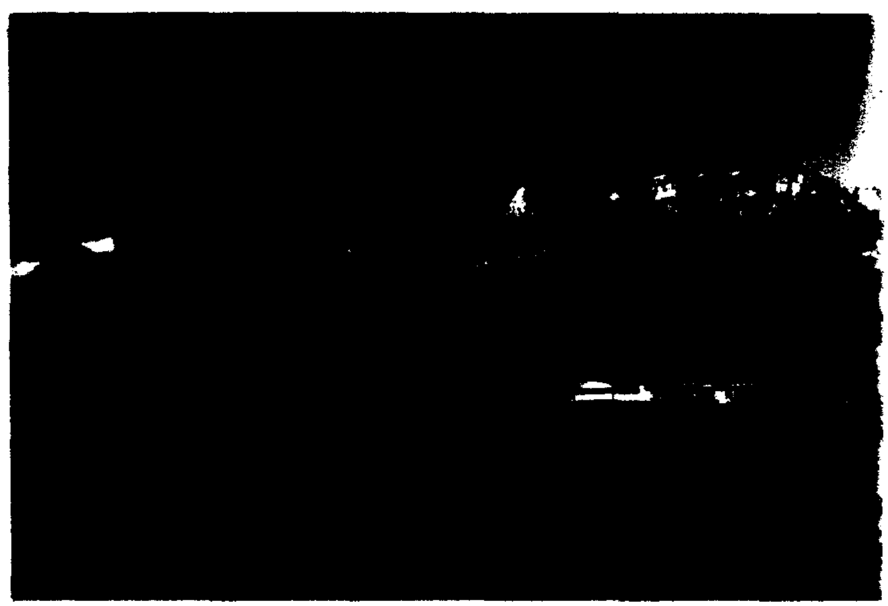
El Paso
Water Resource
Management Plan

FEASIBILITY REPORT ON WASTEWATER REUSE OPPORTUNITIES

Prepared for

El Paso Water Utilities
Public Service Board

November 1992



BOYLE
ENGINEERING CORPORATION

El Paso Water Resource

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1.0 INTRODUCTION

This report describes the wastewater reuse facilities which are recommended to be constructed by the El Paso Water Utilities (EPWU) over the next ten years (1993-2002). A summary of representative wastewater applications in other states and a comparison of reuse water quality standards in states having significant wastewater reuse in operation are also included.

Reclamation and reuse of wastewater in El Paso currently averages about 8 mgd or 9,000 acre-feet per year (af/yr) for the following purposes:

- Irrigation of Ascarate Golf Course using secondary effluent from the Haskell Street Wastewater Treatment Plant - 550 af/yr
- Irrigation of the Painted Dunes Golf Course using advanced tertiary effluent from the Fred Hervey Water Reclamation Plant - 350 af/yr
- Cooling water make-up at the El Paso Electric Company's Newman Power Plant using advanced tertiary effluent from the Fred Hervey Water Reclamation Plant - 1,040 af/yr
- Reinjection of the balance of the advanced tertiary effluent from the Fred Hervey Water Reclamation Plant into the Hueco Bolson - 7,060 af/yr

El Paso's recently completed Water Resource Management Plan prescribes a substantial increase in reclamation and reuse of wastewater as the second component in priority to be implemented (after the water conservation program). Based on reconnaissance-level assessments, it was projected that reclamation and reuse of wastewater would expand from the existing 1990 reuse level, estimated at the time to be 1,350 af/yr exclusive of the Fred Hervey effluent reinjected into the Hueco Bolson, to 19,400 af/yr by the year 2040. As shown in Table 1.1, the projected increase of 18,050 af/yr consisted of 11,150 af/yr for irrigation of turf and landscaping and 6,900 af/yr of process water for industries. This projected level of additional wastewater reuse to be developed for implementation of the Water Resource Management Plan was based on a reconnaissance-level assessment of reuses which could be delivered at a cost slightly less than the cost of potable water. Subsidization of wastewater reuse was not considered in the Water Resources Management Plan. A major portion of the projected industrial reuse consisted of advanced treated effluent from the Fred Hervey Water Reclamation

Plant for the El Paso Electric Company's Newman Power Plant amounting to as much as 2,900 af/yr initially for cooling water and up to 4,000 af/yr ultimately for both cooling water and boiler feed water. The first phase delivery of cooling water to the Newman Power Plant commenced January 3, 1992.

The principal objective of expanding the reuse of reclaimed wastewater as part of the Water Resource Management Plan is to reduce the demand for potable water supplied by the EPWU. This result is not realized if the user does not now, or would not in the future, be supplied water by the EPWU. The Newman Power Plant previously obtained all of its water from privately owned wells; therefore, substituting reclaimed water from the Fred Hervey Water Reclamation Plant technically does not reduce the potable water demand on the EPWU. However, this reuse was included in the Management Plan projections of industrial water supplied from reuse of wastewater since the Newman Power Plant is turning its wells over to the EPWU. This action results in an increase in the EPWU's water supply capability. On the other hand, although the reinjection of the advanced tertiary effluent from the Fred Hervey Water Reclamation Plant is technically classified as reuse of reclaimed wastewater, this use does not reduce the potable water demand on the EPWU. Accordingly, expansion of wastewater reclamation for reinjection into the groundwater was not considered in this feasibility study.

Depending on the rates established by the EPWU for reclaimed wastewater service and the amounts of subsidization necessary to get customers to use reclaimed wastewater, the potential development of up to 20,400 af/yr of reuse of reclaimed wastewater over the next 10 years has been identified as being feasible.

TABLE 1.1

WASTEWATER REUSE CUSTOMERS IDENTIFIED IN EL PASO WATER RESOURCE MANAGEMENT PLAN

(Values in Acre-feet per Year)

Nature of Reuse and Customer	Year 1990	2000	2010	2020	2030	2040
TURF IRRIGATION						
Golf Courses:						
Ascarate	1,000	1,000	1,000	1,000	1,000	1,000
Coronado CC	0	0	500	500	500	500
Cielo Vista	0	450	450	450	450	450
Vista Hills	0	0	800	800	800	800
Underwood	0	0	0	400	400	400
Horizon	0	0	400	400	400	400
Painted Dunes	350	350	350	350	350	350
Cemeteries:						
Evergreen	0	0	40	40	40	40
Restlawn	0	100	100	100	100	100
Memory Gardens	0	0	40	40	40	40
Desert View	0	40	40	40	40	40
Fort Bliss	0	0	60	60	60	60
Concordia	0	60	60	60	60	60
Existing Parks:	0	300	420	620	620	620
New Parks & Golf Courses:	0	200	400	2,900	5,900	7,400
Other Large Turf Areas:						
Fort Bliss Parade G'nds	0	0	50	50	50	50
El Paso Comm. College	0	0	90	90	90	90
Chamizal Nat'l Park	0	100	100	100	100	100
Total Turf Irrigation	1,350	2,600	4,900	8,000	11,000	12,500
INDUSTRIAL PROCESSES						
Asarco	0	0	200	500	1,000	1,000
El Paso Refining Co.	0	100	100	100	100	100
Phelps Dodge	0	0	200	200	200	200
Chevron Refining	0	0	0	200	200	200
Newman Power Plant	0	4,000	4,000	4,000	4,000	4,000
New Industries	0	0	0	0	400	1,400
Total Industrial	0	4,100	4,500	5,000	5,900	6,900
TOTAL REUSE	1,350	6,700	9,400	13,000	16,900	19,400

2.0 WASTEWATER REUSE NATIONWIDE

2.1 OVERVIEW

Reclamation and reuse of wastewater is expanding rapidly throughout the United States, particularly in the Southwest and other sunbelt states. An assessment of the present level of wastewater reuse nationwide was made for the purpose of determining wastewater reuse practices and policies that have been developed through this experience and associated research. This assessment was performed by means of research and review of current literature and by personal contacts with knowledgeable individuals. The focus of these surveys was on the practical applications of wastewater reuse rather than on theoretical considerations. Chapter 5.0 lists the most relevant of the documents reviewed. Numbers contained in brackets in this report, e.g. [2], are references to the numbered listings in Chapter 5.0. Table 2.1 lists the various individuals and entities contacted personally.

2.2 WASTEWATER REUSE TRENDS

Conclusions regarding current practices and trends in the reclamation and reuse of wastewater which can be drawn from the literature research and contacts surveyed are as follows:

a. Reclamation and reuse of wastewater is practiced throughout the United States, but is most prevalent in the Southwest and sunbelt states.

b. Reuse of wastewater is not a new concept in the United States. One of the uses of reclaimed wastewater which is only now starting to expand, the reuse of wastewater for toilet flushing, has been practiced in the United States since 1926 [10].

c. California is generally recognized as the leading state in the nation for development of wastewater reuse. California has had a Wastewater Reclamation and Reuse Law in effect since 1967. Florida, however, may be equal to or ahead of California in volume of wastewater reused. California was reported to be reusing about 267,000 af of reclaimed wastewater per year in 1987 [12]. Florida was reportedly using about 361,000 af of reclaimed wastewater in 1990 [16].

TABLE 2.1

INDIVIDUALS AND ENTITIES SURVEYED

Entity	Representative Contacted
Arizona Division of Water Resources, Phoenix, AZ	Dave Johnson, Water Resource Specialist
Aurora, CO	Tom Griswold, Utilities Director Darrell Hogan, Sewer Supervisor
California State Health Services Sacramento, CA	Mike Keatas
California State Water Resources Control Board, Division of Clean Water Programs, Sacramento, CA	Lynn Johnson, Chief, Office of Water Recycling
Colorado Springs, CO	
Utilities Department	James Phillips, Utilities Director
Department of Wastewater	Dennis T. Cafaro, Director
East Bay Municipal Water District, San Francisco, CA	Judy Parber
Florida Department of Environmental Regulation, Tallahassee, FL	Don W. Berryhill, Chief, Bureau of Local Government Wastewater Financial Assistance
Harris County Water Conservation District, Houston, TX	Caroline Britton
Houston, TX, Water Department	Bill Bullock
Lower Colorado River Authority, Austin, TX	Nora Malarkey
Phoenix Water and Wastewater Department, Phoenix, AZ	William Mee, Administrator
St. Petersburg, FL	
Department of Public Utilities	William D. Johnson, Director
Water Treatment Department	Joseph Towry
Texas Water Development Board, Austin, TX	Bill Hoffman
Texas Water Resources Institute, College Station, TX	Ric Jensen, Information Specialist
Trinity River Authority, Arlington, TX	Bill Smith
Tucson Water, Tucson, AZ	John O'Hare Kirk Guilde, Chief Planning Engineer

d. At the present time there are no known applications in the United States of direct reuse of reclaimed wastewater for potable purposes. Even if direct potable reuse were permitted by law, the public generally is unwilling to accept it. Direct potable reuse is also effectively constrained by the EPA's drinking water regulations.

e. The driving force behind the reuse of wastewater throughout the country is nearly always one of two reasons, both of which are governed by underlying economic considerations: 1) increasing scarcity of additional raw water supplies, and 2) more stringent pollution control requirements for disposal of wastewater than for its reuse. According to the 1987 California survey [12], 70 percent of the reclaimed water systems in the state were constructed as a more cost-effective option than discharging the wastewater to streams and the ocean. In other states, such as Arizona, the unavailability or extreme cost of additional water sources is the predominant factor.

f. The types of reuse of reclaimed wastewater vary considerably around the country. Table 2.2 lists most of the common uses for reclaimed wastewater and indicates the relative proportions of each use taking place in the two heaviest-use states, California and Florida. It appears, however, that reuse of wastewater for irrigation, either agricultural or landscape or both, is by far the principal use of reclaimed wastewater in the United States. Reuse of wastewater for industrial purposes is small in comparison to other uses. Indirect potable reuse, such as El Paso's wastewater reclamation at the Fred Hervey Water Reclamation Plant and reinjection into the Hueco Bolson, is currently practiced at only a few locations in the United States.

TABLE 2.2

TYPES AND DISTRIBUTION OF WASTEWATER REUSE

Type of Reuse	California	Florida
Agricultural irrigation	62%	28%
Landscape irrigation	13%	31%
Total irrigation	**75%**	**59%**
Industrial	2%	4%
Environmental enhancement	4%	25%
Recreational impoundment	3%	---
Groundwater recharge	14%	9%
Total non-irrigation	**23%**	**38%**
Other or mixed	2%	3%

g. Wastewater reuse systems for the various uses are generally similar and conventional in concept, but vary widely in operational and financial aspects. Appendix A contains descriptive summaries of seven representative wastewater reuse projects covering a variety of uses. These seven projects, located in four different states as indicated on Figure 2.1, consist of the following:

1. City of Aurora, Colorado - Turf irrigation

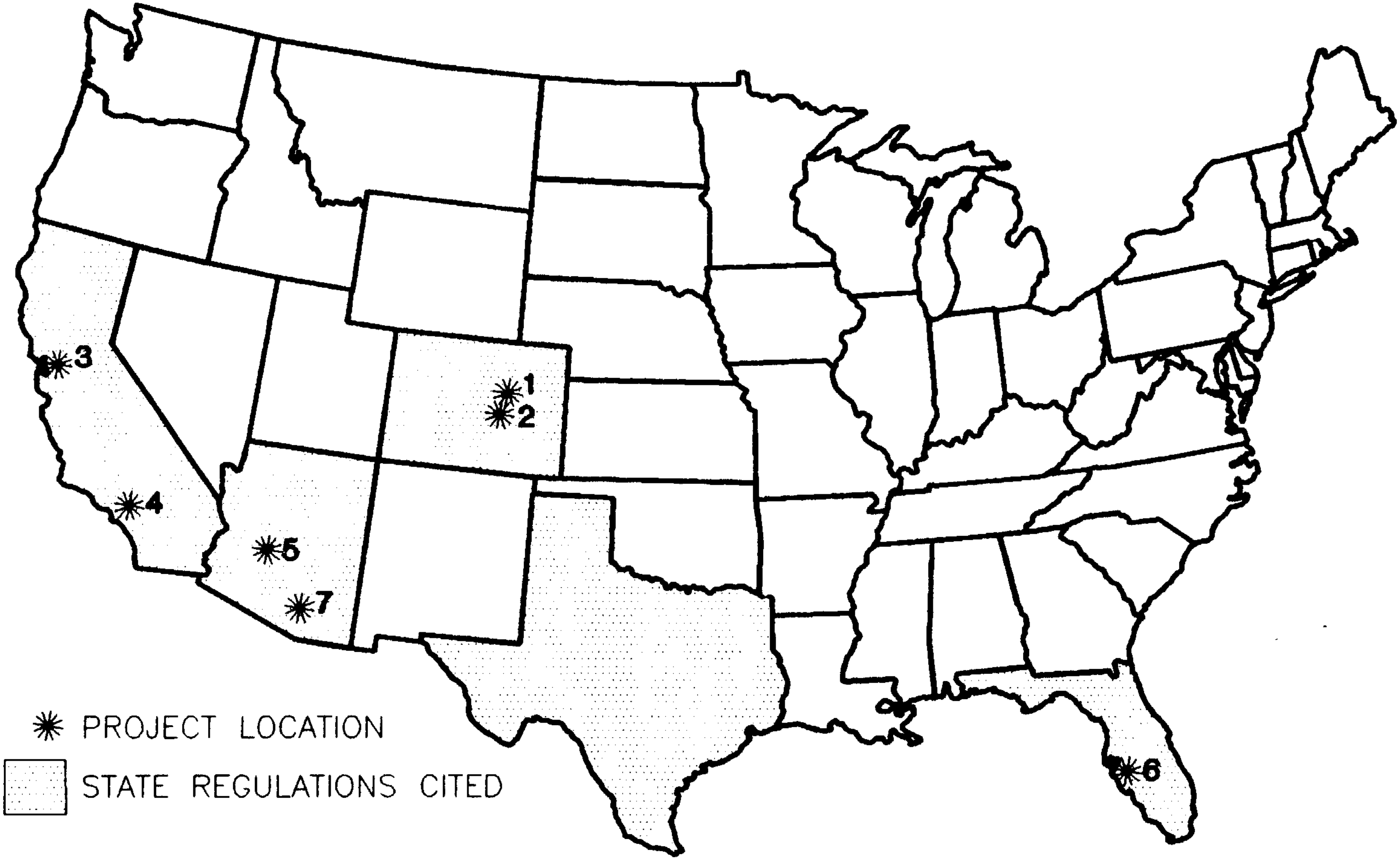
2. City of Colorado Springs, Colorado - Landscape and turf irrigation; construction

3. East Bay Municipal Water District, San Francisco, California - Industrial cooling

4. Los Angeles County, California - Ground water recharge

FIGURE 2.1

WASTEWATER REUSE PROJECT LOCATIONS



5. City of Phoenix, Arizona - Turf and agricultural irrigation, industrial cooling, exchange

6. City of St. Petersburg, Florida - Landscape irrigation, industrial, groundwater recharge

7. City of Tucson, Arizona - Turf irrigation, golf course irrigation

2.3 QUALITY OF RECLAIMED WASTEWATER

Although there are similarities in types and relative proportions of wastewater reuse among the larger-use states researched, there is a noticeable lack of uniformity in the water quality standards required by the states for reclaimed wastewater. Considerable disagreement persists among authorities regarding the degree of treatment required for various uses of reclaimed wastewater. In spite of continued advancement in the technology for monitoring and treating water to potable standards, concerns about the possible presence of a myriad of synthetic organic compounds and reaction products which result from disinfection outpace the gains. It appears doubtful that direct potable reuse of reclaimed wastewater will take place in the United States in the foreseeable future.

The water quality standards for reclamation and reuse of wastewater in California are under the authority of the State Department of Health. The California Health Department's regulations for reclamation and reuse are considered to be the most comprehensive and stringent in the United States. In spite of being widely acclaimed, legislation is being considered in California to lessen some of the requirements now considered to be too restrictive. Although the research has been somewhat limited, the literature reviewed unanimously observes that there have been no documented incidences of gastrointestinal or other illnesses from contact with, or use of, turf irrigated with reclaimed wastewater.

Figure 2.1 also shows which five states were compared with respect to their standards for reclaimed wastewater. Table 2.3 gives a comparison of the treatment regulations for reclaimed wastewater for the five high-use states.

RECLAIMED WASTEWATER
COMPARISON OF TREATMENT REGULATIONS

	CALIFORNIA	TEXAS	COLORADO	FLORIDA	ARIZONA
GROUNDWATER RECHARGE	20% RECLAIMED, TERTIARY ONLY 50% ALSO REMOVE TRACE ORGANICS 1000' HORIZ. SEPARATION FROM SPRAY TO FIRST DOMESTIC WELL	INDIVIDUAL CASE BASIS	INDIVIDUAL CASE BASIS	INDIVIDUAL CASE BASIS	INDIVIDUAL CASE BASIS
SPRAY IRRIGATION	OXIDATION,COAGULATION,CLARIFICATION, FILTRATION AND DISINFECTION MEDIAN # COLIFORMS 2.2 PER 100 mL		MEDIAN # COLIFORMS 23 PER 100 mL MAX. DAILY LEVEL = 200 PER 100 mL	SECONDARY PLUS DISINFECTION MEAN # COLIFORMS 200 PER 100 mL	
SURFACE IRRIGATION – FOOD CROPS	DISINFECTION, OXIDATION MEDIAN # COLIFORMS 2.2 PER 100 mL	NON-POND SYSTEM – BOD5 = 10 mg/L TURBIDITY = 3 NTU MAX. # COLIFORM 75 PER 100 mL POND SYSTEM 3) – BOD5 = 30 mg/L MAX. # COLIFORM 75 PER 100 mL	MEDIAN # COLIFORMS 23 PER 100 mL MAX. DAILY LEVEL = 200 PER 100 mL	SECONDARY, FILTRATION, DISINFECTION 75% OF COLIFORM OBSERVATIONS MUST BE BELOW DETECTABLE LIMITS, NO OBSERVATION MAY EXCEED 25 PER 100 mL. MAX TSS = 5 mg/L	pH 4.5 – 9 MEDIAN # COLIFORMS 2.2 PER 100 mL MAX # COLIFORMS 25 PER 100 mL
LANDSCAPE IRRIGATION, UNRESTRICTED 2)	OXIDATION,COAGULATION,CLARIFICATION, FILTRATION AND DISINFECTION MEDIAN # COLIFORMS 2.2 PER 100 mL	BOD5 = 5 mg/L, TURBIDITY 3 NTU MAX. # COLIFORM 75 PER 100 mL	MEDIAN # COLIFORMS 23 PER 100 mL MAX. DAILY LEVEL = 200 PER 100 mL	SECONDARY, FILTRATION, DISINFECTION 75% OF COLIFORM OBSERVATIONS MUST BE BELOW DETECTABLE LIMITS, NO OBSERVATION MAY EXCEED 25 PER 100 mL. MAX TSS = 5 mg/L	pH 4.5 – 9 MEDIAN # COLIFORMS 25 PER 100 mL MAX # COLIFORMS 75 PER 100 mL MAX ENTERIC VIRUS 125 PER 40 l
RECREATIONAL IMPOUNDMENT, UNRESTRICTED	OXIDATION,COAGULATION,CLARIFICATION, FILTRATION AND DISINFECTION MEDIAN # COLIFORMS 2.2 PER 100 mL	NON-POND SYSTEM – BOD5 = 20 mg/L MAX. # COLIFORM 800 PER 100 mL POND SYSTEM – BOD5 = 30 mg/L MAX. # COLIFORM 800 PER 100 mL	MEDIAN # COLIFORMS 23 PER 100 mL MAX. DAILY LEVEL = 200 PER 100 mL	SECONDARY, FILTRATION, DISINFECTION 75% OF COLIFORM OBSERVATIONS MUST BE BELOW DETECTABLE LIMITS, NO OBSERVATION MAY EXCEED 25 PER 100 mL. MAX TSS = 5 mg/L	pH 4.5 – 9 MEDIAN # COLIFORMS 25 PER 100 mL MAX # COLIFORMS 75 PER 100 mL MAX ENTERIC VIRUS 125 PER 40 l
RECREATIONAL IMPOUNDMENT, RESTRICTED	DISINFECTION, OXIDATION MEDIAN # COLIFORMS 2.2 PER 100 ML	BOD5 = 10 mg/L, TURBIDITY 3 NTU MAX. # COLIFORM 75 PER 100 mL	MEDIAN # COLIFORMS 200 PER 100 mL	SECONDARY PLUS DISINFECTION MEAN # COLIFORMS 200 PER 100 mL	pH 4.5 – 9 MEDIAN # COLIFORMS 200 PER 100 mL MAX # COLIFORMS 1000 PER 100 mL
LANDSCAPE IRRIGATION, RESTRICTED 1)	DISENFECTION, OXIDATION MEDIAN # COLIFORMS 23 PER 100 mL IN LAST 7 DAYS	NON-POND SYSTEM – BOD5 = 20 mg/L MAX. # COLIFORM 800 PER 100 mL POND SYSTEM – BOD5 = 30 mg/L MAX. # COLIFORM 800 PER 100 mL	MEDIAN # COLIFORMS 200 PER 100 mL	SECONDARY PLUS DISINFECTION MEAN # COLIFORMS 200 PER 100 mL	pH 4.5 – 9 MEDIAN # COLIFORMS 200 PER 100 mL MAX # COLIFORMS 1000 PER 100 mL
PASTURE IRRIGATION FOR MILKING ANIMALS	DISINFECTION, OXIDATION MEDIAN # COLIFORMS 23 PER 100 mL	NON-POND SYSTEM – BOD5 = 20 mg/L MAX. # COLIFORM 800 PER 100 mL POND SYSTEM – BOD5 = 30 mg/L MAX. # COLIFORM 800 PER 100 mL	MEDIAN # COLIFORMS 23 PER 100 mL MAX. DAILY LEVEL = 200 PER 100 mL		pH 4.5 – 9 MEDIAN # COLIFORMS 1000 PER 100 mL MAX # COLIFORMS 4000 PER 100 mL
LANDSCAPE IMPOUNDMENT	DISINFECTION, OXIDATION MEDIAN # COLIFORMS 23 PER 100 ML	BOD5 = 10 mg/L, TURBIDITY 3 NTU MAX. # COLIFORM 75 PER 100 mL	MEDIAN # COLIFORMS 200 PER 100 mL	SECONDARY PLUS DISINFECTION MEAN # COLIFORMS 200 PER 100 mL	
SURFACE IRRIGATION – ORCHARDS, VINEYARDS	QUALITY EQUIVALENT TO PRIMARY EFFLUENT PROVIDED FRUIT DOES NOT COME INTO CONTACT WITH WATER	NON-POND SYSTEM – BOD5 = 10 mg/L TURBIDITY = 3 NTU MAX. # COLIFORM 75 PER 100 mL POND SYSTEM – BOD5 = 30 mg/L MAX. # COLIFORM 75 PER 100 mL		SECONDARY, FILTRATION, DISINFECTION 75% OF COLIFORM OBSERVATIONS MUST BE BELOW DETECTABLE LIMITS, NO OBSERVATION MAY EXCEED 25 PER 100 mL. MAX TSS = 5 mg/L	pH 4.5 – 9 MEDIAN # COLIFORMS 1000 PER 100 mL MAX # COLIFORMS 4000 PER 100 mL
IRRIGATION OF FODDER, FIBER, SEED CROPS	QUALITY EQUIVALENT TO PRIMARY EFFLUENT	BOD5 = 30 mg/L	QUALITY EQUIVALENT TO PRIMARY EFFLUENT	SECONDARY PLUS DISINFECTION MEAN # COLIFORMS 200 PER 100 mL	pH 4.5 – 9 MEDIAN # COLIFORMS 1000 PER 100 mL MAX # COLIFORMS 4000 PER 100 mL

1) GOLF COURSES, FREEWAY LANDSCAPES, ETC.
2) PARKS, PLAYGROUNDS, SCHOOLYARDS, ETC.
3) POND SYSTEM – FACILITY IN WHICH PRIMARY TREATMENT FOLLOWED BY STABILIZATION PONDS ARE USED FOR SECONDARY TREATMENT

2.4 STATE FINANCIAL ASSISTANCE PROGRAMS

Both of the leading wastewater reuse states, California and Florida, have financial assistance or incentive programs specifically set up to promote development of reclamation and reuse of wastewater. Financial assistance by both states is in the form of low-interest rate loans. Grants are not provided by either state.

California's Water Reclamation Loan Program is administered by the State Water Resources Control Board (SWRCB). The program is designed to promote cost-effective water reclamation projects to augment water supplies [19]. The Water Reclamation Loan Program helps improve the financial feasibility of projects that are economically justified by providing capital funds at a subsidized interest rate [21]. Funding for the program is provided by two bond laws: the *Clean Water Bond Law of 1984* and the *Clean Water and Water Reclamation Bond Law of 1988.*

A Water Reclamation Account was established under the Clean Water Bond Law of 1984 which authorized up to $25 million for loans to municipalities to assist in the design and construction of water reclamation projects. Repayments of principal and interest are returned to the Water Reclamation Account to make additional loans. Loans from the Water Reclamation Account for water reclamation projects can be for a period of up to 25 years at an interest rate equal to 50 percent of the rate paid by the State on the most recent sale of state general obligation bonds. No single project may receive more than a $10 million loan from this program. Loans can cover any part of a project up to 100 percent of project design and construction costs.

Up to $30 million is available under the Clean Water and Water Reclamation Bond Law of 1988 for loans to public agencies to aid in the design and construction of water reclamation projects. Loan repayments from these funds do not become part of a revolving fund as is the case under the 1984 Bond Law. The loan provisions are the same as for the 1984 Bond Law with the exceptions that the maximum loan period is 20 years instead of 25 years and no maximum loan amount per project is specified.

It has been the policy of the California SWRCB to provide loans from the Water Reclamation Loan Program covering 100 percent of eligible costs. In spite of the higher limits authorized under the bond laws, the SWRCB has limited loans under the Water Reclamation Loan Program to a maximum of $5 million for a single project. Eligible water reclamation projects are those which are cost-effective when compared "to the development of other new sources of water" (1984 Bond Law) or "with the cost of alternative new freshwater supplies" (1988 Bond Law) and for which no federal assistance is currently available. Loans under the Water

Reclamation Loan Program are restricted to water supply projects; therefore, wastewater reuse for pollution control is not eligible under this program. Loans for wastewater reuse projects for pollution control as well as loans larger than $5 million for water supply projects can be obtained from the State Revolving Fund (SRF). Loans under the Water Reclamation Loan Program effectively provide a subsidy of about 25 percent as the result of the reduction in debt service compared to other methods of financing.

Florida's Water Reclamation Financial Assistance consists of preferential incentives rather than a specific loan program. Funding for water reclamation projects in Florida is provided from the SRF. Preferential incentives in obtaining SRF loans for water reclamation consist of:

1) 15 percent of the SRF is set-aside for small community projects;

2) Using the "cost of potable water saved" in the cost-effective economic analysis required to obtain a SRF loan; and

3) Allowing a high base score (the highest given for water supply projects) in calculating economic justification.

At the present time, there are no state loan or grant programs in Texas specifically established to promote wastewater reclamation in spite of wastewater reuse being a major goal of the Texas Water Plan.

3.0 IDENTIFICATION OF REUSE OPPORTUNITIES

3.1 IDENTIFICATION PROCEDURE

Based on the guidelines of the newly developed Water Resource Management Plan and the results of the survey of current wastewater reclamation and reuse practices elsewhere around the United States, the identification of potential reuse customers was governed by the following assumptions:

* Reuse of reclaimed wastewater should have a high priority and be developed to the maximum extent practicable to reduce the demands for potable water from the EPWU's municipal water system and conserve the scarce raw water supplies. In this context, reclaiming wastewater by tertiary and advanced treatment and injecting it into the ground to recharge the groundwater, such as now being performed at the Fred Hervey Water Reclamation Plant, was not considered as reuse in this study since it does not reduce the demands on the EPWU.

* On the other hand, even though it will not reduce the demands on the EPWU, substitution of reclaimed wastewater for drinking quality water now being pumped from private wells by industries and other large water users for non-potable applications was considered in this study since this will conserve the EPWU's limited water supplies.

* Feasible reuse opportunities will consist primarily of entities using large quantities of fresh water for irrigation of large turf areas and landscape and for commercial and industrial processes.

* It is unlikely that construction of dual pipeline distribution systems for irrigation of residential lawns will be economically feasible because of the comparatively higher installation costs, greater public concerns, and more stringent health and safety requirements.

* Existing EPWU water customers and large private well owners within the EPWU's presently developed service area will probably provide more than adequate

opportunities for reuse of reclaimed wastewater from existing treatment plants commensurate with the funding available for the next ten years. Accordingly, possibilities for reuse by future customers which may develop over the next ten years were not considered, except in a few specific instances -- the Riverside International Industrial Center being developed by the EPWU and the expansion of the El Paso Zoo.

Following the above assumptions, information regarding existing large turf and landscape irrigators and heavy water using industries was compiled and evaluated. These included:

a. Parks five acres and larger in size

b. All public and private golf courses

c. Cemeteries

d. Landscaped highway and boulevard medians and entrance areas

e. Major school campuses and other grassed sports fields

f. Multiresidential and commercial complexes using 12 MG and more per year for irrigation

g. Refineries and other large water use industries

h. Commercial laundries and garment finishers

i. Private wells pumping 20 MG and more per year

The basic information on these existing large water users was obtained from data previously compiled for development of the Water Resource Management Plan, from the EPWU Water Conservation Office, and from the El Paso office of the USGS.

One major potential user of reclaimed wastewater which does not exist at the present was also included in the list of potential customers since reuse of wastewater is being considered in the initial planning of the facility. The Riverside International Industrial Center being developed by the EPWU in the vicinity of the Bustamante WWTP is being planned to use reclaimed wastewater for landscape irrigation and industrial processes. In addition, the El Paso Zoo plans to expand from its present five acres to 30 acres within the next ten years.

3.2 EVALUATION OF REUSE CANDIDATES

The initial listing of potential users of reclaimed wastewater was evaluated to ascertain their locations, the amounts of water being used for nonpotable purposes, and the areas of turf and landscape being irrigated. The locations of the individual potential users were plotted on a planning map of the EPWU service area. Also plotted on the planning map were the boundaries of the parks and other large turf areas, the EPWU wastewater treatment plants, and the locations of the private wells supplying large non-potable water uses.

Simultaneously with the data acquisition, notification of this study was mailed on EPWU/PSB letterhead to a selected list of interested parties, including large water users, heads of agencies, and government officials. This notification indicated that the recipients might be contacted by Boyle to obtain information relevant to their water use and also invited interested water users to contact Boyle directly. Appendix B contains a copy of the notification letter and a list of the water users, agencies and individuals sent the notification. A number of the parties (as indicated on the list) were subsequently contacted by Boyle to obtain or verify information regarding their possible reuse of reclaimed wastewater. Three water users, the Final Finishing and Supreme Laundries and the El Paso Zoo, contacted Boyle directly to indicate their interest.

Boyle engineers also met with the agencies and officials in El Paso listed in Table 3.1 which were considered to be particularly knowledgeable of, or interested in, various aspects of the study. Several meetings and frequent individual consultations were held with various EPWU staff to obtain their input and to verify information and conclusions during the compilation and evaluation of the data.

TABLE 3.1

AGENCIES AND OFFICIALS CONSULTED

El Paso Community Foundation
Mr. Nestor Valencia, Vice-President for Planning

El Paso Department of Planning, Research and Development
Mr. Natividad Campos, Director
Mr. Leslie G. Smyth, Historic Development
Ms. Elizabeth Blackmond, Planner

El Paso Department of Parks and Recreation
Mr. Rick Garcia, Parks Department Engineer

El Paso Department of Traffic and Transportation
Mr. Tony Mixer, Traffic Engineer

El Paso International Airport
Mr. Ramon Sida, Airport Planner

Texas Water Commission, District 15
Mr. Terry L. McMillan, Field Investigator

Keep El Paso Beautiful
Ms. Susan Gorman, Executive Director

Fort Bliss
Mr. Jim Kemp
Mr. Alan Smith
Mr. Joe Mathis

3.3 PRELIMINARY LAYOUTS AND SCREENING

Preliminary layouts of reclaimed wastewater distribution systems were made for each of the four areas which will be served from the EPWU's existing wastewater treatment plants:

1. Central and East areas served by the Haskell Street WWTP

2. Southeast area served by the Roberto R. Bustamante WWTP

3. Northeast area served by the Fred Hervey WRP

4. Northwest area served by the Northwest WWTP

Considering the visual groupings of potential customers on the large planning map, tentative locations of the reclaimed wastewater distribution pipelines were laid out. The preliminary configurations of the distribution systems were based on the premise that their economic feasibility would be highest where the greatest volume of reclaimed wastewater could be used with the smallest number of trunk lines and least total length of all distribution pipelines.

Tentative sizes of pipes in the preliminary distribution system networks were assigned based on the average flow rate for the peak month demand for irrigation users and for the average annual flow rate for commercial and industrial water users.

The nonpotable water demands for the potential commercial and industrial users were based on recent meter records for those obtaining their water from the EPWU and from USGS records of well production for those obtaining their water from private wells. Adjustments in these demand values were made in a limited number of instances to reflect changed conditions obtained from direct contacts with the users or discussions with EPWU staff.

An analysis of the available meter records for parks, cemeteries, golf courses, and yard meters served by the EPWU indicated considerable variation in both quantity used per acre and distribution patterns over the year. Both the peak month and total annual demands for the large lawn irrigators (commercial, institutional, and multiresidential complexes) were taken directly from the EPWU meter records where available. Similar values derived during development of the Water Resource Management Plan were used for the golf courses and cemeteries. Because of the large number of parks and high variability in recorded water use, standard monthly demand curves per acre of turf were developed for three zones:

Zone 1 - The northwest area served by the Northwest WWTP

Zone 2 - The northeast area served by the Fred Hervey WRP

Zone 3 - The central, east and southeast areas served by the Haskell Street WWTP and Roberto R. Bustamante WWTP

These standard unit demand curves were derived by averaging the recorded water usage for selected groups of parks in each of the three areas, using only those meter records which were complete and appeared to be normal, and assuming that, on the average, 80 percent of the total area of each park would be irrigated grass and trees. The adopted unit irrigation demands for parks in each of the three zones are shown graphically on Figure 3.1 for comparison. The monthly values in thousands of gallons per acre are listed in Table 3.2. The standard demand values for the peak month (June for Zone 1 and July for Zones 2 and 3) were multiplied by 80 percent of the area for each park to determine the peak month demand used to tentatively size the respective distribution supply pipelines.

TABLE 3.2

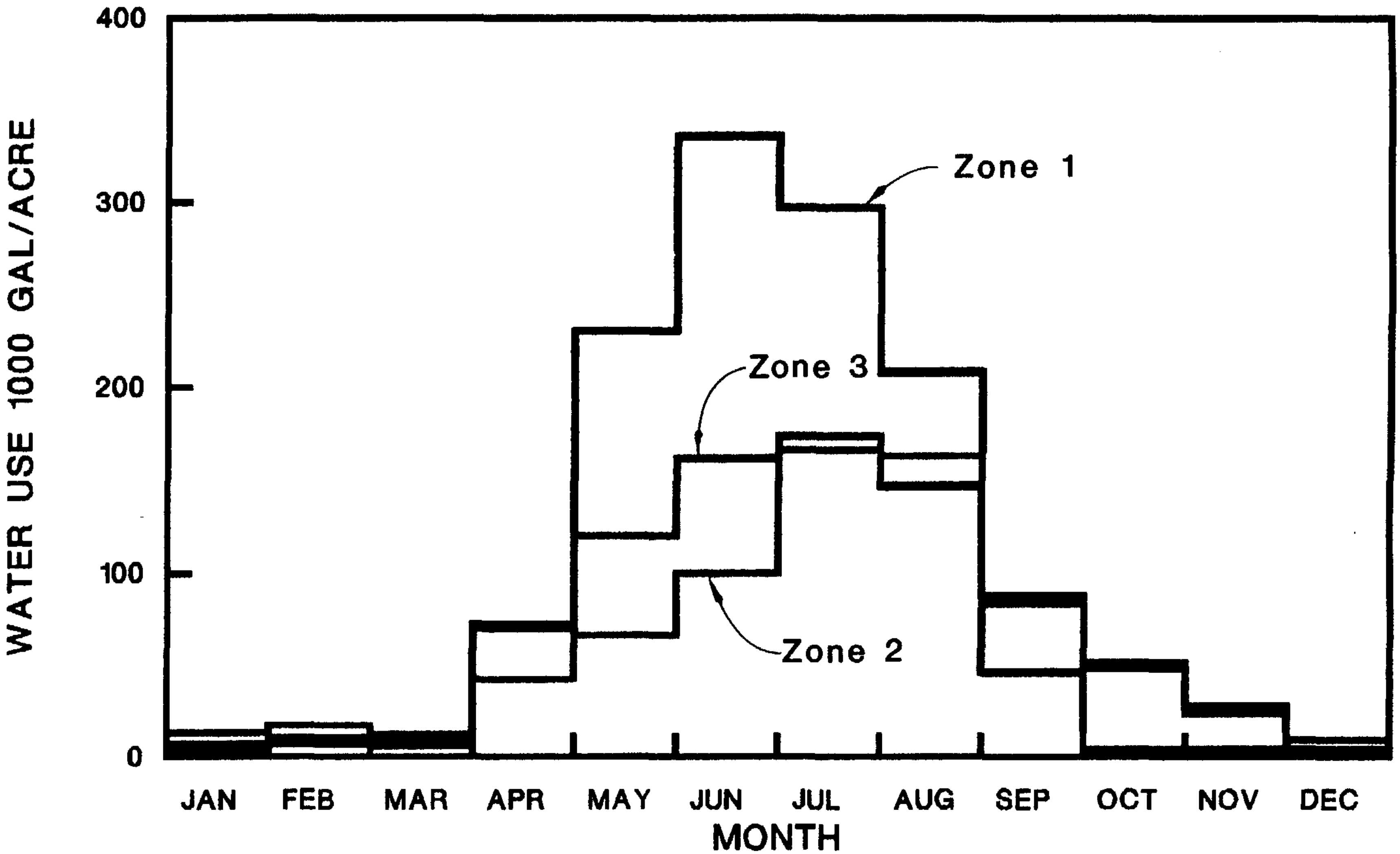
IRRIGATION DEMANDS FOR PARKS

(All in values in 1000 gallons per acre)

Month	Zone 1	Zone 2	Zone 3
January	7	13	2
February	10	17	7
March	8	12	6
April	70	42	72
May	230	66	120
June	336	100	162
July	297	166	174
August	208	163	147
September	46	83	88
October	4	51	48
November	4	23	28
December	4	9	3
Annual Total	1224	745	857

FIGURE 3.1

STANDARD IRRIGATION DEMANDS FOR PARKS



Reconnaissance-level comparative cost analyses of each preliminary wastewater reuse distribution system were prepared to determine rough estimates of the cost of delivering reclaimed water to the various potential customers. These costs of delivered wastewater were then used in a screening evaluation to eliminate potential customers having comparatively high costs of delivered wastewater. Tables C-1 through C-4 in Appendix C list the remaining potential customers connected to the four preliminary reclaimed water distribution systems. The potential customers are grouped according to whether they presently are, or would be, supplied potable water from the EPWU system or presently obtain groundwater from private wells. In some cases, potential customers who presently obtain water both from the EPWU and from private wells, are listed under both categories. Tables C-1 through C-4 also show the adopted peak month and total annual demands in thousands of gallons for each potential customer, the aggregate total potential use of reclaimed water, and the minimum and average annual reclaimed water volumes presently available from the wastewater treatment plant supplying each system. The volume of wastewater being discharged exceeds the potential demand for reclaimed wastewater in all four of the proposed wastewater reuse distribution systems.

The present availability of reclaimed effluent from each of the EPWU's four principal treatment plants was derived by averaging the records of monthly discharge at each plant for three to six years prior to and including 1990. The discharge of the Socorro WWTP was used to represent the new Roberto R. Bustamante WWTP due to lack of an adequate period of operating record for the Bustamante Plant. Figures 3.2 through 3.5 show the recent actual average and minimum monthly discharge patterns for the four wastewater treatment plants.

FIGURE 3.2

HASKELL STREET WASTEWATER TREATMENT PLANT
MINIMUM AND AVERAGE MONTHLY DISCHARGE

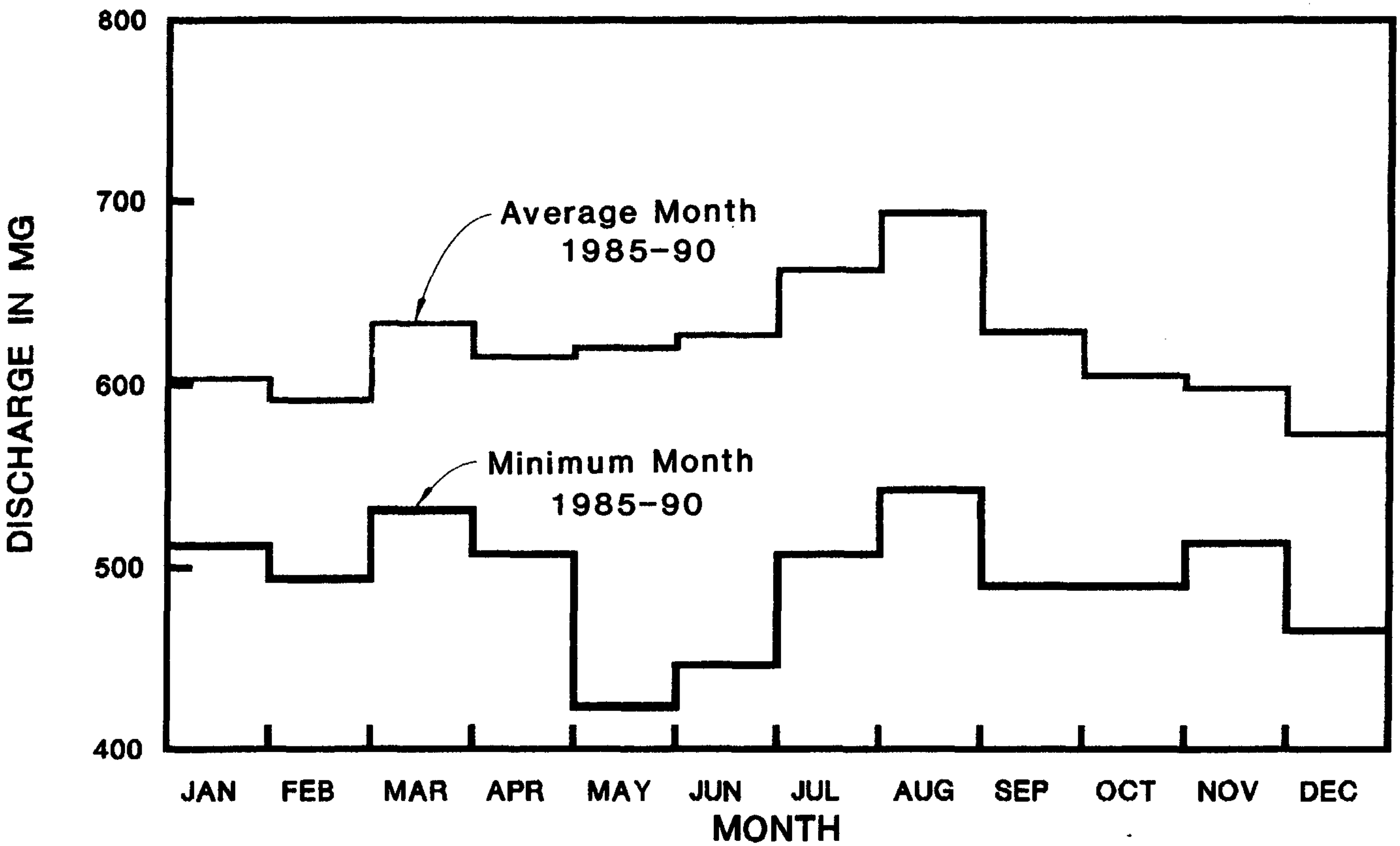


FIGURE 3.3

SOCORRO (BUSTAMANTE) WASTEWATER TREATMENT PLANT
MINIMUM AND AVERAGE MONTHLY DISCHARGE

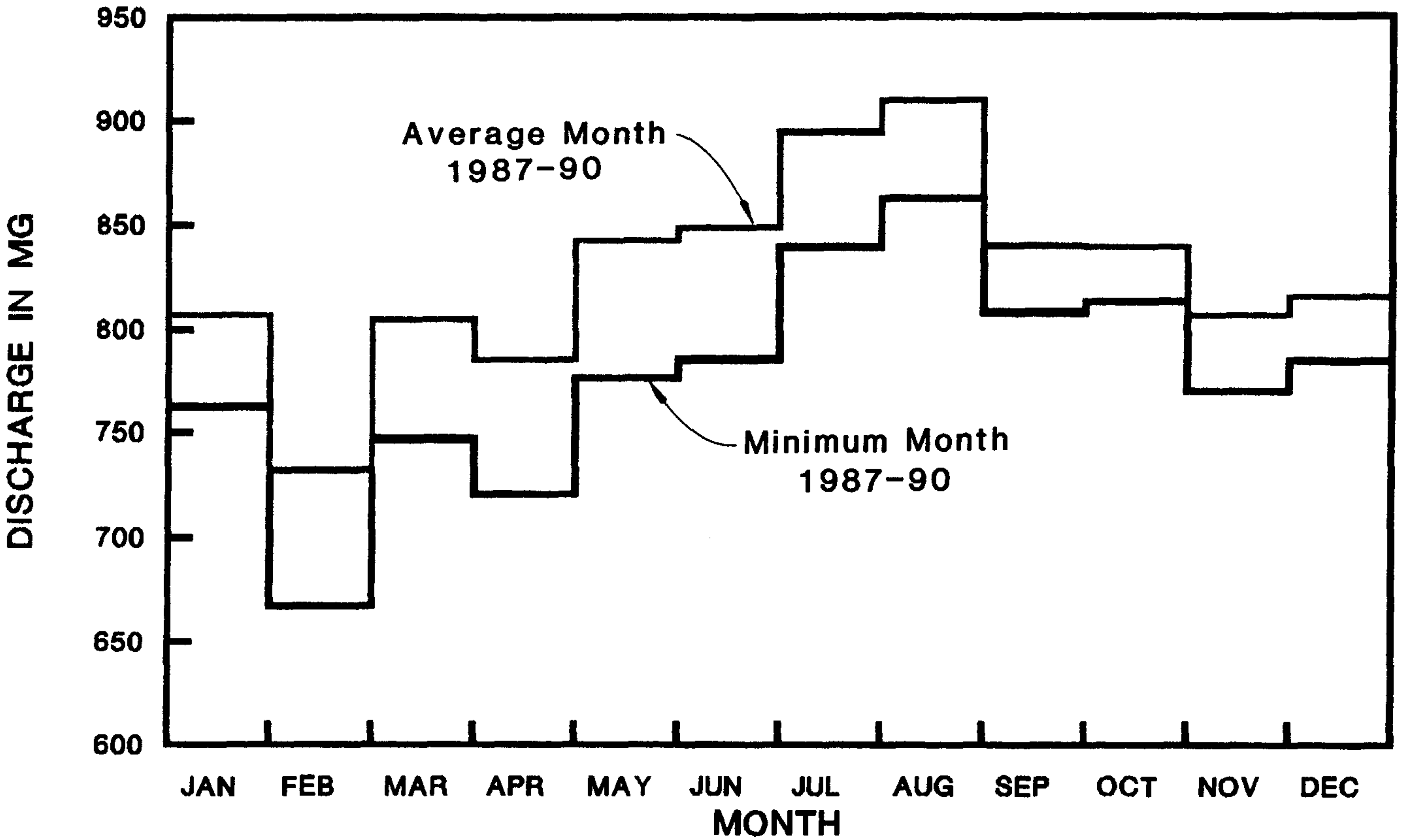


FIGURE 3.4

FRED HERVEY WATER RECLAMATION PLANT
MINIMUM AND AVERAGE MONTHLY DISCHARGE

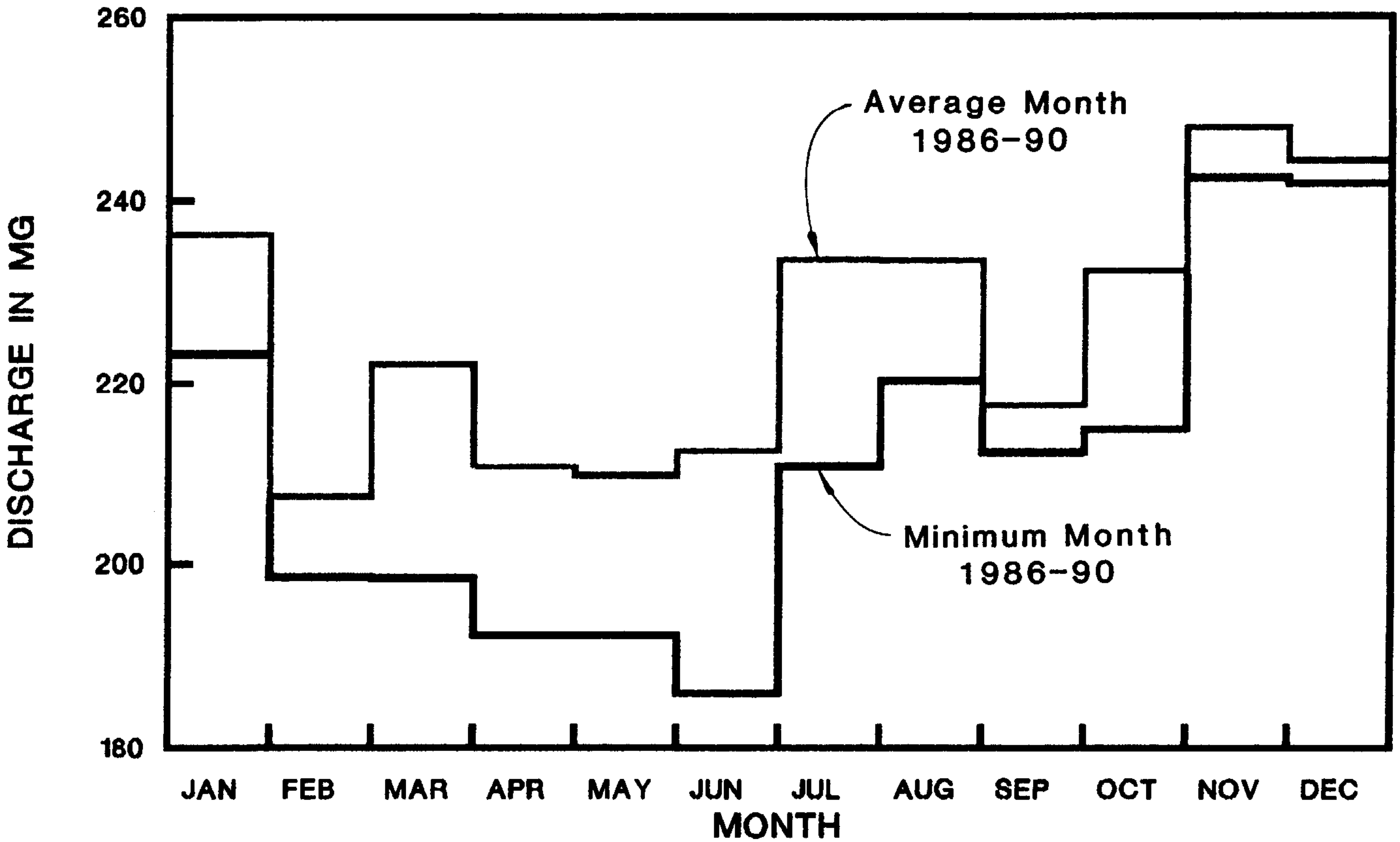
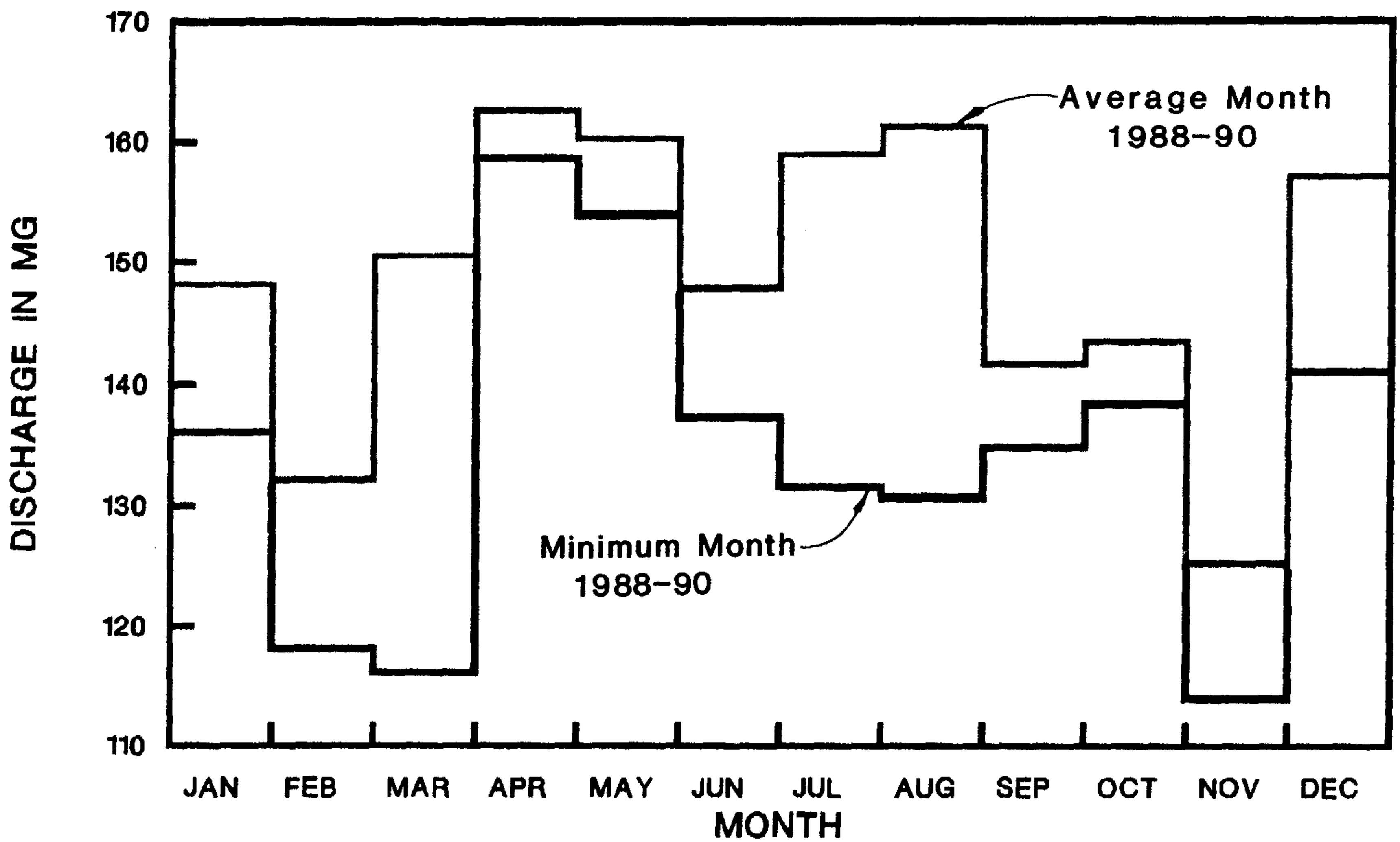


FIGURE 3.5

NORTHWEST WASTEWATER TREATMENT PLANT MINIMUM AND AVERAGE MONTHLY DISCHARGE



4.0 PROPOSED WASTEWATER REUSE SYSTEMS

4.1 GENERAL CONSIDERATIONS

In general, it is proposed that reclaimed wastewater distribution systems be constructed during the next ten years to serve the majority of the potential customers identified in the initial screening process. This conclusion is based on the following guidelines and assumptions developed in consultation with EPWU staff:

a. The EPWU intends to make a major commitment to implement substantial reuse of reclaimed wastewater starting immediately and plans to budget an average of about five million dollars per year in capital expenditures for this purpose over the next ten years, subject to Board approval.

b. In order to help persuade EPWU customers to use reclaimed wastewater in lieu of potable water, the rate charged for reclaimed wastewater delivered should be less than the comparable charges for potable water obtained from the EPWU or the customers' costs of pumping groundwater from private wells. Rates charged by the EPWU for reclaimed wastewater will be determined on the basis of individual analyses of the fixed and commodity costs of reuse service to each customer or group of customers.

c. Grants and other financial assistance will be aggressively solicited from the Texas Water Development Board, El Paso Community Foundation, and other agencies to subsidize the reuse of wastewater in instances where the EPWU's actual costs of delivering reclaimed wastewater exceed the rates that can be charged.

d. As a general precept, the wastewater reclamation and distribution systems from the EPWU's existing treatment plants will be developed in the order which will result in the greatest amount of reuse for the least capital expenditure. An exception to this rule will be the system to supply reclaimed wastewater from the Roberto R. Bustamante WWTP. The transmission line between the Bustamante WWTP and the EPWU's proposed Riverside International Industrial Center must be laid prior to completing the access road to the Center in 1993; however, the treatment and pumping components of the system will not be constructed until 1994-95.

e. To the extent that the above guidelines of maximizing the reuse for the expenditure can be achieved, the desired order of development of the wastewater reclamation and distribution systems should be:

   1) Haskell Street WWTP system

   2) Roberto R. Bustamante WWTP system

   3) Fred Hervey WRP secondary effluent distribution system

   4) Northwest WWTP system

f. The future North WWTP projected to be put on line early in the next decade is presently planned to be a zero discharge facility. Accordingly, it will be necessary to design and construct the wastewater reuse distribution system for the upper northwest area concurrent with the plant. Since most of the potential users which would be supplied from the North WWTP have not been established at the present time, the preliminary planning and feasibility assessment for the North WWTP distribution system should be deferred until late in the initial 10-year Capital Improvement Program (CIP), around FY 2001-2002.

4.2 SYSTEM LAYOUTS AND DESIGNS

The distribution systems serving the potential customers identified in the screening assessment were laid out on intermediate-scale (1"=2000 feet) maps of the EPWU water and sewer systems. In consultation with EPWU staff, optimum locations were determined for the reuse pipelines avoiding areas where utility easements are lacking and areas where boring and jacking and other high-cost construction techniques would be required. The preliminary reuse pipeline systems for each treatment plant were then designed in accordance with the following criteria:

a. Except in instances where irrigation customers provide their own on-site storage or where demand-side storage in the systems reduces peaking demands, the pipelines will be designed to carry peak flows equivalent to 3.0 times the average flow of the adopted peak month irrigation demand. Where practical, demand-side storage will be provided in the systems in order to reduce peak pumping demands and line sizes and to reduce variations in the operating pressures in the systems.

b. Pipelines serving irrigation customers with on-site storage capabilities, such as the Painted Dunes Golf Course, will be sized for the average flow of the adopted peak month demand.

c. Reuse pipelines serving commercial laundries and garment finishers will be sized for a peak flow of 1.5 times the adopted average demand to provide for 16-hour (two-shift) operations.

d. Reuse pipelines serving refineries and other industrial users will be sized for the average adopted flow without any peaking.

e. Various segments of the reuse distribution systems from each treatment plant will be conservatively sized and will be designed with a reserve capacity of 25 to 50 percent for future extension into developing areas. Assumptions used in sizing pipelines and storage and pumping facilities are indicated in the system cost summaries in Appendix D.

f. The distribution pipeline networks will be sized to carry the cumulative flows in all branches taking into consideration flows from both pumping and storage. No allowance will be made for scheduling of the peak demands so they will not occur simultaneously.

g. All secondary wastewater effluent to be reclaimed for all uses will be additionally treated at the EPWU's treatment plants by filtering and chlorine disinfection to meet the quality standards for irrigation of unrestricted landscaped areas and other applicable requirements set forth in Chapter 310, Subchapter A of the Texas Water Code.

h. Except in special cases, any additional treatment required for reuse by industrial customers will be the responsibility of the customers. In specific instances where it is determined to be more feasible, the EPWU may contract with one or more industrial users to provide the additional treatment, either at the EPWU's treatment plant or at a satellite site near the customer(s). In these cases the industrial customers would be charged higher rates for the reclaimed wastewater to cover the costs of additional treatment by the EPWU. The potential water requirements and necessary treatment for the refineries on the east branch of the Haskell Street WWTP system are discussed in Appendix F.

i. The wastewater distribution systems will be designed to supply a minimum pressure of 30 psi at service connections to provide for operation of sprinkler systems and will be designed to limit maximum service pressures to 100 psi. The upper end of the north branch of the Haskell Street WWTP system serving four irrigated areas on Fort Bliss will have service pressures less than 30 psi and special design considerations may be required.

The proposed reclaimed wastewater distribution systems for each of the EPWU's four existing wastewater treatment plants based on the above preliminary design concepts are shown on Figures 4.1 through 4.4. Post-secondary treatment facilities for each wastewater reclamation system will consist of rapid sand filters and chlorination equipment located at the wastewater treatment plants. These filtration and chlorination components are included in the expansion of the Northwest WWTP which is underway and have not been included in the cost of the reclaimed wastewater system facilities for the Northwest plant. Nominal equalization or clearwell storage will be provided between the rapid sand filters and the booster pump station at each treatment plant. The reclaimed effluent will be chlorinated at this point of storage. To meet peak demands and to provide more uniform system operating pressures, storage reservoirs will be located in the distribution systems at high points and at booster pump stations. An elevated storage tank will be necessary for the Bustamante WWTP system since there is no high ground available. The post-secondary filtering, chlorination, pumping, and distribution storage reservoirs required for each of the wastewater reuse systems consist of the following:

Treatment Plant	Filtration, Chlorination & Pumping Facilities (MGD)	Steel Tank Distribution Reservoirs (MG)
Haskell Street WWTP	19.5	1.2, 1.5
Roberto R. Bustamante WWTP	4.3	1.0 (elevated)
Fred Hervey WRP	3.0	1.0
Northwest WWTP	2.5	1.0, 0.8, 0.7, 0.65

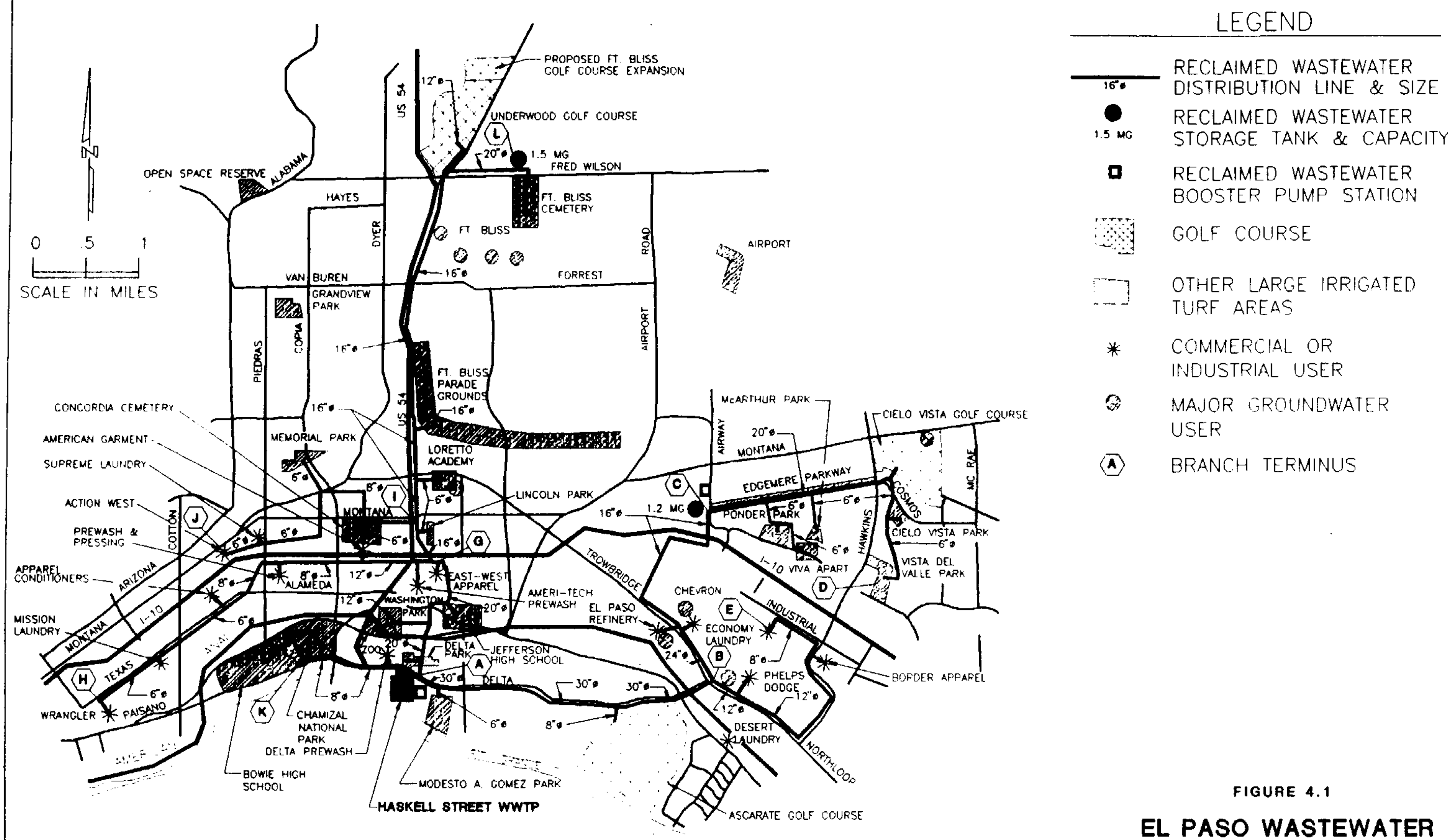


FIGURE 4.1

EL PASO WASTEWATER REUSE POTENTIAL HASKELL STREET WWTP

Boyle Engineering Corporation

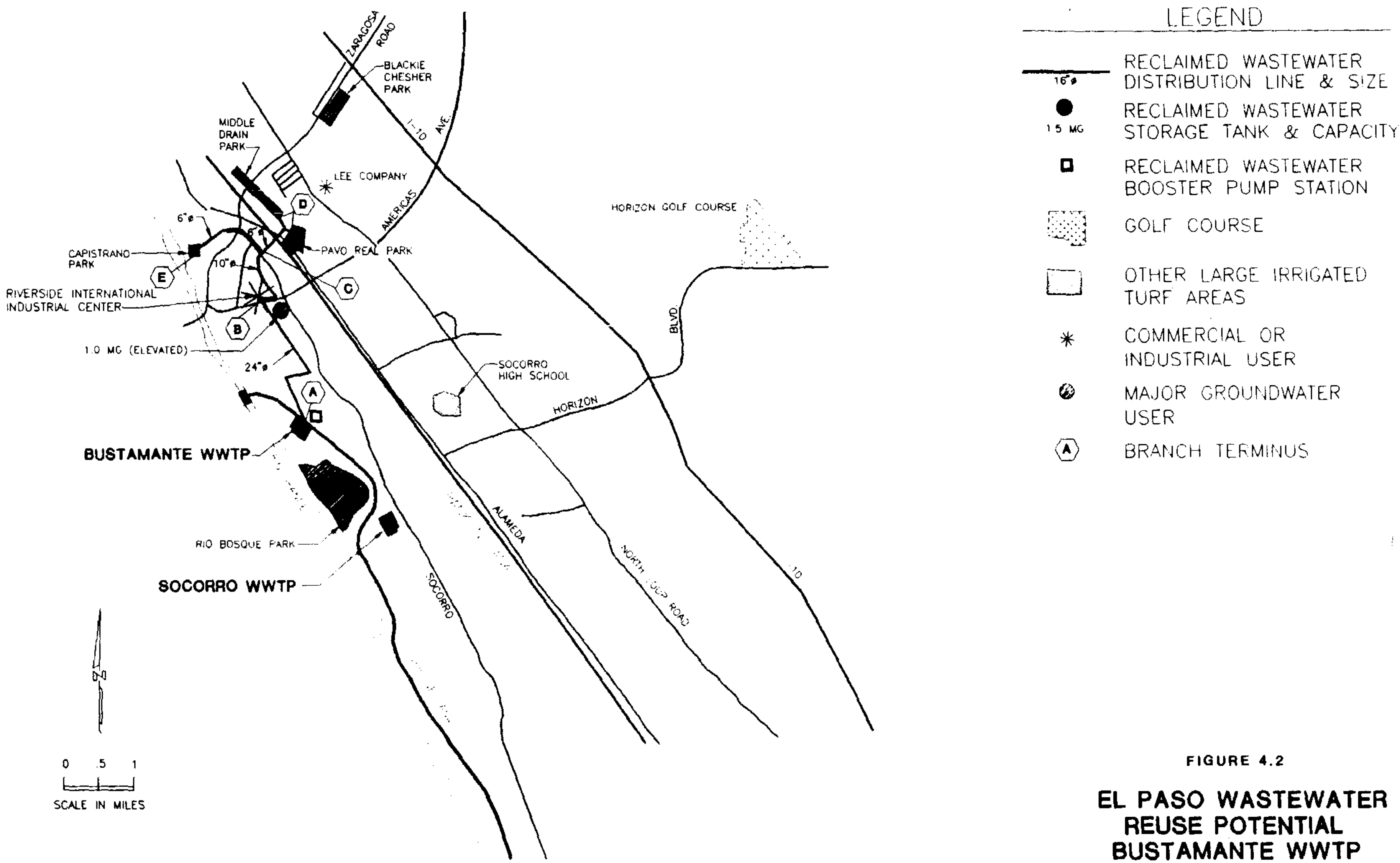
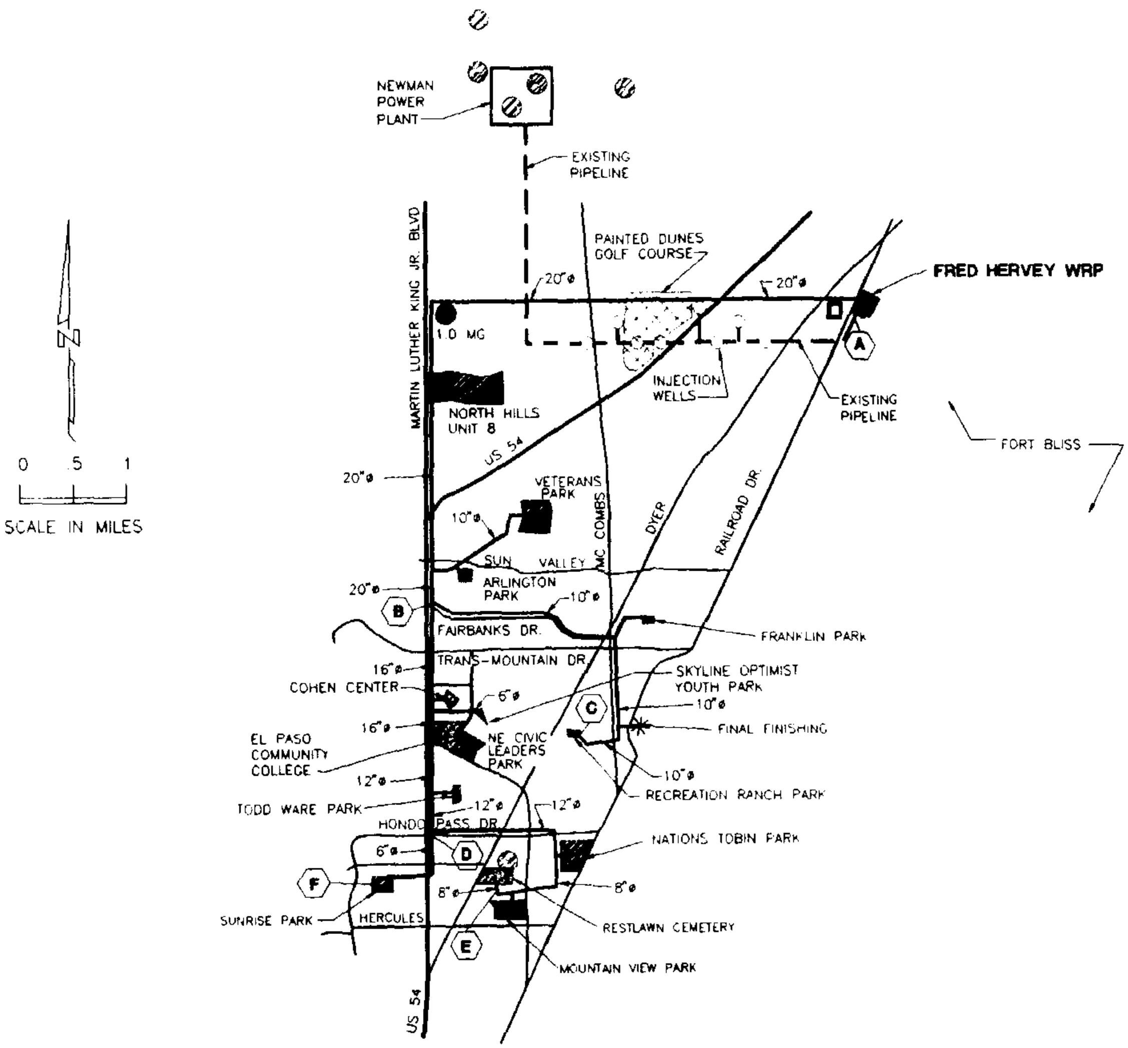


FIGURE 4.2

EL PASO WASTEWATER REUSE POTENTIAL BUSTAMANTE WWTP

Boyle Engineering Corporation



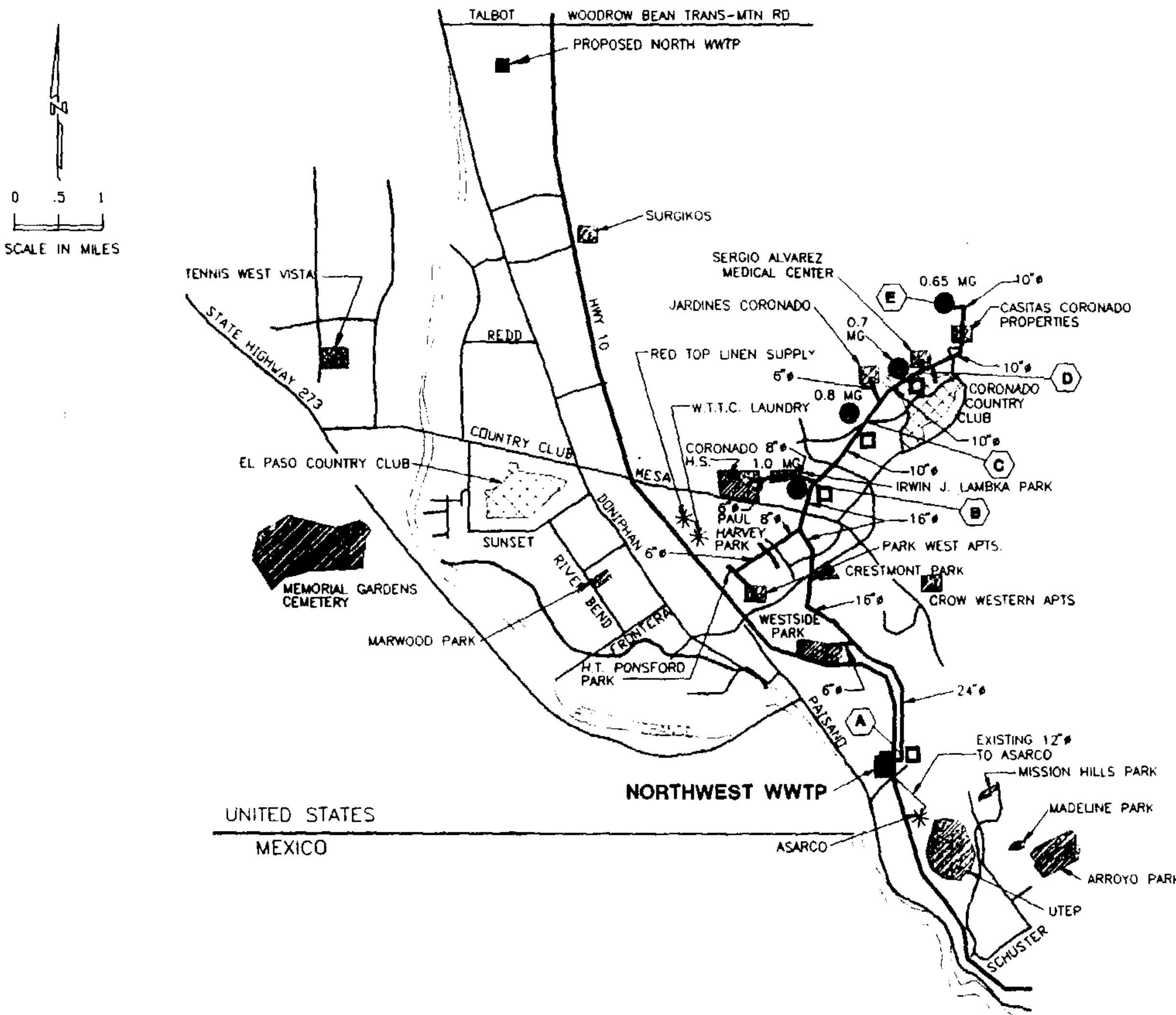
LEGEND

- 16"ø — RECLAIMED WASTEWATER DISTRIBUTION LINE & SIZE
- 1.5 MG — RECLAIMED WASTEWATER STORAGE TANK & CAPACITY
- RECLAIMED WASTEWATER BOOSTER PUMP STATION
- GOLF COURSE
- OTHER LARGE IRRIGATED TURF AREAS
- COMMERCIAL OR INDUSTRIAL USER
- MAJOR GROUNDWATER USER
- (A) BRANCH TERMINUS

FIGURE 4.3

EL PASO WASTEWATER REUSE POTENTIAL FRED HERVEY WRP

Boyle Engineering Corporation



LEGEND

- 16"ø — RECLAIMED WASTEWATER DISTRIBUTION LINE & SIZE
- 1.5 MG — RECLAIMED WASTEWATER STORAGE TANK & CAPACITY
- RECLAIMED WASTEWATER BOOSTER PUMP STATION
- GOLF COURSE
- OTHER LARGE IRRIGATED TURF AREAS
- COMMERCIAL OR INDUSTRIAL USER
- MAJOR GROUNDWATER USER
- BRANCH TERMINUS

FIGURE 4.4

EL PASO WASTEWATER REUSE POTENTIAL NORTHWEST WWTP

Boyle Engineering Corporation

The distribution storage reservoirs were sized to supply the peak daily demands with a constant rate of post-secondary treatment and to maintain system operating pressures between 30 and 100 psi by gravity. Steel tanks were selected for the distribution storage reservoirs on the presumption that space available at the high points in the system would not be adequate for excavated and lined open pond reservoirs, although open pond reservoirs would cost substantially less. Also, enclosed steel tank reservoirs may have fewer operating problems with algae and bacteria growth than open ponds.

4.3 ESTIMATED COSTS OF RECLAIMED WASTEWATER SYSTEMS

Using the layouts and preliminary designs of the four wastewater reclamation and reuse systems, estimates of the capital costs of constructing each system were prepared. The capital cost estimates are based on the following criteria and assumptions:

a. Unit pipeline and other construction costs were derived from "Means Construction Cost Data, 1992" adjusted by a factor of 79.8 percent to fit the El Paso area. These unit costs were compared with actual costs from similar construction where available and were further adjusted where considered necessary to fit local conditions.

b. All cost estimates are based on 1992 prices. No escalation was applied in developing the 10-year Capital Improvements Program (CIP) and evaluations of financial feasibility.

c. Contingencies included in the capital cost estimates were assumed to be 30 percent of the construction cost for pipelines and pumping stations, 20 percent for additional treatment facilities, and 10 percent for the steel tank distribution storage reservoirs.

d. The estimated capital costs also include an allowance of 15 percent of the construction cost for engineering and construction phase administration.

Table D-1 in Appendix D gives the capital costs per lineal foot for the various sizes of pipe used in the wastewater distribution systems, broken down into the principal components of the installed pipe cost. For ease of analyzing different scenarios of phased construction of the wastewater reuse systems to fit a workable CIP, the capital costs, consisting of the construction cost, contingencies and engineering and administration costs, were developed on a unit cost basis.

Ground elevations within each of the four proposed distribution systems were analyzed to determine pumping requirements. Each of the distribution systems requires a pumping station at the treatment plant. The Bustamante and Fred Hervey distribution systems will each have a single pressure zone. The Northwest WWTP distribution system requires booster pumping stations in the system and will have four pressure zones. The Haskell Street WWTP distribution system will have one pressure zone for most of the system, with a second pressure zone for the upper east branch (C-D). Service in Branch C-D along Edgemere Parkway will be boosted by pumping to meet demands since the elevation of the area will not accommodate on-line storage. The four potential irrigation services on Fort Bliss at the upper end of the north branch (I-L) will also require supplemental booster pumping to increase pressures sufficiently for sprinkler irrigation. Operating pressures in the distribution systems will range from 30 psi to 100 psi. Table D-2 in Appendix D gives the estimated construction and total capital costs of the pumping stations for each of the reclaimed wastewater distribution systems.

Estimated total capital costs of the wastewater reclamation and distribution systems for each of the four service areas were prepared using the pipeline quantities scaled from the preliminary layouts and the unit pipeline capital costs and the lump sum capital cost estimates of the pumping stations, treatment facilities, and storage tanks. The estimated total capital cost of the four wastewater reuse systems in 1992 dollars is:

Haskell Street WWTP System:	$	23,195,000
Roberto R. Bustamante WWTP System:		7,313,000
Fred Hervey WRP System:		9,779,000
Northwest WWTP System:		9,033,000
Total Capital Cost:	$	49,320,000

Details of the cost estimates for each of the four systems are given in Tables D-3 through D-6, respectively, in Appendix D. Table D-7 shows the total system capital and operating costs allocated among the main branches in each system and the comparative unit cost of delivered reclaimed wastewater for each branch. The main branches in each system are designated by letters at their junctions and end points as shown on Figures 4.1 through 4.4. The costs of treatment facilities, booster pump stations, main trunk lines, storage tanks and other components common to more than one branch were allocated among the branches in proportion to the reclaimed wastewater volumes handled.

Capital construction cost estimates were prepared for a representative residential area to assist in deciding if installation of dual pipeline systems to distribute reclaimed wastewater for lawn irrigation should be included in the wastewater reuse systems. Layouts of a dual pipeline residential distribution system were made on a large-scale plot of the North Hills Unit 8 Subdivision, containing 282 lots. Comparative cost estimates were made for this subdivision for two conditions: one on the basis of installing the dual pipeline reuse system initially, along with other utilities construction at the time the subdivision is developed; and the second for retrofitting the reuse distribution system in an existing subdivision. The comparative capital construction costs for residential dual pipeline reuse distribution systems given in Table 4.1 amount to $2,140 per lot if installed at the time of subdivision development and $2,620 per lot (22.4 percent more) for retrofitting in an existing subdivision. These estimates are for the distribution network within the subdivision only, and do not include the proportional costs of the reuse system between the treatment plant and the subdivision. When the proportional costs of the reuse system between the treatment plant and the subdivision are added, the costs in relation to amount of wastewater reuse are comparatively high. For this reason, along with the political and environmental concerns mentioned in Section 1.0, it was concluded that retrofitting of reuse pipeline systems in existing subdivisions in the four proposed reuse service areas will not be feasible at this time. However, the installation of reuse pipeline systems should be re-evaluated in the future on a case-by-case basis for new developments.

TABLE 4.1

ESTIMATED COST OF RESIDENTIAL DUAL PIPELINE SYSTEMS

NEW CONSTRUCTION

ITEM	QUANTITY/ UNIT	UNIT COST	TOTAL COST
8" PIPE	1,100 LF	$ 26.00	$ 28,600
6" PIPE	9,000 LF	21.50	193,500
8" VALVES	3 EA.	765	2,295
6" VALVES	10 EA.	430	4,300
8" FITTINGS	LUMP SUM	-	1,115
6" FITTINGS	LUMP SUM	-	2,100
1 1/2 SERVICES	6,000 LF	1.75	10,500
METERS	282 EA.	240	67,680
BACKFLOW PREVENTER	282 EA.	375	105,750
SUBTOTAL- CONSTRUCTION COST			$415,840
ENGINEERING (15%)			62,408
CONTINGENCIES (30%)			124,752
TOTAL CAPITAL COST			**$603,000**

RETROFIT EXISTING RESIDENTIAL AREA

ITEM	QUANTITY/ UNIT	UNIT COST	TOTAL COST
8" PIPE	1,100 LF	$30.50	$33,550
6" PIPE	9,000 LF	26.00	234,000
8" VALVES	3 EA.	765	2,295
6" VALVES	10 EA.	430	4,300
8" FITTINGS	LUMP SUM	-	1,115
6" FITTINGS	LUMP SUM	-	2,100
1 1/2 SERVICES	6,000 LF	1.75	10,500
METERS	282 EA.	240	67,680
BACKFLOW PREVENTER	282 EA.	375	105,750
TRENCHING FOR SERVICE LINES	6,000 LF	3.50	21,000
PAVEMENT REPLACEMENT FOR SERVICE LINES	6,000 LF	4.50	27,000
SUBTOTAL- CONSTRUCTION COST			$509,290
ENGINEERING (15%)			76,710
CONTINGENCIES (30%)			153,000
TOTAL CAPITAL COST			**$739,000**

4.4 RECOMMENDED 10-YEAR RECLAIMED WASTEWATER CIP

The total capital cost of $49.3 million for development of the four reuse systems proposed to serve existing users is within the budget commitment of $50 to $60 million being considered by the EPWU. Assuming that necessary financial assistance and subsidies can be obtained to construct all of the systems and connections shown on Figures 4.1 through 4.4, a CIP for planning and construction of all four systems over the next ten years was developed. Scheduling of the CIP was based on the system priority guidelines discussed in Section 4.1. To accomplish a reasonably workable expenditure track, design and construction of the reclaimed wastewater distribution systems were scheduled in phases as follows:

<u>Haskell Street WWTP System</u>

Phase 1 - One-half of the treatment facilities at the plant, the pumping facilities at the plant, the east trunk line (Trunk A-B-C) and 1.2 MG storage tank serving the refineries, and Branch B-E.

Phase 2 - Second-half of the treatment facilities at the plant, the north trunk line (Trunk A-G-I-L) and 1.5 MG storage tank, Branch A-K, Branch G-H, and the booster pump station for Branch C-D.

Phase 3 - Branch C-D and Branch I-J.

<u>Roberto R. Bustamante WWTP System</u>

Phase 1 - The trunk line (Trunk A-B) serving the Riverside International Industrial Center.

Phase 2 - The treatment and pumping facilities at the plant and the 1.0 MG elevated storage tank.

Phase 3 - Branch B-C-D and Branch C-E.

Fred Hervey WRP System

Phase 1 - The treatment and pumping facilities at the plant, the 1.0 MG storage tank, and the first portion of the main trunk line (Trunk A-B).

Phase 2 - Trunk B-D, Branch B-C, Branch D-E, and Branch D-F.

Northwest WWTP System

Phase 1 - Trunk A-B, including Booster Pump Station No. 1 and 1.0 MG storage tank, and Trunk B-C, including Booster Pump Station No. 2 and 0.8 MG storage tank.

Phase 2 - Trunk C-D, including Booster Pump Station No. 3 and 0.7 MG storage tank, and Trunk D-E, including Booster Pump Station No. 4 and 0.65 MG storage tank.

The post-secondary filtration and disinfection facilities for the Northwest WWTP are included in the expansion of that plant which is currently under way. Therefore, the capital costs for these facilities have not been included in the estimated costs for the Northwest WWTP.

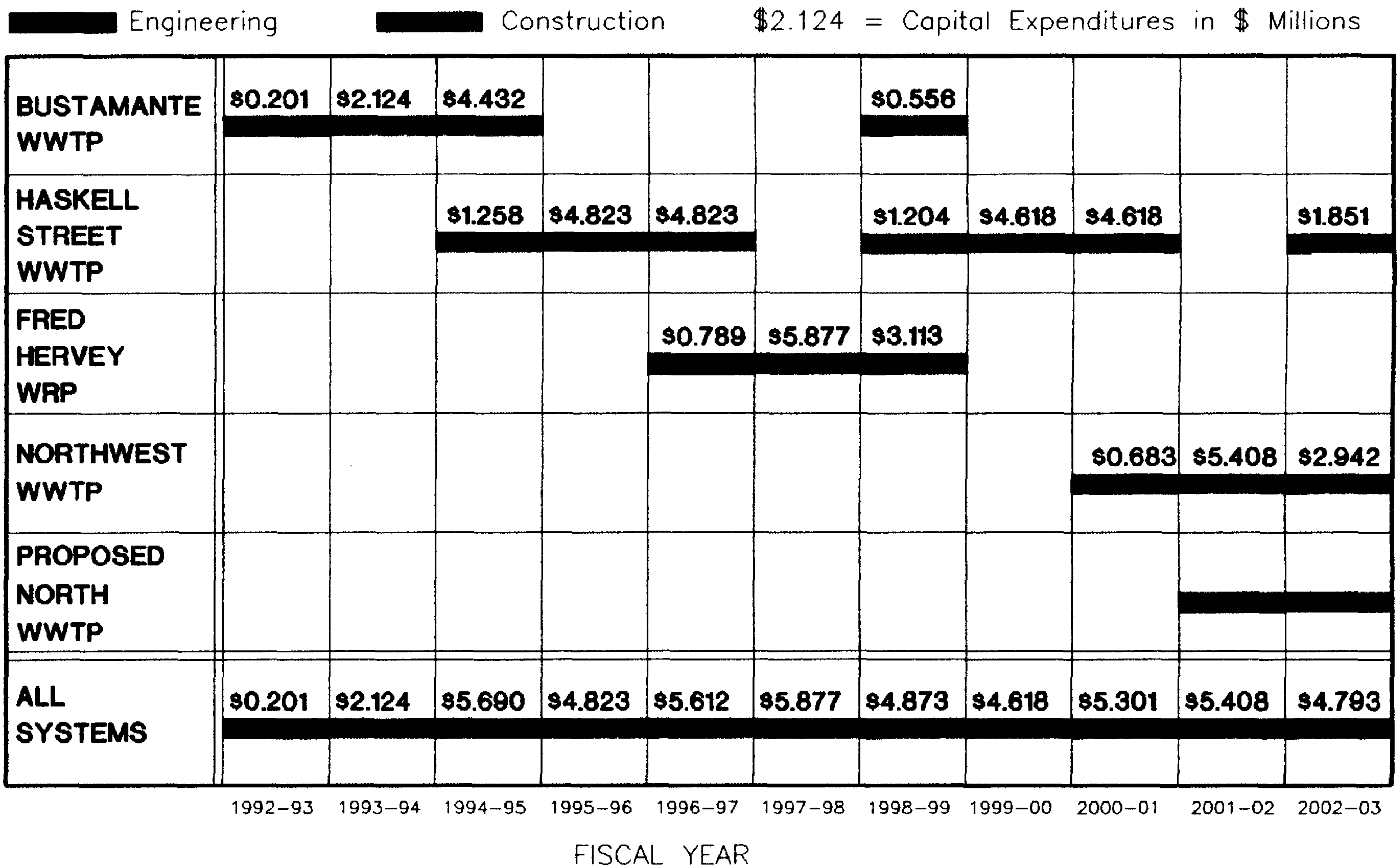
Figure 4.5 graphically portrays the proposed 10-year wastewater reuse CIP. Table D-8 in Appendix D contains a detailed breakdown of the CIP components for the four proposed systems. Although the costs are not included in the CIP, it is envisioned that the planning, design and construction of the reclaimed wastewater reuse system for the proposed North WWTP would commence in FY 2001-2002 and continue through FY 2003-2004, utilizing the balance of the 10-year budget committed to development of wastewater reuse.

4.5 DELIVERED COST OF RECLAIMED WASTEWATER

A composite average cost of delivering the reclaimed wastewater to all of the potential customers was estimated for each principal branch and for the total system. The average delivered costs consist of the estimated annual operation and maintenance (O&M) costs for each system component plus the debt service (capital recovery) for financing the capital construction costs of each system component at 6.5 percent interest for 20 years, divided by the total volume of reclaimed wastewater delivered annually (from Tables C-1 through C-4) by the respective system components. In determining the average unit costs of delivering

FIGURE 4.5

SCHEDULE FOR WASTEWATER REUSE SYSTEMS CAPITAL IMPROVEMENTS



reclaimed wastewater, capital and operating costs for treatment facilities at the plants, trunk lines serving several branches, and other components common to two or more sections of the systems were distributed among the respective branches in proportion to the relative amounts of wastewater distributed by each branch.

The O&M costs for the rapid sand filters include the cost of pumping the wastewater through the filter and polymer feed systems to reduce turbidity. Booster pump station power requirements were calculated for the estimated total dynamic head required and an overall efficiency of 70 percent. Operating times for each system were estimated from the relative amounts of irrigation and industrial demands. Electric power costs for pumping were calculated using a rate of $0.071 per kilowatt-hour. All O&M costs were estimated in 1992 dollars. Table 4.2 gives a summary of the estimated O&M costs and the composite cost of delivered reclaimed wastewater for each system.

The composite unit costs of delivered reclaimed wastewater are generally feasible and economical. The Northwest WWTP distribution system is estimated to have the highest average total system unit cost of delivered reclaimed wastewater and was, therefore, given the lowest priority for development. The relatively higher costs for the Northwest System result from the major potential customer (the Coronado Country Club) being located at a high elevation near the end of the system and because the major portion of the distribution system consists of the main trunk line and a series of booster pump stations and storage tanks.

The Bustamante WWTP distribution system has the apparent lowest total system average unit cost of delivered reclaimed wastewater. It was given a high priority for development for this reason coupled with the desirability of constructing the main trunk line to the Riverside International Industrial Center prior to the access road to the Center being surfaced. The comparative low average unit cost of delivered reclaimed wastewater for the Bustamante system results from the relatively short distance from the WWTP to the major customer, the general lack of development in the area, and the easy terrain for pipeline construction.

The Haskell Street WWTP distribution system has a comparatively low total system average unit cost of delivered reclaimed wastewater because of the large concentration of potential customers relatively close to the plant.

All of the average delivered costs are considerably higher than the costs reported by some users for obtaining groundwater from private wells. The final cost of delivered reclaimed wastewater to individual users will depend on how many of the potential users can be

TABLE 4.2

O&M COSTS AND AVERAGE DELIVERED COST OF RECLAIMED WASTEWATER

Component	Haskell St WWTP System	Bustamante WWTP System	Fred Hervey WRP System	Northwest WWTP System
Filtration	$ 773,000	$ 150,000	$ 70,000	$ 71,300
Chlorine Disinfection	163,000	42,600	22,400	22,700
Distribution Facilities Maintenance	72,000	30,000	24,000	56,000
Pumping Power Cost	278,400	44,300	20,800	57,700
TOTAL ANNUAL O&M COSTS	$ 1,286,400	$ 266,900	$ 137,200	$ 207,700
CAPITAL RECOVERY (20 years @ 6.5%)	$ 1,105,100	$ 663,700	$ 887,500	$ 819,800
TOTAL ANNUAL COST	$ 3,391,500	$ 930,600	$ 1,024,700	$ 1,027,600
ANNUAL VOLUME DELIVERED	4,365 MG	1,503 MG	409 MG	367 MG
AVERAGE DELIVERED COST PER 1,000 Gal.	$ 0.78	$ 0.62	$ 2.51	$ 2.80

contracted to use reclaimed wastewater, the availability of financial subsidies, and the method adopted for allocating the treatment, storage and distribution costs to individual customers.

4.6 CONCLUSIONS

1. Current reclamation and reuse of wastewater in El Paso, other than the injection of advanced tertiary treated water from the Fred Hervey WRP into the Hueco Bolson, averages about 1.73 MGD, which is approximately 1.7 percent of the present demand on the EPWU potable water system.

2. Potential development of an average reuse of over 18 MGD of reclaimed wastewater by the year 2000 has been identified in this study. This is three times the amount of reuse predicted for the year 2000 in the Water Resource Management Plan and will amount to about 16.5 percent of the projected EPWU's net demand by that time.

3. The identified potential reuse is principally process water for commercial and industrial uses, with a smaller portion for irrigating golf courses, public parks, and other large turf areas. There does not appear to be any political constraints nor public objections in the El Paso area to this extent of reuse.

4. Subject to the willingness of the prospective customers, development of substantially all of the identified potential reuse appears to be technically and economically feasible within the budgetary guidelines being considered by the EPWU. Development of all of the potential reclaimed wastewater reuse identified in this study is estimated to cost approximately $49.3 million at 1992 prices.

5. The willingness of potential reclaimed wastewater customers to switch over to reusing reclaimed wastewater will probably be governed by the delivered reclaimed wastewater rates developed by the EPWU for this service. The actual cost of service in turn will be dependent on the percentage of the total number of potential customers identified in this study which contract with the EPWU for reclaimed wastewater service.

6. Because of the scarity of additional raw water supplies for the El Paso area and the continuing need to develop acceptable potable water service to the colonias, the TWDB should be approached regarding establishment of grants or other financial assistance specifically designated for the development of reuse of reclaimed wastewater.

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REPRESENTATIVE WASTEWATER REUSE PROJECT DESCRIPTIONS

APPENDIX A

WASTEWATER REUSE PROJECT NO. 1

CITY OF AURORA, COLORADO

TYPES OF USES

Turf irrigation

DESCRIPTION

Additional treatment, irrigation of 300 acres of city parks. Capacity is 2.5 MGD, but utilization is low at .25 to .38 MGD. In operation since the early 1960's.

REFERENCES

Phone conversation with Darrell Hagen, Sewer Superintendent, City of Aurora, Colorado (303) 695-7000

STATISTICS

Volume

130 AF/year (based on 0.25 MGD for 6 months per year)

Additional Treatment

Filtration and disinfection

Costs

Current costs of reclaiming are not separate from total wastewater treatment and disposal.

Estimated in feasibility study for an expanded system of 9300 AF/year

	Cost ($/1000 GAL)
Capital, Annual	
Treatment System	0.06
Transmission Pumping	0.02
Transmission System	0.23
Storage	0.02
Distribution Pumping	0.02
Distribution System	0.28
Operations & Maintenance	
Treatment System	0.16
Pumping System	0.23
TOTAL	1.02 ($332/AF)

Wastewater Reuse Project No. 1 (Cont.)

Fees Charged

Same as for potable water. (Only user is the City Parks Department.)

Financing

Information not available.

Potable Water Charges

$1.36/100 CF ($593/AF)

COMMENTS

Although the City did a feasibility study to expand its reclaimed wastewater program, there are no immediate plans to expand the system. Present raw water supply is sufficient due to less growth and a new raw water reservoir coming on line. Future plans will probably not include the expansion of a dual transmission/distribution system due to high cost. A possibility in the future may be tertiary treatment of wastewater and pumpback to raw water reservoir(s) for reuse in potable water system.

WASTEWATER REUSE PROJECT NO. 2

CITY OF COLORADO SPRINGS, COLORADO

TYPES OF USES

Landscape and turf irrigation; construction, such as dust control.

DESCRIPTION

Additional treatment, 5.5 mile transmission line, plus 7.5 miles of distribution lines. 5 MGD capacity. Extensive sampling program to assure high quality water. Initiated in 1957.

REFERENCES

Phone conversation with James Phillips, Utility Director. City of Colorado Springs (303) 636-1212

Health Effects of Reused Water for Public Park Irrigation, Proceeding: Implementing Water Reuse, August, 1987

Water Reuse Via Dual Distribution Systems, EPA, 1985

STATISTICS

Volume

2760 AF/Yr (Based on 5 MGD average for 6 months per year)

Additional Treatment

Filtration and disinfection. System can provide tertiary treatment, but this high level of treatment is not required by the Colorado Department of Health and is therefore not generally used due to cost.

Costs

Information not available

Fees Charged

$.54/100 CF ($235/AF)

Financing

No outstanding debt.

Potable Water Charges

$1.22/100 CF ($531/AF)

Wastewater Reuse Project No. 2 (Cont.)

COMMENTS

Wastewater reclamation was initiated in 1957 during a severe drought. No treatment criteria were directly applicable at the time but the City voluntarily complied with Colorado Health Department Guidelines for review of land application wastewater treatment systems: 200 fecal coliforms/100 mL. No outbreaks of water-borne disease have been associated with the system. In 1982, when the wastewater treatment plant discharge permit was renewed, a more stringent treatment standard was proposed for the reclaimed wastewater: 23 fecal coliforms/100 mL, based on California standards. Colorado Springs undertook an epidemiology study which showed no significant difference in the incidence of gastrointestinal symptoms in patrons of parks irrigated with reclaimed wastewater and patrons of parks irrigated with potable water.

There are no immediate plans to expand the reclaimed wastewater system at present. The City has effectively exchanged its reuse water rights to imported trans-mountain water to a point upstream of the City raw water intake. This exchange and the current reuse program provide an ample raw water supply for the near future.

WASTEWATER REUSE PROJECT NO. 3

EAST BAY MUNICIPAL WATER DISTRICT

SAN FRANCISCO, CALIFORNIA

TYPES OF USES

Refinery cooling towers (Chevron)

DESCRIPTION

Secondary effluent is treated and delivered to power plant

REFERENCES

Phone conversation with Judy Parker, (415) 835-3000

Model Study Report

STATISTICS

Volume

5 MGD

Additional Treatment

High lime addition in reactor clarifier, acid addition, filtration, chlorination.

Costs

$25.5 million includes design, construction management, construction

Fees Charged

100% of potable water charges, but give user discount for required on-site construction costs and capital improvements of approximately $3 million, also give user discount because need to use 15% more reclaimed water than potable water. With these discounts taken into account, fees charged are 85% of potable water charges.

Financing

$22 million in state loans at 3.5% interest.

Potable Water Charges

$457/AF

Wastewater Reuse Project No. 3 (Cont.)

COMMENTS

Lime treatment yields 25,000 pounds of lime sludge. Disposal is a problem. Using filter press to get 50% solids. Post-secondary treatment selection was aided by a Nalco model cooling tower to simulate effects of treated water on metals. Chrome-zinc anti-corrosion additive to the cooling water had to be changed to a polymer phosphate compound to meet discharge requirements. Cooling water was cycled 8 times.

Filtration or RO might have been a better post-secondary treatment process.

WASTEWATER REUSE PROJECT NO. 4

LOS ANGELES COUNTY, CALIFORNIA

TYPES OF USES

Groundwater recharge

DESCRIPTION

Groundwater recharge program in conjunction with local surface runoff and imported water. Over 800 acres of percolation basins and unlined river channels. System initiated in 1960's.

REFERENCES

Phone conversation with Earl Hartling, L.A. County Sanitation District, (213) 699-7411.

"Conjunctive Use Operations in the Central and West Coast Basins of Los Angeles County", Richard R. Rhone and William D. O'Brien, Proceedings of U.S. Committee on Irrigation and Drainage, 1991.

"Expanding the Use of Reclaimed Water in Los Angeles County", Earle C. Hartling, Proceedings of Water Reuse Symposium, IV, 1987.

STATISTICS

Volume

50,000 AF/YR - limited by Regional Water Quality Control Board (over 75,000 AF/YR is available)

Additional Treatment

Tertiary treatment and disinfection less than 1 fecal coliform per 100 ml.

Unit Costs

No additional cost associated.

Fees Charged

$10.00/AF (least expensive to purchase for recharge)
Untreated imported water $115 to $153/AF

Financing

None required.

Potable Water Charges

Information not available.

Wastewater Reuse Project No. 4 (Cont.)

COMMENTS

Recharge using reclaimed water is limited to a total of 50,000 AF/YR by the Regional Water Quality Control Board. However, the amount of effluent available for recharge is over 75,000 AF/YR. (Los Angeles County uses reclaimed water for irrigation and manufacturing but 66% is used for groundwater recharge. Flood control channels are used to deliver the effluent by gravity flow to the spreading basins). No extra treatment costs are associated with the reuse program. Tertiary treatment is already required because receiving waters are designated for un-restricted recreation uses. The effluent generally meets EPA and State standards for drinking water.

A health effects study, completed in 1984, showed no detectable health problems in those people ingesting groundwater containing treated effluent from reclaimed water recharge.

WASTEWATER REUSE PROJECT NO. 5

CITY OF PHOENIX, ARIZONA

TYPES OF USES

Turf and farm irrigation, industrial cooling, exchange.

DESCRIPTION

Three City sponsored primary components: 1) delivery to Palo Verde Nuclear Generating Station, contract amount 57,260 AF/year; 2) delivery to Buckeye Irrigation Company, contract amount 18,525 AF/year; and 3) delivery to the Arizona Department of Game and Fish, contract amount 8,000 AF/year. Also, several developer-sponsored components treat and reuse wastewater for turf irrigation. The wastewater used varies considerably from contract amounts.

REFERENCES

Phone conversation with William Mee, Water Conservation & Resources Administrator, City of Phoenix, Arizona.

Phoenix Water Resources Plan, City of Phoenix, 1990

STATISTICS

Volume

84,000 AF/year commitment, actual use varies considerably. Plant capacity is 145,000 AF/year.

Additional Treatment

Secondary effluent delivered directly to Palo Verde Plant, they provide additional treatment

Costs

No upgrade to treatment plant was required.

Fees Charged

$30/AF

Financing

None required.

Potable Water Charges

$400/AF

Water Reuse Project No. 5 (Cont.)

COMMENTS

Additional turf irrigation as well as potable reuse are planned. Dual systems for turf irrigation will be required of developers.

In the northern part of the City, future plans call for reuse of essentially all generated wastewater. Secondary effluent will be used directly for turf irrigation. Treated secondary effluent (treatment will probably be RO, to remove salts) will be used for ground water recharge.

WASTEWATER REUSE PROJECT NO. 6

CITY OF ST. PETERSBURG, FLORIDA

TYPES OF USES

Landscape irrigation, industrial, groundwater recharge

DESCRIPTION

Initiated in 1977. All city wastewater from 4 plants is used - none is discharged to surface waters. The largest effluent spray irrigation system in the United States.

REFERENCES

"Water Reuse 2000: Trends influencing change", Garret P. Westerhoff, P.E., and Judy Berclun, Proceedings of Water Reuse Symposium IV, 1987.

"The Unique Benefits/Problems When Using Reclaimed Water in a Coastal Community", William D. Johnson, Dr. John R. Parnell, Proceedings of Water Reuse Symposium IV, 1987.

Phone conversation with Joseph Towry, St. Petersburg Water Treatment Department, St. Petersburg, Florida.

STATISTICS

Volume

68.4 MGD capacity, currently 42 MGD is treated and 21 MGD is reused.

Additional Treatment

Filtration and disinfection

Costs

No additional cost associated with the treatment. Initial $110 million investment includes upgrade of existing treatment plants and installation of 264 miles of distribution mains.

Fees Charged

Monthly Fees
$10.36/AF for first AF
$5.92/AF for additional

Wastewater Reuse Project No. 6 (Cont.)

Industrial Fees

$.30/1000 gal ($97.75/AF)

In addition

- Connection fees begin at $180.00 for 3/4" service
- Backflow prevention device and proportionate share of main extension - $500 (single user) to $85,000 (large development)
- Usually less than 30 month recovery for setup fees

Financing

Project completed in several stages. EPA grants and Federal funding covered 55% to 70% of cost depending on phase.

Potable Water Charges

$1.08/100 CF for first 10,000 CF ($470/AF)
$1.18/100 CF for next 20,000 CF ($514/AF)
$1.27/100 CF for remainder ($553/AF)

COMMENTS

The State of Florida requires advanced treatment for wastewater treatment plants discharging into the Tampa Bay area, so no extra treatment cost is required for reuse. Approximately 50% of reclaimed water is used for deep well injection. The remainder is used for industrial and irrigation. Residential homeowners account for more than 33% of the 5500 total acreage under irrigation. Parks, schools, commercial acreage and golf courses comprise the remaining acreage. A treated wastewater main ties all four treatment plants together, eliminating supply and pressure drop problems. Four ground storage tanks with a capacity of 23 million gallons allow for nighttime pumping. The system is expanded on a petition basis. One half of the property owners in a given area must want the project for extension. The property owners pay 50% of the extension costs over a three year period. The city pays the remaining 50% and recovers the cost as more property owners hook up to the project.

WASTEWATER REUSE PROJECT NO. 7

CITY OF TUCSON, ARIZONA

TYPES OF USES

Turf irrigation (reclaimed), golf course irrigation (secondary effluent)

DESCRIPTION

Additional treatment, pumping, 85 miles of transmission and distribution pipelines. System initiated in 1984.

REFERENCES

Phone conversation with Kirk Guilde, Chief Planning Engineer, Tucson Water, (602) 791-2685

Tucson Water, Capital Improvement Program 1991/1992 - 2000/2001, July 1991

Development of 110-Year Water Resources Plan for Tucson, Arizona, Proceedings of Conserv 90, August 1990.

STATISTICS

Volume
5.4 MGD average, 13 to 15 MGD peak (5200 AF of reclaimed water in 1989, plus direct use of 2700 AF of secondary effluent)

Additional Treatment
Filtration and disinfection (reclaimed)

Unit Costs
$180/AF O&M
$650/AF O&M + Debt Service (Cash Flow)
$300/AF Project Cost (Amortized over project life.)

Fees Charged
$462/AF

Financing
Bonds

Potable Water Charges

$2.50/100 CF for over 4000 CF/MO ($1089/AF) Winter Rate
$2.00/100 CF for over 4000 CF/MO ($870/AF) Summer Rate

Wastewater Reuse Project No. 7

COMMENTS

Tucson is expanding their reclaimed water system as fast as they can. Present investment is about $70 million. Objective is to remove large irrigation uses from the potable water system and include in reuse system. Reduction in potable water peak and average demand is major advantage.

Wastewater treatment plant effluent (secondary treatment only) is used directly to irrigate golf courses.

Puma County owns the wastewater treatment plants, Tucson owns the effluent. Therefore, the City maintains a separate staff at the treatment plants for O&M of the post-secondary treatment facilities.

Ten year capital improvement program includes total expenditures of $55.6 million (inflated) for the Reclaimed Water System.

LARGE WATER USERS, AGENCIES AND GOVERNMENT OFFICIALS CONTACTED

APPENDIX B

EL PASO WATER UTILITIES
PUBLIC SERVICE BOARD

P O BOX 511
EL PASO TX 79961-0001
PHONE 915-594-5500
FAX 915-594-5699

November 25, 1991

Notice To Interested Parties

In order to preserve the precious water resources available to El Paso, the El Paso Water Utilities Public Service Board is planning to make more efficient use of water by recycling wastewater for landscape irrigation and industrial uses. In order to properly plan for the treatment and distribution of reclaimed wastewater, potential customers must be contacted to determine their needs.

The El Paso Water Utilities Public Service Board has contracted with an engineering firm, Boyle Engineering Corporation, to provide engineering and planning services related to water reclamation and reuse.

As part of the planning effort, it may be necessary for a representative of Boyle Engineering Corporation to contact you or your organization. Moreover, if you feel your organization may be interested in obtaining reclaimed wastewater for landscape irrigation, industrial use or some other use, please contact Geoff Taylor of Boyle Engineering Corporation at (303) 987-3443.

LARGE WATER USERS, AGENCIES AND GOVERNMENT OFFICIALS NOTIFIED OF STUDY

(* Indicates Entities Contacted by Boyle)

COMMERCIAL LAUNDRIES AND GARMENT FINISHERS

Mr. Mario Morales	2 M Enterprise
Mr. Tony Jaquez	A & J Finishing
Mr. Don Shapiro	Action West
Mr. Tony Flores	Action West
Mr. Jack Tips	American Garment
Mr. Arthur Fernandez	Ameri-tech Prewash
Ms. Martha Varreras	Apparel Conditioners
Mr. Alfredo Lopez	Border Apparel
Mr. Sam Ellowitz	Clothing Mfgs Of El Paso
Mr. Valdez	Cotton Bath Corp.
Mr. Robert Campos	Delta Prewash
Mr. Nathan Goldman	Desert Laundry
Mr. Michael Goldman	Dust-tex Rentals
Mr. Mario Morales	Eagle Laundry
Mr. Hilario Gamez	East West Apparel
Mr. Dan Sosa	Economy Laundry
Mr. James J. Watkins	El Paso Laundry
Mr. Julian Dow	Farah Manufacturer
Mr. Howard Goldberg *	Final Finishing
Mr. Kamal Mahmood	Garment Processing Inc
Mr. Filmon Maldonado	Greater Tx Finishing
Mr. Craig Conklin	Lee Company
Ms. Amanda Cattermole	Levi Strauss
Mr. Javier Castaneda	Lor Commercial Laundry
Mr. Phil Stach	Mission Laundry
Mr. Jose Luis Ortega	Prewash & Pressing
Mr. Andy Skiar	Red Top Linen Supply
Mr. Alfredo Vasquez	Sun Belt Industrial Stain
Mr. Howard Goldberg *	Supreme Laundry
Mr. George Duran	Texas Industrial Service
Mr. Tomas Estrada	Wrangler
Mr. Gene Rivera	W.T.T.C. Laundry
Mr. Francisco Garate	Xclusive Garment

REFINERIES

Mr. Jim Rice *	ASARCO
Mr. Chuck Trujillo *	Chevron Refining
Ms. L. Ann Allen *	El Paso Refining
Mr. Steve Sjostrom	Phelps Dodge Copper
Mr. Bobby E. Stephens *	Phelps Dodge Copper Refinery

OTHER INDUSTRIES

Mr. Bob Castro	Swift Eckrich
Mr. Marvin Mccorgary	Taylor Publishing
Mr. Rodrigo Herrera	Texas Plating

PUBLIC OFFICIALS

Hon. William Tilney	Mayor,	City of El Paso, Texas
Dr. Kenneth Beasley	Chief Administrative Officer	City of El Paso, Texas
Mr. Carlos Ramirez	Executive Asst. to Mayor	City of El Paso, Texas
Rep. Gene Finke	Westside District	City of El Paso, Texas
Rep. Jesus Terrazas	West Central District	City of El Paso, Texas
Rep. Joe Pickett	Eastside District	City of El Paso, Texas
Rep. Stanley Roberts	Northeast District	City of El Paso, Texas
Rep. Tony Ponce	East Central District	City of El Paso, Texas
Rep. Jay J. Armes	Lower Valley District	City of El Paso, Texas
Mr. George Perry	Airport Director	City of El Paso, Texas
Ms. Alejandrina Drew	Arts Resources Dept.	City of El Paso, Texas
Mr. David Caylor	City Attorney	City of El Paso, Texas
Mr. Charles McNabb	First Asst City Atty	City of El Paso, Texas
Mr. Carole Hunter	City Clerk	City of El Paso, Texas
Ms. Debbie Hamlyn	Director, Community Development	City of El Paso, Texas
Mr. Brad Platt	Comptroller	City of El Paso, Texas
Mr. Bill Ward	Data Processing	City of El Paso, Texas
Mr. Robert Franco	Director, Economic Development	City of El Paso, Texas
Mr. Jack Parks	Director, Emergency Management	City of El Paso, Texas
Chief Bill Brown	Director, Emergency Medical Services	City of El Paso, Texas
Mr. Fermin Dorado, P.E.	City Engineer	City of El Paso, Texas
Mr. Nelson Cardona	Environmental Enforcement	City of El Paso, Texas
Mr. Curtis Wingwood	Equipment Maintenance	City of El Paso, Texas
Chief Andrew Mehl	Fire Department	City of El Paso, Texas
Mr. Al Tellez *	Historic Preservation	City of El Paso, Texas
Mr. Ron Pollard	Risk Management	City of El Paso, Texas
Mr. Ramiro Salazar	Library	City of El Paso, Texas
Mr. Joe Soto	Maintenance	City of El Paso, Texas
Mr. Sal Morales	Municipal Court	City of El Paso, Texas
Mr. Kevin Donovan	Museum of Art	City of El Paso, Texas
Mr. Rene Harris	Museum of History	City of El Paso, Texas
Mr. Robert McAllister	Office of Management & Budget	City of El Paso, Texas
Ms. Pat Diamanti	Personnel	City of El Paso, Texas
Mr. Nat Campos	Planning	City of El Paso, Texas
Chief John Scagno	Police	City of El Paso, Texas
Ms. Janet Ellison	Public Inspection	City of El Paso, Texas
Mr. David Harned, P.E.	Director, Public Works	City of El Paso, Texas
Mr. Roger Meeks	Purchasing Agent	City of El Paso, Texas
Mr. Freddie Dowling	Retired Sr. Volunteer Program	City of El Paso, Texas
Mr. Felix Tellez	Sanitation Superintendent	City of El Paso, Texas
Mr. Armando Uuevano	Street Department	City of El Paso, Texas
Ms. Martha Hernandez	Tax Office	City of El Paso, Texas
Mr. Dryden Smith	Traffic & Transportation	City of El Paso, Texas
Dr. Lea Hutchinson *	Zoo Director	City of El Paso, Texas

----	Director	Convention & Tourist Bureau
Mr. Mark Dieseldor	Manager	Sun Metro
Mr. Edd Fifer	General Manager	EPCWID #1
Mr. Mike Ciesielski	Director	EPCLVWDA
Mr. Luis Chavez	President	EPCLVWDA
Mr. Hector Villa	Section Chief	Texas Water Commission
Mr. Narendra Gunaji	Commissioner	Int'l Boundary & Water Commission
Mr. Ron Rodenhauer	Manager	EPCWA-Horizon
Mr. Jack Hammond	Commissioner	Rio Grande Compact Commission
Mr. Dan Page	Project Superintendent	US Bureau of Reclamation
Mr. Don White	Geologist	U.S. Geological Survey
Dr. Howard Malstrom	Director	Texas A&M Agric. Research Center
Mr. Wilson Dolman	Director, Parks Division	Texas Parks & Wildlife Dept.
Mr. C. Thomas Grimshaw	Regional Engineer	Texas Dept. of Health - Region 3
Hon. Charles Hooten	County Commissioner	El Paso County
Hon. Orlando Fonseca	County Commissioner	El Paso County
Hon. Rogelio Sanchez	County Commissioner	El Paso County
Hon. Jimmy Goldman	County Commissioner	El Paso County
Hon. Alicia Chacon	County Judge	El Paso County
Dr. Laurence Nickey	Director	City-County Health District
Mr. Salvador Conchola	Director, Parks and Recreation	El Paso County
Mrs. Dorline Wonciar	County Extension Service	El Paso County
Mr. John White	CEA-Horticulture	County Extension Service
Hon. Samuel Monreal	Mayor	City of Vinton
Hon. Mayor		City of Anthony
Hon. Mayor		City of Socorro
Mr. Justin Ormsby	Executive Director	Rio Grande Council of Governments
Mr. Tim Owens	Director	Sierra Medical Center
Mr. David Bustillos	Director	Southwestern General
Mr. Bill Osborn	Mgr. Plant & Maint	Providence Memorial
Mr. Sam Lail	Eng Supervisor	Sun Towers Hospital
Mr. David Herrera	Dir Eng Dept	Thomason General Hospital
Mr. Alberto Roldan	Maintenance Superintendent	Valley Community Hospital
Mr. Robert Johnston	Director of Plant Operations	Vista Hills Medical Center
Mr. Arturo Acost	Facility Engineering	William Beaumont Army Med Ctr
Mr. Kurt Desidero	Groundskeeper	El Paso Country Club
Mr. Lee Wagner	Groundskeeper	Vista Hills Country Club
Mr. Manny Martinez	Groundskeeper	Ascarate Municipal Golf
Mr. Marl Pelletier	Groundskeeper	Cielo Vista Golf Course
Mr. Bruce Erhard	Groundskeeper	Coronado Golf Course
Mr. Andy McCormick	------	Painted Dunes Golf Course
Mr. Raymond J. Ponteri	President	El Paso Employees Federal CU
Mr. Jonathan W. Rogers	President	Bank of the West
-----	Superintendent	El Paso Independent School Dist.
Dr. Roy Buckmaster	Superintendent	Clint Public Schools
Dr. Rosie Edwards	Superintendent	Gadsden Independent School Dist.
Dr. R. Jerry Barber *	Superintendent	Socorro Independent School Dist.
Dr. Mauro Reyna	Superintendent	Ysleta Independent School Dist.
Mr. Wilson Knapp	Superintendent	Canutillo Independent School Dist.
Dr. Diana Natalicio	President	University of Texas at El Paso
-----	President	El Paso Community College
Col. Alan C. Smith *	Director, Installation Support	Fort Bliss
Mr. David Wiggs	President	El Paso Electric Company
Mr. Alan Johnson	Dist Vice-President	Southern Union Gas Company

Ms. Marilyn Taylor	President	Upper Valley Neighborhood Assn
Mr. Ricardo Diaz	Citizen's Water Advisory Committee	
Mr. Michael Izquierdo	Citizen's Water Advisory Committee	
Mr. Jose Juarez	Citizen's Water Advisory Committee	
Mr. Ray Pearson	Citizen's Water Advisory Committee	
Dr. William H. Rivera	Citizen's Water Advisory Committee	
Mr. Moshe Azoulay	Citizen's Water Advisory Committee	
Mr. Richard Sanchez	Citizen's Water Advisory Committee	
Dr. Gary T. Ryan	Citizen's Environmental Advisory Committee	
Ms. Marise Textor	Citizen's Environmental Advisory Committee	
Mr. James Edward Bates	Citizen's Environmental Advisory Committee	
Mr. Salvador Gonzalez-Barney	Citizen's Environmental Advisory Committee	
Ms. Linda Johnson	Citizen's Environmental Advisory Committee	
Mr. Jim Rath	Citizen's Environmental Advisory Committee	
Ms. Teresa de Prato	Citizen's Environmental Advisory Committee	
Ms. Terry Contreras	Citizen's Environmental Advisory Committee	

POTENTIAL RECLAIMED WATER USERS

APPENDIX C

TABLE C-1

HASKELL STREET WWTP

POTENTIAL RECLAIMED WATER USERS

EPWU IRRIGATION CUSTOMER	Peak Monthly (1000 Gal/Mo)	Average Annual (1000 Gal/year)
Modesto A. Gomez Park	3,200	15,800
Delta Park	1,300	6,500
Washington Park	8,300	41,100
Lincoln Park	3,200	15,800
Edgemere Parkway	1,900	9,200
Ponder Park	3,200	15,800
McArthur Park	1,100	5,600
Cielo Vista Park	900	4,500
Vista Del Valle Park	2,300	11,200
Memorial Park	5,700	25,600
Ft. Bliss Parade Grounds	23,200	104,400
Viva Apartments	1,900	12,300
Loretto Academy	3,000	14,000
Underwood Golf Course (Ft. Bliss)	24,000	95,100
Proposed Ft. Bliss Golf Course Expansion	7,000	34,300
Ascarate Golf Course	31,000	190,800
Cielo Vista Golf Course	24,000	147,700
Concordia Cemetery	3,100	19,100
Ft. Bliss Cemetery	3,100	19,100
El Paso Zoo	5,200	25,700
Bowie High School	4,500	22,400
Jefferson High School	1,200	6,000
IRRIGATION WELL USER		
Cielo Vista Golf Course	13,100	158,000
Chamizal National Park	6,600	79,000
Subtotal Irrigation Reuse	182,000	1,079,000

(Continued next page)

TABLE C-1 (Cont.)

HASKELL STREET WWTP

POTENTIAL RECLAIMED WATER USERS

EPWU COMMERCIAL/ INDUSTRIAL CUSTOMER	Peak Monthly (1000 Gal/Mo)	Average Annual (1000 Gal/year)
Action West	2,700	32,500
Ameri-Tech Prewash	600	7,400
American Garment	29,100	349,500
Apparel Conditioners	1,500	17,500
Border Apparel	4,100	49,100
Economy Laundry	11,400	137,300
Delta Prewash	600	6,800
East-West Apparel	24,900	298,400
Mission Laundry	700	7,900
Prewash and Pressing	11,200	134,000
Supreme Laundry	2,600	31,700
Wrangler	3,800	45,300
Phelps Dodge Refinery	200	8,400
El Paso Refinery	25,600	307,200
Chevron USA Refinery	21,100	241,200
INDUSTRIAL WELL USER		
Phelps Dodge Refinery	30,500	366,000
El Paso Refinery	41,600	500,000
Chevron USA Refinery	62,100	746,000
Subtotal - Commercial & Industrial Reuse	274,300	3,286,200
TOTAL POTENTIAL REUSE	456,300	4,365,200

	Min. Monthly (1000 Gal/Mo)	Average Annual (1000 Gal/year)
TOTAL AVAILABLE FROM WWTP	572,800	7,451,400

TABLE C-2

ROBERTO R. BUSTAMANTE WWTP

POTENTIAL RECLAIMED WATER USERS

EPWU IRRIGATION CUSTOMER	Peak Monthly (1000 Gal/Mo)	Average Annual (1000 Gal/year)
Pavo Real Park	2,800	13,700
Middle Drain Park	2,500	12,300
Capistrano Park	1,300	6,500
Riverside International Industrial Center	600	3,100
Subtotal - Irrigation Reuse	7,200	35,600
EPWU INDUSTRIAL CUSTOMER		
Riverside International Industrial Center	124,600	1,467,300
TOTAL POTENTIAL REUSE	131,800	1,502,900

	Min. Monthly (1000 Gal/Mo)	Average Annual (1000 Gal/year)
TOTAL AVAILABLE FROM WWTP (Socorro)	732,000	9,921,300

TABLE C-3

FRED HERVEY WRP

POTENTIAL RECLAIMED WATER USERS

EPWU IRRIGATION CUSTOMER	Peak Monthly (1000 Gal/Mo)	Average Annual (1000 Gal/year)
El Paso Community College	5,200	41,600
Recreation Ranch Park	700	3,000
Skyline Optimist Youth Park	1,900	6,700
Todd Ware Park	800	3,500
Sunrise Park	1,100	4,800
Veterans Park	5,300	23,700
Arlington Park	1,000	4,500
Franklin Park	1,300	6,000
NE Civic Leaders Park	2,600	11,600
Nations Tobin Park	5,800	26,200
Mountain View Park	700	3,000
Restlawn Cemetery	5,200	32,000
Painted Dunes Golf Course	17,800	128,400
Cohen Center	500	2,400
IRRIGATION WELL USER		
Restlawn Cemetery	2,500	30,000
Subtotal - Irrigation Reuse	52,400	327,400
EPWU COMMERCIAL CUSTOMER		
Final Finishing	6,800	81,900
TOTAL POTENTIAL REUSE	59,200	409,300

	Min. Monthly (1000 Gal/Mo)	Average Annual (1000 Gal/year)
TOTAL AVAILABLE FROM WRP (Excluding amount currently delivered to Newman Power Plant)	113,500	1,762,100

TABLE C-4

NORTHWEST WWTP

POTENTIAL RECLAIMED WATER USERS

EPWU IRRIGATION CUSTOMER	Peak Monthly (1000 Gal/Mo)	Average Annual (1000 Gal/year)
Irwin J. Lambka Park	3,800	13,800
Paul Harvey Park	2,100	7,700
H.T. Ponsford Park	1,500	5,400
Crestmont Park	1,800	6,500
Westside Park	5,800	21,000
Casitas Coronado Properties	2,300	29,000
Park West Apartments	3,800	13,800
Sergio Alvarez Medical Center	2,200	12,800
Jardines Coronado Apartments	2,000	15,800
Coronado Country Club	19,000	130,200
Coronado High School	4,300	15,700
Subtotal - Irrigation Reuse	48,600	271,700
EPWU INDUSTRAL CUSTOMER		
ASARCO Refinery	8,000	95,500
TOTAL POTENTIAL REUSE	56,600	367,200

	Min. Monthly (1000 Gal/Mo)	Average Annual (1000 Gal/year)
TOTAL AVAILABLE FROM WWTP	132,100	1,796,000

COST ESTIMATES OF RECLAIMED WASTEWATER SYSTEMS

APPENDIX D

TABLE D-1

UNIT COST OF WASTEWATER DISTRIBUTION PIPELINES

($ Per Lineal Foot)

	DIAMETER OF PIPE								
INSTALLED COST COMPONENT	**6"**	**8"**	**10"**	**12"**	**16"**	**20"**	**24"**	**30"**	**36"**
Materials & Labor	$10.50	$15.00	$18.30	$23.20	$32.20	$43.20	$59.00	$72.80	$85.30
Excavation, Backfill & Compaction	6.70	6.70	6.80	6.80	8.60	8.60	8.60	8.80	8.80
Fittings	2.00	2.50	3.00	4.10	8.70	15.70	24.90	30.10	57.60
Testing	1.30	1.30	1.30	1.30	1.30	1.30	1.30	1.30	1.30
Trench Safety	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00
Pavement Replacement	4.50	4.50	4.60	4.60	5.20	5.20	5.20	6.00	6.00
TOTAL CONSTRUCTION COST	**$28.00**	**$33.00**	**$37.00**	**$43.00**	**$59.00**	**$77.00**	**$102.00**	**$122.00**	**$162.00**
Contingencies (30%±)	8.50	10.00	11.00	13.00	18.00	23.00	31.00	37.00	49.00
Engineering & Administration (15%±)	4.50	5.00	6.00	7.00	9.00	12.00	15.00	18.00	24.00
TOTAL CAPITAL COST	**$41.00**	**$48.00**	**$53.00**	**$63.00**	**$86.00**	**$112.00**	**$148.00**	**$177.00**	**$235.00**

TABLE D-2

CAPITAL COST OF DISTRIBUTION SYSTEM PUMPING STATIONS

(Costs in $ 1000)

Cost Component	Haskell St WWTP Booster #1	Haskell St WWTP Booster #2	Northwest WWTP Booster #1	Northwest WWTP Booster #2	Northwest WWTP Booster #3	Northwest WWTP Booster #4	Roberto R. Bustamante WWTP Booster	Fred Hervey WRP Booster
Pumps	$ 240	$ 180	$ 80	$ 60	$ 60	$ 60	$ 180	$ 80
Electrical	400	200	100	100	100	100	200	100
Instrumentation	80	60	30	20	20	20	40	30
Building	400	300	200	150	150	150	300	200
Piping	200	150	40	25	25	25	120	40
Misc. Equipment	150	100	75	25	25	25	100	75
Misc. Sitework	75	50	50	50	50	50	50	50
Start-up & Testing	10	10	10	10	10	10	10	10
Clean-up	6	6	6	6	6	6	6	6
Total Construction Cost	$ 1,561	$ 1,056	$ 591	$ 446	$ 446	$ 446	$ 1,006	$ 591
Contingencies (30%±)	470	317	177	134	134	134	302	177
Engineering (15%±)	230	158	89	67	67	67	152	89
Total Capital Cost	**$ 2,261**	**$ 1,531**	**$ 857**	**$ 647**	**$ 647**	**$ 647**	**$ 1,460**	**$ 857**
Total Pump Station Cost Per System	**$3,792**		**$2,798**				**$ 1,460**	**$ 857**

TABLE D-3

TOTAL CAPITAL COST OF HASKELL STREET WWTP SYSTEM

System Component *	Quantity	Unit Cost	Total Amount
6" Dia. Pipelines	33,500 LF	$ 41.00/LF	$1,373,500
8" Dia. Pipelines	16,000 LF	48.00/LF	768,000
10" Dia. Pipelines	2,500 LF	53.00/LF	132,500
12" Dia. Pipelines	18,000 LF	63.00/LF	1,134,000
16" Dia. Pipelines	8,500 LF	86.00/LF	731,000
20" Dia. Pipelines	15,500 LF	112.00/LF	1,568,000
24" Dia. Pipelines	11,000 LF	148.00/LF	1,736,000
30" Dia. Pipelines	18,500 LF	177.00/LF	3,274,500
36" Dia. Pipelines	1,000 LF	235.00/LF	235,000
Subtotal - Pipelines			**$10,953,000**
Treatment Facilities	Lump Sum	----	6,440,000
Booster Pump Stations	Lump Sum	----	3,792,000
Storage Tanks	Lump Sum	----	2,010,000
Total Capital Cost			**$23,195,000**

* Pipelines sized for 25% to 50% reserve capacity for system expansion. Booster pump stations and treatment facilities sized for total system demand with standby capacity for maintenance.

TABLE D-4

TOTAL CAPITAL COST OF ROBERTO R. BUSTAMANTE REUSE SYSTEM

System Component *	Quantity	Unit Cost	Total Amount
6" Dia. Pipelines	7,100 LF	$ 41.00/LF	$291,100
10" Dia. Pipelines	5,000 LF	53.00/LF	265,000
24" Dia. Pipelines	11,800 LF	148.00/LF	1,746,400
Subtotal - Pipelines			**$2,303,000**
Treatment Facilities	Lump Sum	- - - -	1,900,000
Booster Pump Station	Lump Sum	- - - -	1,460,000
Storage Tank	Lump Sum	- - - -	1,650,000
Total Capital Cost			**$ 7,313,000**

* Pipelines sized for 25% to 50% reserve capacity for system expansion. Booster pump station and treatment facilities sized for total system demand with standby capacity for maintenance.

TABLE D-5

TOTAL CAPITAL COST OF FRED HERVEY WRP SECONDARY REUSE SYSTEM

System Component *	Quantity	Unit Cost	Total Amount
6" Dia. Pipelines	9,200 LF	$ 41.00/LF	$ 377,200
8" Dia. Pipelines	8,300 LF	48.00/LF	398,400
10" Dia. Pipelines	24,800 LF	53.00/LF	1,314,400
12" Dia. Pipelines	16,200 LF	63.00/LF	1,020,600
16" Dia. Pipelines	28,700 LF	86.00/LF	2,468,200
20" Dia. Pipelines	14,400 LF	112.00/LF	1,612,800
Subtotal - Pipelines			**$7,192,000**
Treatment Facilities	Lump Sum	----	980,000
Booster Pump Station	Lump Sum	----	857,000
Storage Tank	Lump Sum	----	750,000
Total Capital Cost			**$ 9,779,000**

* Pipelines sized for 50% or greater reserve capacity for system expansion. Booster pump station and treatment facilities sized for total system demand with standby capacity for maintenance.

TABLE D-6

TOTAL CAPITAL COST OF NORTHWEST WWTP REUSE SYSTEM

System Component *	Quantity	Unit Cost	Total Amount
6" Dia. Pipelines	11,300 LF	$ 41.00/LF	$ 463,400
8" Dia. Pipelines	2,400 LF	48.00/LF	115,000
10" Dia. Pipelines	15,000 LF	53.00/LF	795,000
16" Dia. Pipelines	14,000 LF	86.00/LF	1,204,000
24" Dia. Pipelines	8,500 LF	148.00/LF	1,258,000
Subtotal - Pipelines			**$3,835,000**
Booster Pump Stations	Lump Sum	----	2,798,000
Storage Tanks	Lump Sum	----	2,400,000
Total Capital Cost			**$ 9,033,000**

* Booster pump stations and trunk pipelines sized for 50% or greater reserve capacity for system expansion.

TABLE D-7

CAPITAL AND O & M COSTS AND AVERAGE DELIVERED COST OF REUSE WATER FOR MAJOR SYSTEM BRANCHES

	Capital Costs in $ Millions										
System and Branch	Branch Pipelines	Trunk Pipelines*	Treatment Facilities*	Booster Pumping Stations*	Distribution Storage Tanks*	Total Capital Cost	Annual Capital Recovery	Annual O&M Costs	Total Annual Cost	Annual Volume Delivered (MG)	Average Delivered Cost per 1000 Gal.
HASKELL STREET WWTP											
Branch B-E	$ 0.670	$ 0.514	$ 0.213	$ 0.084	$ 0.061	$ 1.542	$ 139,900	$ 53,000	$ 192,900	133	$ 1.45
Branch C-D	1.256	0.575	0.688	1.531	—	4.050	367,700	149,000	516,700	487	1.06
Branches A thru E	6.353	—	3.857	2.777	0.910	13.897	1,261,200	770,600	2,031,800	2,956	0.69
Branch A-K	0.375	—	0.174	0.068	0.075	0.692	62,800	34,700	97,500	133	0.73
Branch G-H	0.750	0.241	0.986	0.387	0.419	2.783	252,600	206,100	458,700	664	0.69
Branch I-J	0.596	0.114	0.193	0.077	0.083	1.063	96,500	40,900	137,400	133	1.03
Branches A-G thru L	4.600	—	2.583	1.015	1.100	9.298	843,900	515,800	1,359,700	1,409	0.96
Total System	**$ 10.953**	—	**$ 6.440**	**$ 3.792**	**$ 2.010**	**$ 23.195**	**$ 2,105,100**	**$ 1,286,400**	**$ 3,391,500**	**4,365**	**$ 0.78**
BUSTAMANTE WWTP											
Branch A-B	—	$ 1.589	$ 1.710	$ 1.314	$ 1.485	$ 6.098	$ 553,400	$ 240,200	$ 793,600	1,467	$ 0.54
Branch B-C-D	$ 0.351	0.071	0.152	0.117	0.132	0.823	74,700	21,400	96,100	29	3.31
Branch C-E	0.205	0.087	0.038	0.029	0.033	0.392	35,600	5,300	40,900	7	5.84
Total System	**$ 0.556**	**$ 1.747**	**$ 1.900**	**$ 1.460**	**$ 1.650**	**$ 7.313**	**$ 663,700**	**$ 266,900**	**$ 930,600**	**1,503**	**$ 0.62**
FRED HERVEY WRP											
Branches A-B-D	$ 0.612	$ 1.985	$ 0.402	$ 0.351	$ 0.307	$ 3.657	$ 331,900	$ 56,300	$ 388,200	252	$ 1.54
Branch B-C	0.969	0.911	0.206	0.180	0.158	2.424	220,000	28,800	248,800	91	2.73
Branch D-E	0.893	1.496	0.343	0.300	0.262	3.294	298,900	48,000	346,900	61	5.69
Branch D-F	0.217	0.109	0.029	0.026	0.023	0.404	36,700	4,100	40,800	5	8.16
Total System	**$ 2.691**	**$ 4.501**	**$ 0.980**	**$ 0.857**	**$ 0.750**	**$ 9.779**	**$ 887,500**	**$ 137,200**	**$ 1,024,700**	**409**	**$ 2.51**
NORTHWEST WWTP											
Branch A-B	$ 0.380	$ 0.788	—	$ 0.857	$ 0.760	$ 2.785	$ 252,700	$ 75,800	$ 328,500	150	$ 2.19
Branch B-C	0.084	0.433	—	0.647	0.600	1.764	160,100	16,000	176,100	30	5.87
Branch C-D	0.082	0.139	—	0.647	0.540	1.408	127,800	7,700	135,500	16	8.47
Branch D-E	0.033	1.896	—	0.647	0.500	3.076	279,200	108,300	387,500	172	2.25
Total System	**$ 0.579**	**$ 3.256**	—	**$ 2.798**	**$ 2.400**	**$ 9.033**	**$ 819,800**	**$ 207,800**	**$ 1,027,600**	**367**	**$ 2.80**

* Cost of common components distributed in proportion to relative volumes of reuse water delivered

TABLE D-8

CAPITAL IMPROVEMENT PLAN FOR WASTEWATER REUSE DEVELOPMENT

SYSTEM	1992 - 1993	1993 - 1994	1994 - 1995	1995 - 1996
HASKELL STREET WWTP			Engineering and Design for 1995-1997: **$1,258,000**	2 Year Construction Start: 1/2 Treatment $2,813,000 Pump Station #1 1,688,000 Trunk A-B-C 3,650,000 Branch B-E 646,000 Tank C 849,000 $9,646,000 **1st Year Cost = $4,823,000**
BUSTAMANTE WWTP	Engineering and Design for Trunk A-B: **$201,000**	Construction of: Trunk A-B $1,545,000 Engineering and Design for 1994-1995: $579,000 **$2,124,000**	Construction of: Treatment $1,673,000 Pump Station 1,299,000 Elevated Tank 1,460,000 **$4,432,000**	
FRED HERVEY WRP				
NORTHWEST WWTP				
TOTAL PER YEAR	**$201,000**	**$2,124,000**	**$5,690,000**	**$4,823,000**

TABLE D-8 (Page 2)

SYSTEM	1996 - 1997	1997 - 1998	1998 - 1999	1999 - 2000
HASKELL STREET WWTP	Finish 2 Year Construction Started 1995-1996: **$4,823,000**		Engineering and Design for 1999-2001: **$1,204,000**	2 Year Construction Start: 1/2 Treatment $2,797,000 Pump Sta #2 1,672,000 Trunk A-G-L 2,694,000 Tank L 995,000 Branch G-H 698,000 Branch A-K 379,000 $9,236,000 **1st Year Cost = $4,618,000**
BUSTAMANTE WWTP			Design and Construction of: Branch B-C-D $351,000 Branch C-E 205,000 **$556,000**	
FRED HERVEY WRP	Engineering and Design for 1997-1998: **$789,000**	Construction of: Treatment $ 890,000 Pump Station 786,000 Trunk A-B 3,505,000 Storage Tank 696,000 **$5,877,000**	Design and Construction of: Trunk B-D $1,035,000 Branch B-C 968,000 Branch D-E 893,000 Branch D-F 217,000 **$3,113,000**	
NORTHWEST WWTP				
TOTAL PER YEAR	**$5,612,000**	**$5,877,000**	**$4,873,000**	**$4,618,000**

TABLE D-8 (Page 3)

SYSTEM	2000-2001	2001-2002	2002-2003	TOTAL SYSTEM COST
HASKELL STREET WWTP	Finish 2 Year Construction Started 1999-2000: **$4,618,000**		Design and Construction of: Branch C-D $1,256,000 Branch I-J 595,000 **$1,851,000**	**$23,195,000**
BUSTAMANTE WWTP				**$7,313,000**
FRED HERVEY WRP				**$9,779,000**
NORTHWEST WWTP	Engineering and Design for 2001-2002: **$683,000**	Construction of: Pump Sta. #1 $ 766,000 Trunk A-B 2,454,000 Tank B 684,000 Pump Sta. #2 588,000 Trunk C-B 367,000 Tank C 549,000 **$5,408,000**	Design and Construction of: Pump Sta. #3 $647,000 Trunk C-D 321,000 Tank D 540,000 Pump Sta. #4 647,000 Trunk D-E 287,000 Tank E 500,000 **$2,942,000**	**$9,033,000**
TOTAL PER YEAR	**$5,301,000**	**$5,408,000**	**$4,793,000**	**$49,320,000**

POLICIES AND PROCEDURES
FOR
REUSE OF WASTEWATER

APPENDIX E

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1.0 GENERAL

1.1 PURPOSE AND APPLICABILITY OF THIS DOCUMENT

This document (Appendix E to Feasibility Report on Wastewater Reuse Opportunities) is intended as a policy and procedural guide for the EPWU and its reclaimed wastewater customers. This document is especially oriented to help assure compliance with Texas Water Commission requirements for use of reclaimed water, to promote safe reclaimed wastewater practices, and to establish EPWU and reuse customer responsibilities in achieving these goals.

Policies and actions, which in general are necessary for the protection of the health and welfare of the public, include:

a. Regulatory and permitting actions mandated by local, state and federal authorities having jurisdiction.

b. Quality standards required for reclaimed wastewater to be reused for beneficial purposes.

c. Standards for design and operation of reclaimed wastewater distribution systems.

d. Recommended administrative and operating procedures for reusing reclaimed wastewater.

As presently planned, the reclaimed wastewater will be distributed by the EPWU using piping and equipment similar to that utilized in the EPWU's potable water system. The major difference in dealing with reuse of reclaimed wastewater is the need to avoid unnecessary human contact with the reclaimed wastewater and the great importance of assuring that reclaimed wastewater is not deliberately or accidentally ingested by humans. The two potential situations which can lead to human ingestion of reclaimed wastewater are: 1) an assumption that the reclaimed water storage pond, hose bib, or other system component contains potable water, and 2) cross connections between the reclaimed wastewater and potable water systems.

A secondary concern is protection of the groundwater from nitrates or other contaminants which do not impact the reuse of reclaimed wastewater for irrigation or industrial uses but may impact later use of underlying groundwater as a potable water resource.

The primary authority having jurisdiction over the proposed reuse of reclaimed wastewater is the Texas Water Commission which regulates wastewater reuse under Title 31, Chapter 310 of the Texas Administrative Code. Section 310.1 of the Code defines "reclaimed water" as:

> *Domestic wastewater that is under the direct control of the treatment plant owner/operator which has been treated to a quality suitable for a beneficial use.*

Chapter 310 of the Code also specifies reclaimed wastewater quality standards required for various types of beneficial use and specifies certain reclaimed wastewater distribution system design and operational requirements. As used in this document, all references to Chapter 310 of the Texas Administrative Code means the current regulations which became effective June 25, 1990, including any amended versions of Chapter 310 which may be effected in the future.

The present plans for reuse of reclaimed wastewater are for two types of use:

a. Irrigation of large turf areas and landscaping, including parks, golf courses, cemeteries, school grounds and other sports fields, and highway medians and beautification zones.

b. Commercial and industrial process water, including garment finishers, smelting, refining, and cooling.

The policies, requirements and standards for reuse of reclaimed wastewater set forth in this document apply only to the two general types of reuse listed above. The different and additional requirements and standards for other uses of reclaimed wastewater are not covered in this document.

1.2 DEFINITIONS

Where used in this document, the following abbreviations and terms shall have the meanings indicated:

BOD_5	- Five-day biochemical oxygen demand
CFU	- colony forming units
EPA	- U.S. Environmental Protection Agency
EPWU	- El Paso Water Utilities
gpd	- gallons per day
HPC	- heterotrophic plate count
mg/l	- milligrams per liter
NPDES	- National Pollutant Discharge Elimination System
NTU	- nephelometric turbidity units
Restricted landscaped area	- land which has had its plant cover modified and access to which may be controlled in some manner; includes golf courses, cemeteries, roadway right-of-ways, and median dividers.
TAC	- Texas Administrative Code
TOC	- total organic carbon; the organic (non-mineral) carbon content as measured by accepted instrumental analysis methods.
TSS	- total suspended solids
TWC	- Texas Water Commission
Unrestricted landscaped area	- land which has had its plant cover modified and access to which is uncontrolled; includes parks, school yards, greenbelts, and residences.

2.0 PERMITS AND NOTIFICATIONS

2.1 PERMITTING REQUIREMENTS IN GENERAL

Section 310.5 of the TAC addresses the permits required from the TWC for reclaimed water use. In general, permits are required only when the reclaimed water is discharged to waters of the State of Texas, or when a user provides additional treatment to enable use of the reclaimed water for an application having more restrictive quality requirements.

Permits for discharge of reclaimed water to receiving waters are covered in Title 31, Chapter 305 of the TAC which relates to "consolidated" discharge permits. The EPWU currently has discharge permits for the wastewater treatment facilities which will supply the reclaimed wastewater for the four planned wastewater reuse distribution systems. Discharge of reclaimed wastewater not consumed by reuse customers to "Waters of the State" would require that the customer involved obtain a discharge permit. Since the reclaimed wastewater to be distributed will be treated by the EPWU to standards not exceeding 5 mg/l of BOD_5, 3 NTU of turbidity, and 75 CFU per 100 ml of fecal coliforms, additional treatment by customers or by the EPWU at satellite treatment facilities will not require separate permitting.

Chapter 310 of the TAC does not require permitting of reclaimed wastewater uses that do not result in additional discharges to surface waters. For the planned uses of reclaimed wastewater within the proposed wastewater reuse systems and guidelines described in this report, no additional specific permits will be required from the TAC and permits will not be required from any other state or federal agency.

2.2 NOTIFICATIONS REQUIRED

Under Section 310.4 of the TAC, the EPWU must notify the Executive Director of the TWC of the EPWU's intent to supply reclaimed wastewater to customers for reuse and must obtain approval of the Executive Director prior to such reuse. The notice of intent submitted to the TWC should include the following:

2.2.1 A description of the intended wastewater reuse, including origin, destination, quantity, and quality of the reclaimed wastewater to be reused;

2.2.2 A clear description of means for compliance with the applicable requirements of Chapter 310 of the TAC; and

2.2.3 An operation and maintenance plan containing, as a minimum:

a. a copy of a signed contract between the proposed customer and the EPWU,

b. a labeling and separation plan for the prevention of cross-connections between reclaimed wastewater distribution lines and potable water lines,

c. the security that will be utilized to prevent unauthorized and unintentional access to reclaimed wastewater,

d. the EPWU's procedures for monitoring reclaimed wastewater,

e. a plan for how the use of the reclaimed wastewater will be scheduled to minimize the risk of inadvertent human exposure,

f. the EPWU's schedules for routine maintenance,

g. the EPWU's plan for worker training and safety, and

h. the EPWU's contingency plan for system failure or upsets.

Any anticipated changes in the approved reuse plan must also be submitted in advance to the TWC. The above EPWU notification of the TWC is all that is required for customers reusing reclaimed wastewater for landscape irrigation. Industrial customers planning to reuse reclaimed wastewater for washing, cooling or other processes must also separately notify the TWC of such intent prior to implementing the reuse. Notifications to the TWC by industrial users shall contain the same information specified in Subsections 2.2.1 through 2.2.3 above.

The EPWU must also notify EPA Region 6 for modifications of the NPDES permits for the four wastewater plants involved. These notifications should include the submission of a Wastewater Reuse Master Plan containing the EPWU's policies and procedures for wastewater reuse customers along with the EPWU's operation and maintenance plan. An executive summary of the information covered in Subsections 2.2.1 through 2.2.3 listed above should be included. This should satisfy the notification requirements of the NPDES permit.

Approval by the Executive Director of the TWC and modification of the EPWU's discharge permits by Region 6 of the EPA will be necessary in order to proceed. Submission of these notices of intent should be initiated as soon as possible and prior to commencing design of any facilities.

2.3 OTHER NOTIFICATIONS RECOMMENDED

The Texas Department of Health and the City/County Health Department do not regulate wastewater reuse other than greywater systems using less than 5,000 gpd. However, it is recommended that both the Texas Department of Health and the City/County Health Department be informed by the EPWU of its wastewater reuse plans.

3.0 DOCUMENTATION

3.1 FORMS AND DOCUMENTS

The preceding section describes formal notifications the EPWU is required to make to the TWC and the EPA Region 6. The following sections describe advice, instructions and agreements recommended to be communicated between the EPWU and its proposed reclaimed wastewater customers. To facilitate these actions, the EPWU should develop the following standard forms and documents related to reuse of reclaimed wastewater:

3.1.1 EPWU Rules and Regulations for Reuse of Reclaimed Wastewater, including Reclaimed Wastewater Rates

3.1.2 Reuse Customer Instructions and Checklist

3.1.3 Reuse Customer Application Form

3.1.4 Standard Reuse Customer Agreement

3.1.5 Standard Details for Reclaimed Wastewater Distribution System Connections and Other Customer - Provided Appurtenances

3.1.6 EPWU Reclaimed Wastewater Master Plan and Executive Summary

3.1.7 EPWU Reclaimed Wastewater Distribution Systems Operations and Maintenance Instructions for EPWU Staff

3.1.8 Standard Form for Irrigation Water Balance and Application Rate Calculations

4.0 EPWU POLICIES AND PROCEDURES

4.1 DESIGN AND INSTALLATION STANDARDS

The design and installation of the planned reclaimed wastewater treatment and distribution systems shall comply with the following standards and requirements:

4.1.1 All wastewater treatment plant effluent to be reclaimed and reused shall be treated by addition of polymer coagulant aids, if necessary, followed by rapid sand filtration and disinfection prior to introduction into any reclaimed wastewater distribution system. Such treatment shall be designed to continually meet the water quality requirements of Subsection 310.8 (1) (D) (i) of the TAC with a suitable margin of safety.

4.1.2 Demand equalization storage provided in the wastewater distribution system shall consist of covered, leak-proof storage vessels meeting the requirement of Subsection 310.7 (c) of the TAC.

4.1.3 Disinfection shall be accomplished by chlorination systems designed to feed chlorine at a rate sufficient to produce a concentration of at least 10 mg/l at peak flow and the feed rate shall be adjustable to less than 1 mg/l.

4.1.4 Reclaimed wastewater shall be chlorinated immediately prior to introduction into the reclaimed wastewater distribution system.

4.1.5 All reclaimed wastewater treatment processes, including filtration and chlorination, shall have backup equipment sufficient to allow operation at peak capacity with loss of one third (or one unit where less than three units are provided) of the pumping, chemical feed, and other essential equipment.

4.1.6 Reclaimed wastewater distribution systems shall be designed to the same standards and with the same equipment and material specifications as the EPWU potable water distribution system.

4.1.7 Underground reclaimed wastewater piping in the treatment and distribution systems shall be separated from potable water piping by a distance of at least 9 feet. Where the 9-foot separation distance cannot be achieved, the reclaimed wastewater piping shall meet the requirements of Subsections 317.13(a)(1) through (4) of the TAC.

4.1.8 All underground reclaimed wastewater distribution piping and service connections shall be violet colored and shall be marked by magnetic tape placed 6 inches directly above the backfilled pipe.

4.1.9 All exposed reclaimed wastewater piping shall be violet colored and stenciled with a warning reading, "NON-POTABLE WATER" in both English and Spanish languages.

4.1.10 Reclaimed wastewater distribution system designs and materials shall be approved by the Executive Director of the TWC in accordance with the Texas Engineering Practice Act (Article 3271a, Vernon's Annotated Texas Statutes).

4.2 EPWU OPERATING PROCEDURES

Providing of reclaimed wastewater service to customers and operation of reclaimed wastewater treatment and distribution systems by the EPWU shall conform to the following policies and procedures:

4.2.1 Reclaimed wastewater service connections shall be provided only to those wastewater reuse customers who have executed an agreement with the EPWU which includes provisions that they will conform to the requirements of Section 5.0 of this document.

4.2.2 No distribution of reclaimed wastewater to customers shall begin prior to approval of the Executive Director of the TWC pursuant to Subsections 2.2 and 4.1.11 above and modification of the discharge permit for the relevant wastewater treatment plant by Region 6 of the EPA.

4.2.3 Any major reclaimed wastewater operational problems, customer complaints, treatment failures, distribution system leaks and other issues of potential concern shall be reported by the EPWU verbally within 24 hours, followed by a written report within five days to the Executive Director of the TWC, Region 6 of the EPA, and the El Paso City/County Health Department.

4.2.4 Whenever the reclaimed wastewater does not meet the requirements of Subsection 310.8(1)(D) (i) of the TAC and cannot be improved to meet said requirements by simple treatment adjustments executable in less than one hour, the plant operator shall immediately shut down the reclaimed wastewater system and shall notify his supervisor and the Wastewater Collection and Treatment Manager.

4.2.5 Reclaimed wastewater shall be sampled once every operating shift for chlorine residual; daily for TOC, TSS, turbidity, HPC and fecal coliform concentration; and weekly for BOD_5 in accordance with methods described in Chapter 319 of the TAC. The samples shall be taken from a location in the distribution system upstream of the service to the first customer.

4.2.6 Standard application rates for irrigation reuse customers shall be developed by the EPWU Water Conservation Manager following the detailed water balance procedure specified in Subsection 310.8(3) of the TAC. Different application rate schedules shall be developed as appropriate for the different areas served by the EPWU reclaimed wastewater systems and furnished to reuse customers as part of their contract agreement with the EPWU.

4.2.7 Records of reclaimed wastewater reuse shall be maintained by the EPWU for a period of three years and shall include the following information and data:

a. Copies of all notifications made to the TWC pertaining to reclaimed wastewater systems operations.

b. Copies of contract agreements with reclaimed wastewater users.

c. Records of reclaimed wastewater meter readings for each wastewater reuse customer.

d. Reclaimed wastewater quality analyses.

4.2.8 The EPWU shall report to the TWC the following information on a monthly basis by the 25th day of each month following the reporting period:

a. The volume of reclaimed wastewater delivered during the reported month to each wastewater reuse customer.

b. The quality of reclaimed water delivered to reclaimed wastewater users reported as a monthly average for each quality standard, except those listed as not to exceed values which shall be reported as individual analyses.

4.2.9 The EPWU shall notify the Executive Director of the TWC in writing within 5 days of learning of a reclaimed wastewater use not authorized in the customer's contract or approved by the Executive Director of the TWC.

5.0 CUSTOMER REQUIREMENTS AND COMPLIANCE

5.1 CUSTOMER FACILITIES STANDARDS

Reclaimed wastewater customer connections and system components, including piping, valves, sprinkler systems, hose bibs, and all other elements of the reclaimed wastewater distribution system downstream of the EPWU service meter, shall conform to the following requirements and standards:

5.1.1 Any reclaimed wastewater storage provided by the customer on-site shall meet the requirements of Section 310.7 of the TAC.

5.1.2 Reclaimed wastewater customer piping shall be separated from potable water piping by a distance of at least 9 feet. Where the 9-foot separation distance cannot be achieved, the reclaimed water piping shall meet the requirements of Subsections 317.13(a)(1) through (4) of the TAC.

5.1.3 Reclaimed wastewater customers who have a potable water service system shall install in their potable water system a reduced-pressure principle backflow preventer of the same size as the potable water service meter. The backflow preventer shall be installed within ten feet of the meter and in a location allowing access for testing and servicing, which will prevent ponding of any leakage, and which will provide protection against freezing. The backflow preventer shall be tested immediately after installation and at least once per year thereafter, and certification of the testing shall be kept on file at the customer's on-site offices.

5.1.4 Where an emergency backup for a reclaimed wastewater supply is provided with potable water, the potable water shall be supplied to a tank or reservoir through an air gap having at least 6 inches of separation at the highest possible water level in the reclaimed wastewater system.

5.1.5 All new or replacement buried reclaimed wastewater customer pipelines shall be violet colored and shall be marked by magnetic tape, as specified by the EPWU, placed 6 inches directly above the backfilled pipe.

5.1.6 All exposed reclaimed wastewater customer piping shall be violet colored and stenciled with a warning reading "NON-POTABLE WATER" in both English and Spanish languages.

5.1.7 All reclaimed wastewater customer systems shall have a master cut-off valve located near the reclaimed wastewater service connection.

5.1.8 Reclaimed wastewater irrigation systems operated by automatic controllers shall have a drawing of the area served by the controller sealed in plastic and placed in the controller box. The controller box shall be keyed so that only authorized customer personnel have access to the controller. The controller shall be clearly labeled in both English and Spanish languages indicating it is a component of a reclaimed wastewater irrigation system.

5.1.9 Signs in both English and Spanish languages shall be posted at all storage areas, hose bibs, faucets, valves, and other readily accessible components of the customer's reclaimed wastewater system. Alternatively, and if approved, such features may be secured to prevent access by unauthorized personnel. The means of securing the features may include valves keyed to be operable only with special tools or by other means as approved by the EPWU.

5.1.10 Turf and landscaped areas irrigated with reclaimed wastewater shall be posted at points of normal access with signs in English and Spanish languages indicating that the area is irrigated with reclaimed wastewater.

5.1.11 Irrigation tailwater controls shall be constructed as required to prevent discharge of reclaimed wastewater outside the customer's property boundaries.

5.1.12 Customer on-site storage, fountain, restricted recreational, or other reclaimed wastewater impoundment shall either naturally be, or shall be designed, constructed and operated such, that impounded water, including stormwater run-off collected by the impoundment, will not overflow when the portion of reclaimed wastewater is equal to or greater than one tenth the volume of overflow.

5.1.13 EPWU representatives at their discretion shall be allowed to review plumbing plans, inspect the customer's reclaimed wastewater system, inspect and/or test potable water backflow preventers, and conduct dye tests for cross connections before serving the customer with reclaimed wastewater.

5.2 CUSTOMER OPERATING PROCEDURES

Prior to being supplied reclaimed wastewater by the EPWU, each customer must consummate an agreement with the EPWU in writing certifying the uses which will be made of the reclaimed wastewater and agreeing to comply with the requirements set forth in Subsection 5.1 above and to the following customer operating procedures:

5.2.1 Any customer storing reclaimed wastewater on-site for more than 24 hours after delivery from the EPWU distribution system must provide for additional disinfection sufficient to ensure that the reclaimed wastewater will meet a bacteriological quality standard of 75 fecal coliforms/100 ml or less prior to any reuse.

5.2.2 Each reclaimed wastewater customer shall designate a responsible individual who is normally available on-site as the customer's reclaimed wastewater system manager. The customer's reuse manager will be listed as such in the wastewater reuse agreement, and the EPWU shall be notified of any change in the customer's manager within 5 days after termination of employment of the reuse manager.

5.2.3 Notwithstanding any omission herein, no customer shall reuse reclaimed wastewater in any way which violates any conditions set forth in the reclaimed wastewater reuse contract with the EPWU or the provisions of Chapter 310 of the TAC as amended and in effect at the time.

5.2.4 It shall be the responsibility of the reclaimed wastewater customer to handle and reuse the reclaimed wastewater supplied by the EPWU by methods and in a manner which will not permit any of the following situations to occur:

a. Nuisance conditions from use or storage.

b. Spray irrigation or contamination of crops which may be consumed raw by humans.

c. Discharge beyond the customer's property line of either runoff or aerial spray from reclaimed wastewater.

d. Any threat to groundwater quality.

e. Irrigation of an area while occupied by humans or animals to be milked for human consumption.

f. Irrigation of any area without vegetative cover.

g. Application of reclaimed wastewater for irrigation in amounts in excess of the application rates established by the EPWU's water balance calculations.

h. Application rates and times resulting in excessive "wet grass" conditions in unrestricted landscaped areas.

i. Irrigation with reclaimed wastewater stored at the customer's location for more than 24 hours without additional disinfection.

j. Allowing spray irrigation, spray cooling, or other aerosol dispersal in windy weather conditions or otherwise conducting spraying in a manner which would allow spray to reach public drinking fountains, areas such as picnic tables used for food preparation, private residences, or other areas which may be sensitive to water born disease.

k. Applications of reclaimed wastewater to frozen or saturated ground.

5.2.5 Each customer shall maintain a record of the reclaimed wastewater used and shall make such records available to the EPWU or to the TWC.

CONSIDERATION OF JOINT SATELLITE TREATMENT FACILITY FOR REFINERIES AND PHELPS DODGE

APPENDIX F

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INTRODUCTION

The Chevron USA and El Paso Refineries and the Phelps Dodge Smelter operation are major groundwater users located near the end of line A-B, the major eastern trunk of the proposed Haskell Street WWTP reuse system. In addition to these three users, Economy Laundry and Border Apparel are served from Branch B-E and several irrigation users are served from Branch C-D of this trunk line. The apparel company, laundry and irrigation users will probably be able to use the reuse water at currently planned treatment levels. Phelps Dodge and the two refineries are concerned about total dissolved solids in general and also about particular dissolved constituents which may be higher in the filtered Haskell Street wastewater than in either their well water supplies or the EPWU potable water supply.

Chevron and Phelps Dodge use reverse osmosis (RO) and ion exchange processes for treating boiler feed water. El Paso Refinery uses zeolite ion exchange. Operating costs for these systems increase with the total dissolved solids concentration of the raw water source. In addition, the Chevron and El Paso Refineries are particularly concerned with silicates, because they are not effectively removed in either RO treatment or zeolite ion exchange and can become the controlling factor in the amount of boiler blow down required. Both refineries are also concerned with initial dissolved solids levels in cooling water. Reuse water may also produce cooling water problems due to phosphate, manganese and/or ammonia.

Phelps Dodge is less concerned with silicates since they precede RO treatment with hot lime/soda ash softening and precipitation which removes most of the silica. They use untreated raw water (currently well water) in their cooling water "lake" for cooling copper molds. They have a groundwater-protection-based limit imposed by the Texas Water Commission of 500 mg/l of chloride in the concentrate resulting from evaporation of this cooling water. They are, therefore, concerned with the chloride concentration in the feedwater for this process. Phosphorus and nitrogen (either ammonia or nitrate) are not present in significant quantities in the groundwater sources used or in the potable water supply. All three firms might have difficulty in cooling water applications of reuse water with the current levels of phosphorus and ammonia in the Haskell Street WWTP effluent. Use of polymers in sand filtration may remove some phosphorus, but would not influence levels of either nitrate or ammonia nitrogen. Chlorination would tie up some ammonia nitrogen in chloramines. At the levels likely to be in delivered reuse water, ammonia nitrogen may increase slime control problems in cooling water applications and phosphate may lead to precipitation. In addition, reuse water manganese levels are elevated over treated Rio Grande surface water or groundwater and could produce problems with manganese precipitates in cooling water systems without additional treatment.

FEASIBILITY OF ALTERNATIVE WATER SOURCES

These firms use groundwater for process and cooling water because it has been more economical than purchase of water from EPWU. However, they are becoming increasingly concerned with well water level and water quality declines. General water levels in the area are declining about 10 feet per year and the relatively fresh water aquifer is overlain by brackish water. This brackish water will eventually move in to the fresh water zone as general levels decline, and may arrive more quickly at a particular well depending on the cone of depression produced locally by aquifer conditions and pumping rate.

All three firms have had problems with existing wells and Chevron and Phelps Dodge have attempted to develop new wells for improved water quality. Phelps Dodge recently completed a new well designed to produce from the lower part of the fresh water zone only. This well produces water with 400 to 500 mg/l TDS which is comparable to or slightly better than EPWU potable water supply TDS levels. However, the estimated usable life is 10 to 15 years depending on local and general rates of withdrawal from the aquifer. Eventually these industries will have to obtain their water from either EPWU potable supply or Haskell Street WWTP reclaimed wastewater. Dissolved solids in either of these two EPWU sources may also increase, depending on the relative contribution of the lower valley wells to the supply available from the distribution system at this location, until the EPWU is able to completely substitute surface water for local Hueco Bolson sources.

Haskell Street WWTP effluent has elevated TDS, some increase in chloride, and significant manganese levels when compared to current potable water quality in the area. The difference in quality is less than might be expected, possibly because the Haskell Street WWTP influent source area has lower water supply TDS than the average at the refinery area. Haskell Street WWTP effluent manganese data collected in the first six months of 1992 indicate a high of approximately 0.3 mg/l, low of about 0.1 mg/l, and about 0.15 mg/l average, which is fairly low but higher than the potable system sources. Table F-1 summarizes 1991 water quality data from the surface water treatment plant and each of the four well fields. The Haskell Street WWTP plant effluent quality for 1991 is summarized in Table F-2.

TABLE F-1

EL PASO WATER UTILITIES POTABLE WATER CHEMICAL ANALYSIS

(Values in mg/l; < = less than)

	CENTRAL AREA	WEST AREA WELL FIELD	NORTHEAST AREA WELL FIELD	EAST AREA WELL FIELD	LOWER VALLEY WELL FIELD
PARAMETERS	TREATMENT PLANT	18 WELLS	26 WELLS	51 WELLS	29 WELLS
Total Dissolved Solids	584	472	527	578	805
Phenol Alkalinity as CaCO3	3.5	6.7	<1.0	<1.0	<1,0
Total Alkalinity as CaCO3	76	82	134	115	114
Total Hardness as CaCO3	179	71	206	124	186
Chlorides as Cl	134	89	126	169	273
Sulfates as SO4	178	139	67	76	122
Fluorides as F	0.7	0.7	1	0.73	0.7
Silica as SiO2	23	31	31	32	29
Nitrates as N	0.3	<0.2	2.4	1.4	1.2
Phosphates as P	<0.3	<0.3	<0.3	<0.1	<0.3
Calcium as Ca	44	24	47	35	54
Magnesium as Mg	16	2.4	12	8.9	12
Sodium as Na	121	127	102	132	199
Potassium as K	6.8	2.3	5.8	9.3	7
Iron as Fe	<.15	<.03	<.03	<.1	<.06
Manganese as Mn	<.05	<.05	<.02	<.03	<.03
pH	8.34	8.62	7.88	8.12	8.09
Turbidity	0.4	0.15	0.28	0.27	0.36

Table from EPWU.

The City is supplied by five distinct blended sources that are interconnected in the distribution system and it is possible that the water from one source can be distributed to all parts of the City. Normally, the areas supplied by each of these sources are as indicated by Figure F-1. However, the ratios of water supplied by one source or another are constantly changing and therefore intermixing within these areas.

TABLE F-2

HASKELL STREET WWTP EFFLUENT QUALITY (1991)

Parameter	Milligams per Liter Minimum	Maximum	Average	Effect of Filtration
TDS	912	1410	1050	none
Electrical Cond.	1500	2060	1716	none
Total Alkal. ($CaCo_3$)	120	280	242	none
Tot. Hard. (as CaCo3)	156	300	207	none
Chlorides	196	390	270	none
Sulfates	230	338	230	none
Fluorides (F)	0.76	1.39	1.02	none
Silica (SiO_2)	12	35	22	none
Nitrates (N)	0.27	4.24	1.4	none
Total Phos. (as P)	2.13	8.75	5.93	Possible reduction with polymer
Calcium	44.1	100	62.4	none
Magnesium	0.6	16	10.1	none
Sodium	2.13	423	259	none
Potassium	0.8	108	22	none
Manganese (approx)	0.1	0.3	0.15	none
pH	6.7	7.3	7.0	none
Turbidity (NTU)	2.3	28	9.0	Reduction to less than 3 NTU
BOD	2	14	6	Reduction to less than 5
COD	43	117	67	Reduction
TSS	4	54	15	Reduction
TS	868	1466	1076	Slight Reduction
NH3 (N)	7.3	31.7	18.2	No Effect
TKN (N)	11.8	32.8	21.9	Slight Reduction
Oil and Grease	0.4	19.5	6.0	Reduction

The mix of sources supplying the refinery area varies with time of year. Water samples from EPWU water quality points No. 5 and No. 24, distribution system sampling points bracketing the area, contained the concentrations shown in Table F-3 on the two sampling dates listed. Variations in TDS and chloride are rather large, probably depending on the presence or absence of surface supply. Figure F-1 shows the summer source pattern for the EPWU potable water distribution system.

Water quality requirements for cooling and boiler feed water for the three plants are shown in Table F-4. These requirements are somewhat arbitrary and may be based more on the quality available from current water sources and quality necessary for the current operational setup than absolute quality requirements. Cost of treatment of boiler feed water increases with increasing TDS levels. Chevron currently spends $1.64 per 1,000 gallons, strictly for treatment, to prepare the EPWU potable supply for the boilers. Cost of this treatment would increase almost linearly with TDS concentrations. In general, increased raw water dissolved solids leads to fewer cooling water cycles and increased blow down volumes, therefore increased expense.

Other problems may be created by specific dissolved parameters. Presence of ammonia will probably require increased chemical and other expense for slime control. Presence of higher silica, manganese and/or phosphorus levels may limit the number of cooling water cycles or increase the necessary boiler blow down beyond that which would result from TDS alone. Therefore, operating costs might be lowered if the constituent in question could be selectively reduced.

PRACTICALITY OF SATELLITE TREATMENT

Some economies of scale would result from satellite RO or membrane softening and/or ion exchange treatment of the supply for all three facilities. The levels of silica in the Haskell Street WWTP effluent are not much higher than in the available potable sources but may be high enough to interfere with membrane processes, especially membrane softening, without chemical pretreatment. Table F-5 compares costs for ion exchange and lime softening (with and without ammonia stripping) as well as various lime sludge and ion exchange regenerate disposal options. Given the reuse water quality and discharge permit problems which might result from sewer disposal of brine or lime sludge, the difficulty and hazards in operating a large ion exchange facility and the higher cost of ion exchange, lime softening appears to be the practical choice. Ammonia may turn out to be a significant problem for many industrial and commercial users, including the refineries and Phelps Dodge, and ammonia stripping is also recommended. Dewatering and hauled sludge disposal is more expensive but probably more

TABLE F-3

REFINERY AREA DISTRIBUTION SYSTEM WATER QUALITY
(Concentrations in mg/l)

Water Sample	TDS	Hardness	E. Cond.	Ca^{++}	Mg^{++}	Na^{+}	$SO_4^{=}$	Cl^{-}	NO_3^{-}(N)	Tot.P	SiO_2
Site 24 Feb, 92	1,081	356	1,850	105.5	22.4	237	192	420	0.0	<.03	35
Site 24 May, 92	799	252	1,330	68.2	19.8	177	215	220	0.94	<.03	20
Site 5 Feb, 92	823	224	1,320	55.3	20.8	196	249	218	0.7	<.03	23
Site 5 May, 92	538	154	937	44.9	10.1	124	58	180	1.56	<.03	35
Average:	810	246	1,359	68.5	18.3	184	178	260	0.8	<.03	28

Notes:

(1) Mn values were below detection (<0.02 to 0.05).

(2) February values appear to be heavily influenced by Lower Valley sources and substitution of either surface water or west area wells (no withdrawal from Hueco Bolson) would improve potable water quality in the area.

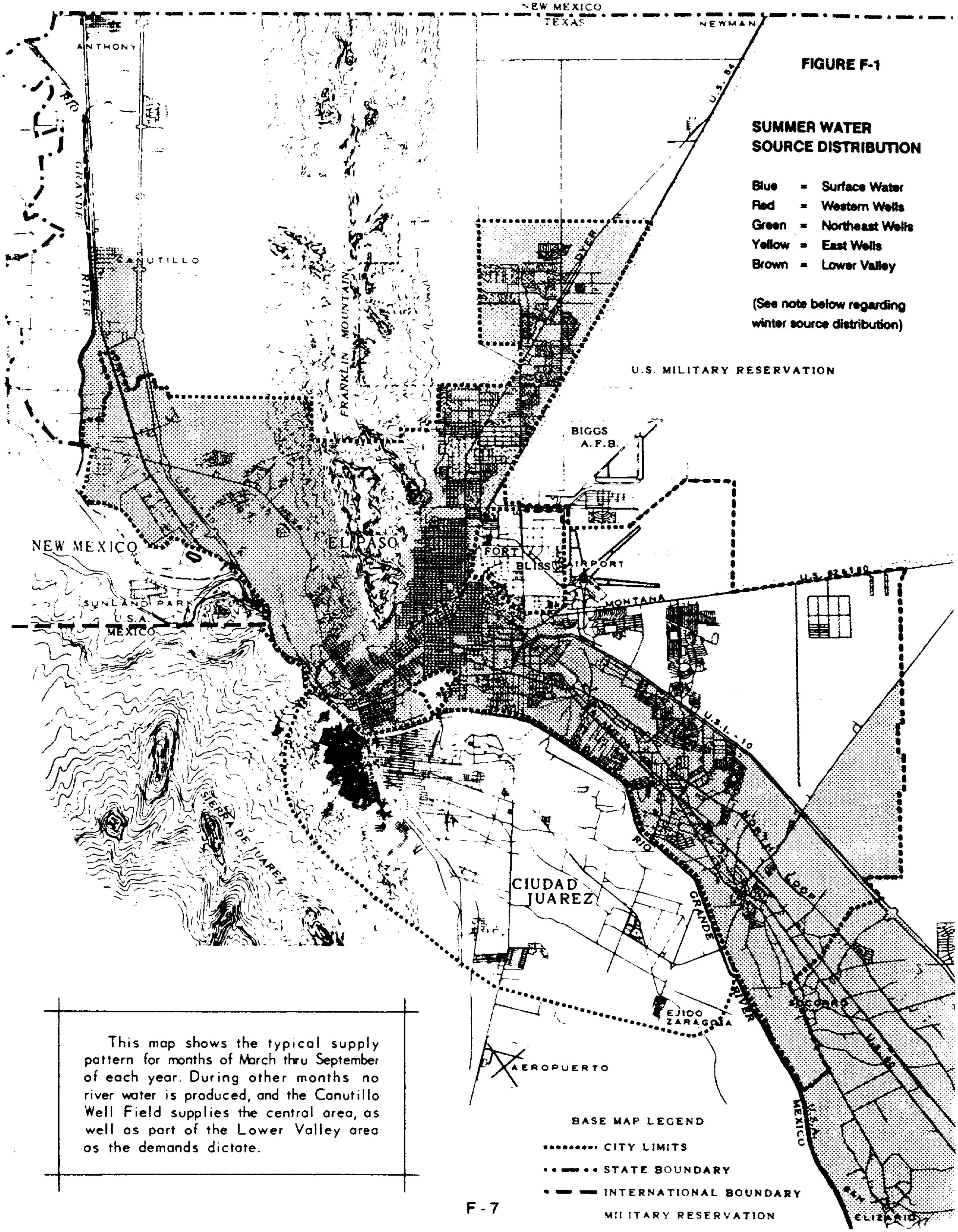

FIGURE F-1

SUMMER WATER SOURCE DISTRIBUTION

This map shows the typical supply pattern for months of March thru September of each year. During other months no river water is produced, and the Canutillo Well Field supplies the central area, as well as part of the Lower Valley area as the demands dictate.

TABLE F-4

INDUSTRIAL FACILITY WATER QUALITY REQUIREMENTS

Parameter (ppm)	El Paso Refinery	Chevron Refinery	Phelps Dodge Smelter
TDS	1,429		810
Alkalinity (CaCo3)	70	**132**	
Tot. Hard. (CaCo3)		299	246
Conductivity	2,858	1,380	1,359
Chloride	150	**265**	**260**
Sulfate	700	**180**	178
Fluoride	**0.15**		
Silica	**43**	**32**	**28**
Phosphorous	**1.30**	**0.13**	
Calcium	**136**	**70**	68
Magnesium	20	**17.76**	18
Sodium	195	**205**	184
Potassium	332		
Manganese	**0.06**		
Chronium	**0.15**		
Copper	**0.06**	0.05	
Iron	**0.60**	**0.24**	
Suspended Solids	**3**		
Ammonia	10.20		
pH		**7.90**	

Note: Concentrations printed bold are considered important parameters to the user in question.

TABLE F-5

COSTS OF SATELLITE TREATMENT COMPONENTS

Process	Engineering and Capital Cost	Annual Capital Recovery	Annual Operating Costs	Total Annual Cost
Lime Treatment (with Filtration)	$ 6,756,000	$ 613,000	$ 640,000	$ 1,253,000
Ammonia Stripping	3,504,000	318,000	300,000	618,000
Ion Exchange	12,720,000	1,154,000	1,500,000	2,654,000
Lime Sludge Dewatering	2,700,000	245,000	260,000	505,000
Lime Cake Transport	252,000	23,000	80,000	103,000
Sewer Disposal of Lime Sludge	(Estimate 5% of volume, 300% sewer surcharge)		300,000	300,000
Sewer Disposal of Ion Exchange Reject	(Estimate 10% regeneration/raw feed)		400,000	400,000
Lime Treatment with Ion Exchange and Ammonia Stripping, Sludge Dewatered and Hauled	13,212,000	1,199,000	1,280,000	2,479,000
Satellite Treatment Trunk Line (Additional Cost in B-C Trunk right-of-Way)	100,000	9,800	- - - -	9,800

practical than sewer or other lime sludge disposal choices. The most practical and cost effective collective treatment would probably be lime soda ash softening with filtration followed by ammonia stripping and recarbonation. A facility of this type would reduce silica, phosphorus and manganese to levels lower than either the groundwater or the EPWU potable water supply and ammonia to levels low enough to eliminate any cooling water problems. Silica does not appear to be higher in the Haskell Street WWTP effluent than in EPWU potable sources, but it is one of the greatest concerns of the industrial users. It is not removed by cation exchange, is detrimental to RO, and becomes a limiting factor in treated boiler feed water.

Due to the potentially higher sodium and chloride levels in the Haskell Street WWTP effluent, total dissolved solids may still be higher in the lime softened satellite treatment effluent than the EPWU potable water supply. Increased TDS may or may not decrease allowable cooling water cycles. (Allowable cycles could actually increase if current limitations are due to one of the problem ions or due to carbonate hardness.) Boiler feed water treatment costs by RO would definitely go up with increased TDS. Zeolite feed water treatment cost might drop due to reduced hardness. Phelps Dodge might be able to eliminate their individual lime treatment prior to RO treatment with group satellite lime treatment in place. Silica is greatly reduced by lime softening and all three facilities could reduce boiler blow down percentages with silica reductions. The Phelps Dodge chloride problem would not be improved by lime softening treatment. Individual facility problems with TDS or chloride could be handled more effectively by ion exchange or membrane processes with the clean, nonbiologically active, and low silicate satellite treated reuse water supply. Phelps Dodge may be able to address their chloride problem in the cooling "lake" by retrofitting a lined system or other approaches.

It is also important to realize that substitution of treated surface water for Hueco Bolson potable system sources may lessen the benefits of satellite softening. This depends mostly on the level of treatment (reduction in hardness) carried out at the water treatment plant. Domestic use of the water supply results in more increase in sodium and chloride than in the hardness cations. Lime softening water treatment practices do not remove all the hardness, however, because complete removal is not really necessary for domestic uses. In addition, the coagulation and filtration processes of a satellite lime softening plant would improve reclaimed wastewater quality as well as condition the reclaimed wastewater for ammonia stripping.

LOCATION OF SATELLITE TREATMENT FACILITY

The ideal location for satellite treatment was not examined in detail. El Paso Refinery has expansion plans which will use up any excess space. Chevron and Phelps Dodge may have some available space. The plant could be located at either Chevron or Phelps Dodge or in the general vicinity. The 24-inch line extending northwest from Trunk A-B to point C could be reduced to 16 inches and paralleled with a 16-inch satellite treated supply line going from a plant in the Chevron area back to Phelps Dodge and Branch B-E, or with a 12-inch line from a plant in the Phelps Dodge area feeding Branch B-E and going back to Chevron and El Paso Refineries. Branch B-E was included as part of the satellite system demand because the two garment finishers on this line would probably also benefit from the improved water quality. Actual design flow selection should consider potential expansion of demand for the high quality reuse water.

Line cost adjustments are also included in Table F-5. If the satellite treatment lines are placed during the original reuse trunk line construction, additional cost would be minimal.

COST OF SATELLITE TREATMENT

Cost of delivered filtered reuse water for customers on Branches A through E is about $0.69/1,000 gallons (see Table D-8 in Appendix D). Table F-6 gives an approximate estimate of unit volume cost for lime softening with and without ammonia stripping and ion exchange. Annual demand for identified satellite treatment users is 2,355 MG, including both well and EPWU potable water consumption. Well water consumption of about 1,612 MG/yr, by the refineries and Phelps Dodge only, presumably occurs at more or less constant average daily demand. Design flow for the proposed softening plant is 4,600 gpm, which represents the sum of average daily demand during the peak month for combined well and EPWU potable water demands.

The incremental cost of lime softening and ammonia stripping satellite treatment is $1.05/1,000 gallons, assuming sludge dewatering and hauling will be necessary. The total cost per thousand gallons for reuse water with additional satellite treatment is $1.74. Cost of potable water depends on the summer versus winter demand structure and total volume of use. Chevron currently pays $1.59/1,000 gallons in the month of June but only uses EPWU potable water for 30 percent of their total demands. If EPWU potable water were substituted for well water, the cost per 1,000 gallons would be reduced. The lower limit to EPWU potable water

TABLE F-6

SATALLITE TREATMENT OPTIONS

DELIVERED WATER COST

Satellite Treatment Combination	Total Annual Cost	Treatment Cost per 1,000 Gal.	Delivered Cost per 1000 Gal.
Lime Softening Only	$ 1,253,000	$ .53	$ 1.22
Lime Softening (Including Sewer Sludge Disposal)	$ 1,553,000	$ .66	$ 1.35
Lime Softening and Ammonia Stripping (Sewer Sludge Disposal)	$ 2,171,000	$ .92	$ 1.61
Lime Softening and Ammonia Stripping (Dewater and Haul Sludge)	$ 2,479,000	$ 1.05	$ 1.74
Ion Exchange (Sewer Brine Disposal)	$ 3,054,000	$ 1.30	$ 1.99

cost is the lowest block water rate, \$0.76/100 ft^3 which equates to \$1.02/1,000 gallons. Higher summer than winter demands would increase this rate.

CONCLUSIONS

As long as the refineries can find groundwater of suitable quality and as long as they are allowed to overdraft the Hueco Bolson, groundwater will probably remain the cheapest alternative. Assuming the EPWU has switched mainly to surface water sources and overdraft of the Hueco Bolson by private wells has been discouraged or eliminated, satellite lime softening is likely to be more economical than individual treatment of the filtered reuse supply to an equivalent quality level. EPWU potable water (treated surface water) may be lower in cost than satellite treated reuse water. Depending on relative hardness levels, silica and TDS, satellite treated water may or may not be more valuable to the refineries than potable water as a process supply. The moderately higher cost of the reuse water could be offset by a subsidy in order to facilitate conservation of the potable supply.

Another variable beyond the scope of this study is consideration of ammonia reductions through adding aeration capacity for increased nitrification at the Haskell Street WWTP. The Haskell Street WWTP reuse system has other laundries and garment finishers on the western portions of the distribution system with process water needs which may be impaired by ammonia. Reduction of ammonia for the system as a whole would also reduce the cost of satellite treatment for the east branch industries.

Nitrogen, as either ammonia or nitrate, may actually be of benefit to irrigation users (for its fertilizer value) as long as application rates and practices are controlled to prevent migration of excess nitrate toward the groundwater. Nuisance problems can be caused by ammonia-fed slime growth or possible stimulation of algal blooms (by either form of nitrogen) in open storage reservoirs. Should nitrogen become a concern, nitrification/denitrification could be added to the Haskell Street WWTP to reduce total nitrogen. Ammonia and/or total nitrogen levels in the effluent may also become a future regulatory concern relative to possible NPDES discharge limits for control of un-ionized ammonia toxicity and/or nutrient enrichment in waters receiving that portion of the Haskell Street WWTP effluent which is not reused.