Detergent Fact
16	6/30/98	Snack Foods	Qassrawi Industrial + Trading Food Co
17	6/30/98	Shoe Mnftr (small)	King Star Shoe Factory
18	6/30/98	Shoe Mnftr (small)	Super Star Shoe Factory
19	6/30/98	Glass Factory	Al Salam
20	6/28/98	Shoe Factory	Tosetti
21	6/30/98	Foundry & Blacksmith	Hope Factory & Blacksmith Shop
22	6/30/98	Car Wash	Al-Karaki Car Washing Shop
23	6/30/98	Electro Plating (Galvanizing)	Al Najafah Golden Company
24	6/28/98	Slaughter House	Hebron Municipality Slaughter House
25	6/28/98	Ready Mix Concrete	Al-Amir Factory
26	6/28/98	Welding Electrode	Al-Shark Electrode Co
27	6/29/98	Tile Factory	Al Batra For Tile Bricks
28	6/29/98	Metal Fabrication	Taqaddom Scales Co Ltd –Fabrication Shop
29	6/30/98	Food/Oil/Tahina	Daood Shawer Sons for Tahina, Halawah Oil
30	6/30/98	Foundry	Thabit Abu Aishah Foundry
31	6/30/98	Textile	Al Alameen Textile Factory
32	7/2/98	Trade Association	Union of Stone & Marble in Palestine (USMP)

Figure 3 1 Location of the Industrial Sites Visited



Interviews and Available Information

Initial documentation of the water and wastewater information available was gathered at the FORWARD office in Bethesda, Maryland Additional background information was provided by the USAID mission in Tel Aviv Documents were also obtained from ASIR and through their contacts in Ramallah Meetings with the various governmental and industrial representatives were always cordial and all appeared to have a desire to help the team in any way requested

Among the key information gathering visits were meetings with

- The mayor of Hebron and several department representatives,
- The heads of Hebron's municipal departments responsible for water issues, including the Health Department Wastewater and Solid Wastes Head,
- The director of the Palestinian Water Authority,
- The director of the Palestinian Environmental Agency and the technical director,
- Hebron Ministry of Industry representative, and
- The head of Hebron's Chamber of Commerce and several aides

Table 3 4 Distribution of Industries Registered at the Chamber Of Commerce, 1995-1996[a]

Industry	Number	Remarks
Leather		*mostly very small shops with no sign of significant water use or wastewater generation other than domestic
Tanneries	10	
Shoes Factories*	28	
Others*	404	
	442	
Stone Cutting & Processing		
Cutting	60	
Others	146	
	206	
Car Washes**	2	**20 reported during site visit
Food Processing	37	
Chem , Metal, Misc	418	
Total Registered Industries	**1,105**	

[a] Data derived from the Hebron Chamber of Commerce & Industry, *Commercial Industrial Guide – 1995 to 1996*, [2]

Most of Hebron's larger facilities, including all known tanneries and the majority of the stone cutting facilities are largely concentrated in a relatively small area in the extreme southeast corner of the municipality Many small and a few large facilities are located throughout Hebron's municipal boundary As may be seen in Figure 3 1 many of the sites visited were not in the designated industrial zone The municipality is actively encouraging industries located outside this planned industrial zone to relocate by providing new multiple light industrial use buildings within the district, see Figure 3 2

CHAPTER 4

INDUSTRY-SPECIFIC FINDINGS AND RECOMMENDATIONS

This chapter provides detailed descriptions and findings relative to the major industrial groups evaluated for their potential impact on the wastewater management system and also provides suggestions for controlling or reducing these impacts

Stone Cutting Industries

Stone Cutting in Hebron

Stone cutting industry is considered a major industry in the West Bank Moreover it is one of the heaviest water consumers [3] Stones are used primarily for building construction, and the West Bank buildings are characterized by their stone covered appearance There is no agreement on the number of such facilities in the West Bank Abu-Hijleh (1997) [4] stated that there are about 400 facilities, while the Union of Stone and Marble in Palestine [5] stated that the number is much higher (about 1,000 facilities)

In Hebron the stone cutting industry is also considered among the largest water consumers The number of such facilities, their production capacity and sizes are not known currently Table 4 1 details the various stone cutting industry counts found in available documents From the wide range of facilities cited, 47 to 120 within the municipal boundaries of Hebron, the uncertainties as to the total contribution and estimates may be understood

Table 4 1 Stone Cutting Facilities in Hebron City and District

Information Source	Number of Facilities
Ma an Development Center Business (1995) [3]	47 within Hebron District
ARIJ (1995), [6][1]	60 within Hebron District
Chambers of Commerce Book (1995-1996),[2][2]	60 within Hebron District
MOPIC (1996) from Abu-Hijleh (1997), [4]	62 facilities within the Hebron District
Gauthier (1996), [17][3]	44 plants throughout the WB & Gaza
Abu Hijleh (1997) [4][4]	82 facilities within the Hebron District
Said Abu-Ghosh/Administrative Manager of USMP (1998 meeting) Visit No 5	150 180 in Hebron District ~ 120 within the municipality
Munzer Al-Jabari out going President of the Union of Stone & Marble in Palestine (1998 meeting) Visit No 32	~ 200 in Hebron District ~ 120 within the municipality

(1) ARIJ referenced this number from Hebron Chambers of Commerce
(2) This number is a combination of both building material and stone cutting within the district
(3) This study focused mainly on quarries in addition to stone cutting industries and the number given above does not indicate the difference The waste mentioned in this study was the debris produced in either stone cutting or quarries and not the slurry from stone cutting industries
(4) This number was based upon 1997 statistics from the Union of Stone and Marble in Palestine

Previous Page Blank

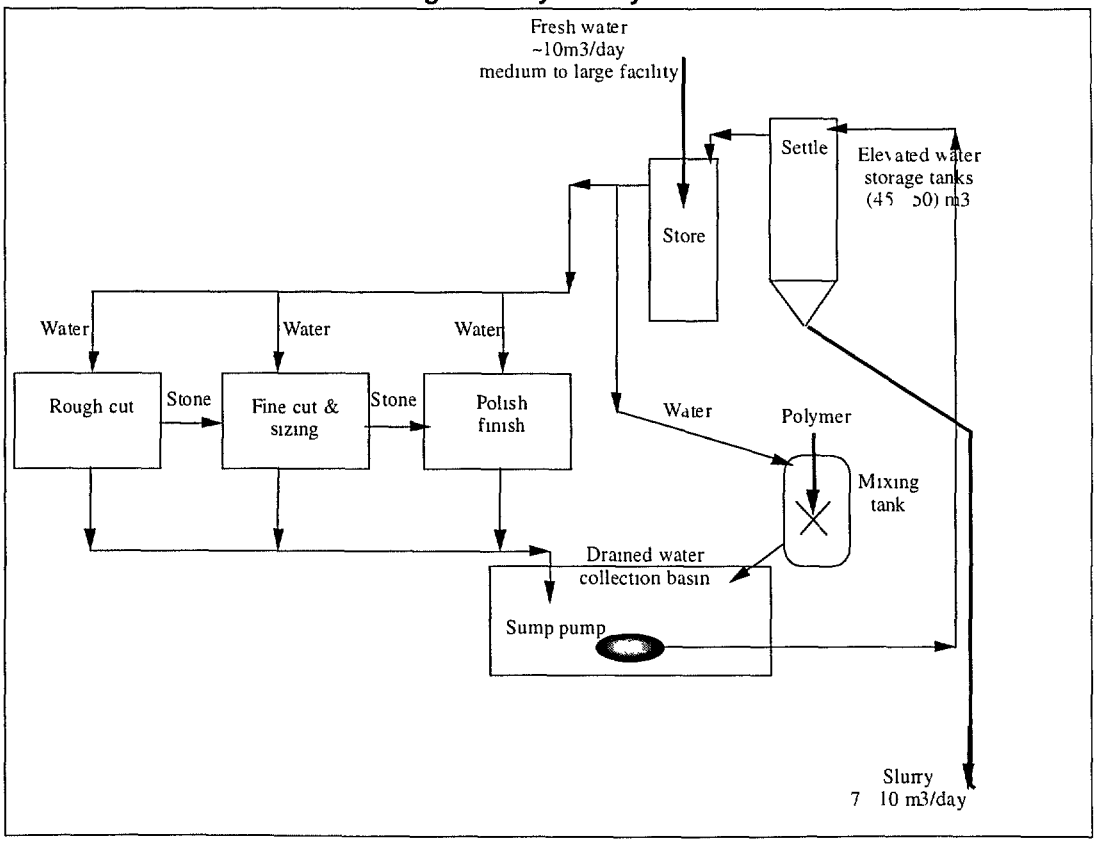
From Table 4 1, it appears that the number of facilities in Hebron is rapidly increasing The actual number is unknown but a range of from 100 to 120 stone cutting operations will be used for estimates and discussions in this initial exploration phase

The size distribution of these facilities (large, medium or small) was not indicated in all existing documents or information sources The difference between large/medium facilities and small facilities is typically based upon the presence of a finishing line which uses polishing machines (Visit Nos 5 & 10, and [4]) According to Visit Nos 5 and 10, most facilities in Hebron fall within the range of medium to large Regardless of the size of the facility, the stone cutting process is the same The following section describes the typical production process with a focus on the water use

Stone Processing in Hebron

Figure 4 1 is a conceptual portrayal of the stone production and the water usage observed by the team at the facilities visited During these visits it was indicated that the majority of the Hebron facilities also operated in a similar fashion The numbers shown indicate typical values for a medium to large facility Each facility has a raw materials stockyard of large stones In the first step a stone is moved by cranes into the facility and is cut into a rough cubic shaped stone block (1-2 m) The second step saws the large stone block into thin pieces according to the desired size Further shaping into the dimensions desired is performed using saws and/or shearing machines The final step involves polishing the surfaces of these stones according to the quality desired using special polishing machines and/or manual finishing tools

Figure 4 1 Schematic diagram describing water usage in a typical medium/largestone cutting industry facility



Water Usage and Recycle

Water is used in all three steps of production Water is primarily used as a cooling, lubricating, and cleaning agent Figure 4 2 shows a saw beginning a cut through a rough block of stone Recycled water directed from nozzles above the block are spraying continuously downward onto the active cutting surface Two advantages of using water over the use of mineral oils, are the relatively low cost and avoiding staining or changing stone color The water collects and carries the stone dust generated during the sawing and polishing processes Water is drained and collected in a main sump or collection tank

The collected water, laden with stone dust and particulates is stored in the collection sump and where polymer is added as a settling aid This solution settles rapidly Figure 4 3 was photographed 10 minutes after settling began It appeared that solid separation was nearly complete in that short time period The following points describe the polymer addition process

- Based upon Visit Nos 5 and 10 and interview Visit No 32 it appears that over 90 percent of the existing facilities use polymer

- Earlier reports [14, 16] did not indicate a substantial usage of polymer suggesting that this is a recent practice

- Only one polymer vendor exists in Hebron (Visit Nos 5 and 10) and only one type of dry flaked polymer (acqueNYMCO, SPA) is used in all facilities in Hebron

- The polymer is not allowed to age in a separate tank after addition to water for better activation

- The dry polymer is added in batches (usually twice a day) to the polymer tank where it is mixed with the water Polymer is added into the mix and dose tank as illustrated in Figure 4 4 This tank is poorly mixed The tank contents are allowed to form a deep vortex indicative of low turbulence and poor dispersion as shown in Figure 4 5 Recycled water from the storage reservoir is added continuously to the polymer tank and thus polymer solution is added continuously by gravity overflow to the collection sump This will lead to high polymer concentration at the beginning of each batch and a very diluted solution at the end

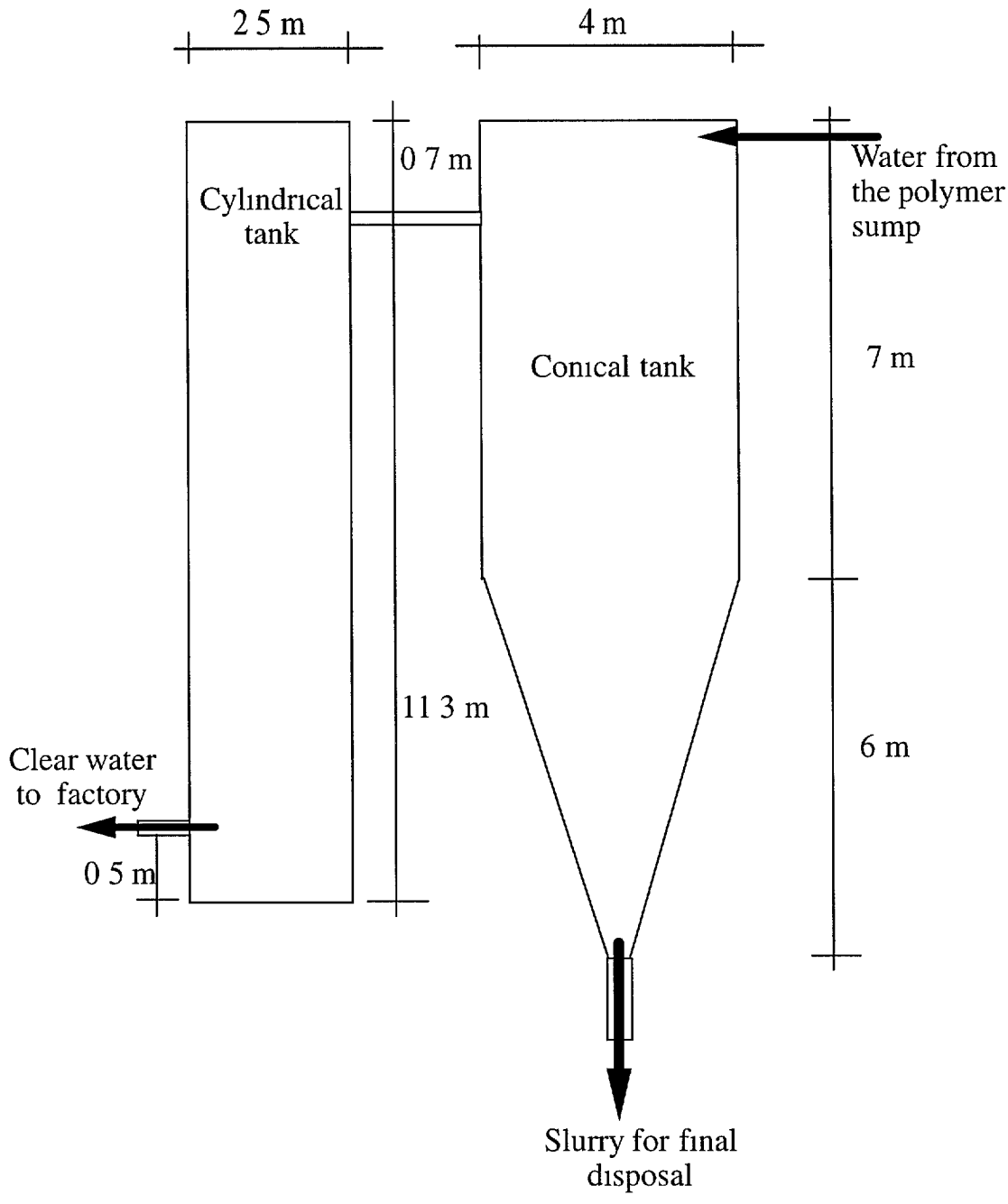
- Polymer is added at a fixed rate with no polymer dose optimization operational control

- For best results the polymer solution must be thoroughly mixed with the solids carrying stream prior to settling No polymer mixing system is present in these installations

The collected water and the polymer solution are then pumped to a conical bottom-shaped elevated tank The solids are allowed to settle in this tank, and the supernatant flows to the second cylindrical tank which serves as the return water feed reservoir (Figures 4 1 and 4 3) Figure 4 6 provides typical dimensions for these tanks These elevated tanks, as seen if Figure 4 7 are prominent landmarks for locating stone cutting facilities in the Hebron Industrial Zone This suggests that these systems were

introduced and sold to most of the facilities at about the same time These tanks are now produced locally at metal fabrication shops The dimensions shown in Figure 4 6 were obtained during Visit No 28

Figure 4 6 Schematic Diagram Describing Typical Dimensions of Elevated Tanks in Medium/Large Facilities



The partially clarified water (still containing significant suspended solids) flows by gravity from the storage tank and is reused for stone cutting as described earlier Fresh water is added to the cylindrical tank on a daily basis since some water is lost via evaporation and some leaves the system in the settled slurry on a daily basis Slurry removal is usually conducted at the end of the day or when appropriate during operation Thus the flow of water is continuous as long as the facility is operating It is believed that the existence of unsettled solids in the recycled water can decrease the life cycle expectancy of the expensive cutting saws by about 60 percent (Visit Nos 5 and 10 and ref [4])

Waste Slurry

The settled slurry is the primary wastewater discharged from stone cutting facilities (A relatively minor amount of domestic waste is generated) This slurry is further dewatered in a few facilities, Abu-Hijleh indicated about 6 percent [4], using small plate and frame presses However, it is believed that the current number of such facilities is increasing due to the realization that about 2/3 of the slurry water can be recovered and reused, thus generating water and monetary savings when compared to the normal practice for slurry disposal The two main methods for slurry disposal currently appear to be

- Discharge to existing sewers serving the plants (Visit No 5), and
- Hauled by tank truck to designated sites (Visit No 10) These sites are either wadis, privately owned sites that charge for dumping privileges, or by dumping into a convenient existing Hebron City sewer system manhole

These practices for water recycling and reuse have only recently gained acceptance among stone cutters According to Abu-Hijleh's study conducted in 1997 [4], most facilities in the Hebron District (78 percent) used plain rectangular sedimentation tanks for slurry collection and water clarification, and only 16 percent used the polymer addition followed by two elevated separation and storage tank approach However, from interviews and general observations of the industrial area from nearby hills, most stone cutting facilities appear to currently be using the elevated tanks with polymer system While these water recycling and reuse systems are very efficient, compared to the plain sedimentation system, optimization of polymer addition could prove to be beneficial and cost effective for reclaiming additional water

A small portion of the stone cutting facilities (about 6 percent) used an additional slurry dewatering process employing small plate and frame presses [4] The economics of on-site dewatering do not appear favorable due to the adverse economies of scale for small installations The cost of a small plate and frame system as installed in Hebron was reported to be approximately $45,000 U S or 165,000 NIS (Visit No 27) If this type of system could recover 65 percent of the slurry water, at a hauled water cost of 10 - 16 NIS/m^3, where 5 -10 m^3/d of slurry is produced 312 days per year, and an interest free loan could be obtained for the purchase, a simple pay back period on the capital cost would be between 5 and 15 years Once more typical financing, and/or an expected rate of return on investment is considered, and operation and maintenance costs are factored in, the pay back period could easily be from two to four times as long, or 10 to 64 years If these assumptions and costs are in the right range it is not surprising that only a few of these systems are operating in Hebron With lower water cost and greater availability expected in the future on-site system economics become increasingly tenuous

Estimates of Slurry Discharged The study by Abu-Hijleh in 1997 [4] reported an average annual total slurry volume of 289,500 m^3/yr from Hebron's 82 stone cutting facilities Based upon 312 working days in the year, the average production per facility is about 11 3 m^3/facility-day Most of these facilities were using plain rectangular sedimentation tanks for slurry collection Currently the vast majority of the stone cutting facilities employ the polymer addition and elevated tanks system described above It is predicted that the current approach will produce a 20-40 percent reduction in slurry discharge through increased efficiency A resulting reduced slurry volume in the range of from 5 - 9 m^3/facility-day is expected This range agrees with the estimated numbers for medium to large facilities suggested during Visit Nos 5 and 10 which was between 7 - 10 m^3/facility-day For the purpose of this study an estimated range of 5 - 10 m^3 per day per facility will be used

The total amount of slurry currently discharged may be estimated using the number of facilities, between 110 and 120 at present, and the 5-10 m^3/facility-day discharged from each Thus, the total slurry volume discharged is 550 - 1,200 m^3/day Based on a current average water usage in Hebron of approximately 30 L/capita-day, this flow has a hydraulic population flow equivalent of about 20,000 to 40,000 people

Slurry Characteristics The team was able to grab some limited samples for qualitative observations as illustrated in Figure 4 3 showing the settled slurry after 10 minutes No rigorous sampling or analyses were performed, and no data was available on the engineering characteristics of the stone cutting waste slurry from Hebron facilities Two studies were reviewed containing information on the slurry discharged from other stone cutting industries One was conducted in the Netherlands at Delft [29] and the other addressed the stone cutting industry in Ramallah [4] Though it is believed that the characteristics of the slurry produced in Hebron is likely to be similar to those produced in Delft and Ramallah, direct sampling of the discharges in Hebron is strongly recommended The information presented in this section is to provide a starting point and frame of reference for the next steps in developing a conceptual design, but **may not** be depended on for design purposes

Chemical

A study at An-Najah National University study [11] used 10 grab samples from 10 facilities in northern West Bank and yielded the following characteristics

pH	Ca^{+2}	Mg^{+2}	Bicarbonate	Carbonate	$CaCO_3$
units			10^{9} moles/L		
8 4 - 12	7 8 - 8 7	21-34	59-88	1,300-4,600	1 3-8 7

- This study revealed that most of the slurry is $CaCO_3$ and $MgCO_3$ with high alkalinity The carbonate and calcium carbonate concentrations where calculated from the equilibrium relationships after measuring the pH and the Ca^{+2} and the bicarbonate concentration

- TSS content in the recycled wastewater (from channels beneath the cutting saws) was within the range of 5,000 - 12,000 mg TSS/L (From visual

observations during our visits it is estimated that this slurry would have a TSS content range of 5 – 15 percent)

- The pH of this slurry from 4 different facilities in Ramallah District was measured at 8 9 - 11 [4]

- The BOD, COD, TKN concentration are expected to be negligible in these inorganic slurries

Physical Characteristics with Some Design Parameters

- The permeability coefficient was measured by a falling head test to be 2 8(10^{8}) m/sec (ref #16)

- Based upon visual observations of drained water settling at the Hebron facilities, it appears that more than 90 percent of the TSS settles within the first 10 minutes (polymer residual probably does exist in these wastestreams)

- Based upon settling tests of the drained water, the hydraulic surface loading rate for sedimentation tanks with polymer addition must be less than 1 5 m/hr [4]

- Jar tests on drained water with polymer indicated a dose of 180 mg/L for produced water with a TSS content of less than 10 mg TSS/L [4] Testing on the drainage water collected for treatment and reuse in Hebron facilities will be required to determine if similar results will be obtainable and what type of polymer will provide the best results

- Column settling tests conducted at An-Najah National University [4] on slurry without polymer addition found that particle settling followed zone settling characteristics and that 90 percent removal of the TSS was achieved after 80 minutes The use of polymer was recommended for better solids removal and water recovery

- Mechanical dewatering would appear to recover about 65 percent of the slurry water [4] and Visit Nos 5 and 10

Potential Impact of Slurry on Treatment System As previously estimated, the total slurry volume to be disposed is about 500 - 1,200 m^3 per day with an assumed TSS concentration of 50,000 - 150,000 mg/L Thus, the stone cutting industry in Hebron probably contributes about 25,000 - 180,000 kg TSS/day Based upon the current Hebron City statistics and using an assumed solids generation for the United States, as cited by the UNDP Wastewater Planning Study [1], of 86 gm of TSS per capita per day, and 30 liter of wastewater per capita per day, the population equivalent on a volume basis is approximately 20,000 to 40,000 people and on a mass loading of TSS is equivalent to 290,000 to 2,100,000 people

Probable Impacts of Stone Cutting Solids on Wastewater Treatment Systems

- Solids deposition in the sewer system will lead to sewer clogging, especially under low flow conditions and potential abrasion scouring damage

- High pH (>8 5) is may affect biological wastewater treatment activities and hence reuse options if not diluted or neutralized to normal ranges

- The TSS must be removed prior secondary or tertiary treatment or substantial maintenance and operational efforts will be required due to extensive abrasion of equipment

- Scaling could form in all stages of the treatment process and may cause plant operating difficulties, and hinder the treatment processes This may be especially problematic for pretreatment and primary treatment units due to the deposition of $CaCO_3$ once the pH is reduced to near neutral or normal ranges

Potential Impact of Slurry Disposal Impacts upon the overall environment if the slurry is randomly discharged to wadis and open agricultural areas without appropriate control [4]

- Excessive Ca^{2+} can potentially hinder the uptake of ions by plants

- At high application rates the slurry could produce high soil pH values lethal to vegetation

- Nutrient uptake and fixation may also be hindered by high pH

- The increase in the pH can decrease the bioavailability of trace metals to vegetation

- The low permeability of the slurry may decrease air movement to plant roots and decrease the water infiltration rate of the soil which in turn can decrease the recharge of the aquifer from rain water Hydraulic conductivity rates for the slurry are reportedly very slow at permeability coefficients of approximately 2 8 (10^{8}) m/sec [4] For comparison, clays deemed appropriate for lining landfills have a recommended conductivity range of (10^{9}) m/sec to (10^{11}) m/sec [32]

- Water that may be economically recovered under current high water cost conditions is wasted Plate and frame dewatering can be expected to recover 65 percent of the slurry water for reuse This represents about 101,400 - 243,360 m^3 of water per year for the conditions assumed for the Hebron area

On the other hand, a controlled slurry application may prove beneficial Studies have been undertaken at the Al Arroub Agricultural School in the Hebron to determine the appropriate agronomic beneficial application rates for stone slurry Descriptions and results of these studies were not available at the time of this report The photo Figure 4 8 was taken of a test plot at the Al Arroub Field Experiment Station

It appears that the stone slurry was applied to the grapes to the right and those on the left received no slurry and are assumed the controls Though details of the experimental design and findings are not in hand, it appears that the grapes receiving the stone slurry are doing appreciably better than the control plants [10]

Recommendations

Treatment and Handling Options Many technically viable options exist for reducing the impacts from stone cutting upon the proposed wastewater collection, treatment and reuse systems These options must be considered as components of an overall strategic plan for cost effective impact minimization Options for consideration include

- Improve on-site settling characteristics of the collected water (more concentrated slurry) One existing facility should be used as a demonstration study Specific improvements to be demonstrated include

  - Selecting the most appropriate polymer type and dosage rate after allowing the polymer an appropriate aging time,
  - Optimize the polymer dosage,
  - Use the measured hydraulic surface loading rate for sedimentation tank design, and
  - Use better polymer mixing within the collection tank or sump

- Develop and apply regulations that prevent random disposal of the slurry to either existing sewers or non-dedicated approved sites

- Establish a centralized collection facility for slurry treatment and dewatering Since the economics of on-site dewatering appears marginal, the economies of scale gained by a large single facility might prove more attractive Most stone cutting facilities exist in the industrial area, which will facilitate tank truck transport to a centralized facility This facility could potentially recover 100,000 - 240,000 m^3 of water per year The recovered recycle water can be returned to individual stone cutting factories on the return trips

  - Economics must dictate the target solids concentration for efficient transfer to a centralized treatment station but concentrations of 8-10 percent TSS are potentially achievable in the on-site systems,
  - The TSS in recycled water within the facility should be kept as low as feasible to protect worker health and prolong the life cycle of saws and other stone processing equipment,
  - An effluent discharge concentration of less than 500 mg TSS/L is potentially obtainable from a centralized dewatering facility, and
  - Dewatered slurry solids from the centralized facility may achieve a cake solids content of 50-60 percent

  Note It is understood that the usage of local plate and frame dewatering devices currently used are intended to recover about 2/3 of the slurry volume as water and not to reduce disposal hauling costs Accordingly, local dewatering practices will not be as desirable if water availability is increased and prices lowered

- Evaluate the feasibility of different options for the beneficial use of both dewatered and non-dewatered slurries These options include

  - Production of lime using thermal energy,
  - Production of light bricks used for patios and walkways,

- Use as a soil amendment,
- Use as a component of plastering material,
- Use as a component material for wall painting, and
- Use as a component material for landfill liners

- On-site drying of stone cutting slurries at the facility producing the wastestream is practiced in many stone processing factories around the world [17] The slurry is placed in open drying pits and allowed to drain and evaporate, this approach would not work for most of the tightly crowded facilities in Hebron

Data needs and suggestions for gathering Evaluation and implementation of wastewater management system options for the stone cutting industry will require the collection of data and specific feasibility studies must be conducted These include

- **A survey of the existing stone cutting facilities** To describe the industrial activity in Hebron, require that all facilities to obtain a license from the municipality or other authority The license application can include specific information about facility production and size

- **Estimate volumes of slurry to be disposed of from each facility** This could be accomplished through conducting water balances on a selected cross-section of representative facilities Production rates should be adjusted to account for seasonal variations

- **A sampling program must be developed to determine the actual chemical composition and physical characteristics of the slurry to be discharged** The focus should be on important parameters such as TSS, TDS or salinity, cation composition, pH, and surface charge (zeta potential) This sampling program should include representative and reflect seasonal variation

- **Dewatering efficiency for a variety of slurries and different samples to permit appropriate sizing of a centralized dewatering facility** These data should include jar test evaluations for different types of polymers (high charge density and high molecular weight) at typical optimum dosage ranges to select best polymer candidates In addition sludge dewaterability indicators such as capillary suction time, time to filter test, turbidity of the supernatant, TSS of the supernatant, and viscosity of the supernatant must be conducted on a representative selection of samples Evaluations with pilot scale dewatering devices (belt and frame presses and belt filter presses) should be conducted with the selected polymers in order to economic dewatering data

- **Information concerning evaluations of the different beneficial use of the dewatered slurry** With the exception of burning to produce CaO, most of the options for reuse are innovative and require economical as well as experimental evaluations Details concerning these experiments are beyond the scope of this study

Impacts of Tanning Industry on the Hebron Wastewater System

Tanneries in Hebron

Tanning is the age-old process of converting animal skins into a useful, long lasting product, leather The basic process consists of removing flesh and hair (usually) from the skin, trimming to size and thickness and impregnating the skin with a permanently bactericidal material At this point the skin has been converted to leather Additional steps usually include shaving the leather to a uniform thickness, oiling to provide pliability and flexibility characteristics, dying to the desired color and other surface preparations specified by the end user Unfortunately the tanning process consumes major quantities of water (typically 100 liter of water per kg hide [7]) and generates significant pollution loads to the environment, primarily in the wastewaters [a] somewhat as solid wastes, and frequently as objectionable odors

There are ten or eleven very small independent tanneries in Hebron [2] All are clustered together in the recently created Industrial District (see map Figure 3 1 and Table 3 3) and their liquid wastes are all discharged to a common sewer manhole The owners are all reported to be members of an extended family (Visit Nos 2, 7, 8) but are competitive in meeting the needs of the 400 local shoe manufacturing factories [2] Cowhides, both of local origin and imported, are the main animal skins that are tanned, although one tannery (Visit 8) also works with goat hides and sheepskins

When the tanneries were originally constructed at least 20 years ago (Visit No 11), they were some distance from population centers and the environmental impacts, mostly odors, were not objectionable However, new nearby housing developments and industrial establishments object to tannery odors and current tannery operations are designed to avoid external odor releases at all costs (Visit No 11), even at the expense of trying new water saving process changes

As previously stated, the 11 tanneries are considered to be very small, each employing about 10 workers and processing from 10-15 cowhides/day (A small U S tannery would process about 500 hides per day) Each tannery uses 10-20 m^3 of water per day Available water appears to be the limiting production factor, with one owner reporting that his facility is operated at only 30 percent of potential capacity due to water shortages (Visit No 11)

Tanning Process in Hebron

The tanning processes used in Hebron appear to be reasonably uniform with only minor differences observed between the three tanneries visited (Visit Nos 2, 11, 14) Eighty-five percent of the dry animal hide consists of collagen, a complex protein Similarly, animal hair primarily consists of specialized proteins The tanning process usually results in dissolving hair and hide materials These dissolved proteins are very objectionable in wastewater and are extremely difficult to treat by conventional municipal systems Both dissolved hide and hair components may serve as a basis for protein recovery and waste minimization if a suitable market can be found for the specific proteins involved

The basic tanning process consists of a series of sequential batch steps, each of which generates a significant pollution load as described in Table 4 2

Table 4 2 Generalized Tanning Process Used in Hebron

The tanning process is very labor intensive and time consuming As practiced in Hebron it may take up to 15 days to process a raw hide to finished leather The generalized stepwise batch processes described below generate many waste streams, each having extremely diverse characteristics However, each process waste stream can be characterized as being a high strength or extremely high strength waste stream compared to normal domestic wastewater

1 **Salt/Store** Hides (heavily salted) are received and stored until needed

2 **Trim/Soak/Wash** Excess flesh (mostly fatty tissue) is trimmed from the hides - about 1,000 1,200 kg hides are placed in a large drum (3 m diameter by 2 m wide, see Figure 4 9) along with 3-4 m^3 of water to wash dung, dried blood, salt dirt and flesh particles from the hides The water used for this soaking-washing process is drained to the municipal sewers and contains high TDS or salinity, high TSS, moderate to high BOD concentrations along with some fat and grease

3 **Dehairing** The drum containing the soaked hides is charged with 3 4 m^3 of fresh water along with 3% by weight of lime, 3% by weight of sodium sulfide and proprietary enzymes After rotation for about a day the solution is drained to the municipal sewer This solution is of very high pH (about 11) may contain extensive hair particles, up to 4,100 mg S^{2}/L , up to 20,000 mg/l lime and much dissolved protein (high BOD and high TKN) [7 8]

4 **Rinse** About 1 5m^3 of fresh water is used to further clean the dehaired hides This rinse solution contains objectionable materials and is also drained to the sewer

5 **Splitting** The hides may be removed from the drum and split into an outer more desirable grain layer and an inner portion called the "split "

6 **Bating and deliming** The hides are returned to a drum and about 2 m^3 of 40^0C water containing 1% $(NH4)_2SO_4$ and a proprietary chemical are added to reduce the pH to about 8 A proprietary "smoothings "chemical is added and the excess solution is drained to the sewer This drainage contains significant quantities of TKN

7 **Tanning** About 8% NaCl and 0 8 % H_2SO_4 are added to 3 m^3 of fresh water and the pH is lowered to about 3 in a drum Next about 8 kg of chromium sulfate is added to the drum per 1,000 kg hides Excess water, very low in pH and high in chrome is discharged to the sewer An additional 1 m^3 of water and Na_2CO_3 are used to raise the pH This solution is also drained to the sewer At this point the hides have been tanned "through the blue" (a light blue color is imparted to the leather) Excess water is squeezed from the leather and the leather may be shaved to uniform thickness and trimmed to remove undesirable pieces Hides at this point in the tanning process are shown in Figure 4 10

8 **Fatliquoring and dying** The hides are once more placed in a drum with oil (6 7%), about 1 m^3 of hot water and the dying solution All the batch steps are done in the large rotating drums and all materials enter and leave through large hinged doors being pointed to in Figure 4 11 After oiling and dying the leather is dried and given sprayed surface treatments, redried, measured and packed for sale

Wastewater Impacts

Impacts based on current water use data from site Visit Nos 11 and 14 and literature values [8], were used to estimate the daily wastewater loading values shown in Table 4 3 These index values are based on current water practices

Table 4 3 Estimated 1998 Equalized Hebron Tannery Loads to the Sewer

Parameter	Estimated Unit Values	Mass Load Kg/d	Population Equivalent[b]
Total Flow	122 m^3/d	-	4,050
TSS	8000 mg/L	976	11,300
NaCl	4000 mg/L	488	--
BOD_5	1000 mg/L	122	1,400
VS	1500 mg/L	183	--
Protein[a]	1000 mg/L	122	-
Sulfides	1000 mg/L	122	31,000
Chrome	50 mg/L	6	--
NH_4 –N	60 mg/L	7 3	520
pH	11-12	--	--

[a] TKN in protein = 15 20 kg/d

[b] Population equivalents based upon the current use of 30 L/capita d and 86 mg TSS and 86 mg BOD_5 per capita per day

These numbers should not be taken as absolute values but rather as magnitude of order guidelines Although significantly stronger than domestic wastewaters, the TSS, BOD_5 and TKN loads can be handled by conventional biological treatment processes if appropriate allowances are made However of special concern are the high pH, high sulfide (S^{2}) and high chrome loads along with the sulfate (SO_4^{2}) generated from the ammonium and chrome salts and the sulfuric acid used in the tanning process The sulfates are very likely to be reduced to sulfides in the main trunk sewer leading to the wastewater treatment plant under low flow conditions, especially during warm weather Hydrogen sulfide (H_2S) will potentially be generated, enter the gas phase and cause crown corrosion where pipe coal tar epoxy coatings are incomplete or have been compromised by erosion These sulfides also will cause excessive corrosion in the head works of the proposed treatment facility In addition they will exert an excessively high oxygen demand at the wastewater treatment plant and must be accounted for during design

The high pH of tannery wastewaters will also cause extensive corrosion problems unless neutralized in sewers Chrome is of special concern because it may bioaccumulate in residual wastewater treatment plant sludges and hence present final sludge disposal problems Figure 4 12 shows the effluent overflow sump that receives all the drainage from a tannery typical for Hebron The very dark color is expected for this highly contaminated wastewater

Solid Wastes

Substantial quantities of solid wastes are generated at each tannery consisting of hide trimmings, packaging materials and unusable shavings and scraps of leather Unlike all other industries in Hebron (except stone cutting), the municipality will not collect and transport tannery solid wastes Refuse was observed to be stored outside the three tanneries visited (Visit Nos 2, 11, 14) and periodically loaded on trucks and hauled to the Hebron burn-dump for disposal Each of the tannery owners complained about the discriminatory municipal solid waste collection practices It is very likely that leachates generated at the burn dump during the wet season reach and contaminate groundwater

Recommendations

Tannery wastewaters will clearly have major impacts on the wastewater collection system, treatment system and residual sludge disposal practices Several opportunities are available to minimize tannery water use, diminish discharge loads and provide for pretreatment At present only crude estimates concerning the concentration and mass loading can be made Published data [6] do not agree with current estimates and greatly underestimate the impacts due to the tanning industry Implementation of the following recommendations should significantly increase the level of understanding concerning the potential impacts of tannery wastes, and allow for the development of cost effective amelioration procedures

- **Develop a comprehensive sampling program at a key tannery** A flow weighted composite sampler should be installed at a tannery and the individual flows and their constituents characterized Key parameters to be measured and correlated with production include flow rate, pH, BOD_5, $SBOD_5$, COD, SCOD, TSS, TVSS, TDS or salinity, TKN, NH_4-N, S^2 and Cr These characterization data are necessary to provide information that will be used to evaluate the feasibility of on-site or regional pretreatment systems It is further recommended that the Modern Tanning Company (Visit No 14) be selected for this study because the owner agrees with the need for a demonstration project and wishes to cooperate in future studies

- **Carry out comprehensive sampling at the industrial zone manhole serving the tanneries** A flow weighted composite sampling program measuring the combined tannery wastewaters should be undertaken to better estimate the overall combined impact of the eleven (ten) tanneries Perhaps the municipality of Hebron can be encouraged to sponsor this work The parameters discussed in the first recommendation should be measured

- **Develop an on-site water reuse and pollution minimization program** It is strongly recommended that a demonstration program such as that suggested by Thomas Thorstensen [6] be implemented after Recommendation Number 1 has been completed This program should include a second characterization study to demonstrate the pollution minimization and water reuse rates attainable, especially for chrome and sulfides containing streams Again, it is suggested that this program be completed at the Modern Tannery Co site (Visit No 14) The owner is willing and eager to participate in such a demonstration and understands that the demonstration

site will be open to all other tannery owners This is important because tannery owners and operators are especially recalcitrant to adopt process changes However experience has shown that tanners are generally eager to adopt new procedures if someone else goes first This educational program may also be expanded to evaluate protein recovery possibilities

- **Make conceptual and final designers of the proposed wastewater management system aware of the exceptionally corrosive and high strength nature of tannery wastewaters and that they must take unique, albeit more expensive, precautions in equipment selection and system layout** Though this may well increase initial costs, the resulting life cycle operation and maintenance cost reductions will provide substantial net savings

Car/Truck Washes

An unexpected finding was that the truck and car washing facilities in Hebron cumulatively may have a significant impact on water use and wastewater treatment Magnitude of order estimates based on visual observations and discussions with an owner/operator (Visit No 22) suggests there are about 20 facilities that cumulatively use and discharge about 300 m^3 to the sewers each day This quantity of water is equivalent to that currently consumed by about 10,000 Hebronites (at 30 L/capita-d) An estimated 600 L/day of spent oil/fuel and 1,200 pounds of TSS are daily discharged to the sewers in this wastewater Trucks and cars pulled into the washing bays are first coated by hand with diesel fuel Figure 4 13 shows a driver throwing diesel fuel that has been siphoned out of the truck's fuel tanks onto the truck to loosen dirt, oils, and tar deposits After a few minutes the dissolved material and fuel is washed from the surfaces of the vehicle using high pressure water as seen in Figure 4 14 The resulting material that is discharged to the sewer appears to be indeed heavily contaminated as indicated by the overflow sump photograph, Figure 4 15

Impacts on Wastewater Treatment and Reuse

The organic load in the cumulative daily discharge may potentially contain at least 400 kg BOD_5 and equivalent to the load generated by a Hebronite population of 4,700 (at 86 gm/capita-d) In addition to creating a BOD load, oily wastewaters are known to interfere with oxygen transfer in biological wastewater treatment facilities and can render aquifers unusable The TSS concentration is estimated as 2,300 mg TSS/L, about ten times higher than that found in typical municipal wastewaters

Recommendations

- **An intensive sampling program should be undertaken at a representative truck wash and the number of truck wash bays in Hebron should be accurately enumerated** These data are needed to verify the estimates described above and potential impact

- **If these estimates are verified, a demonstration and educational program using a typical water recycling car wash system such as those used in the United States and elsewhere may be warranted** If only one half of the water can be salvaged the impact would be comparable to providing water for another 5,000 Hebronites In addition, it should be possible to salvage much of the waste oil going to the sewers for use as a fuel at local blacksmith and foundry facilities Installation of oil and grease separator system designs similar to those approved by the American Petroleum Institute (API) should be considered at each installation

- **The Municipality of Hebron maintains a large truck washing facility in the center of the city A demonstration project involving several city departments could prove more beneficial than a project associated with a single private facility**

Food Processing

Food processing wastes frequently place significant loads on municipal waste treatment facilities Waste and spoiled foods along with other residues such as shells, stalks, trimmings etc are often discharged to sewers In addition grease and oils from machinery, cooking oils and cleaning solutions can further complicate municipal wastewater treatment processes Food processing wastes typically add very high BOD_5, COD and TSS loads to the sewer The seasonal nature of some food products (such as olives) can further complicate wastewater treatment procedures by introducing short-term maximum peak loads to the wastewater treatment system In general, the final liquid residues resulting from well treated agricultural or food processing wastewaters typically will have little impact on agricultural reuse or ground water recharge Prior to this team's visits, there have been no known attempts to evaluate the impact of the food processing industries in Hebron

In order to estimate the potential impact of food processing wastes on the wastewater management system, several major food processing facilities were visited These included a major milk processing plant (Visit No 1), a milk production farm or dairy farm (Visit No 4), an olive press (Visit No 6), a spaghetti factory (Visit No 7), a vegetable cannery (Visit No 12), an ice cream factory (Visit No 13), a snack food producer (Visit No 16), a slaughterhouse (Visit No 24), and a sesame oil/tahina manufacturing facility (Visit No 29) In general, dry processes such as the snack foods and spaghetti factories have or will have little or no impact on the wastewater treatment system The wet industries, such as the slaughterhouse, dairy and olive pressing facilities probably will have substantial loading impacts on the proposed wastewater treatment facility This impact will be amplified during the high processing rates seen annually during Ramadan As seen in Table 3 1, each of these three industries has an estimated load that will require special considerations by the conceptual design team For all three one or more parameters exceed a population equivalence of wastestream contribution of more than 10,000 people

Olive Presses There are three contract olive pressing facilities in Hebron Each typically operates on an around the clock basis during the harvest season The olives are washed , pressed and the resulting oil-water mixture is centrifuged to separate the oil Solid residues are collected and used as animal fodder Based on data collected during site Visit No 6 and our estimate that the liquid discharged to the sewer contains

15 g/l of oil, it can be estimated that a total of 1125 kg/day of olive oil is discharged to the sewers by the three facilities in 25 m^3/day of wastewater This mass of lost oil amounts to a daily BOD_5 load of about 900 kg BOD_5/day at a concentration of 12,000 mg BOD_5/L

If these estimates are correct, the population equivalence of these discharges during the 45 day season are equal to an additional 2,500 persons on a flow bases and 10,500 persons on a BOD_5 basis as detailed in Table 3 1 Thus, the impact of the olive presses can be seasonably significant and should be considered during the conceptual and final design of the wastewater treatment facility It is recommended that a short term sampling program to measure and characterize flow, COD, BOD_5, and TKN be undertaken during the next olive pressing season to better quantify the potential impacts of this industry

Chemical, Metal, and Miscellaneous Industries

A number of facilities covering a broad range of industrial categories were visited based on team experience with similar industries that would typically prove significant contributors to a wastewater treatment system Examples are a producer of solar water boilers (Visit No 8), a manufacturer of scales and office furniture (Visit No 9), a foundry (Visit No 21), producer of welding electrodes (Visit No 23), and textile production (Visit No 31) Also a facility that was indicated to be a manufacturing unit was visited where detergents and cleaning agents are only repackaged from bulk vessels into containers appropriate for consumers, labeled and distributed (Visit No 15) However, either do to the size, type of water use, the processes used or a combination of these factors, all these were judged to have little likely impact on the wastewater management system

A qualified but noteworthy exception would be the ready mix concrete facility (Visit No 25) and tile operation (Visit No 27) having relatively small impacts in total but with problems similar to the stone cutting industry from a sewer maintenance and solids handling perspective At present neither have a connection to the sewer for process wastewater The tile manufacturer was proud that, to his knowledge, his was the only facility using recycled broken tiles for production materials Figure 4 16 is a photograph of that unit in operation Water use and the types of reuse and wastewater discharged for production in the tile industries is similar to that described for the stone cutting industry This was observed during the team visit to one of the two large tile factories in the City of Hebron There are many very small tile factories in Hebron, but it is believed that the water usage and thus the daily slurry disposal for this industrial sector as a whole is very small and hence not consequential

An on-site settling pond as pictured if Figure 4 17 for the facility visited presently handles wastewater generated by the flushing of return ready-mix concrete trucks A pump in the bottom of this small impoundment is used to recycle water for multiple uses The overflow goes through the wall at the property edge as seen in Figure 4 18 and discharges into an open field were it travels only a few feet before all the water was either infiltrated or evaporated This water should pose no significant impact on the groundwater

The concern in both cases should be for future uses Most of the facilities indicated that they would use more water if it were available Both of these operations will be tempted

to use that extra, less expensive resource to perhaps discharge materials to the sewer system resulting in problems similar to those identified for the stone cutting industry

Since pottery manufacturing has been practiced in Hebron for millennia and is still recognized as an important activity identified with the town, it was felt that for cultural if for no other reasons, a representative production unit should be included Visit No 19 revealed practices where water was important The simple, perhaps primitive, techniques are seen (Figure 4 19) to involve processing the clay in several basins filled with water The resulting clay is formed, still using hand throwing, into many sizes and shapes (Figure 4 20) fired in beehive kilns, then sometimes painted for sale mostly to export markets Almost no water appeared to leave the site other than by evaporation

However there were disturbing practices observed that could lead to threats to the groundwater resource, and human health and safety Several locations noted that they disposed of spent cutting oils, solvents, or other potentially hazardous materials in a casual fashion Typically this meant onto or into the soil beneath or adjacent to their production area Figures 4 21 and 4 22 illustrate one such practice The modern, well maintained electroplating facility in Figure 4 21 used kerosene and perhaps other solvents to clean and prepare the surface of sheet metal and metal parts They disposed of this grease and contaminant laden material to an adjacent field The photograph in Figure 4 22 shows an area of soil discolored by the residues remaining after infiltration from the surface dumping of this spent kerosene At another facility spent kerosene and perhaps other solvents were discharged to an on-site infiltration or cesspit These disposal techniques pose a direct threat to the groundwater that underlies the entire region This did not appear to be malicious or irresponsible dumping, but rather a harmful practice due to ignorance This points directly to one of the basic needs for public and industrial educational programs

Note During each site visit, information interview, and agency meeting the team asked the interviewees to identify any and all industries and any other type of operation that could potentially have an impact on the proposed wastewater management system The visits made cover all of those found However, the site visit list and information available in this report should be carefully reviewed by those performing subsequent efforts to determine if any key components need to be added for further investigations

Solid Wastes

The municipality of Hebron collects solid wastes from all industries except tanning and stone cutting facilities These wastes, along with other municipal wastes are tucked to an open burn-dump facility located about 17 km southeast of Hebron The team visited the site late in afternoon of June 23,1998 The site is located on a high, rocky hill and covers 5-10 hectares The site is neither fenced nor protected by a caretaker

Refuse is apparently dumped at random locations during the day and ignited At the time of the visit, several piles were actively burning, as may be seen in Figure 4 23 and many were smoldering Smoke and odors were very objectionable in the downwind direction Figure 4 24 shows one edge of the burning piles and indicates the general appearance and area setting of the burn-dump The site overlays karstic soils and drains eastward Seasonal runoff passing through the ashes and unburned refuse probably percolates into

and contaminates the Eastern Aquifer The leachate is very likely to be acidic, contain many heavy metals as well as other contaminating organic and hazardous materials Although not observed at the time of visit, it is probable that vermin and birds that have disease transmitting capabilities inhabit the burn-dump site For these reasons, we recommended that early attention be given to modifying Hebron's solid waste disposal practices

- One option would be to modify the existing random burn site that is diked and has an impervious bottom layer to prevent leachate from leaving the site Two or three burn cells might be constructed so that the cooled ashes from one site can be removed, perhaps sifted for reusable ferrous metals, and placed in an environmentally secure landfill

- A second and better alternative would be to develop and operate a true sanitary landfill using current modern design criteria and operating methods This would assure that leachate would not contaminate groundwater and that air pollution transmission sources would be eliminated

- A third and intriguing possibility might be to couple the incineration of solid wastes with the drying and thermal conversion of stone cutting slurries into lime The lime could then be used to both to reclaim acid soils in the West Bank and to supply a necessary ingredient for the tanning and cement/concrete industries in Hebron Conceptually , solid wastes including those from the tanning industry, could be burned in a modern incinerator and the heat used to recalcine stone cutting wastes, e g

CaCo3 + heat	→	CaO and Co2
Limestone		Lime & Carbon dioxide

To minimize heat requirements, the stone cutting solids should be concentrated as much as possible by sun drying and palletized prior to use Alternatively, the potential for generating power from a refuse burning incinerator should be evaluated

Recommendations

- **A comprehensive solid waste study should be undertaken that characterizes Hebron's solid wastes by amount, composition, compactability and heat content** These data are necessary for evaluating mass and heat balances for evaluating incineration or landfill design options

- **Once the studies are completed a preliminary design and siting for a sanitary landfill and an incinerator should be conducted** It should be emphasized that North American and European solid waste generation patterns and power generation design procedures cannot be expected to apply to Hebron conditions

CHAPTER 5

EDUCATIONAL OPPORTUNITIES AND OPTIONS

Two overall goals should be considered for educational efforts First these efforts should focus on the demonstration of more efficient and less polluting industrial practices and on the training of industry owners and workers in their implementation Secondly, there is a real need to inform the public of the real and present threats to their water resources This involves informing the industry owners, workers, and citizens of threats to their precious water resources, and how to avoid contamination and waste

The preceding sections have identified current industrial practices and have suggested alternatives for maximizing water use and reducing pollutant loads to the sewers Virtually every industrial water user interviewed complained about the lack of water and power availability, and the excessive cost of water especially when water had to be trucked to the sites at a cost of 10 to 16 NIS per cubic meter A few managers seemed primed to invest capital and adapt water conservation techniques if they can be convinced that these new practices would economically reduce water purchases and/or result in improved production or product quality However, other managers proved to be recalcitrant toward suggested changes because of a) fear of product quality deterioration or b) the inability to identify with and picture the benefits suggested by the interviewer The general concerns of the latter group of managers seemed to follow the old adage, "If it isn't broke, don't fix it " The following subsections suggest educational and/or demonstration program directions that USAID may wish to consider sponsoring to convince facility managers to adopt water saving, pollution and pollution minimization practices

Stone Cutting Industry

The efforts to be considered should be designed for both the industries' owners and workers and tank haulers This plan should focus on clarifying the following

- Negative environmental impacts of the slurry on the environment if disposed of or applied improperly in open areas,
- Negative impacts of the slurry upon the wastewater collection and treatment system if discharged into sewers,
- Overall worker health and safety,
- Advantages and disadvantages for operations, treatment efficiency and economics of using on-site or centralized treatment facilities for water recovery from slurry dewatering,
- Polymer types, methods of selection, effects of mixing, polymer aging effects, and methods of dose determination and optimization for better sedimentation results, and

Previous Page Blank

- How can the by-products of stone cutting industries be used in terracing, road repair, prevention of soil erosion, and land reclamation

Tanning Industry

Tanners are perhaps the most resistant to change of all the Hebron industrialists interviewed and may have the most to gain As previously described, tanning is a water consumption intensive industry that produces significant quantities of highly polluted wastewater (BOD_5, chrome, sulfide, excess lime, etc) The Hebron tanning industry provides a unique opportunity for a USAID demonstration project specifically directed toward (1) reducing water consumption, (2) minimizing the use of expensive chemicals and (3) significant reduction in critical pollutants discharged to the sewer The latter is most important from a waste management perspective and least important to the tanners The management changes suggested by Thorstensen [6], would require relatively little capital investment (a few 10 m^3 tanks, two or three small pumps and hose/pipe lines to connect drum discharge sumps to the tanks) If shown how to save money and improve competitiveness without sacrificing leather quality, it is very likely that these techniques would be adapted rapidly throughout Hebron

It is recommended that the Modern Tanning Company (Visit No 14) be selected for the demonstration project The owner is agreeable to participating in a demonstration project with the understanding that all other tanners would be invited to observe In addition this tannery has ample space available that can be used for process water storage If Thorstensen's claims about recycle and reuse of tannery wastewaters can be demonstrated [6], a potential water savings of 30 percent, with the concurrent reduction (by reuse) of chrome, and sulfide expenditures, should quickly repay on-site capital investment requirements as well as eliminate major pollutant discharges to the sewer

General Industrial and Public Educational Needs

Many practices were observed that pose direct threats to the environment In many instances educational programs aimed at industrial owners, workers and citizens would increase awareness and reduce the threats to the very precious water resources as detailed in the sections discussing each industrial sector Three problems that appear to need broad-based educational efforts concern the proper ways to handle and dispose of spent oils and contaminated petroleum based materials, waste solvents, paints and similar materials, and hazardous materials in general

It appears that basic definitions for these types of materials and their potential for harm are understood by only a small minority of the target population The long term health and prosperity of the West Bank region depends upon correcting this deficiency

Proper Reuse of Treated Wastewater

The most effective water treatment system design possible can be fully successful only if the final discharge meets the needs of the community served Even the best treated wastewater appropriate for multiple uses but not used for any reason can compromise

the effectiveness of the entire management system Potential beneficial users of the discharge must be educated as to the best ways this for using this resource and the constraints on proper use of the water made available

Many, often conflicting concerns must be addressed and resolved by user/public education Some examples are

- Political responsibility and administration within and across municipal and state boundaries,
- Protection of public and user health,
- Need to fully use a valuable resource,
- Resource conservation,
- Religious and societal custom restraints and encouragements,
- Protection of the soil, and surface water and groundwater, and
- Sustainable use

The workshops-educational program may be set-up utilizing the facilities of existing educational industrial institutions in Hebron and the southern areas of the West Bank near Hebron Examples of industrial educational institutions and programs that may serve as potential resources are listed in Appendix E

CHAPTER 6

REGULATORY AND INSTITUTIONAL CONSIDERATIONS

In general, to take advantage of the options that have been identified, and to complete the studies and sampling programs discussed, the highly political nature of the region must be considered carefully All work potentially seen as significant should be, to the extent practical, conducted in conjunction with and by gaining the cooperation of the institutions impacted It will be politically important to involve key players from the Hebron Municipality the Palestinian Water Authority, the Palestinian Environmental Authority and others From the side of the industries, input and cooperation from groups like the Union of Stone and Marble in Palestine (this is not a labor union) should be sought Citizen groups and religious authorities may well need to be seriously considered also for long term progress to be assured

The many industrial operations in Hebron discharge materials to the sewer with little or no oversight or restrictions This practice poses an on-going threat to the region's water resources Political authority in the region is fragmented with overlapping responsibilities and little true enforcement capabilities One potential solution could be the formation of a strong local industrial sewage pretreatment authority A local pretreatment authority could potentially safeguard reuse and recharge options, protect treatment system components and operations, provide municipal and industrial operation guidance and training, and potentially fund operations through appropriate sewer use charges

It is recommended that a municipal sewer use ordinance and pretreatment program be implemented in Hebron The goal of the program should be the protection of public health and infrastructure while simultaneously saving industry owners water and chemical costs Details of such a program are beyond the scope of this activity

Previous Page Blank

CHAPTER 7

ACTION PLAN

General Wastewater Data Collection

Additional information on Hebron wastewaters as currently generated is necessary to develop a viable, meaningful conceptual design for the Hebron wastewater treatment system This information will become the basis for developing solid estimates of flows and characteristics after the water supply becomes more economical and plentiful in the future These data can be obtained by a stepwise wastewater characterization survey The results from each step or phase in the proposed characterization study will determine, or inform, the specific needs of each following step This will minimize the overall efforts required by collecting only relevant data directly needed and help assure a cost effective final design A traditional engineering comprehensive source and wastewater generation study is not recommended in order to save time and resources A comprehensive study would also be of less value if the context of the rapid changes and growth anticipated Though the specifics of such a program must be determined in general the major steps in such a focused program would include

1 Location of sewers and facilities to determine the sources of wastewater generated from the major geographic and demographic areas of Hebron Services, laterals and mains collecting wastewater should be entered into a master plot with each major industrial client identified It may be possible to group collection system drainage areas that predominately serve major industries, domestic areas, and mixed domestic/commercial/industrial areas Conceptually such divisions may look like the arbitrary sectors plotted on Figure 7 1

2 Limited wastewater flow measurement and sampling program

   A Isolate a large, predominately domestic area for sampling to determine current typical per capita loading rates for Hebron, for example Sampling Point A in Figure 7 1 At the same time measure the wasteflow characteristics at the municipal outfall as it discharges into the wadi, Sampling Points B and D With population estimates and industrial/commercial facility information gather previously, a reasonable estimate may potentially be obtained for the true impact of industrial contributions

   B Next, based on initial data evaluations, select subdrainage areas serving specific industrial categories, perhaps like comparing the data from Sampling Point C to B and D, to determine the general importance of each These data will then be used with sampling data collected at specific industrial installations for accurate characterization The industries to be sampled may then be selected based upon the importance of their contribution and the potential impacts on the collection, treatment and reuse system

3 Based upon the above, the relative impact of each industry can be evaluated and determinations concerning the economic feasibility and advantages obtained for all practical pretreatment, reuse, recharge, or discharge options identified This would

Previous Page Blank

be a preliminary economic feasibility study comparing the impacts of pretreatment, preliminary treatment, and collection system operation and maintenance costs to the impacts and costs of the overall wastewater treatment system The focus will be on the cost or value to the industries served compared to the impact and cost savings for wastewater treatment and handling These investigations must carefully consider and evaluate all alternatives in relation to the discharge quality required for specific recycle, reuse, recharge or surface discharge options Each of the proposed end uses of the treated wastewater will directly effect the treatment train required and resultant system cost

4 Once feasible treatment system options are identified then potential on-site demonstration projects or pilot treatment studies should be considered These projects should only be pursued when the treatment system effectiveness goals have been addressed

These steps are not all purely sequential and portions may rationally overlap Conceptual design may be well underway concurrently with steps 3 and 4 but should not proceed before steps 1 and 2 have been accomplished

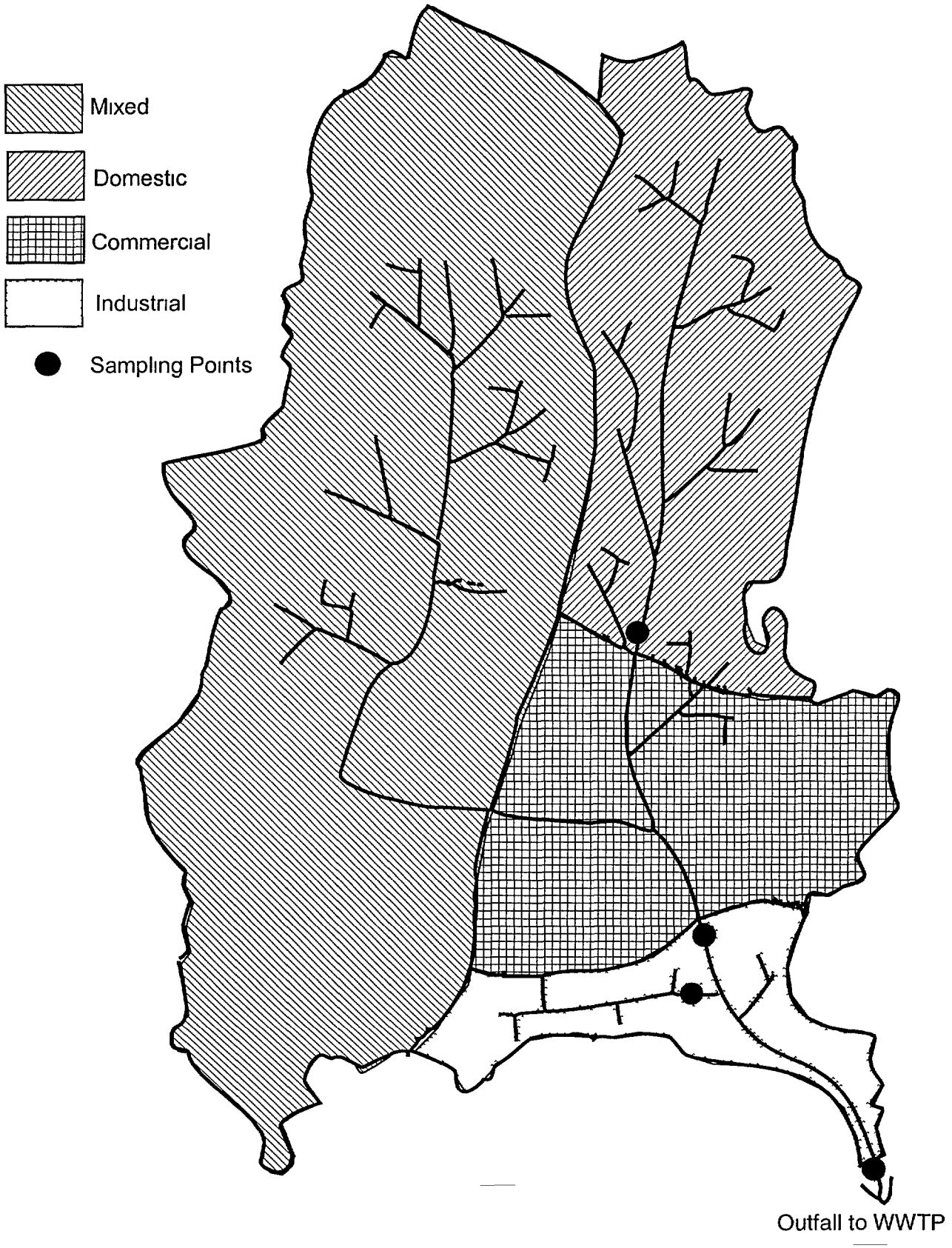
Industry Specific Actions

The ideal time to begin a demonstration project at a stone cutting facility and tannery, as recommended, is during and concurrent with the period required to collect wastewater characterization data Specific demonstration project recommendations for Hebron's industrial base are detailed in Chapter 5 Detailed recommendations for wastewater characterization data and for each individual industry or sector are presented in Chapter 4

Solid waste disposal at an open burn dump threatens all three key environmental media — air, land, and water Serious consideration should be given to converting or replacing the current open burn-dump operations to a controlled sanitary landfill There are also possibilities for using the solid wastes as refuse derived fuel for converting the stone cutting slurry waste to valuable lime Dried slurry could also be used as a cover material for operations due to its low hydraulic conductivity

Solid waste management changes are needed to better serve the industries that generate substantial amounts of solid waste The most critical improvement sighted by many would be to have the municipality take the waste away on a predictable, routine basis

Figure 7 1 Schematic, Arbitrary Example of Sampling Point Locations Along Hypothetical Existing Sewers for a Stepwise Wastewater Characterization Study



REFERENCES

[1] United Nations Development Programme (UNDP), "Conceptual Master Plan for Sewage Treatment & Reuse for Hebron City, draft final report," Ramallah (January 1997) English

[2] Hebron Chamber of Commerce & Industry, "Commercial Industrial Guide – 1995 to 1996," Arabic with some English in summary tables and graphs

[3] US Agency for International Development – Small Business Support Project/DAI (SBSP), "Stone-Cutting Establishments Survey in the West Bank," Maan Development Center Business Consulting Services, Ramallah (1995) English

[4] Abu-Hijleh, Othman Hussein, "Minimizing Water Consumption and Environmental Pollution from Stone-Cutting Industry in Palestine," International Institute for Infrastructural, Hydraulic and Environmental Engineering (IHE), seminar handout notes and MS Sanitary Engineering Thesis, Delft, Netherlands (April 1997) English

[5] Palestinian Directory for Stone & Marble, Palestinian Establishment for Economic & Technical Services (PEETS), Bethlehem (undated 1998) Arabic

[6] Applied Research Institute – Jerusalem (ARIJ), "Environmental Profile for the West Bank Volume 3 – Hebron District," Bethlehem (November 1995) English

[7] Thorstensen, Thomas, "Pollution Prevention and Control for Small Tanneries," draft copy of review paper without tables and figures, (May 1998) English

[8] Nemerow, N L , "Liquid Waste of Industry, Theory, Practices, and Treatment," Addison-Wesley Company, (1971)

[9] Metcalf & Eddy, "Wastewater Engineering - Treatment, Disposal and Reuse," 3rd Ed , McGraw-Hill (1991)

[10] Al-Khateeb, Nader, personal communications with Al-Aroub Field Experiment Station (July 1998)

[11] Abdi, Munadil I A , "Effects of Quarries & Stone Cutting on the Environment in Northern Palestine," Senior Undergraduate Project Report, Department of Civil Engineering, An-Najah National University (January 1997)

Previous Page Blank

ANNEX A

SITE VISITS

Proof Page Blank

The site visit numbers listed below correlate to those shown in Table 3 3 and referred to throughout the report

1 AL-JUNEIDI DAIRY

Date 6/23/98

Industry Diary & food products

Name Al - Juneidi Diary
P O Box 274
Hebron - Palestine Tel 02-9929432

Person Mr Nidal N Al-Juneidi

Reason for Selection
Dairies generate high BOD_5 and TKN loads along with pH swings caused by cleaning agents

Products
Fresh milk, yogurts, sour whey, labaneh, sour cream and fruit juices

General Observations
Raw milk — About 50% from Israel but not a secure source, about 25% from local dairies (including family farms) and about 25% from skim milk powder
Three separate factories on same site — milk, salad, and Tahina
Use about 100,00 L milk/day
Use about 80,000 L water/day on average, with an absolute minimum water requirement of approximately 60,000 L / Day
Dairy owns tanker for collecting raw milk, cleaned on site
Produce about 12-15,000 L/Day of cheese whey, about 10,000 L/Day sour whey and about 2-5000 L/Day sweet whey
Whey is processed by centrifugation for fat removal
No market for dried milk sugars, lactose & whey according to market study done last year, investment of $250,000 would be required for process equipment
Production increases significantly during Ramadan — increasing water requirements

Water Use
Most of the water is used for cleaning (small portion, about 5 - 10%, is used to reconstitute orange and grape juice from imported concentrates)
Cleaning agents 60% HNO_3, NaOH or KOH, H_2O_2, acetic acid, phosphate detergents, NaOCl (floors only)
Claims that water use about 80% of that in Europe
Cleaning water — heated to 90 ^{0}C or steam with fuel oil (1 2 NIS/L)
Water availability — piped water from municipality is limited in availability (rainy months only) and amount available at any time
Import 8-10 tank trucks /day for about 100 m^3/day @ 10 NIS/m^3
On site storage about 2500 m^3

Salad factory produces homus, mayonnaise, tabullah, cold slaw, and Turkish salad using about 7 - 8,000 L/day

Water Use

Facility employs 165 -170 persons, two 8 hour shifts with 2 hour cleaning cycle, 6 days/week (milk received 7 days/week

Maximum production during Ramadan about 120% of average

Wastewater generated About 90 - 95% of water purchased goes to sewer, all cleaning water goes to sewer No sewer use fee 60% HNO_3 used - five 25 L containers/ day, 100 Kg NaOH/day, 80-100 L detergent /day

Use low-pressure washing

Wastewater to sewer Manhole cover removed at the point just prior to discharge to the municipal sewer — No fat or grease accumulations observed, pipe about 1/3 full, little surface sheen suggests little oil and grease, white turbidity, appeared to be a good effluent for diary, no odors at manholes

Electricity

Used for cooling & pumping 144/KWH, not always available from municipality, shift to on-site diesel, generator as needed

Solid Wastes

Spoiled cheese products (poor quality products), packaging materials, cartons and metal containers stored in open area and collected by municipality at no charge — about 3 m^3/hr, collected twice/day and taken to burn dump about 10 km south

General Comments

1 Product quality — self monitored and regulated by Ministry of Health with random samples
2 Dairy serves market of about 2 million people
3 No near term expansion plans
4 Water availability is critical and frustrating
5 Enlightened management — very cooperative — modern, clean facility, no objectionable odor
6 Concerned about environment in general
7 Two other dairies in Hebron are very small 2-3,000 L/day each
8 Dairy located in middle of municipality

Impact

Potentially significant source of BOD_5 and TKN loading to the treatment system but should pose few difficulties as currently operated

2 PALESTINE LEATHER COMPANY

Date 6/23/98

Industry Training

Name Palestine Tanning Factory
Hebron Industrial Zone
Hebron Palestine
Tel 9929103

Person Mr Fayez El Za'tari, director

Reason for Selecting

Tanneries traditionally have high organic loads, major pH swings in effluent, high TSS, high sulfide, chrome and other salts — might negativity impact sewers, proposed treatment plant, and groundwater recharge, this facility is one of 11 tanneries located in the industrial area

Products

About 25,000 sq ft/month of dyed, chrome tanned cowhide leather for consumption in local shoe manufacturing industry

General Comments

Small facility (about 10 workers), 4 drums for chrome tanning, 4 drums for liming, 3 drums for oil addition each drum 2 5 m wide with 3 m diameter
Overall current water use estimated at 20 m^2/day
Production reported as 50 hides/day
Water shortage limits production and quality
Wastewater to sewer
Water not generally available from municipality
Competition between neighboring tanneries — all part of one extended family

Batch Process

1 Wash and soak — Raw hides are first trimmed and washed and then soaked for 24 hr, all wash water (3-4m^3) containing NaCl, flesh, dung, etc goes to municipal sewer
2 Dehairing — 3 to 4 m^3 new water with 3% $Ca(OH)_2$, NaS, and a proprietary processing chemical "seical f " used for 24 hr, solution discharged to sewer (high pH, very high sulfides, dissolved protein, dissolved hair proteins, BOD_5 and TKN)
3 Rinse — 1 5m^3 to sewer, then wet hides are mechanically shaved
4 Delime — 2m^3 of water at 40°C containing 1% $(NH_4)_2SO_4$ and a proprietary organic chemical "Decalcinate sintetico " reduces pH from 14 to about pH 8, process requires about 90 minutes, next a smoothing agent is added and then drum liquids are discharged to the sewer
5 pH adjustment — 8% NaCl added, with H_2SO_4 (0 8%), lowers pH to 3 , then rotate drum 2-3 hours, allow to sit overnight, next day add 8 kilo of chromium sulfate per 100 kilos of hides
6 Next — drain water to sewer, remove hides from drum, squeeze excess water from hides, and shave hides to uniform thickness, trim, replace in drum, add $Na(HCO_3)$ and 1 m^3 of fresh water and rotate for 1 5hr, then drain to sewer
7 Add 1 m^3 of 45°C water and 6-7% (of hide weight) oil to improve flexibility and rotate for 1 hour — this swells the leather, liquids discharged to sewer
8 Hides are painted and dried for shipment

General Comments

1 No dyes go to sewer
2 Can't improve quality or production because water not available
3 Major hand work — labor intensive
4 Trimmings hauled by tanner to burn-dump, owner cannot understand why municipality doesn't collect solid wastes from tanneries
5 Hides typically require 15 day cycle for conversion to final product
6 Not much room to expand operations
7 Was not receptive to suggestions for water use minimization procedures

Impact

Probable major impacts on sewer and proposed treatment plant — corrosion of facilities, wide pH swings potentially toxic to wastewater treatment plant biomass

3 HEBRON MUNICIPAL SOLID WASTE BURN DUMP

Date 6/23/98

Name Hebron Municipal Solid Waste Burn Dump

Location South and east of Hebron Outside the municipal jurisdiction area

Reason For Selecting

Stored solid wastes generate leachate that requires special collection system and treatment arrangements Major concerns about organic and heavy metals infiltration into the Eastern Aquifer

General Comments

1 An uncontrolled dumping site
2 Industrial waste that contains heavy metals is dumped on site
3 Site is located on karstic aquifer
4 High risks of groundwater pollution
5 Good access road
6 Large amounts of smoke from burning waste

Impact

This facility is a health and environmental hazard Operations should be converted to a controlled facility to ameliorate multiple environmental threats

4 AL RAYAN CATTLE FARM

Date 6/23/98

Industry Cattle Farm

Name Al Rayan Cattle Farm
Hebron, Dhahyat Al Rama

Reason for Selecting
Cattle farms can generate high BOD_5 and TKN loads Concerns about wastewater discharge to wastewater treatment plant and infiltration to groundwater aquifer

Products
Fresh milk for dairy industry

General Notes
1 Sewage is discharged to the nearby land without treatment
2 Currently the farm has 150 cows (80 milkers, 50 heifers and 20 pregnant)
3 Milk production is 2,500 l/day (30-35 l/day/cow)
4 The milk parlor uses a 12 stall herring-bone arrangement, high pressure water cleaning, modern up-to-date Alfa Laval equipment

Water Use
Water consumption is 20 m^3/day
Water is used for drinking and washing the cows
Piped water from municipality is limited Import 2 tank trucks/day (20 m^3/day @ 16NIS/m^3)
Onsite storage

Solid Waste
Manure mixed with hay and animal feed is collected and stored outside for drying People collect the dry manure free of charge and use it as an organic fertilizer

5 MONZER MARBLE & STONE FACTORY

Date 6/24/98

Industry Stone Cutting

Name Monzer Marble & Stone Factory
Owned by Monzer and Maher Al-Jabari

Note
The person initially interviewed was the production manager The owner arrived and appeared to provide much more candid responses correcting many points of misinformation from the production manager

General Comments
1 Produce different types of stones for building construction
2 Production rate is 7,000 - 8,000 m^2 per month of limestone
3 Twenty workers
4 Considered a mid-size facility by owner

Production of stones is a three step process,

1 The large stone is cut into square shape ~ 1 - 2 m^3
2 The stone is then cut to thin pieces (1-3 cm thickness)
3 Stone pieces are smoothed by a separate final finishing machine

About 70% of the facility's production goes to Israel

Power Source

Municipal electricity, 35,000 NIS/month

Water Usage and Cycle

- Water source trucked, $2,000 - 3,000/month
- Water is used as a lubricant to the cutting saws
- Water is collected in the plant drains and channeled to one sump
- Polymer (acqueNYMCO, SPA) is added as a settling aid to the sump
- The polymer is dry and available in 20kg bags
- No safety data sheets are available for the polymer
- Technical data about the polymer was not available either on the bags or in the owner's files A visit to the polymer sales office also failed to yield any information about the polymer Apparently the manufacturer wishes to keep all polymer data sequestered for business reasons
- Dose of polymer in mg polymer /liter of treated water is random, and the concentration of the added polymer is also random and fluctuates
- Polymer consumption is 80 - 100 kg/month, and cost 800-1000 NIS
- The collected water is pumped to an elevated silo with a conical bottom where the water borne particulates and dust generated during the cutting process are allowed to settle
  The supernatant from this silo is connected to another cylindrical silo, which acts as a water storage reservoir
- Water is allowed to drain from this second storage silo by gravity and reused for the stone cutting processes
- The factory can only obtain water from the municipality during the winter season
- During summer water (10-20 m^3/day) is trucked to the factory at a cost of 100-120NIS
- Slurry from the first settling silo is discharged daily (7-10 m^3/day) to the municipal sewer

Additional Comments

Constraints to increase production are

- Water usage around $ 2,000 to 3,000 per month
- Electricity usage around $1,000 month
- If water was made more available, more water will be used and less recycled for two reasons
- Clearer water (less TSS) will produce better stone surfaces
- Clearer water (less TSS) will increase the life cycle of the cutting saws
- The owner was honest in telling the actual disposal of slurry, while his aid previously mentioned that they truck it to dedicated sites He also commented that most stone cutting personnel will tell us the wrong practice
- The owner mentioned that only a limited number of facilities have a slurry dewatering system He was exploring this option since dewatering can potentially lead to considerable water recovery (~60% of slurry volume)

6 AL HARAMEIN OLIVE PRESS (OLIVE OIL MILL)

Date 6/24/98

Industry Food Processing

Name Al Haramein Olive Press

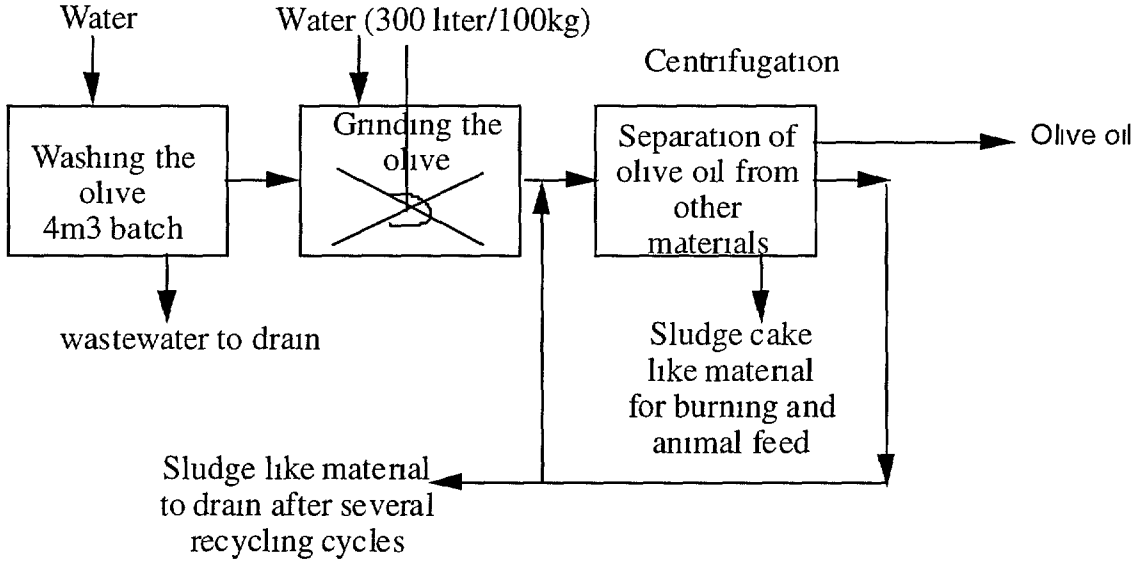
Person Farid Abu-Hadeed, Owner

General Information

This mill produces olive oil from local olives
The capacity of the mill is 1500 kg oil per/hour
The mill production is limited to the olive harvesting season during which the mill works for 24 hours/day
The olive season is typically from October 15th until the end of November
Only 3 facilities exist in Hebron The other two facilities each have a production capacity of 1,000 kg/hour during the olive season
During the olive season, 4 workers operate the facility
The facility was not in active operation at the time of the visit

Water Usage

Water is used for washing the olive prior to squeezing and is added to the olive during the grinding process to produce a paste
The following schematic diagram describes the production process



The wash-water, about 4 m^3/day is discharged to the sewer
During the whole season the mill receives only 30m^3 from the municipality and the remaining water required is trucked to the facility
If water is available on a continuous basis, more water will be used for washing the olives prior to grinding
The residue after grinding and centrifugation is given back to the owners of the olive and is used as a fuel source or as an animal food

About l00 kg of raw olives usually produce 25-35 kg of olive oil, 50-60 kg of semi-dry residue cake and liquid materials that are discharged to the sewer
Electricity is generated on site and cost about 200-300 NIS/day
Research suggests that wastewater from the olive oil industry is = wash water + 0 6 mass of olives

Name
Potentially significant organic load during short production season

7 K A R FOR MACARONI & FOOD STUFF

Dates 6/24/98 and 6/30/98

Industry Food Processing, Spaghetti and other pasta

Name K A R for Macaroni & Food Stuff MFG Co
P O Box 256
Hebron Palestine 972-02-9920459

Person Osama O Hirbawi (General Manager)
Abu-Madi Mohamed (Technical)

Products
Various forms of spaghetti, macaroni and pasta products

Reason for Selecting
Potential for discharge of high BOD_5 and TSS from bad batches and cleaning operations may organically overload the wastewater treatment system Cleaning solutions can be toxic when discharged in quantity

General Observations
Plant products about 150 tons of products per year for sale in the West Bank, Gaza and Israel year around operation, 16 employees
Major raw materials are flour, water and coloring agents
Water use is currently about 80 -90 m^3/month
50% of water is discharged (along with domestic wastewater) to "cesspits"
at present the area is not sewered
A 250 m^3 reservoir is available for use when municipal water is not available, pays municipality 4 when available Imports tanked water at 10 NIS/m^3 when the cistern is empty and municipal water is not available
Claims (but not shown) that water evaporated during product drying is condensed and used for irrigation
Site revisited on 6/28/98 for viewing operation
- Two production lines for extruding and drying products
- No signs of liquid clean up —all dry — no floor drains, no corrosion of metal
- Very clean facility
- Solid wastes — spaghetti, flour, paste, plastic bags are collected by municipality

Conclusion
No impact on potential wastewater treatment plant or future reuse

8 NIEROKH SOLAR FACTORY

Date 6/24/98

Industry Solar Water Boilers

Name Nierokh Solar Factory

Person Hamza Nierokh

General Observations
1 Total number of workers is 17
2 The product is in the form of boilers and solar collecting mirrors a unit is one boiler and 3 mirrors
3 Current Production Rate 10 units per day
4 Future plan is to expand for producing radiators and central heating equipment
5 No water is used for production
6 Kerosene is used as a cleaning agent at the rate of 100 L per month
7 This Kerosene is recycled using an air pump and reused several time until dirty
8 During this cleaning process 50% of the kerosene is lost due to evaporation Thus, on a monthly basis, the factory disposes of 50 liter of Kerosene
9 An on site infiltration pit is used for spent kerosene disposal
10 Strong VOC odors exist around the facility and the risk of fire due to an adjacent burning oven and cigarette smoking is high

Impact
Although no direct impact of this factory is expected on the wastewater management system, there exists a great potential impact on the aquifer due to kerosene infiltration from the cesspit

9 NIEROUKH SCALE

Date 6/24/98

Industry Metallic Furniture

Name Nieroukh Scales Metallic Furniture Co LTD

Person Adnan Nieroukh

General Observations
1 Products regular scales, metallic furniture and electronic scales
2 There are 103 workers in the factory

3 Previously, 80% of the production went to Israel, but now most production is being distributed in the West Bank
4 The factory is operated 6 days a week, for one 8 hour shift
5 Raw material is imported from France, Russia and Belgium via Israel
6 Electropainting of metals is used and no electroplating is practiced
7 Paint is imported from Tambour Co in Israel
8 Very modern and spacious factory
9 Another factory is being established and will start operation within August 1998
10 Scrap steel is sold to Israeli factories and recycled
11 Solid waste production is mainly from packaging material averages about 2 m^3/day
12 Electricity source municipality, but has a standby generator

Water Use

Water is used for automatic washing of the metal prior to painting, and for sanitary purposes
Certain chemicals are also used as a cleaning aid, these are phosphate-based surface active agent, detergents, and Na_2CO_3
Water consumption for washing is about 42-50 m^3/month
Washwater is blown down based on visual inspection of the metal surface A conductivity meter was available but not operating
Washwater is collected in a plant sewer and is discharged to an on-site infiltration pit
Owner has a positive attitude concerning water reuse

Impact

Minimal impact is expected from this facility

10 AL-ANWAR MARBLE COMPANY

Date 6/25/98

Industry Stone Cutting

Name Al-Anwar Marble Company Ltd
Owned by Nimir and Barakat Al-Atrash and Mohammad Al-Manasrah

Person Nimir Al-Atrash

General Observations

1 Produces different types of stone products for building construction
2 Production rate is 7,200 m2 of limestone per week
3 Ten workers + five administrators
4 Considered as mid/large size facility by owner
5 Stones are available from local quarries
6 Production of stones is as previously described in Visit No 5
7 One shift a day (8-10 hours), 6 days per week
8 Certain chemicals are used as hardening catalyst and an epoxy filler is used to repair pits and blemishes (expensive materials)
9 Power source Municipal electricity
10 Water source trucked, ~12 m^3/day, at 100 NIS per truck

11 Polymer usage 1 5 - 2 0 kg/ day
12 About 70% of the facility's production goes to the West Bank and Israeli markets, and 30% goes to Jordan

Water Usage and Recycle

1 Water is used as a lubricant to the cutting saws
2 Water is collected in plant drains and channeled to a sump
3 The same polymer as described in Visit No 5 (acqueNYMCO, SPA) is added as a settling aid to the sump
4 Dose of polymer in mg polymer/liter of treated water is random, and the concentration of the added polymer is also random and fluctuates Dose is based upon visual observation of water clarity
The dry polymer is added twice a day to the polymer tank where it is mixed with the water Water is added continuously to the tank and thus polymer solution is added continuously to the collection tank This practice leads to high polymer concentrations at the beginning of the day and very dilute solutions at the end of the day This was observed as a general practice of polymer addition
5 Mixing of dry polymer appeared to be inefficient

Note Items 4 and 5 indicate the need for an effective educational program

6 The used water is pumped to an elevated silo with a conical bottom where the collected particulates and dust from the cutting process are allowed to settle
7 The supernatant from this silo flows to a flat bottomed cylindrical silo, which acts as a water storage reservoir
8 Clear water is allowed to drain from this silo by gravity and is used throughout the plant
9 The two silos have a water capacity of about 48 m^3
10 The factory is only able to obtain municipal water during the wet winter season
11 Slurry from the first silo is disposed off daily (~10m^3) According to the owner, they truck it to a site where they pay about $7 per truck load

Additional Comments

1 If additional water was made available at a reasonable cost, more water would be used and less recycled since cleaner water (less TSS) increases the life cycle of the cutting saws thus lowering operating costs
2 They are very much interested in slurry dewatering system and they recently purchased a used plate and frame press but it is not working Dewatering will lead to considerable water recovery (~60% of slurry volume), and save hauling costs for slurries
3 Their main problem is slurry disposal
4 They are very much interested in education about polymer selection and optimization They are willing to pay for determining how to select and optimize polymer use
5 The owner mentioned that almost 90% of the current stone cutters use the polymer and silo settling method for water recycling This modern practice began in 1992
6 The owner also stated that the municipality should take some action and try to solve the problem of slurry disposal He was in favor of a centralized facility

Impact

Facilities in this industrial sector will have a potentially substantial effect on all aspects of the proposed wastewater management system — collection, treatment, reuse and recharge

11 NATIONAL LEATHER COMPANY

Date 6/25/98

Industry Tannery

Name National Leather Co
Yatta Road Tel 052-286595
Hebron Industrial Zone 02-928451
Hebron - West Bank

Person Amer and Walid Sa'eed Zatari
owners and proprietors

Reason for Selecting

Tanneries may discharge materials that impact collect system, treatment plants and reuse of wastewater This tannery was selected from similar facilities at random

Products

About 2000-2500 tanned cowhides per year (about 8 to 10 hides /day) — all production is sold to local shoe makers, high demand

General Observations

1 All hides are of local origins, arrive heavily salted to prevent decay
2 Extreme water shortages — one ton of hides requires 20 m^3 water
3 Could use 20-25,000 m^3 water but only about 7,000 m^3 available per year

Batch Process

1 Wash and soak — Each drum is charged with 1000 - 1250 Kg cowhides) and with 3 m^3 of fresh water and rotated for 24 hours The water is then drained to the sewer
2 Dehairing — 3 m^3 of fresh water with Na_2S (3%) and lime (2 5-3%) by weight and rotated for 30 minutes, then for 5 min/hr up to 24 hours Then the very corrosive, odorous liquid is discharged to the municipality sewer
3 Rinse with 3 m^3 fresh water (16-30 minutes) and discharge to municipal sewer
4 Add 0 5 - 0 6 m^3 fresh water + 2% $(NH_4)_2SO_4$ and a proprietary chemical called MOT (pH rises), rotate for 90 minutes and discharge Ω of water say 0 3 m^3) to sewer, replace with 0 3 m^3 fresh water plus proprietary chemical (Orobine), rotate for one hour, then discharge water to sewer
5 Wash with 3m^3 fresh water for 10 minutes, drain and discharge to sewer
6 Add 100% by weight fresh water (say 1 to 1 2 m^3), plus NaCl and rotate for 10 minutes
7 Add 0 5 -1% formic acid, rotate for 10 minutes then add 0 1 to 1 2% H_2SO_4 and rotate for 2 hour, pH will be about 2 5 to 3, next add 8% chromium sulfate and

rotate for 8-10 hours, may then add 0 5% Na_2CO_3, discharge water to sewer at pH 4, may rinse with water (say 1 m^3)

8 Remove hides, shave for uniform thickness
9 Add hides and 1 m^3 fresh water to drums, neutralize with lime or Na_2CO_3
10 Add dyes, oils and formic acid, rotate, then wash with 3 m^3 of fresh water then discharge to sewer
11 Air dry hides, measure and sell product

Additional Comments

1 Owners claim that they are operating at 30% of capacity due to water shortage
2 Apparently there have been extensive odor complaints, and there was no interest in establishing water conservation procedures for fear of reducing product quality and generating odors
3 Owners claim that when all the tanneries were established about 20 years ago, there were no neighbors to complain Now they are surrounded by development
4 Firm electrical supply a problem, must have standby power
5 All wastewater to sewer (say 20 m^3/day)
6 Owners claim no sheep tanning in Hebron (However, tanned sheepskins were observed at another tannery)
7 All tanners serve favored customers
8 As for all tanners, owners must haul solid waste residues to the Hebron municipal burn dump, they claim about 6m^3/month of solid wastes are generated

12 AGRICULTURAL INDUSTRIES CO

Date 6/28/98

Industry Vegetable Canning

Name Agricultural Industries Co Ltd
PO Box 8 Hebron
Tel 02-9928141

Person Mr Taher Abdul Nabi
Owner and Manager

Products

Canned tomato paste, chick peas, fava beans, white beans, ground chick peas and green peas

Reason for Selecting

"Only Cannery" in Hebron
Vegetable canning potentially results in massive organic loads (BOD_5 and TSS) requiring special consideration for wastewater treatment

General Observations

1 All dried raw materials used (except for tomatoes) are imported from Israel, Turkey, Bulgaria, Argentina and Canada In past, fresh tomatoes were imported in bulk seasonally from Israel and Jordan for 2 to 5 months per year)

2 Eight workers, 6 days/week, all year
3 When not processing fresh tomatoes, cooks and repacks tomato paste imported in barrels from Israel
4 Last year, purchased 2,500 tons of fresh tomatoes (6 tons of fresh tomatoes yields about one ton of tomato paste, also purchased about 50 tons of tomato paste for repackaging
5 Last year produced about 300 tons of tomato paste and about 1,000 tons of all other products
6 Will not work with fresh tomatoes this year or in foreseeable future Equipment is too old and current staff is not adequately trained to follow through
7 Existing political situation discourages expansion via capital investment A study suggested that it would require about fifteen million dollars to expand and modernize the business
8 Products are primarily sold in West Bank

Water Use

- Typically uses 6-7 m^3/day for all purposes (except steam generation)
- 0 4 m^3 per ton required to swell dried vegetables
- 0 6 m^3 per ton of product added for canning
- Uses about 10 m^3/day to generate steam for cooking canned products in autoclaves About 50% of this water is wasted to sewer
- Water from Municipality available about 1-2 days per week, otherwise buys tanker water at 16 NIS/m^3
- Overall, owner claimed that about 40% of water goes to sewer (A much higher percentage when washing fresh tomatoes)

Note — Interviewers have concerns about accuracy of water use data

- Boiler water is softened, apparently by Ion-Exchange
- Water costs are high, 16 NIS/m^3 for tankers
- Generates all power onsite using diesel generators, uses about 100 l/day of diesel fuel at 1 15-1 2 NIS per liter (Note- He claims that it is cheaper to generate power onsite He has a dispute with the Municipality over electricity)
- Uses 3 steam cooker sterilizers Was not interested in reusing condensed steam when suggested (This water might profitably be saved and reused)
- At time of visit was repacking tomato paste Waste tomato paste going to sewer from cleaning vat estimated at 5l/hr Undoubtedly very high BOD_5 load
- Uses vacuum pumps for canning processes Vacuum pump cooling water is wasted to sewer, estimated at 1 5 l/min Owner not interested in capturing and reusing
- Clean operation
- Produces about 100 kg/day of solid waste that is collected by Municipality and taken to Hebron's burn dump

13 PETRA FOOD PRODUCTS

Date 6/28/98

Industry Ice Cream and Other Frozen Sweet Products

Name Petra Food Products Co
PO Box 376 Tel 02-928618
Hebron, Palestine Tel 050 207 854

Person Mr Humaidan Salman
Owner and Manager

Products Ice Cream Products in Summer, Ras Al Abed in Winter

Reason For Selection

Dairies and ice cream manufacturing frequently discharge very high BOD_5, TKN, and high grease and oil loads to sewers which may interfere with wastewater collection and treatment

General Observations

1 Facility has about 30 employees, 8 hours/day, 6 days/week This was reported to be the largest ice cream factory in the West Bank
2 All raw materials are imported from or through Israel including sugar, glucose, powdered milk, and margarine, emulsifiers and flavoring agents Eggs are used extensively in winter products
3 Products sold throughout West Bank, about 10 tons/day
4 Raw water is softened by ion exchange using NaCl
5 Cleans with NaOCl, followed by NaOH, followed by detergent

Water Use

- Summer 20 - 25 m^3/day (15 - 20m^3 in product, 5 - 10 m^3 to sewer)
- Winter 10 - 15 m^3/day (7 - 12 m^3 in product, 3 m^3 to sewer)
- Water not available from Municipality in summer, purchases three 10 m^3 tank trucks per day at 16 NIS/m^3 each
- Spoiled products (20 - 30 L /week) are melted with fresh water and discharged to sewer
- Ice cream prices have remained fixed since 1990, while raw material prices have doubled according to owner, substantially reducing profits

Solid Wastes

- The Municipality collects solid wastes daily

Power

- Small standby diesel generator for winter use when power outages are frequent — most of power is used for cooling In Summer, pays 30 - 35,000 NIS/month at 0 39 NIS per kWh In winter pays 5 - 6,000 NIS/month

Other Observations

- Facility would not likely pass US cleanliness standards Milk delivery and make up tank was dirty Floor was dirty Some employees used plastic gloves on production line Others did not Raw milk stands in open tanks and on floors for up to 8 hours
- Uses 400-500 kg 77% $CaCl_2$ for machine coolant brine solution per week — discharges spent brine to sewer This may represent an opportunity for water conservation and reuse of brine

14 MODERN TANNERY

Date 6/29/98

Industry Tanning

Name Modern Tannery Co LTD
Industrial Zone
Hebron, West Bank
Tel 02-929497

Person Muhammad Shaban Shams Al-Za'atari, Owner

Reason For Selecting

Tanneries discharge deleterious materials to sewers including high BOD_5, sulfides, TKN, and wide pH swings All can adversely impact wastewater treatment

General Observations

1 All Tanneries in Hebron are located in same portion of the Industrial Area
2 Owners are all related and compete All tannery discharges appear to pass through a single manhole to the main trunk sewer
3 This is biggest tannery in Hebron, 10 - 15 employees
4 Production about 250 cowhides / month, 1,500 sheep hides per month , 1,000 goat hides per month
5 Raw cow hides 50% from Hebron area and the other 50% from Gaza, and West Bank, Israel
6 Goat and sheep hides obtained from Hebron area
7 Last year bought 2 containers (1000 cowhides per container) of chrome tanned hides for finishing from Turkey as an experiment
8 Tannery has 6 drums
9 Gets about 3 NIS/ $foot^2$ for tanned and oiled goat hides versus about 10 NIS/$foot^2$ for tanned and oiled cow hides

Water Use

- Claims about 20 m^3/day, 6 days/week, most is discharged to sewer
- Insufficient water available from municipality

Tanning Process (Cowhides)

1 Wash and soak — 4 to 5 m^3 fresh water per ton hides, discharge polluted wash water to sewer
2 Trim hides to remove fat and unwanted pieces
3 Dehairing — add 3% Na_2S, 2 5 - 3% $Ca(OH)_2$ to 4 - 5 m^3 water, waste solution to sewer after 24 hour
4 Rinse with fresh water (5 m^3) wasted to sewer
5 Hides shaved to uniform thickness
6 Swelling — 2 5 m^3 300 c water + Na_2CO_3, + Enzymes, wasted to sewer
7 Rinse — 2 5 m^3 cold water, wasted to sewer
8 Bate — 1 m^3 fresh water with NaCl, then 1 m^3 with 7% H_2SO_4 and 7% formic acid
9 Chrome — Next day add chromium sulfate (About 8%) Followed by raising pH to 5 5 - 6 6 with Na_2CO_3, discharge ~2 m^3 of spent solution to sewer

10 Split and smooth hides mechanically
11 Add oil and dyes to 2 m^3 water waste excess (~2 m^3) to sewer

Solid Waste
Trimmings and other materials are accumulated and stored outside Owner required to haul own wastes to dump, about 3 truck loads per month (24m^3 total)

Power
Stand by diesel generator used about 1 day per week

Special Observations
1 This was the most modern and cleanest tannery visited
2 Owner is receptive to new ideas
3 Owner would be interested in participating in a demonstration project He understands that other tanners would be present to observe techniques

15 HASSOUNEH DETERGENT FACTORY

Date 6/29/98

Industry Detergents and Cleaning Agents

Name Hassouneh Detergent Factory
P O Box 9
Hebron , West Bank
Tel 02-9920497

Person H Hassouneh, Owner

Reason for Selection
Concern about discharged detergents and cleaning agents on wastewater treatment plant and ground water recharge

General Observations
1 This is basically a repackaging operation rather than a manufacturing facility
2 Products include dish washing detergent (25 tons/month) dish washing paste (7 - 8 tons/month), general shampoos (1 tons/month), along with floor and bathroom gel products Also dilutes and repackages bleach from 12% to 3 - 4% for resale
3 Some purchase of raw materials (from Israel) such as fillers, NaOH, NaCl, and pine oil for addition to products
4 Owner is a chemist and is cognizant of potential problems
5 Water use is about 60-70m^3/month (all purchased by tanker in summer)
6 About 2 - 3 % of water is used for washing (about 2m^3/month)
7 No signs of spills on floor or corrosion on metal fixtures

Conclusion
No major concerns about impacts on waste management system

16 AL KASRAWI INDUSTRIAL AND TRADE CO

Date 6/30/98

Industry Food Processing - Snack Foods

Name Al Kasrawi Industrial and Trade Co
PO Box 508
Hebron, Palestine
Tel 972-2-9924924

Person Mr Zuhair D Al Kasrawi
General Manager

Reason For Selection
Food products may have major impacts on wastewater treatment systems via high BOD_5, TSS, and oil and grease loads

General Observations
1 Facility manufactures and packages snack foods from dried potato and corn meal
2 All raw materials are imported
3 About 50 employees during peak season (school year), less in summer
4 Produces about 1,000 tons of products per year
5 Uses 50 m^3 of water/month About 40 m^3 goes to sewer and 10 m^3 is evaporated during product generation
6 About 75% of products sold in West Bank and Gaza and 25% to Arab towns and villages in Israel
7 Claims "Municipal water supplies a disaster!"
8 Has a 2,500 m^3 cistern for storing rainwater and municipal water when available
9 Does not buy tanked water
10 Municipality collects about 300 kg of solid waste every day (Plastic and bad products)
11 Estimates that about 2% of purchased soybean and corn oil is discharged to sewer every year (1,200 L/year)
12 Facility was very clean Would not allow pictures

Conclusion
No major impacts on waste management system

17 KING STAR SHOE FACTORY

Date 6/30/98

Industry Shoes manufacturing (small facility — spot visit, concerns about dyes and chrome in dust and trimmings)

Name King Star Shoe Factory
Hebron - Al Salam Street 49

Person Hatem Abu Omer
Owner
Tel 052-276853

Observation
Discharge only domestic wastewater to the sewer Facility is of no concern for waste management system

18 SUPER STAR SHOE FACTORY

Date 6/ 39 /98

Industry Shoe manufacturing (small facility, spot visit)

Name Super Star
Hebron - Al Salam Street

Observations
Discharges only domestic wastewater to the sewer Facility of no concern to wastewater management system

19 AL- SALAM GLASS & POTTERY FACTORY

Date 6/30/98

Industry Glass artifacts and gifts

Name Al Salam, Glass & Pottery Factory
P O Box 51
Hebron , West Bank
Tel 972-2-9929127

Reason for Selection
Concern about potential for chemicals, and coloring agents reaching the sewer

Observation
Discharge only domestic wastewater to the sewer No concern about impacts on wastewater management system

20 TOSETTI SHOES

Date 6/28/98

Industry Shoe Manufacturing - Large Scale

Name Tosetti Shoes Company Ltd
PO Box 278
Hebron, Palestine
Tel 972-2-9920433

Person Mr Farahat Syag
General Manager

Reason for Selection
Shoe manufacturers may dye shoes, apply waxes and generate scraps containing chrome and other undesirable materials that are sewered

Products
450-500,000 pairs of footwear per year, sandals, athletic shoes, men's dress shoes
Largest manufacturer in Hebron sales 25% in West Bank, 50% in Germany, 25% in Gaza and Israel About 60-70% of production is sandals

General Observations
1 110 employees, 6 days/week, 1 shift
2 About 75% of leather is imported from France, Italy, and Israel because local quality is not acceptable (pliability and color problems)
3 About 25% of leather is of local origin and is used to manufacture inexpensive sandals for local consumption
4 Would buy more local leather if of acceptable quality Opinion that local tanneries need more training in production of high quality leather
5 Does dye shoes but all dyes and waxes are captured and cannot reach sewer
6 Modern factory

Water Use
- Only water use is for domestic purposes with exception of about 20 L/week for generating steam
- Water supplied by municipality, cistern used for onsite storage

Conclusion
No major concerns about impacts on wastewater management system

Solid Waste
Municipality picks up about 1 5 m^3/day for disposal in burn dump

Electricity
From municipality, stand by generator using diesel fuel in winter
Claims cheaper to generate own power

21 HOPE FOUNDRY AND BLACKSMITH SHOP

Date 6 / 30 / 98

Industry Foundry and blacksmithing (very small facility)

Name Hope Foundry and Blacksmith Shop
Hebron - Al Hawooz - Tala't Jame'a Al Basah

Reason for Selection
Concern about heavy metals and sands being discharged to sewer

Observation
No use of water or any other solvent was evident from the process Discharges only domestic wastewater to the sewer

22 AL KARAKI CAR WASHING SHOP

Date 6 /30 /98

Industry Car wash/commercial (small - single bay)

Name Al Karaki Car Washing Shop

Person Mr Sameh Al Karaki
Hebron - Al Fuhs- Yatta Road

Reason for Selection
Many truck washing facilities were observed while driving around Hebron Concern that washwater might be discharged directly to sewer without pretreatment Encouraged a random impromptu visit to this facility

General Observation
1 Large trucks and cars are washed at the same time that oil is changed
2 Much of the motor oil is collected and ends up as fuel for small blacksmith shops, foundries and pottery shops
3 Trucks require about 2 m^3 of fresh wash water each per wash
4 Cars require about 50 L of fresh wash water each per wash
5 High pressure washers, either a 2,200 psi electric sprayer or a 3,200 psi gas engine driven sprayer is used to dislodge dirt and grime
6 The truck washing process begins by adding about 2 L of diesel fuel to 2 L of water and sloshing cup-fulls of the mixture on critical parts of the truck (including the engine and hydraulic lift mechanism)
7 This is followed by a high-pressure wash All wash water, including oily debris flows to a sump and then directly to sewer without pretreatment
8 Cost for a truck wash is about 250 NIS including the oil changes
9 The same process is used for cars except that a detergent solution is substituted for the diesel fuel
10 Water is obtained from the municipality when available, otherwise buys tankers water (5 tanker trucks/week) at 120 - 150 NIS per tank truck)

Comments
1 This was a single bay wash
2 Two and three bay washes were observed to be common in Hebron plus a large municipality owned facility for washing municipal vehicles (mostly large trucks)

3 Mr Al-Karaki estimated that there were at least 20 truck/car wash facilities in Hebron
4 Opportunities exist to reuse water and minimize discharge of oily residues and TSS to sewers (US car washes clean and recycle about 50% of the water)

23 AL NAJAFAH GOLDEN COMPANY

Date 6 /30 /98

Industry Electroplating Job Shop

Name Al Najafah Golden Company
Wadi Al Hariyah
Hebron , West Bank
Tel 9925225

Person Mr Majed Abu Shakhdm

Reason for Selection
Electroplating industries frequently use hazardous materials such as Ni, Zn, Cr, Cd cyanide, and strong acids

Comments
1 This did not appear to be a typical electroplating system but rather a chemical plating system
2 About 90% of work is with zinc (galvanizing) and the remaining 10% with nickle and copper
3 At time of visit, small 2" x 2" steel angles were being coated with zinc
4 There are two lines, one for large parts to be dipped singularly and the second which contains batches of parts carried in baskets, both lines consist of sequential tanks and the parts are moved from tank to tank in the order shown below
5 Currently using about 15 m^3/month of tanker water — owner would like to have 60 m^3/month , this would significantly improve product quality
6 Owner has just invested $15,000 to purchase a used ion exchange system The unit is onsite, but needs to be hooked up by salesman
7 Spent rinse solutions are poured on the ground and theoretically drain to a cesspit A black gooey residue covered the ground surfaces and liquids undoubtedly percolate into the ground carrying heavy metals into the soil
8 A new sewer is available nearby-but facility is not hooked up

Process Description
1 Alkali wash bath
2 Rinse bath
3 Acid bath (HCl)
4 Galvanization bath
5 Coloring agent bath
6 Rinse bath
7 Another coloring bath
8 Final rinse bath

9 Although not observed at the time of visits "drag out" is undoubtedly significant and rapidly fouls waters
10 Galvanization solution is added to tank (4) as needed
11 Also uses H_2SO_4 and HNO_3

Concern
Groundwater contamination

24 HEBRON MUNICIPALITY SLAUGHTER HOUSE

Date 6/28/98

Industry Food Processing

Name Hebron Municipality Slaughter House

Person Hatim Al-Bakri,
Assistant Director of the Slaughter House

Reason for Selection
Slaughter houses typically produce very concentrated waste loads

General Observations
1 The slaughter house is designed to handle about 30 cows per day, and 800 sheep per day
2 The current slaughtering is 4 - 16 cows and 78 - 80 sheep per day
3 All cattle are slaughtered within the house itself, but there is no law for controlling sheep slaughtering outside the municipality slaughter house
4 The estimated number of slaughtered sheep averaged around 300
5 Average monthly slaughtering is 230 cattle and 1,800 sheep
6 Hides are sold to local tanneries
7 The holy month of Ramadan is the busiest season The number of slaughtered sheep is almost 15 times the average number (3,388 sheep last Ramadan)
8 The slaughterhouse is a simple operation, where only killing, hide removal, and intestine removal is practiced Further butchering of cows into four major pieces takes place No further butchering of sheep takes place in the facility
9 Some existing fat beneath the animal skin is cut and disposed of as solid waste if in big chunks or drained in the sewer if smaller in size
10 Slaughtering is only accomplished from 4 am to 8 30 am, with approximately one hour for cleanup afterwards

Water Usage
Water is used for cleaning the meat, the insides and washing the blood from the floor
Washwater, blood and visceral materials are disposed of via existing floor drains
Average water consumption is 10 m^3/day, which is discharged to plant sewers
All plant sewers are connected to the same manhole
Bleach is also used for cleaning the floors after slaughtering, in the amount of 0 5 liters per day

General Information

There is a great resistance to reuse of blood and some visceral materials for animal feed due to religious and health reasons

The municipality is currently seeking funds for establishing two major slaughtering houses one for sheep and cattle and the other for chickens (notes from interviewing Mr Musbah Tahboub, Head of Health Department in the Municipality of Hebron) Once these are constructed, the municipality will reinforce outside slaughtering in cooperation with the Ministry of Health

Impacts

1 The wastewater from the slaughter house will be high in BOD_5, protein, fat, TKN and TSS
2 A slug of wastewater is produced in the early hours of the day and this will increase if all additional slaughtering is conducted within the municipal slaughter house
3 Although this slug will peak in the month of Ramadan as described earlier, we believe (not from interview) that the highest organic load will occur on the first day following the end of Ramadan
4 Another potential day of peak loading is the day prior to the biggest holiday in Muslim culture that is the day of sacrifice because Muslims are supposed to sacrifice by slaughtering sheep and cattle

25 AMEER CONCRETE COMPANY

Date 6/29/98

Industry Ready Mix Concrete

Name Ameer Concrete Company

Person Plant Engineer, Mr Jamal Sharabati
General Director Hijazi Salamah

General Observations

1 This factory produces ready mix concrete and pre-cast concrete products (manholes, and riser sections)
2 The factory has a maximum capacity of 600 m^3/day of concrete
3 Current production rate is 300 m^3/day
4 Summer season (starting June and through September) is the high season where the production becomes 400 - 500 m^3/day
5 Five other concrete factories exist within the Hebron Municipality area and each of their production is about half of this factory's
6 No future plan for increasing current production since the political situation is not encouraging
7 The factory has 130 workers including managers and truck drivers
8 Electricity for the factory is currently generated using an onsite generator with a stand-by unit available Electricity from the municipality is used for offices only

Water Consumption and Wastewater Discharge

1 The factory consumes about 45 m3 per day and used for concrete products
2 The facility is not dependent on the municipality for water Water is currently being trucked to the facility for a price of 120 NIS per 10 m^3
3 Waste water is generated during on site washing of the concrete trucks
4 Daily consumption of washwater is 6 - 8 m^3
5 The factory is not currently connected to a municipal sewer
6 Water is currently collected in a settling basin and is pumped for reuse to an elevated silo
7 Excess water from the sump overflows and seeps directly in to the ground
8 If connected to a sewer, the disposed washwater will be about 5 m^3 per day
9 Cement availability is the limiting factor in production, not water However, adequate water availability from the municipality would decrease the costs and add profit
10 A positive attitude towards recycling and ruse of wastewater was stated

Potential Impacts

Wash water, if disposed to a sewer would result in particulate deposition and increased pH residue

26 AL SHARK ELECTRODE CO

Date 6/29/98

Industry Metal Working

Name Al Sharak Electrode Co
Tel 02-9927460

Person Kamal Hassouneh, Owner

General Observations

1 The main products of the factory are nails and specialized welding electrodes
2 The factory produces 2 million kg/yr of welding electrodes
3 Two types of electrodes are produced regular electrodes and copper coated electrodes
4 In addition, tie wires with different sizes, and nails are currently produced
5 Two thirds of the yearly production is accomplished during the summer season
6 There are 60 workers in the factory, with one 8 hour shift, and certain operations may extend to 12 hours
7 This is the only factory of its kind in Hebron, and according to the owner there is only one similar factory in both Israel and Egypt

Water Usage

1 Water is used to clean the iron prior to coating with the welding material, and also as a solvent for certain chemicals used for cleaning
2 Total consumption of water is 6 - 7 m^3 per day
3 One cubic meter is evaporated and the rest is discharged to the sewer

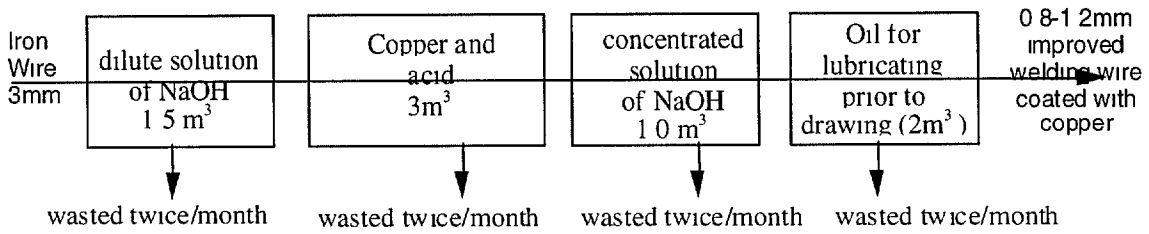
4 About 50% of the water used is obtained from the municipality The rest is trucked to the factory

Wastewater Produced

1 During the process of drawing the wires from 5 5 mm to 0 5 mm water is used to clean the wires Washwater is discharged to the sewer at the rate of 2 m^3 per day during this operation

2 Clean the iron with water and Borax One cubic meter of the Borax solution is used for cleaning and the wastewater collected on-site and disposed of once a month This slug discharge will be about 15 - 20 m^3 of wastewater

3 Automatic welding electrode production The following schematic diagram shows the production of copper coated welding wire Continuous feeding of the wire is practiced and the batches of wastewater are disposed of twice a month



Impact

Risks of potential toxic metals reaching the wastewater treatment plant and accumulating in sludge residues

27 AL-PATRA COMPANY FOR TILES AND BRICKS

Date 6/29/98

Industry Tile Manufacturing

Name Al-Patra Company for Tiles and Bricks
Owned by Several Associates

Person Hani Mohammad Ghaith

General Observations

1 Produce different types of tiles and some bricks
2 Production rate is 150 - 200 m^2 per week of limestone
3 Seven workers plus administrators
4 Considered as a large facility by owner (only one more facility of similar production capacity in Hebron)
5 According to interviewee, there are about 15 small tile making shops, and their production is within the range 30-40 m^2/day each or aggregate
6 Raw materials used for production are aggregates (local and imported), cement, lime, water, and some type of other fine material they call it coarse
7 Total water usage is 6 - 7 m^3 per day

8 Water source They only receive municipal water in winter season when available The factory has a storage tank of 200 m^3 During the summer season, the factory trucks 2 - 3 tanks per week
9 Water is considered the limiting factor for production

Water Usage and Cycle

1 Water is used for making the mix, for wetting the tiles, and as a lubricating agent for final finishing or smoothing of the tiles
2 Water used for wetting the tiles is collected in a separate sump and is considered clean water, and is reused again for either production or rewetting the tiles
3 The water used as a lubricant to the polishing equipment is treated similar to the water used by the stone cutting industry The factory has two silos, and a polymer tank, and discharges concentrated slurries
4 Water is collected in the plant drains and channeled to a sump
5 A polymer (acqueNYMCO, SPA) is used as a settling aid
6 Random polymer dosing is also practiced for improved settling
7 The collected water (with polymer) is pumped to an elevated silo with a conical bottom where the particulates and dusts are allowed to settle to the bottom of the cone
8 The supernatant from this silo is connected to a cylindrical tank which act as a water storage reservoir
9 Water is allowed to drain from the reservoir by gravity and is used for the polishing process
10 Settled solids from the cone section of the first silo are disposed of at a rate of one truck load (10 m^3) every 3 - 4 days
11 The slurry is hauled to a dump (not sure which one) at a cost of 150 NIS per truck load When asked why not dump the slurry in to the sewer, the answer was the slurry will clog the sewer and they have to call the municipality and the factory will have to pay damages, and will get into trouble He also mentioned that they paid $4,500 for connecting to the sewers for nothing

Additional Comments

- When asked about water reuse if water was made more available from the municipality, the answer was that more water will be used and less recycled for two reasons
  1 Increased product quality if clearer water (less TSS) was used
  2 Economical, since for the factory will be using three times as much water for the same price they pay now
- The owner mentioned that only a limited number of facilities have slurry dewatering systems they appear to be gaining popularity during the last two years They would like to get one themselves since it will lead to considerable water recovery (~60% of slurry volume)
- We were told that the price of such a device is in the range of $45,000, and they would like to conduct a feasibility study prior to purchase
- The factory has on-site grinding facilities for solid waste by-product debris disposal
- One major problem of the industry is the disposal of the slurry

28 TAQADDOM SCALES CO LTD

Date 6/29/98

Industry Metal Working Machine Shop

Name Taqaddom Scales Co Ltd

Person Ayman Neiroukh, Owner

General Observations

1 The factory is in the process of moving and expanding its metal works to include the production of electronic and regular scales
2 The new building is large and obvious while driving through the industrial area and we believe operations will be similar to those of the Nieroukh Scales Metallic Furniture Co LTD visited on 6/24/98 (Visit No 9)
3 In the mean time there is no water usage for production
4 Lubricating oil, however, is wasted in the amount of 2 to 5 liters per day, and is disposed off by dumping through a crack in the rocks behind the factory

Concern

Possible groundwater contamination

29 DAWOOD SHAWAR AND SONS FOR TAHINA, HALAWA, AND OIL

Date 6/30/98

Industry Food Processing

Name Dawood Shawar and Sons for Tahina, Halawa, and Oil

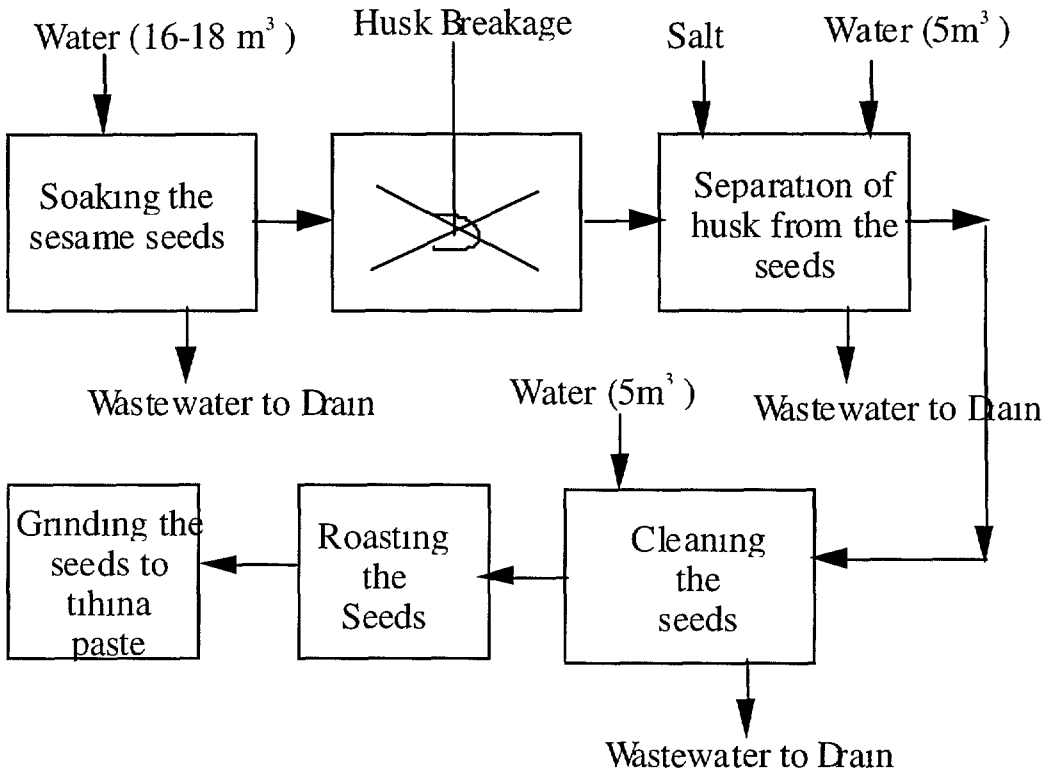
Person Rami Shawar, Owner

General Observations

1 Main raw material is sesame seeds
2 Sesame seeds are imported from Sudan, and Ethiopia through Israel
3 Current production is about 750 kg tahina per day Production was reported to be much higher prior to the peace process
4 Oil is produced at a rate of 30 kg/day
5 Halawa is only produced during the winter season
6 Poppy seed is produced at an average of 50 kg/month
7 There are 6 workers in the factory
8 Electricity is obtained from the municipality and during our visit electricity was unavailable from the municipal source
9 Currently there is another factory in Hebron with almost the same production capacity

Water Use and Disposal

Water is used primarily for soaking and washing the sesame seeds
Water source is from their own spring, where currently 8 springs are available
The production of Tihina paste is shown in the following diagram and is currently as follows



1 The sesame seeds are soaked in fresh water for a whole day The wash water is then drained to the municipal sewer at an average of 16 18 m^3 per day
2 The swollen seeds are then rotated in a circular tank for husk separation
3 The seeds and the husk are moved to another tank where fresh water and salt is added to promote husk and seed separation Salt is added at 800 kg/day The seeds are floated and skimmed, while the husks settle The salted water is then drained to the sewers
4 The drained water averages about 5m^3 per day
5 The seeds are washed finally with 5m^3 of fresh water and the water is drained to the sewer
6 The seeds are then roasted and then ground to producing the sesame paste called tahina
7 No current reuse of water

Impact

The impact is mainly due to the precipitated husk with water disposal which will contribute some COD/BOD_5, TSS and excessive NaCl (800 Kg/day) to the system

30 THABIT ABU-AISHA FOUNDRY

Date 6/30/98

Industry Foundry (Small)

Name Thabit Abu-Aisha Foundry
(02-9929234)

Person Thabit Abu-Aisha, Owner

Reason for Visit
Concern about potential metal and TSS discharges

Observation
No use of water or any other solvent was evident from the process involved

31 AL-ALAMEEN TEXTILE FACTORY

Date 6/30/98

Industry Textile

Name Al-Alameen for Textile Factory

Person Faiz Al-Mahareeq, Owner

Reason for Visit
Concern about potential sizing and dye discharges to the sewer

Observation
The factory uses purchased colored threads to make fabric, which is sold to tailors for clothing manufacturing No dying or usage of water was evident

32 UNION OF STONE & MARBLE IN PALESTINE (USMP)

Date 7/2/98

Industry Stone Cutting

Name Union Of Stone and Marble in Palestine

Person Said M Abu-Ghosh/CPA
Administrative Manager
Tel 02-741502

1 There are about 350 member in the union Membership is voluntary and does not represent the actual number of stone cutting industries in Palestine
2 The projected number of stone cutting industry is about 1000 factory, with various sizes from very small to large sophisticated factories
3 In the Hebron District, the estimated number of facilities is about 150 to 180, with 120 factories existing within the boundaries of Hebron Municipality About 80% of the latter are located within the industrial area or the Al-Fahs Zone
4 There is no available information concerning the production rate for each factory

5 Two major problems of the industry are concerned with stone cutting slurry and debris disposal

Suggested options for usage of the slurry are
- Production of lime (CaO) (with heat)
- Use in painting
- Making of light bricks for slab making
- White plastering for walls inside

The Union suggested the use of a centralized station for collection and treatment of stone cutting slurries, and they are seeking funds at this time for such a facility for further investigations from the European Union through the Italian Government

ANNEX B

DOCUMENTS GATHERED

Previous Page Blank

The documents cited below are the master set of documents gathered and evaluated in detail by the study team during this activity These documents form an initial background starting point for all subsequent work activities in the area A full set was deposited at the Water and Environment Development Organization offices in Bethlehem, Palestine under the care of team member Nader Al-Khateeb Documents referred to directly and from which information was extracted for use in the report, are listed as references in Chapter 8 of the report

1 United States Agency for International Development (USAID), "Integrated Water Resources Managemnet Program, draft report," concept paper no 294-0027 (May 8, 1998) English

2 United Nations Development Programme (UNDP), "Conceptual Master Plan for Sewage Treatment & Reuse for Hebron City, draft final report," Ramallah, Palestine (January 1997) English

3 Hebron Chamber of Commerce & Industry, "Commercial Industrial Guide – 1995 to 1996," Arabic with some English in summary tables and graphs

4 Palestinian Central Bureau of Statistics, "The Industrial Survey – 1996 Main Results," Palestinian Central Bureau of Statistics – Economic Surveys Series, (October 1997) English

5 Olson, Gregory L , "Directory of Economic Development Training Programs in the West Bank and Gaza," USAID - Cooperative Development Project, (October 1994) English

6 Thorstensen, Thomas, "Pollution Prevention and Control for Small Tanneries," draft copy of review paper without tables and figures, (May 1998) English

7 Palestinian Environmental Authority (PEnA), "Annual Report – 1997," (1997) English

8 Tahboub, Musbah A , "Notes on the Calculations and Decissions of the Water Consumption in the Industrial Area (Hebron)," hand written notes and data, 2 pages (June 23, 1996) English

9 Tahboub, Musbah A , "Solid Waste Background Information," notes on solids waste related issues for Hebron, (undated) English

10 Yayets Photogrammetric Survey – Hebron with Municipal and Industrial area boundaries plotted in orange, (Base map 1987)

11 Copy of area map showing roads and Municipal and Industrial area boundaries (Undated)

12 Assaf, Said A , "Guidelines for the Production of High Quality and Quantity of Palestinian Olive Oil," National Agriculture Research Center (NARC), Ramallah (1997) Arabic

13 Palestinian Economic Council for Development and Reconstruction (PECDAR), "Pilot Urban Planning Studies – Al Khaleel (Hebron) – Final Report," (December 1996) English

14 US Agency for International Development – Small Business Support Project / DAI (SBSP), "Stone-Cutting Establishments Survey in the West Bank," Maan Development Center Business Consulting Services, Ramallah (1995) English

15 Heirbaut, Urbain, "Findings and Comments on the Consultant and Training Period, May – June 1997 Outlining Follow-Up Consultation Needs for the Stone & Marble Industry in Palestine," independent consultant's report (1997) English

16 Abu-Hijleh,Othman Hussien, "Minimizing Water Consumption and Environmental Pollution from Stone-Cutting Industry in Palestine," International Institute for Infrastructural, Hydraulic and Environmental Engineering (IHE), seminar handout notes and MS Sanitary Engineering Thesis, Delft, Netherlands (April 1997) English

17 Gauthier, Marcel A Chuck, "Stone and Marble Industry of the West Bank and Gaza," Executive report (September 1996) English

18 Gearhart, Robert, Bahri, Akissa, and Al-Hmaidi, Mohammad Said, "Wastewater Treatment and Reuse Strategy for Gaza and West Bank Water and Wqstewater Sector," for Palestinian Economic Council for Development and Reconstruction (PECDAR), final draft (December 2, 1994) English

19 Masri, Rania, "Assesment of the Environmental Impact of Jewish Industries in the West Bank," Applied Research Institute – Jerusalem (ARIJ) Email to Peter Reiss,etal , (January 1998) English

20 Applied Research Institute – Jerusalem (ARIJ), "Environmental Profile for the West Bank Volume 3 – Hebron District," Bethlehem (November 1995) English

21 Al-Khateeb, Nader and Assaf, Karen, "Palestinian Water Supplies and Demands," Issac and Shuval (Eds), Water and Peace in the Middle East, Elsevier Science, pp 55-68 (1994) English

22 Scarpa, David J , "Eastward groundwater flow from the Mountain Aquifer," Issac and Shuval (Eds), Water and Peace in the Middle East, Elsevier Science, pp 193-203 (1994) English

23 Assaf, Karen, "Replinishment of Palestinian Waters by Artificial Recharge as a Non-Controversial Option in Water Resource Management in the West Bank and Gaza Strip," Issac and Shuval (Eds), Water and Peace in the Middle East, Elsevier Science, pp 301-314 (1994) English

24 Hebron Municipality, "Yearly Consumption of Municipal Water by Registered Industries inHebron," computer print out sheets obtained from Wael Abu-Sharakh, water billing personnel (July 1998) Arabic

25 Hebron Chamber of Commerce & Industry, "List of all Industries & Commercial Businesses & Shops in the District of Hebron," computer print out copy provided by

Aknam Hijazi, Director fo Public Relations Hebron Chamber of Commerce & Industry (July 1998) Arabic

26 Palestinian Directory for Stone & Marble, Palestinian Establishment for Economic & Technical Services (PEETS), Bethlehem (undated 1997?) Arabic

27 Hebron Topographic Maps 1 1000 – 12 sections of Hebron at 1 2,500 but appears to be enlarged to 1 1,000 Shows roads, individual buildings, and 2m elevation contours

28 Palestinian Water Authority, "Task 25 – Water Supply Facility for the Hebron – Bethlehem Service Area," Final Report USAID / CDM/Morganti (March 8, 1998)

29 Abdi, Munadil I A , "Effects of Quarries & Stone Cutting on the Environment in Northern Palestine," Senior Undergraduate Project Report, Department of Civil Engineering, An-Najah National University (January 1997)

30 Al – Hmaidi, Mohammad, "The Solid Waste Problem in the West Bank and the Gaza Strip," from Our Shared Environment Israelis and Palestinians, Eds Robin Turite and Jad Isaac, Israel/Palestine Center for Research and Information (December 1994)

ANNEX C

PEOPLE INTERVIEWED AND CONTACT INFORMATION

The names addresses and contact information provided below details many of the important individuals and resources in the Hebron area These entries should become part of an on-going data base of contacts for all subsequent teams and work efforts

Osama O Hirbawi
Manager
K A R For Macaroni & Food Stuff MFG Co
Hebron, P O Box 526
Palestine
Tel + 972(02) 9920459
Fax + 972 (02) 9929770
Mobile 050 398556

Carl F Maxwell
Chief Engineer
Water Resources Office
U S Agency for International Development/West Bank and Gaza
USAID U S Embassy
71 Hayarkon St
Tel Aviv 63903
Tel 972-3- 511-4859
Fax 972-3-511-4888
cmaxwell @ shani net

Thomas H Staal
Project Development Office
Water Resources Office
U S Agency for International Development/West Bank and Gaza
USAID U S Embassy
71 Hayarkon St
Tel Aviv 63903
Tel 972-3-5114848
Fax 972-3-511 4888
E-mail tstaal @ usald gov

Tom Delaney
Program & Project Development Office
USAID U S Embassy
U S Agency International Development/West Bank and Gaza
71 Hayarkon St
Tel Aviv 63903
Tel 972-3-511-4889 Fax 972-3-511-4888
Cel 050-612-124
Email todelaney @ usaid Gov

Akram Hamıd Hıjazı
Publıc Relatıons Dırector
Chamber of Commerce & Industry
Hebron-Palestıne
Tel 972-2-9928218
Fax 972-2-9927490
E-maıl hebcham @ palnet com
P O Box 272

Jıbreel Natsheh
Hebron Secretary
Chamber Of Commerce
Reem Sport / G Manager
Hebron- Adel Str 80
Tel Fax 009722-9929697
West Bank - Vıa Israel
P O Box 41

Dr Taısır Amre
Dırector General
Regıonal Dırectorate Of Hebron
Al- Rashıd Buıldıng - Eın Sarah
16th O Box 709 Hebron, West Bank
Tel Fax (O) + 972-2- 9926790
(R) 02-9926863 Mobıle 050-268205

Anan Masrı
Engıneer
M S C Water Engıneerıng
Tel 02-6227297
(Home) 09-385010
Fax 02-6259484
Celluler 050-545-385

Palestınıan Natıonal Authorıty
Palestınıan Envıronmental Authorıty (PEn A)
Prof Dr Sufıan Sultan
Presıdent of PEn A
Tel 972(2) 9925328
Tel Fax 9929269-9929276
P O Box 296 Hebron- Palestıne

Nıdal N-Al-Junıdı
Technıcal Man - Daıry Technolejest
Rl-Juneıdı
Daırıes & Food Products
Tel 02-9929432 / 02-9929011, Bel 050-348632
Fax 02-9920558
Al-Salam St 101
16th O Box 274
Hebron- Palestıne
Mashhour S Abu Khalaf

Finance & M Director
Al-Juneidi
Dairies & Food Products
Tel 02-9929432 / 02-9929011, Bel 050-445017
Fax 02-9920558
Al- Salam St 101
16th O Box 274
17th Hebron- Palestine

Fayez E Zatari - Director
Palestine Tanning Factory
Hebron- Industrial Zone
Tel 9929103 Fax 9929117 Mobile 050-255896

Musbah A A Tahboub
Head of Health Dep
WW& Solid Waste Issues
Hebron Municipality
Tel (Work) 02-9928121
Tel (Home) 02-9920428
Fax 02-9928293
Hebron
16th O Box 6

Dr Ihab Isam Barghouthi
Economic Advisor
Palestinian National Authority
Palestinian Water Authority
Water Resources Program Funded by the US Agency for International Development
16th O Box 891,Ramallah, West Bank
17th Tel (972) 2 995 Fax (972) 2 995-9154
E mail pwalib @ planet edu

Eng Fadle Kawash
Deputy Head
Palestinian National Authority
Palestinian Water Authority
Ramallah, P O Box 891
Palestine
Tel +972 2 5747147
Fax +972 2 5 5747148
Email fkpwa@planet edu

Albert Giacaman
Manager / Partner
Qramman Co Ltd
050 - 421713
P O Box 54362 - Jerusalem
Tel + 9722-6261 420 / Fax 6261421
Biet Jala- Tel &Fax + 9722-744646
E-Mail qtm @p-ol com

Akram Hamid Hijazi
Public Relations Director
Chamber of Commerce & Industry
Hebron -Palestine
Tel 972-2-992818
Fax 972-2-9927490
16th O Box 272
17th E-Mail hebcham @ palnet com

Nader Al Khateeb
WEDO - Water & Environmental Development Organization
16th O Box, 844, Bethlehem, Palestine
Tel +972 2 747948
Fax +972 2 745968
Email wedo @ p-ol com

Dhahiat Al Barid
Nieroukh Boilers Factory
Manufacturers of Solar Boilers
and Central Heating Radiators
Hebron-
Telephone 02-9924973
Mobile 050-502552

Dawwod Shawar and Sons for Tahina, Halwa and Oil
Hebron
Tel 02-992597,
02-9928426

Wad-Al Harya Str
Nieroukh Scales Metallic Furniture Co Ltd
Hebron-Palestine
Tel +972- 2 - (992465)
Fax +972-2- (9920425)
16th O Box 439

Mohy Sayeed Ahmad
Public Relations
Hebron Chamber Of Commerce & Ind
Hebron- P O Box 435-
Mobile 050-331859
Fax 02-9929253
Prv 02-9920686

Advocate Kamal Nassouneh
General Manager
Vice Chairman Board of Al-Shark Electrode Co
Director of Palestinian Businessmen Association
Hebron - Palestine
16th O Box (9)-Via Israel
Off Tel 00972-2-9927460
Fax 00972-2-9929477, Res Tel 00972-2-9925797

Orient Palace Hotel
Bethlehem- Manger Street
16th O Box 1067 Bethlehem
Tel 02-742798-
Fax 02-741562

Eng Ayed A-Abu Ramadan
Assistant to the Mayor for Projects
Coordination & Follow up Affairs
Tel 07-866006/7/8
Fax 07-824400
Res 07-822271
P O Box 16
Gaza -Palestine
E-Mail ayed @ marna com

Said M Abu Ghosh / CPA
Union of Stone & Marble in Palestine
Administrative Manager
Mobile 972 2 50 259619
Tel Fax 972 2 741502
P O Box 980
Bethlehem - Palestine

ANNEX D

LICENSED FACTORIES AND SMALL INDUSTRIES IN HEBRON MUNICIPALITY

Previous Page Blank

The Licensed Factories and Small Industries in Hebron Municipality
- with Palestinian Authority License - +

No	Name of Factory or Company	Name of Owner	Nature of Production "Type"
1	* Macronni and Food Materials of Khalil El Rahman	Mohammed Omar El Hirbawi	* Food Products
2	Awaidah Food Products	Hamid Awaidah	Food Products
3	Hassouneh Investment Company	Hathim Hassouneh	
4	Tamimi Industrial and Trade Company		
5	* Al Jnaidi Milk Products Mfg	* Hashim Al Jnaidi	* Milk Products
6	Al Thahriyyih Modern Grains Mill	Izzat Elwraidat	Grains Milling
7	Salah Food Products	Nathmi Salah	Food Productss
8	Al Kurd Brothers Factory	Ribhi al Kurd	Food Products
9	* Al Batra Food Products	* Salman Abu Kharshiq	* Food Products
10	Al Amanih Grains & Feed Mill Co	Jameel Abu Hadeed	Grains Milling
11	Sabah Modern Mill	Khaid El Qaisiyyih	Grains Milling
12	Holy Lands Factory for Olive Oil	Kamel Atwan	Olive Oil Production
13	The National Factory for Meats and Food Mfg	Omar Abu Awwad	Food Products
14	The Grains Mill	Ahmad El Rjoob	Grains Milling
15	Ribhi Al Kurd Factory Co	Ribhi Al Kurd	Food Products
16	Al Thahriyyih Modern Grains Mills Co	Musbah Samamrah	Grains Milling
17	* Food Industries Company	* Taher Abdel Nabi	* Food Products and Canning
18	*Tusetti Shoe Co Limited	Shaker Abu Omar	* Shoes Industry
19	Bama Industrial & Trade Co	Jibril El Natshih	Shoes Industry
20	Reem Sport Shoes Mfg Company	Jibril ElNatshih	Shoes Industry
21	* Al Qasrawi Indusrial Trade Co	Zuhair El Qasrawi	* Food Products
22	Jerusalem Shoes Mfg Co	Omran Abu Shkhaidem	Shoes Industry
23	Al Noor Factory for Shoes	M Al Noor	Shoes Industry
24	Ridco for Trade and Manufacturing	Nabil Kasteero	
25	* Factory of Mohammad Maher and Monthir El Jabari for Stone Cutting	Monthir El Jabari	* Stone Cutting
26	Alwala Stone Cuttin and Marble Co	Mohammed El Ayaydih	Stone Cutting and Marble
27	Naji Factory for Marble	Hasan Naji Amro	Marble
28	Al Rayah Marble Co	Shams El Deen Elkaraki	Marble
29	* Al Anwar Marble Co	Mohammad El Manasrah	*Marble
30	The Ahliyyih Marble & ContractingCo	Mohammad Salhab	Marble
31	Al Harameen Marble Factory	IZ El Ajlouni	Marble
32	The Holding Company	Mosa Hraizat	
33	Alwafa Stone and Marble Factory	Ghalib Abu Quaider	Marble
34	Sulaiman Omar Jaber Factory	Sulaiman Jaber	
35	Burqan Factory for Marble	Oudeh Burqan	Marble
36	Alfanni Factory for Marble	Sudqi El Atrash	Marble
37	Al Tawfeeq Stone and Marble Co	Numan Shubbaneh	Stone Cutting and Marble
38	Al Natshih Factory for Marble	Naim Hamed El Natshih	Marble
39	The Arab Islami Company	Abdul Haleem El Halayqan	Stone Cutting and Marble
40	Ibeedo Marble	Mohamad Ibeedo	Marble
41	Al Masdar Co for Marble & Granitet	Ibrahim ElKhdoor	Marble
42	Al Nakheel Co for Stone & Marble	Jibreen Abu Dawood	Stone Cutting and Marble
43	Hasan Nassar Company and Sons	Hasan Nassar	
44	Jerusalem Factory for Nylon	Othman Hassouneh	Nylon Production
45	The Holy Land Factory for Cleaning Compounds	Mohammad Husain	
46	Ibn El Nafees Veterinary Drugs	Khalid Shawar	Veterinary Drugs
47	Al Noor Factory for Nylon Sacks Production	Hamdi Idais	Nylon Production

continued

No	Name of Factory or Company	Name of Owner	Nature of Production "Type"
48	* Hassouneh Factory for Cleaning Compounds	Jafar Hassouneh	* Cleaning Compounds
49	Royal Industrial and Trade Company	Nabil El Zghayyir	
50	The International Company for Plastic Industries	Azzam El Bayid	Plastic Products
51	Shawar Plastics Factory	Azzam Shawar	Plastics Production
52	Al-Ahliyah National Company for Plastics Production	Hasan Awni	Plastics Production
53	The Modern Textiles Company	Mohammad Idkaidik	Textiles Production
54	Khalil El Rahman Factory for Carpets	Ayyoub Manasrah	Carpets Production
55	Hirbawi Industrial and Trade Company	Abdel Nassar El Hirbawi	
56	Alwataniyyih Company for Carpets	Sulaiman El Natshih	Carpets Production
57	Al Amazoon Factory for Textiles	Mohammad Ata Mu as	Textiles Production
58	* Al alameen Textiles Factory	Fayez El Mahareeq	* Textiles
59	Al Badawi Factory for Tanning Hides	Mohammad Qasem Badawi El Zatari	Tanned Hides
60	Al Ahliyyih Company for Carton Containers	Sufian El Hirbawi	Carton Containers
61	Al Hirbawi Factory for Production of School Notebooks	Mohammad El Hirbawi	Production of School Notebooks
62	Al Khalil Factory for Tanning Hides	Noor El Deen Yaseen El Zatari	Tanning Hides
63	Al Shorooq Company for Carton Containers	Abdul Lateef Qufaishih	Carton Containers
64	Al Tamimi Company for Precast Concrete Preparations	Rujaiy El Tamimi	Ceramic Products
65	* Al Ittifaq Bricks Factory	Mohammad El Awawdih	Bricks*
66	Abu Arqoub Bricks Factory	Nael Abu Arqoub	Bricks
67	Louli Bricks Company	Isa El-Daraweesh	Bricks
68	Al Jarrashi Industrial and Development Company	Khadir El Jarrashi	
69	Louli Industrial and Trade Company for Tiles	Isa El Daraweesh	Tiles Production
70	* Al Batra Co for Tiles and Bricks	Hani Ghaith	* Tiles and Bricks Production
71	Heeto Block Industrial Company	Mohammad Ibaido	
72	The Muhait (Ocean) Company for Contracts (Asphalt)	Ahmad El Omari	Asphalt Factory
73	The Insha Bricks Factory	Majid Abu Mayalah	Bricks Production
74	Al Nahdah Shop for Metallic Ornamentals	Abdul Rahman El Jubih	Metallic Ornamentals
75	Al Khalil Factory for Nails	Shareef Abu Shukr	Nails Production
76	* Nairookh Factory for Production of Electronic Balances, Scales and Metallic Furniture	Abdul Kareem Nairookh	*Electronic Balances, Scales and Metallic Furniture
77	International Factory of Ibrisaif	Robeen El Jolani	
78	Al Taqadom Company for Production of Scales and Balances	Ghassan Nairokh	Scales and Balances
79	Al Jnaidi Company for Trade and Mechanical Industries	Numan El Jnaidi	
80	The Factory for Production and Bottling of Metallic Oils (Mineral Oils)	Mohammad Hassouneh	Mineral Oils
81	* Alsharq Factory for Electrodes Production	Mohammad Hassouneh	* Electrodes for welding

continued

No	Name of Factory or Company	Name of Owner	Nature of Production "Type"
82	Al Sadeq Factory for Solar Heaters* And Metallic Industries	Khalid El Bayid	* Metallic Industries and Solar Heaters
83	Al Akhaween Lafi Shop	Khalid El Jabbarren	
84	Al Natshih Plastic Cords	Sami El Natshih	Electric plastic cords
85	Al Mayameen Company for Marble	Zakariyyah El Manasrah	Marble

(+) Translated from the Ministry of Industry
Document Number S R T 54 98
Dated December 29, 1997

(*) Visited by the activity team between June 23 – July 2 1998
Total factory site visits in Hebron City West Bank were 32

(*) Many factories not listed here were visited by the activity team and are shown elsewhere in a separate table and in the /Appendix Summary on the site visit interviews

ANNEX E

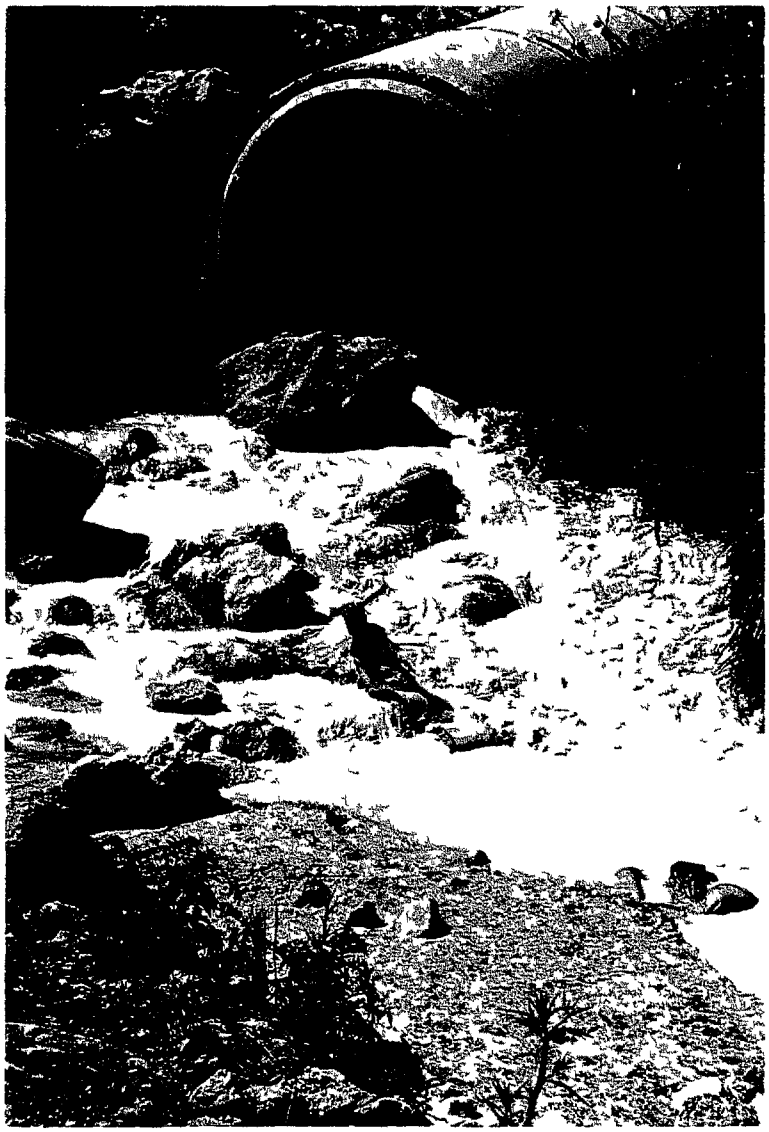
POTENTIAL COOPERATING EDUCATIONAL RESOURCES FOR TRAINING

1	The Polytechnic College of Hebron in Hebron City
2	The Salizyan Industrial School in Bethlehem
3	The Lutheran Industrial School in Deir Dibwan – Ramallah
4	The Orphan Industrial School in Beit Hanina – East Jerusalem (West Bank access area)
5	The Industrial Government School of Beit Jala
6	The UN Technical Training Center at Qalandia – near Qalandia Airport of East Jerusalem
7	Al-Aroub Technical College in Al-Arroub – Hebron District
8	Laboratories of Hebron, Bethlehem and/or Birzeit University
9	ASIR labs (the Arab Scientific Institute for Research and Transfer of Technology) in El-Bireh
10	The Palestinian Authority Program for training of the unemployed and released prisoners of war
11	Stone Cutters Union Program – Bethlehem and Hebron branch
12	Association of Medical and Health Laboratories – Ramallah
13	Association for the Protection of Nature – Ramallah
14	Association of Children for the Protection of the Environment in Bethlehem
15	YMCA technical center in Jericho
16	Association of the Protection of the Consumer – Ramallah
17	Ministries of Information, Education and Higher Education, the Palestinian Water Authority (PWA), the Palestinian Environmental Authority (PENA), the Palestinian Energy Authority (PEA), and other autonomous and semi-autonomous Palestinian government research and extension centers

APPENDIX F

PHOTOGRAPHS

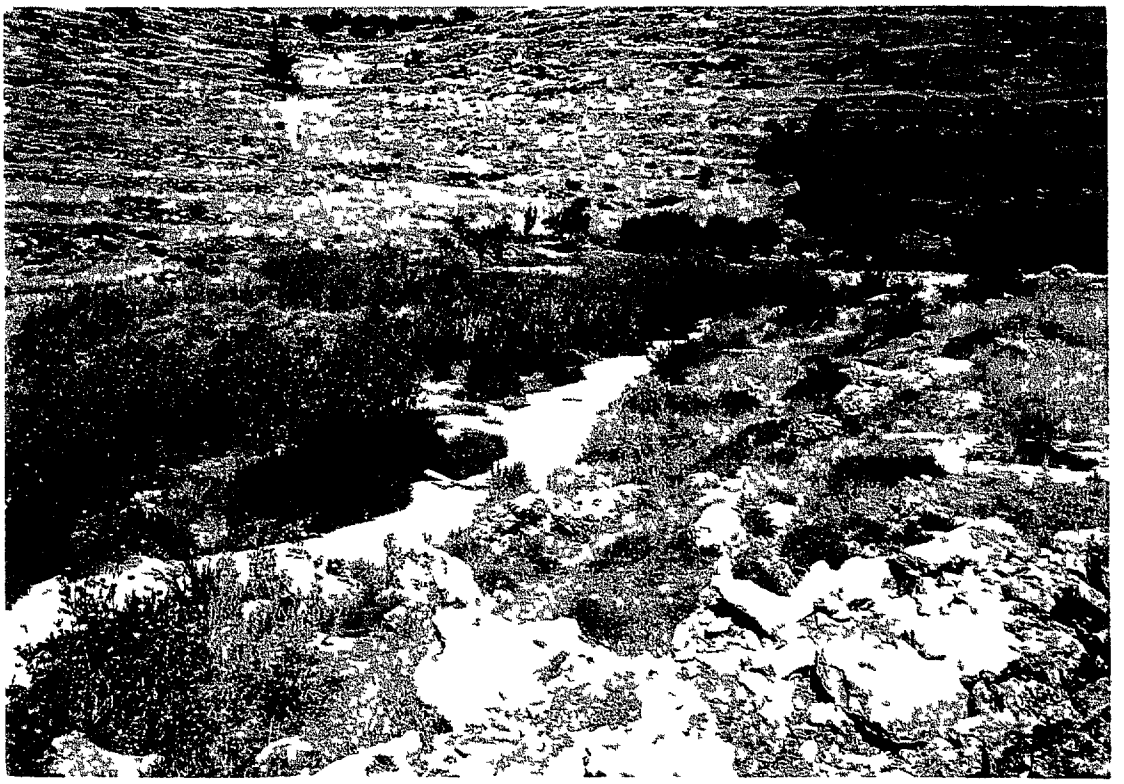
Figure 1 2



Raw sewerage discharge from the City of Hebron to the Wadi Al Samen

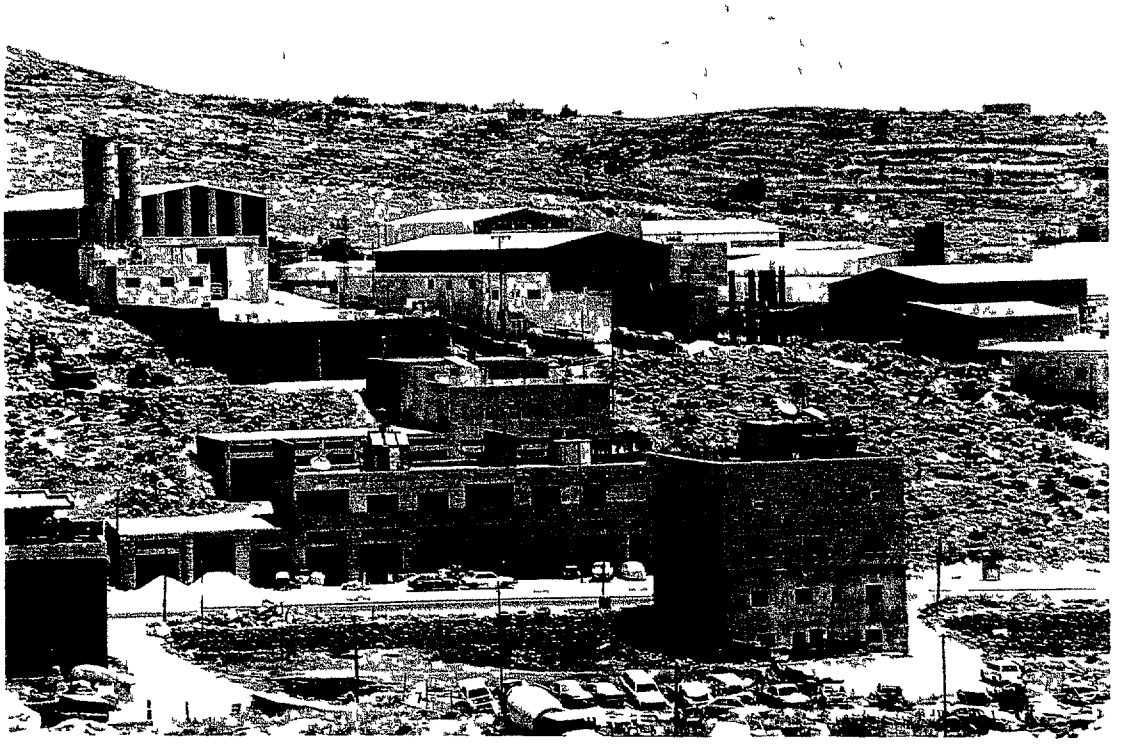
Previous Page Blank

Figure 1 3



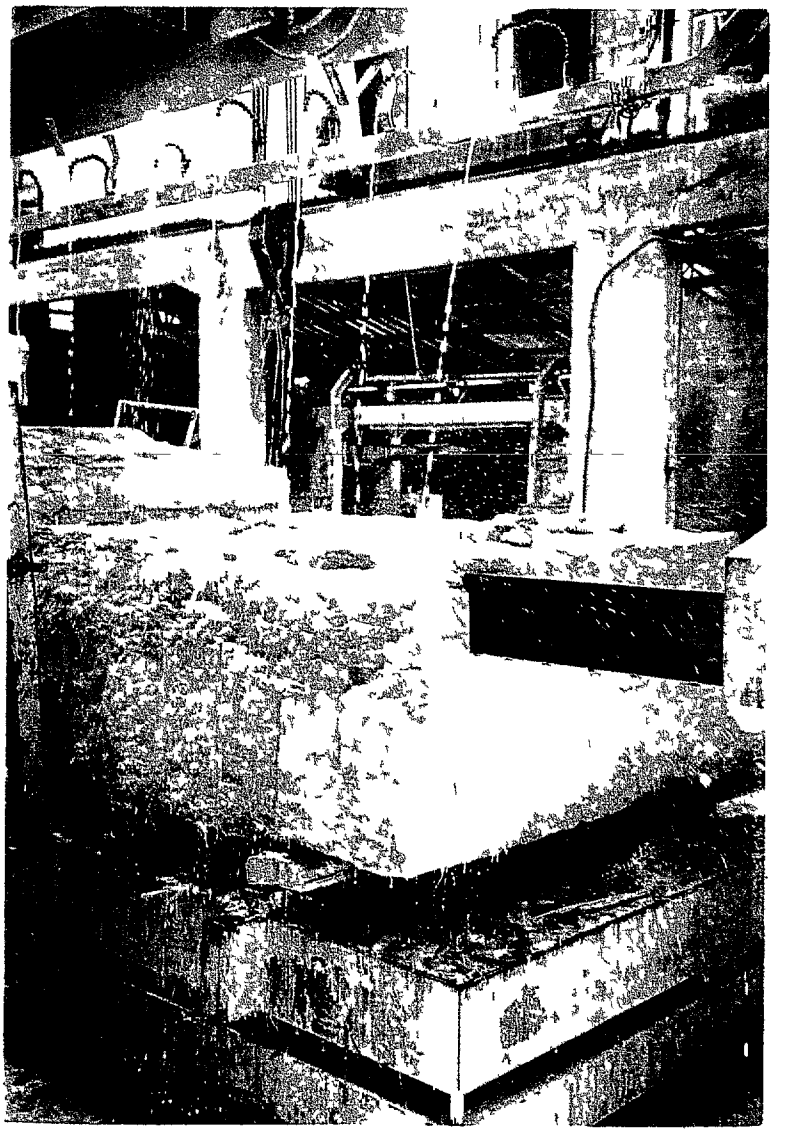
Noticeably bright grayish, white raw sewerage flowing southward down the Wadi Al-Samen

Figure 3 2



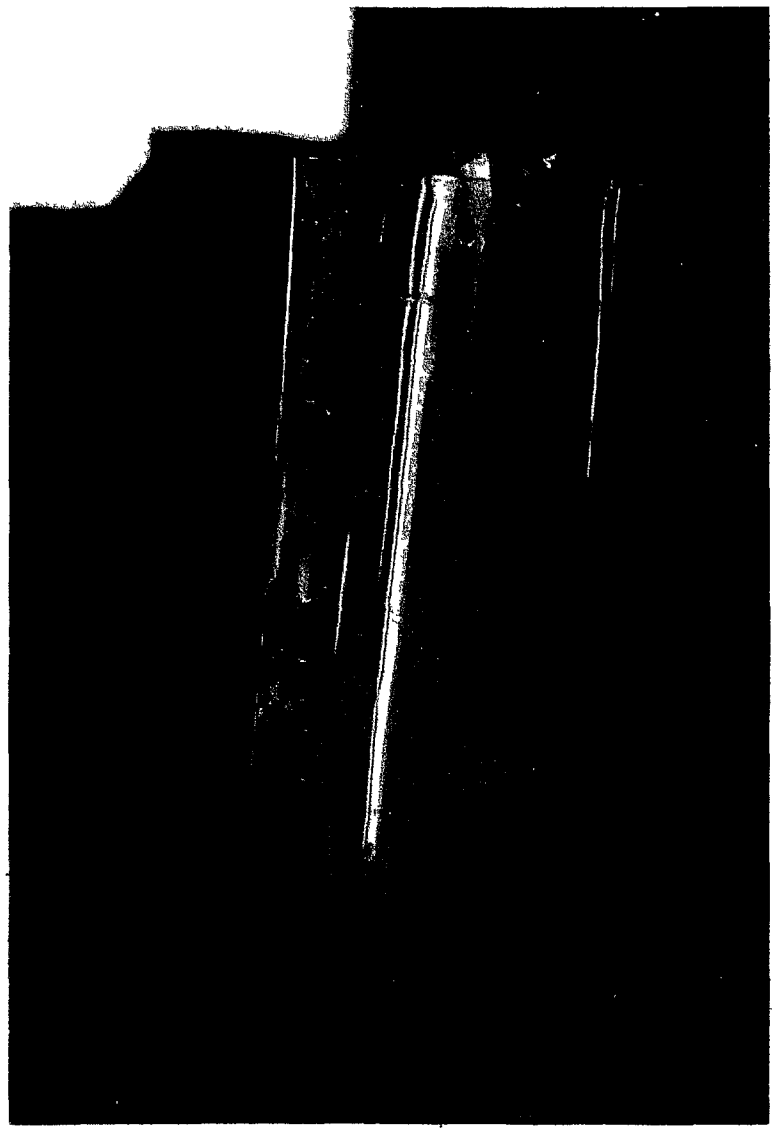
Newly constructed multiple provided by Hebron The multiple bay building behind the just below the center of this picture and behind the road, is one of the many light industrial use buildings built by the city in the industrial zone

Figure 4 2



Continuous water usage for stone sawing

Figure 4 3



Slurry settling after 10 minutes

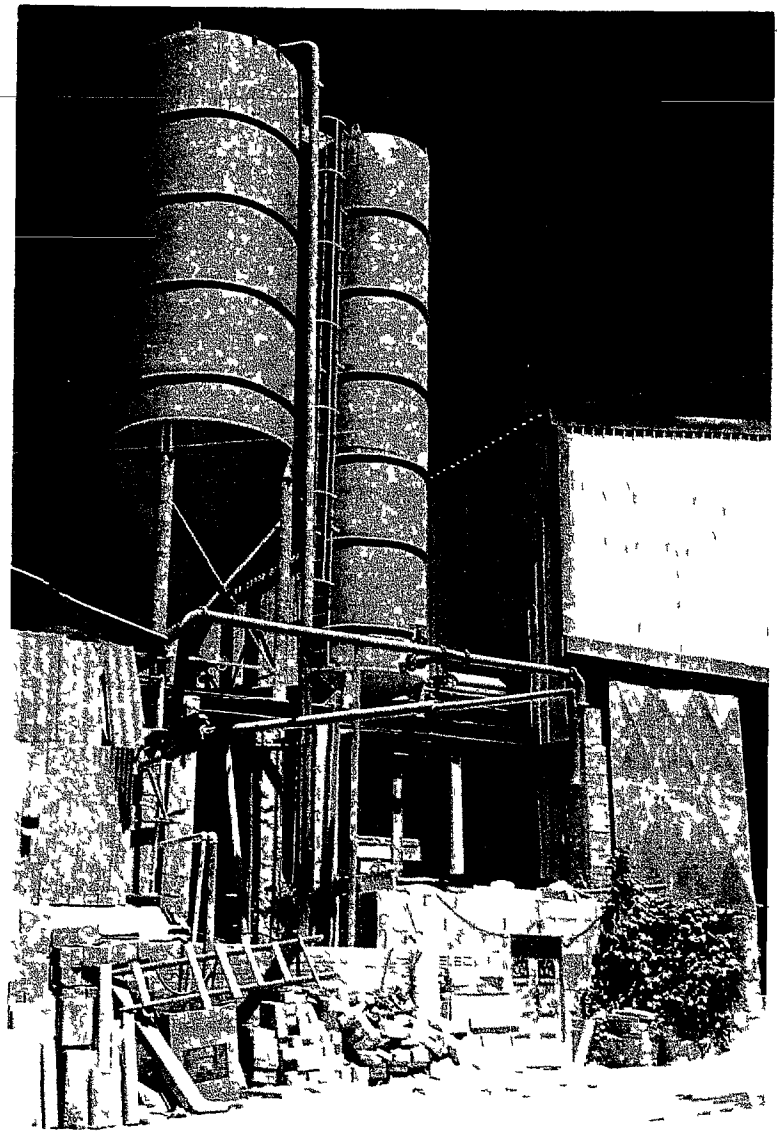
Figure 4 4

Polymer mix and dosing tank

Figure 4 5

Close up of polymer tank showing pronounced vortexing and thus poor mixing

Figure 4 7

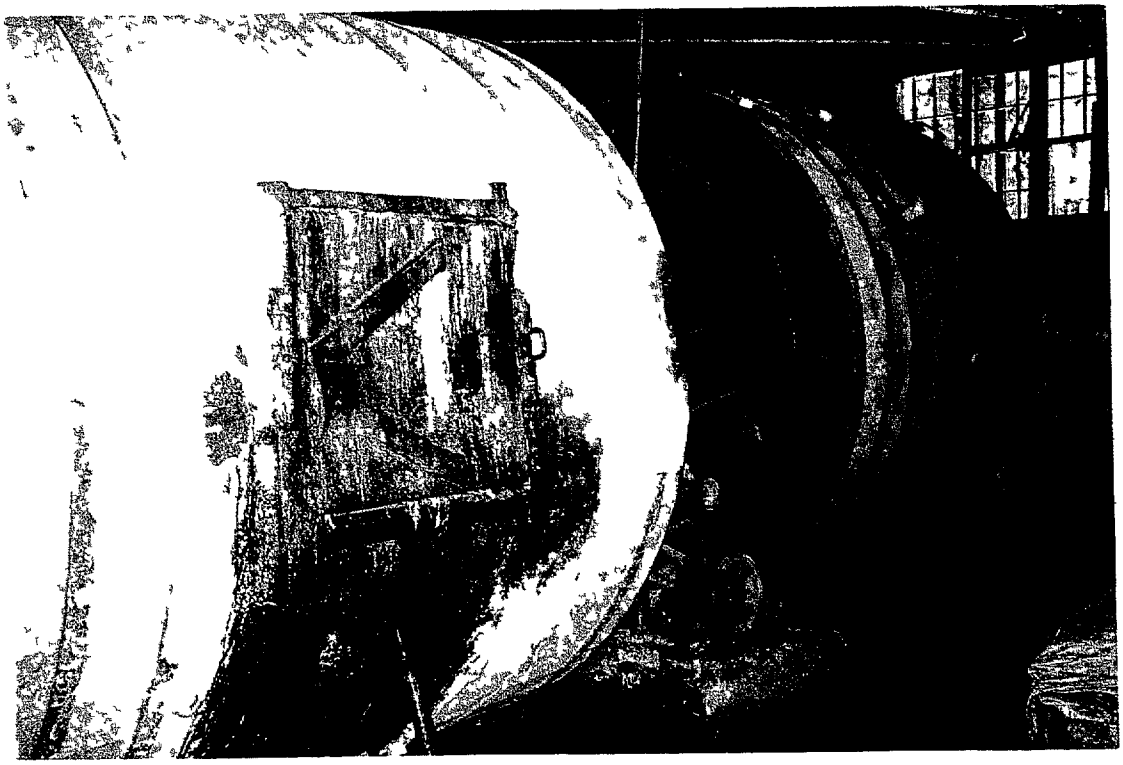


Typical stone cutting process water settling and recycle system tanks commonly visible throughout the Hebron Industrial Zone

Figure 4 8

Agricultural test plot at Al Arroub field demonstration station apparently testing the agronomic use of stone slurry

Figure 4 9

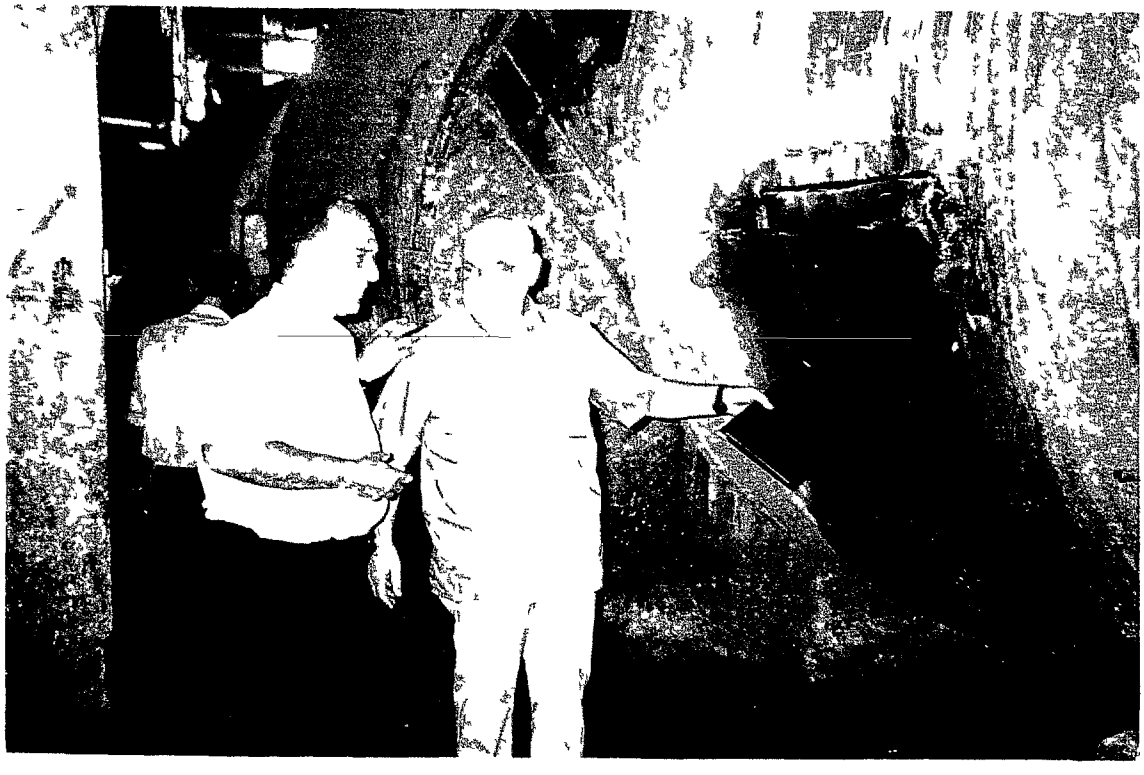


Rotating wooden drums used in the tanning process

Figure 4 10

Light grayish blue hides after completion of the tanning step showing the characteristic "through the blue" color

Figure 4 11



Photograph of tannery drum showing the large hinged door through which all materials pass

Figure 4 12

Wastewater discharge from a typical tannery in Hebron

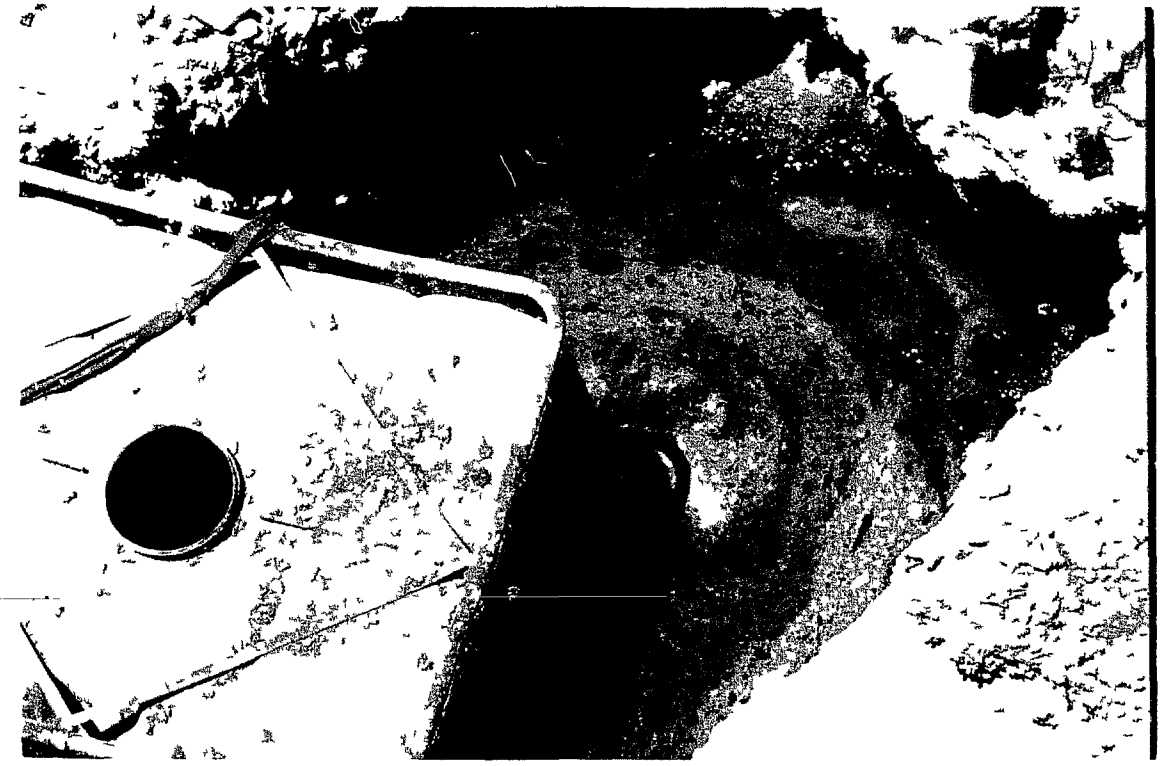
Figure 4 13

Hand application of diesel fuel to truck surfaces is practiced to dissolve road grim

Figure 4 14

High pressure water spray removes the dissolved materials and fuel

Figure 4 15



The highly contaminated liquid in the gravity overflow to the sewer is the expected result of this cleaning technique

Figure 4 16

Waste tile crusher used to recycle broken tiles producing aggregate for tile manufacture

Figure 4 17

Simple, small on-site settling pond used to recover water from the flushing of ready-mix concrete truck flushing

Figure 4 18

Ready-mix recycle pond overflow Pond is in left background Overflow exits property at the right edge of the gap in the wall, lower right foreground

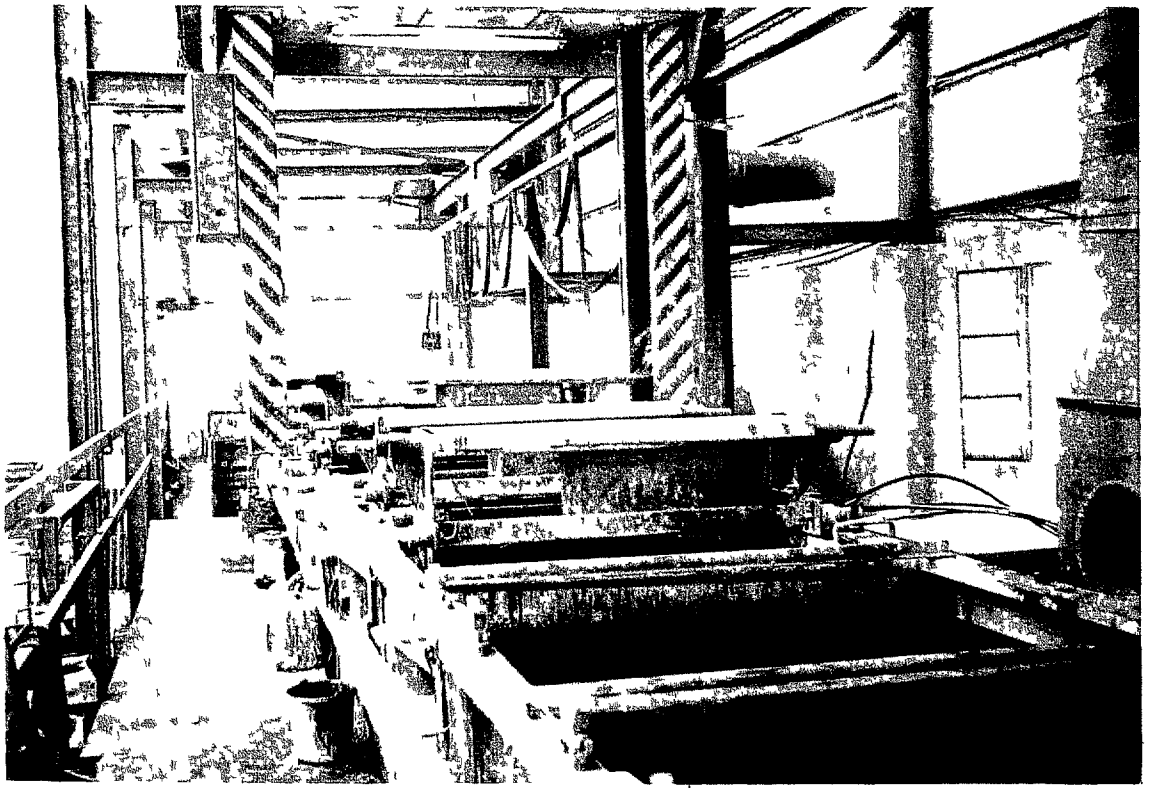
Figure 4 19

Clay processing in open water filled basins

Figure 4 20

Pottery in a storage area awaiting firing

Figure 4 21



Modern electroplating facility in Hebron

Figure 4 22

Ground surface area receiving discharged spent solvents from electroplating facility

Figure 4 23

Randomly dumped piles burning at the Hebron solid waste dump

Figure 4 24

Area setting view of the Hebron open burn solid waste dump