

**WASTEWATER RECLAMATION PILOT STUDY
CITY OF McALLEN, TEXAS**



Water Treatment Technology Program Report No. 26



April 1998

**U.S. DEPARTMENT OF THE INTERIOR
Bureau of Reclamation
Technical Service Center
Environmental Resources Team
Water Treatment Engineering and Research Group**

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by

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ACRONYMS AND ABBREVIATIONS

BOD,	biochemical oxygen demand
CBOD,	carbonaceous biochemical oxygen demand
DBP	disinfection byproducts
DDE	disinfected, dechlorinated effluent
D O	dissolved oxygen
EPA	Environmental Protection Agency
ft ²	square foot
gfd	gallons per square feet per day
gpm	gallons per minute
HAA	haloacetic acid
HRT	hydraulic retention time
IPR	indirect potable reuse
L/s	liters per second
m ²	square meter
MCL	maximum contaminant level
MF	microfiltration
mg/L	milligrams per liter
mgd	million gallons per day
ML	million liters
MLSS	mixed liquor suspended solids
MLVSS	mixed liquor volatile suspended solids
NPDES	National Pollutant Discharge Elimination System
NTU	nephelometric turbidity unit
O&M	operations and maintenance
OUR	oxygen uptake rate
PLC	programmable logic controller
ppm	parts per million
psig	pounds per square inch gauge
RAS	return activated sludge
RO	reverse osmosis
SDI	silt density index
SDS	simulated distribution system
SO ₂	sulphur dioxide
SRT	solids retention time
SWWTP	South Wastewater Treatment Plant
TDS	Total dissolved solids
THM	trihalomethane
TMP	transmembrane pressure
TNRCC	Texas Natural Resources Conservation Commission
TSS	total suspended solids
TWDB	Texas Water Development Board
UOSA	Upper Occoquan Sewage Authority
W	ultraviolet
μg/L	micrograms per liter
μm	microns
WAS	waste activated sludge
WWTP	wastewater treatment plant

1. INTRODUCTION AND BACKGROUND

This report documents a wastewater reclamation pilot study performed at the McAllen, Texas, wastewater treatment plant (WWTP) No. 2. The study was conducted under Task 9: Membrane Separation Process for Wastewater Reclamation of the U.S. Bureau of Reclamation's Water Treatment Technology Program. Testing was conducted from April 1997 to August 1997. The purpose of this study was to evaluate the capability of the Memcor microfiltration (MF) membrane technology and the ZeeWeed MF membrane technology to treat wastewater for indirect potable reuse to supplement the City of McAllen's water supply.

The Memcor and the ZeeWeed MF units were evaluated while treating secondary effluent from the McAllen WWTP. The ZeeWeed MF system was also evaluated when used in conjunction with the ZenoGem process to treat screened, de-gritted wastewater and make it suitable for direct processing by reverse osmosis (RO). The ZenoGem process is designed to biologically treat screened, de-gritted sewage and microfilter the "secondary effluent" that is produced.

This section defines indirect potable reuse and its history in the U.S., defines the City of McAllen's motivations for considering implementation of indirect potable reuse to help solve their water supply problems, describes the regulatory issues associated with implementation, explains the reasons membrane processes are integral to its implementation, and presents conclusions and recommendations.

1 .1 Indirect Potable Reuse-Definition and History

Indirect potable reuse (IPR) is the recovery of water from wastewater for the purposeful reintroduction into either a surface water or groundwater body that ultimately serves as a drinking water supply. Unplanned IPR has been occurring since humans first began disposing of wastewaters into watersheds that are hydrologically connected to raw water supplies. Planned IPR began in the U.S. in the 1960s. A summary of some of the major milestones in the development of potable reuse as a viable component of a water resource management plan is presented below.

Whittier Narrows Groundwater Replenishment Project, California. In 1962, the County Sanitation Districts of Los Angeles began spreading disinfected secondary effluent from a **10-million-gallons-per-day** (mgd) (37.9 million liters [ML]/day) water reclamation plant to an underground potable water supply. The reclaimed water accounts for an annual average of 16 percent of the total inflow to the groundwater basin. The local population is estimated to be exposed to from 0 to 23 percent reclaimed water. An independent, scientific advisory panel to the State of California conducted an extensive review of the project data and concluded that the Whittier Narrows Groundwater Replenishment Project was as safe as commonly used surface water supplies.

Orange County, California, Water District. Since 1976, the Orange County, California, Water District's Water Factory 21 has been reclaiming **unchlorinated** secondary effluent to drinking water quality and recharging it into a heavily used groundwater source to prevent salt water intrusion. The water recovery treatment facility is a **15-mgd** (56.8 ML/day) facility that includes lime clarification, air stripping, recarbonation, filtration, carbon adsorption, slip-stream RO, and disinfection. It is estimated that less than 5 percent of the domestic water supply is recovered water. The Orange County Water District has not identified any significant risk to users of the groundwater from the indirect potable reuse practice.

Upper Occoquan Sewage Authority Water Reclamation Plant, Virginia. In 1978, the **15-mgd** Upper Occoquan Sewage Authority (UOSA) Water Reclamation Plant in northern Virginia began reclaiming wastewater for subsequent discharge to the Occoquan Reservoir. This reservoir is a critical source of drinking water for approximately 1 million people. The reclaimed water has accounted for as much as 90 percent of the flow into the reservoir. Treatment includes primary treatment, secondary treatment, biological **nitrification**, lime clarification and recarbonation, filtration, **activated** carbon adsorption, and disinfection. The plant has been expanded to 26 mgd (98.4 ML/day) and will be further expanded to 54 mgd (204 **ML/day**) by the year 2000. No negative health effects have been attributed to the plant or **effluent** discharges.

Potomac Estuary Experimental Water Treatment Plant, Washington, D.C. From 1981 to 1983, the 1-mgd (3.8 **ML/day**) Potomac Estuary Experimental Water Treatment Plant was operated with an **influent** blend of Potomac Estuary water and **nitrified** secondary effluent. The blend was designed to simulate **influent** water quality expected during drought conditions, when up to 50 percent of the estuary flow may comprise treated wastewater. Treatment included aeration, coagulation, clarification, **predisinfection**, filtration, carbon adsorption, and postdisinfection. An independent panel reviewed the extensive testing performed by the U.S. Army Corps of Engineers and concluded that the advanced treatment could **recover** water from a highly contaminated source similar in quality to three major water supplies for the Washington, D.C., metropolitan area.

San Diego Total Resource Recovery Project, California. In 1983, a 1-mgd (3.8 **ML/day**) potable water recovery demonstration facility was commissioned as part of a total resource recovery program established in San Diego, California. The purpose of the treatment system was to reclaim raw water from raw wastewater. The system included primary treatment, a water hyacinth aquaculture system, coagulation, clarification, filtration, ultraviolet disinfection, reverse osmosis, aeration, carbon adsorption, and disinfection. **An** extensive **chronic** toxicity risk analysis showed that the risk associated with use of the recovered water as a raw **water** supply was less than or equal to the use of the existing raw water entering the **City's** Miramar Water Treatment Plant. The City is now planning on reclaiming up to 20 mgd (75.7 **ML/day**) of secondary effluent for augmentation of their 90,000 acre-foot San Vicente Reservoir for eventual distribution to water customers.

El Paso, Texas, Fred Hervey Water Reclamation Plant. The 10-mgd (37.9 ML/day) Fred Hervey Water Reclamation Plant began operation in El Paso, Texas in 1985. The recovered water is recharged to the Hueco Bolson drinking water aquifer where, over a Z-year period, the water travels to one of El Paso's potable water well fields to become part of the potable water supply. The treatment system includes primary treatment, activated sludge/ powdered activated carbon treatment, lime treatment, recarbonation, filtration, ozonation, and granular activated carbon adsorption. Although no negative health effects have been correlated with the reuse practice, an increase in the total dissolved solids (TDS) content of the aquifer has occurred. Slipstream demineralization will be included in future plant expansions to address the TDS issue.

Tampa Water Resource Recovery Project, Florida. The City of Tampa's Water Resource Recovery Pilot Plan began operation in 1986, with the purpose of evaluating the feasibility of reclaiming **denitrified** secondary effluent to a quality suitable for blending with existing surface water and groundwater sources for indirect potable reuse. Several treatments were evaluated, and one was selected for health effects testing. This treatment system consisted of aeration, high **pH** lime clarification, recarbonation, filtration, granular activated carbon adsorption, and ozonation. The results of the health effects testing, coupled with the microbiological and chemical analyses performed during the evaluation, indicated that the quality of the reuse water was equivalent to or exceeded the quality of the local raw water supply. The City of Tampa intends to develop a **20- to 50-mgd** (189 ML/day) water resource recovery plan in the near future.

West Basin Water Recycling Program, California. From 1990 through 1995, the West Basin Municipal Water District conceived, designed, constructed, and began operating the West Basin Water Recycling Program. This program includes reclaiming 5 mgd (18.9 ML/day) (expandable to 20 mgd, or 75.7 ML/day) of secondary effluent from the City of Los Angeles's Hyperion Treatment Plant for injection into the West Coast Basin Barrier Project. The West Coast Basin Barrier Project has historically received an average of 20 mgd of potable water for injection into the coastal reaches of local south Bay aquifers for mitigation of saltwater intrusion. Substituting reclaimed water for the potable water provides substantially greater water use efficiency in the area. Reclamation treatment includes predecarbonation, lime clarification, recarbonation, filtration, RO, postdecarbonation, and final disinfection. Based on hydrogeologic investigation and modeling of the West Coast Basin, it is anticipated that the reclaimed water will improve groundwater quality along the Barrier due to the high quality of the reclaimed water relative to the imported water and the native groundwater.

Reedy Creek Improvement District, Advanced Water Reclamation Program, Florida.

In 1992, **the Reedy** Creek Improvement District began a pilot program to reduce phosphorus and nitrogen in the effluent from their wastewater treatment plant to very low levels. Although the goal of treatment was not IPR, this was the first project to **evaluate** the feasibility of using microfiltration and ultrafiltration (**UF**) as a replacement to lime clarification, recarbonation, and gravity filtration for RO

pretreatment. This approach was shown to be so effective that **MF** and **UF** have displaced lime treatment as the preferred means of **RO** pretreatment on subsequent **IPR** projects.

City of Scottsdale, Arizona, Water Campus Project. In 1994, the City of Scottsdale began pilot testing **MF** and **RO** for the purpose of reclaiming wastewater for **ground-water** recharge. The testing program, which has culminated in a 6.3mgd (25.7 **ML/day**) indirect potable reuse project currently under construction at the City's Water Campus site, represents the first planned **IPR** project in Arizona. During periods when demand for non-potable reclaimed water is low, product water from the **MF/RO** system will be blended **with** filtered surface water and injected into a potable aquifer using dry wells. The 6.3mgd facility represents the first phase of a multi-year project designated to have an ultimate capacity of 25 mgd (94.6 **ML/day**).

City of San Diego, California, Water Repurification Project. As an outgrowth of their Total Resource Recovery Project, the City of San Diego began the Repurification Project to reclaim up to 20 mgd (75.7 **ML/day**) of wastewater for indirect potable use. The program is currently evaluating the feasibility of using the following advanced water treatment processes to purify tertiary effluent from the City's new North City Water Reclamation Plant to a quality suitable for direct discharge to the San Vicente Reservoir, one of the City's main raw water reservoirs: **microfiltration/ultrafiltration**, reverse osmosis, ion exchange, and ozonation. The project represents the first surface supply augmentation **IPR** project in California and must satisfy stringent California Department of Health Services requirements regarding virus removal and real-time monitoring of individual processes for pathogen removal. If successful, the project will result in the construction of the largest **IPR** plant in the U.S.

1.2 The Need for Indirect Potable Reuse for the City of McAllen

McAllen, Texas, is located in the Lower Rio Grande Valley near the United **States-Mexico** border, approximately 40 miles upstream from the mouth of the Rio **Grande** River. McAllen presently derives its water supply from the Rio Grande River, water rights it shares with multiple parties, including other cities, water supply corporations, irrigation districts, and Mexico. The Lower Rio Grande Valley is a growing area with an existing water shortage problem. The Texas Water Development Board (TWDB) reports that all surface water resources in the area are 100 percent appropriated. Additionally, this semi-arid area often experiences drought conditions. Projected growth in population and water use indicates that the demand for potable water will exceed **McAllen's** authorized water rights by the year 2003. Consequently, alternative water supply strategies are necessary to ensure a safe, reliable source of potable water. The two most feasible alternative sources are groundwater and re-purified wastewater. Many of the groundwater supplies in the Lower Rio Grande Valley have an elevated

dissolved solids concentration and require demineralization to make them suitable for potable use. Consequently, wastewater reclamation is considered by McAllen to be a desirable means of augmenting its water supply.

1.3 Water Quality Considerations and Proposed Treatment Strategy

In general, reclaimed water should be treated to a level where its quality exceeds that of the historical water supply. In Texas, public health issues related to the use of reclaimed water fall under the purview of the Texas Natural Resources Conservation Commission (TNRCC). The preliminary position of TNRCC with respect to IPR for McAllen is (1) reclaimed water must be of equal or better quality than that of the City's current water supply, and (2) reverse osmosis must be used to treat all of the reclaimed water prior to its reuse. Based on these requirements and in view of the City's desire to reduce the dissolved solids of its finished water to improve consumer acceptability, the following IPR treatment sequence is currently proposed:

- Primary and secondary treatment
- Chlorine disinfection
- Microfiltration
- Reverse osmosis
- Ultraviolet disinfection

This sequence not only satisfies TNRCC's preliminary requirements, it also provides multiple treatment barriers to the passage of microbial, inorganic, and organic contaminants in the wastewater. The concept of "multiple barriers" has been adopted by the water supply industry to achieve the appropriate level of safety and reliability by providing redundant treatment steps for the removal of wastewater contaminants, primarily pathogens.

1.4 Membrane Technologies in indirect Potable Reuse

A primary focus of one task of the Bureau of Reclamation's Water Treatment Technology Program is research on membrane processes for wastewater reclamation. A key component of the proposed treatment sequence for IPR at McAllen includes the use of two membrane processes, MF and RO. As described in Section 1.2, RO has been applied for two decades for wastewater reclamation and is considered a proven treatment process. RO serves as the "workhorse" for the IPR process because it is very efficient in removing nearly all contaminants of public health concern. Cost-effective RO operation is highly dependent on the quality of water it receives, and a major challenge of its use in treating wastewaters is to provide a suitable quality feedwater. In this context, MF has become an important process.

Although MF has been used for industrial and pharmaceutical applications for decades, its use for wastewater reclamation is relatively new, and to date, most research with MF has been conducted with only one technology, the Memcor MF process. Memcor has been pilot testing for over 5 years; however, full-scale operations are limited and have been installed only very recently in California. Further, evaluation of technologies competitive to Memcor, including those employing MF and its close relative UF, is in its infancy and is currently restricted to only one or two sites. Thus, research is needed to evaluate Memcor at other IPR sites throughout the U.S. to demonstrate its applicability over a wider geographic area and, more importantly, to examine the feasibility of other **MF/UF** technologies that have equivalent or better capability to meet the feedwater requirements of RO.

One such MF technology is ZeeWeed. ZeeWeed is a relatively new process and no studies on its application to IPR have been reported. Memcor and ZeeWeed were selected for evaluation in this study to develop a cost-effective technical approach to **implementing** IPR for **McAllen** and to contribute vital information on the application of MF technologies for wastewater reclamation. Additionally, the ZeeWeed MF system was evaluated when used in conjunction with the **ZenoGem** process for treating screened, degrittled wastewater.

1.5 Conclusions

Overall project conclusions were developed as well as specific conclusions relating to each phase of study. These conclusions are presented below.

1.5.1 Project Conclusions

The following can be concluded from the results of this study:

1. Both **microfiltration (MF)** technologies evaluated in this study, Memcor and ZeeWeed, are applicable to the advanced treatment of City of **McAllen** wastewater for the purpose of indirect potable reuse.
2. The Memcor MF process can efficiently treat secondary effluent from the **McAllen** South WWTP (SWWTP) for the purpose of producing high quality RO feedwater. Operating over an **18-week** period, Memcor filtrate turbidity and silt density index (**SDI**) averaged 0.10 **NTU** and 2.11, respectively, compared to RO industry recommendations for efficient operation of 0.2 **NTU** and 3. Filtrate quality and operating characteristics of the Memcor system treating this source are similar to those for the treatment of secondary effluents in California and Arizona. Memcor flux rate and feedwater recovery were sustainable at 27 gallons per square foot per day (gfd) (45.8 **L/m²/hr**) and 91 percent in this study compared to a range of 23 to 28 gfd (39.0 to 47.5 **L/m²/hour**) and 90 to 92 percent at reuse facilities in California. The estimated annual cost of Memcor MF and RO treatment for this application

(\$1.93 per 1,000 gallons of wastewater) is slightly less expensive than the cost of treating the secondary effluent with lime clarification, recarbonation, and filtration followed by RO (\$2.18 per 1,000 gallons of wastewater).

- ZeeWeed MF technology is competitive with Memcor MF technology in the production of RO feedwater from secondary effluent when non-economic factors are considered. As shown below, ZeeWeed demonstrated a higher flux rate, greater feedwater recovery, and longer operating intervals between chemical cleanings than Memcor, while producing a filtrate of comparable quality.

Table 1 .1-ZeeWeed and Memcor MF Operating Parameters

	ZeeWeed	Memcor
Flux rate (gfd)	33.0	24.4
Feedwater recovery (%)	96.3	90.1
Interval between cleanings (days)	>48	14

- The ZenoGem process is capable of directly processing screened and de-gritted raw wastewater to a quality that satisfies the City's current effluent discharge requirements of 15 milligrams per liter (**mg/L**) carbonaceous biochemical oxygen demand (**CBOD₅**) and 5 **mg/L** total suspended solids (**TSS**). The ZenoGem process is also capable of meeting the RO feedwater turbidity criterion of 0.2 NTU. ZenoGem filtrate averaged 0.6 **mg/L** **CBOD₅**, less than 1 **mg/L** **TSS**, and 0.16 **NTU** turbidity. Filtrate from the ZenoGem process was of lesser quality than filtrates produced by Memcor and ZeeWeed (treating secondary effluent) with respect to **SDI**. **SDI** tests averaged 5.0 for ZenoGem compared to 2.1 and 2.6 for Memcor and ZeeWeed, respectively, when treating filtered secondary effluent. The RO feedwater criteria for turbidity is 3.0 NTU. The high **SDI** values are not believed to be caused by greater particulate levels. Therefore, it is not known if RO operation on ZenoGem filtrate would result in a greater rate of membrane fouling.
- ZenoGem can treat **McAllen's** raw wastewater to a quality comparable to the City's existing WWTP effluent more efficiently than the existing WWTP. By operating the activated sludge process at average mixed liquor volatile suspended solids (**MLVSS**) concentration of 11,000 **mg/L** and solids retention times of 3 to 5 hours, ZenoGem requires only one-tenth the hydraulic retention time or "Footprint" to achieve the **same** degree of BOD, and ammonia removal as the existing WWTP, which currently operates with an average **MLVSS** concentration of 2,333 **mg/L** and a hydraulic retention time

of 29.8 hours. The **nitrification** rate for the **ZenoGem** process was 0.26 g $\text{NH}_3\text{-N/g}$ **nitrified** volatile suspended solids (NVSS)-day compared to 0.17 g $\text{NH}_3\text{-N/g}$ NVSS-day for the **McAllen** WWTP.

6. Although development of cost estimates for a **ZenoGem** system to treat **McAllen's** wastewater in the context of indirect potable reuse was beyond the scope of this study, it is anticipated that a **ZenoGem/RO** system would be less expensive to construct and operate than the combination of conventional secondary wastewater treatment, Memcor or ZeeWeed MF, and RO.

1.52 Phase I Conclusions

ZeeWeed MF and the Memcor MF systems operating on secondary effluent were compared during Phase I of the study. Conclusions specific to Phase I are presented below:

1. Both Memcor and ZeeWeed MF systems achieved a greater-than-planned interval between cleanings during Phase I.
2. The rate of fouling of the Memcor membrane was significantly greater than for the ZeeWeed membrane. This suggests that the combination of continuous mechanical agitation and periodic backflushing used for the ZeeWeed membrane are more effective for controlling build-up of material on the membrane surface than the method of intermittent backwashing with air and feedwater method used with Memcor.
3. Feedwater recovery for the ZeeWeed MF system during Phase I was approximately 6 to 7 percent higher than the recovery achieved by the Memcor MF system.
4. Although results were variable, turbidity and **SDI** for the effluent from both systems were below RO feedwater criterion during most of Phase I operations.
5. Neither ZeeWeed nor Memcor MF systems were effective in reducing the dissolved inorganic or organic content of secondary effluent.
6. Filtrate from the ZeeWeed MF unit showed higher levels of microbiological contaminants than filtrate from the Memcor MF system during both phases of testing. No fecal or total coliforms were detected in the Memcor filtrate during either phase.
7. During treatment with ZeeWeed MF, **pH** increases. This increase most **likely results** from the stripping of carbon dioxide from the secondary effluent by the aeration in the process tank.

8. Control of suspended solids and algae is critical to successful performance and monitoring of the water treatment system.

1.5.3 Phase II Conclusions

During Phase II, the Memcor system continued to operate on secondary effluent while the ZeeWeed system was operated as part of the ZenoGem process. Feedwater for the ZenoGem process was screened and de-gritted wastewater. Operation of the Memcor system during Phase II was compared to Memcor operations during Phase I. Operating results of the ZenoGem process were compared to those from Phase I for the ZeeWeed and Memcor processes; the City's extended aeration wastewater treatment process; and the Memcor process during Phase II. Conclusions for Phase II are presented below:

Memcor

1. Chemical cleanings implemented during Phase II were very effective for removing accumulated solids and restoring TMP to the target level of 7 to 8 psi (0.46 to 0.53 bar).
2. An increase in filtrate flow during Phase II resulted in an increase in recovery. When filtrate flow was increased during Phase II to 20 gpm (1.26 L/s), recovery rose from 90 to 91 percent.
3. Mean filtrate turbidity was lower during Phase II (0.05 NTU) than during Phase I (0.12 NTU). Additionally, turbidity values were much less variable during Phase II.
4. SDI values were similar during Phases I and II.

ZenoGem

1. The rate of TMP increase during Phase II was significantly lower than that observed during Phase I. This may be a result of a lower rate of solids loading at the surface of the membrane and/or a greater degree of mechanical cleaning of the membrane surface provided by the higher solids level.
2. Phase II recovery was approximately 2 to 4 percent higher and more consistent than that observed during Phase I.
3. Turbidity was higher during Phase II for the ZenoGem process than during Phase I for both the Memcor and ZeeWeed MF systems.

4. Phase I **SDI** levels for both MF systems were much lower than those observed during Phase II for the ZenoGem process.
5. By maintaining higher MLVSS concentrations, the ZenoGem process can attain comparable reduction in BOD, at a much lower hydraulic detention time for the bacterial cells.
6. The ZenoGem process has the capability to be operated with longer solids retention times than conventional wastewater processes because it is not limited by sludge bulking that typically occurs at very long detention **times**.
7. **Nitrification** in the ZenoGem process was inhibited during the early periods of testing, but improved dramatically as DO levels were increased.
 - a. Oxygen uptake rates in the ZenoGem bioreactor indicated good biological activity as evidenced by the BOD, removals achieved.
9. Sludge yields for the **McAllen** WWTP and the ZenoGem process were very comparable.
10. The ZenoGem process produced a filtrate having a CBOD, concentration consistently below the discharge requirement of 15 **mg/L**.
11. The ZenoGem process more efficiently removed CBOD, from the raw wastewater than the WWTP, despite operating with one-tenth the hydraulic retention time.
12. The ZenoGem process is more than capable of producing an effluent meeting **McAllen's** current effluent discharge limit.

1.6 Recommendations

The results of this research offer compelling evidence that ZeeWeed is a versatile water reuse technology that can microfilter secondary effluent and clarify activated sludge to qualities suitable for use as RO feedwater. The testing described herein was of limited duration and could not address the critical issues related to the reliability and cost of this technology. Further, the ZenoGem process was limited to operation for basic secondary treatment; capability for its use in the context of sustained **nitrification** or biological **and/or** chemical nutrient removal was not addressed. There is a compelling need for extensive **research** to:

1. Determine if **ZeeWeed** can consistently produce the necessary quality filtrate at a sustained flux over many thousands of hours of operation and multiple chemical cleanings (process and product reliability)

2. Estimate the full-scale capital and operating costs of ZeeWeed for secondary effluent treatment and of ZenoGem for raw wastewater treatment relative to the currently preferred approach of conventional wastewater treatment and MF
3. Establish that ZenoGem is a sufficiently versatile process to be applied not only for secondary treatment but also for high level **nitrification** or biological nitrogen removal (when preceded by **anoxic** treatment)
4. Demonstrate that RO can be operated as cost effectively on ZeeWeed or ZenoGem filtrate as on Memcor filtrate

Additional recommendations for future research include:

1. Perform a more comprehensive evaluation of ZenoGem on raw wastewater at the **McAllen** SWWTP to:
 - a. Optimize performance characteristics.
 - b. Confirm process reliability.
 - c. Assess operating and maintenance characteristics.
 - d. Evaluate impact of bioreactor conditions (**MLVSS** and **SRT**) on **filtrate** quality, particularly **SDI**.
 - e. Provide data needed to prepare representative estimates of capital and operating costs for the process.

Operate a RO system on ZenoGem filtrate to:

1. Assess RO fouling characteristics of this supply.
2. Determine appropriate design criteria for the RO process in the context of indirect potable reuse.
3. Assess the quality of RO concentrate and its compatibility with the proposed **means** of discharging concentrate at **McAllen**.
4. Demonstrate that the quality of RO product water meets or exceeds IPR requirements.

Pursue in-depth cost analyses of both the ZeeWeed and Memcor MF systems prior to pursuing design of a full-scale water treatment plant using either technology.

Install ammonia feed facilities to prevent free chlorine from combining with trihalomethane (**THM**) and haloacetic acid (**HAA**) precursors.

2. STUDY OBJECTIVES

The research to be conducted under this program has five objectives:

Confirm the applicability of the Memcor MF system for RO pretreatment of secondary effluent from the **McAllen** WWTP and compare its cost for McAllen with that established for full-scale IPR projects in California and Arizona.

Compare the ability of ZeeWeed, a novel microfiltration technology, to provide an RO feedwater of quality equivalent to Memcor filtrate when processing secondary effluent from the **McAllen WWTP**.

Evaluate the ability of ZeeWeed MF, when used in conjunction with the ZenoGem process, to directly treat screened, de-gritted wastewater to a quality suitable for direct processing by RO, and compare ZenoGem **filtrate** quality to that of ZeeWeed and Memcor MF treating secondary effluent.

Compare the operating characteristics of the ZeeWeed MF to Memcor MF, for the purpose of producing an acceptable RO feed for IPR, when used:

To directly treat secondary effluent

- In conjunction with the ZenoGem process to treat screened, de-gritted wastewater.

Compare the wastewater treatment efficiency of the ZenoGem process to that of extended **aeration** as performed at the McAllen WWTP by measuring the removal of CBOD,, TSS, and ammonia nitrogen.

3. PILOT PLANT FACILITIES

The pilot plant facilities used Memcor and ZeeWeed MF systems. The pilot plant consisted of the Memcor and ZeeWeed units, plus ancilliary equipment such as a raw water supply pump, piping, valves, and fittings, all of which interfaced with existing McAllen WWTP electrical and piping systems. A description of the other components of the pilot plant facilities is presented in the following sections.

3.1 Raw Water Supplies

During Phase I, the raw water supply to both treatment systems was secondary effluent from the SWWTP. Three sources of secondary effluent were available from the SWWTP as feedwater during Phase I:

- Effluent prior to disinfection (unchlorinated effluent)

- Effluent disinfected with chlorine

- Disinfected effluent subsequently dechlorinated with sulfur dioxide (disinfected, dechlorinated effluent or DDE).

Based on other pilot studies, the Memcor system appears to operate much more efficiently on disinfected effluent because disinfection greatly reduces fouling caused by bacterial loading on the membranes. Historical use of ZeeWeed in the **ZenoGem** process indicates that the ZeeWeed membrane is not as susceptible to bacterial fouling and should operate with equivalent performance on any of the sources. This is because the bacteria loading and its corresponding fouling is controlled by backpulsing the membranes with chlorinated water every 6 to 12 minutes.

DDE may, however, contain greater concentrations of chlorinated disinfection byproducts (DBPs) that are formed from the reaction of free chlorine and certain organic compounds present in the wastewater. Two of these byproducts, trihalomethanes (THMs) and haloacetic acids (HAAs) are either currently regulated or are scheduled for regulation in drinking water supplies under the Safe Drinking Water Act. Chlorinated DBPs are a concern in the secondary effluent because they are refractory to removal by both MF and RO and may adversely impact the City's ability to produce an acceptable quality of reclaimed water when the reclaimed water is blended with the City's current raw water supply.

Waste-water plants that convert ammonia to nitrite and nitrate through the process of nitrification typically contain insufficient levels of ammonia in the secondary effluent to convert the chlorine applied during the disinfection process to chloramines. Consequently, the free chlorine present during disinfection reacts with the organics to form chlorinated DBPs. Although the McAllen WWTP is not designed to nitrify, the warm wastewater temperatures at McAllen result in unplanned nitrification during a significant portion of the year and produce variable and low levels of ammonia in the

secondary effluent. A review of operating data for the **McAllen** WWTP for a 1-year period indicates that ammonia concentrations vary between <0.1 and 8 **mg/L**, over as little as a **2-week** period. Chlorinated DBP levels in the DDE may be problematic unless ammonia levels are maintained at 0.5 **mg/L** or greater in the unchlorinated effluent.

The City currently minimizes the formation of chlorinated **DBPs** in their water treatment process by avoiding the use of free chlorine. Chlorine dioxide is used as a pre-oxidant and primary disinfectant; chloramines are used for secondary disinfection. Blending reclaimed water that contains significant concentrations of **THMs** and **HAAs** with the City's existing raw water could potentially increase **THMs** and **HAAs** in the potable water to unacceptable levels. The U.S. **Environmental** Protection Agency (EPA) has proposed new regulations that would reduce the maximum contaminant level (**MCL**) for **THMs** from 100 micrograms per liter (**µg/L**) to 80 **µg/L** and place into effect an **MCL** for **HAAs** of 40 **µg/L**. This compares to levels of 50 to 250 **µg/L** for these constituents for nitrified and disinfected secondary effluents (**Najum**, 1997).

An additional concern is that the membrane material used with the Memcor system is intolerant to free chlorine. Any exposure will reduce membrane life. The ZeeWeed membrane material can tolerate continuous high free chlorine levels.

Given these concerns, sampling and analysis for **THMs** and **HAAs** was conducted on a sample of DDE prior to the start of Phase I testing. The results, which are discussed in Section 5, indicated that the best overall source for testing the Memcor and the ZeeWeed MF systems was DDE. Consequently, DDE was used as the feedwater to the two MF units during Phase I.

During Phase II, the water supply for the **ZenoGem** process was screened, de-gritted wastewater while the Memcor unit continued to operate on DDE.

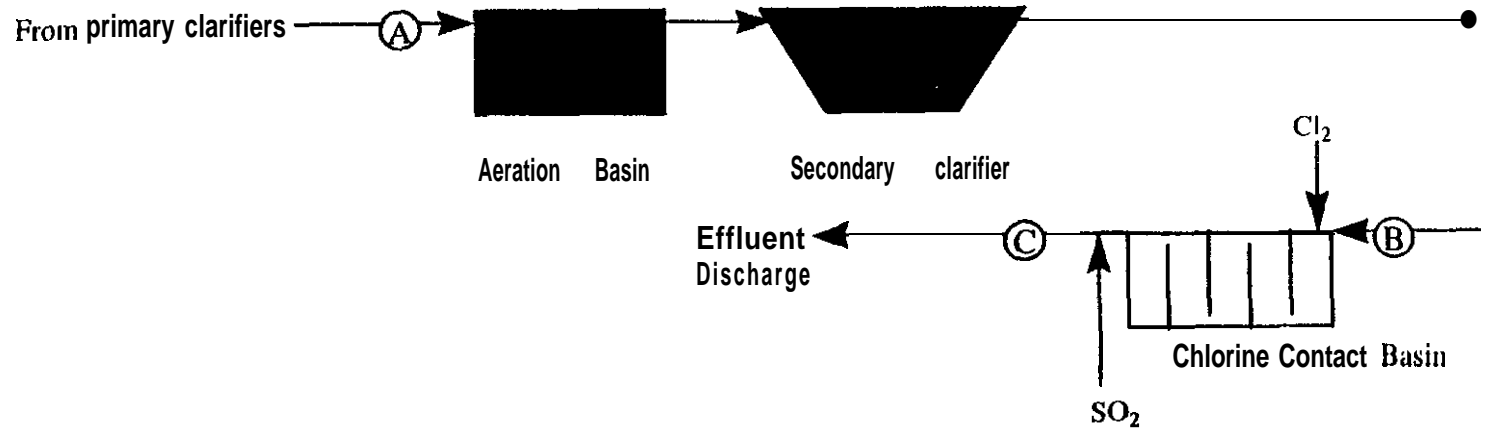
3.2 Raw Water Abstraction and Pumping

DDE was abstracted from the outlet channel of the WWTP chlorine contact basin downstream from the dechlorinating agent (sulfur dioxide [**SO₂**]) injection point. A submersible pump was used to transfer the effluent from the abstraction point to the two treatment systems.

Capability was also provided to abstract unchlorinated effluent from the inlet channel to the chlorine contact basin prior to chlorine injection. However, it was not necessary to use this capability during the study.

Screened, de-gritted wastewater was abstracted from the aeration basin **influent** splitter box and pumped to the ZeeWeed process tank for use in the **ZenoGem** process during Phase II.

Abstraction points relative to the WWTP processes are presented in figure 3.1.



- Ⓐ Primary Effluent (ZeeWeed only)
- Ⓑ Unchlorinated Secondary Effluent
- Ⓒ Dechlorinated, Disinfected Secondary Effluent

Figure 3.1. Location of Effluent Abstraction Points for MF Raw Water Supply

3.3 Raw Water Screening

Raw water to the Memcor MF system was screened using a basket strainer with a nominal retention rating of 500 microns (pm). Screening was necessary to prevent clogging of the inlet distributors of the membrane modules. No screening (other than that provided by the McAllen WWTP headworks) was needed ahead of the ZeeWeed MF system because there were no inlet distributors to clog.

For the first 2 days of Memcor operation, the basket strainer was incorrectly fitted with a larger one-eighth-inch opening basket. This caused larger-sized particles to clog the wye strainer on the suction side of the Memcor feed pump and reduce backwashing effectiveness. The impact of the impaired backwashing on Memcor performance is described in section 5.3.4.1.

3.4 Memcor Microfiltration Treatment System

The Memcor MF treatment system consisted of a 100-gallon (379-Liter) break (feed) tank, a feed pump, and three membrane modules plumbed in parallel. Each module contained 162 square feet (ft²) (15 square meters [m²]) of hollow fiber membrane having a nominal pore size of 0.2 microns. The modules are designed to operate in a direct flow configuration where all the feedwater applied to the module flows from outside the fiber through the fiber wall to the inside (lumen) and is collected as filtrate. All modules were operated concurrently to provide a unit capacity of 16 to 20 gallons per minute (gpm) (1.0 to 1.26 liters per second [L/s]), depending on the target flux rate, with a module feed pressure of 30 to 35 psig (2.0 to 2.3 bar).

Periodically, the modules were backwashed in a three-step procedure to remove solids that had accumulated on the outer surface of the fibers during the filtration cycle. First, the lumen of each fiber was drained of filtrate. Compressed air was introduced into the lumen of the membrane and subsequently forced through the pores of the membranes to the feed side at high pressure (100+ pounds per square inch gauge [psig] [6.9 + bar]). During this process, solids were displaced from the membrane surface into the spaces between the fibers. In the second step, feedwater was used to flush (sweep) the discharged solids from the modules. The resulting backwash water, containing the solids removed from the modules, was conveyed to a 30-gallon (114-Liter) tank especially designed to dissipate energy in the high velocity, air-containing backwash stream. Equipment used for backwashing included a compressor capable of developing 120 psig (8 bar) air pressure, air receiver, pressure regulator, and coalescer and filter for air drying and filtration.

The backwash water was discharged from the backwash tank to one of the secondary clarifiers by gravity. Filtrate was also discharged to the secondary clarifier.

Backwashing did not completely remove the solids trapped on the membrane surface during filtration and eventually the pressure differential across the membrane

(transmembrane pressure) increased to a terminal value (typically 17 to 18 psig [1.1 to 1.2 bar]). At this point, the membrane modules were chemically cleaned to dissolve and remove the refractory solids. Cleaning solutions were batched in the break tank, recirculated through the modules, and discharged to the sanitary sewer upon completion of the cleaning procedure. With the exception of batching of cleaning solutions and initiation of the cleaning sequence, all operations of the system are automated and controlled by a programmable logic controller (PLC).

Cleaning was performed seven times using Memtec's proprietary, **high-pH** caustic/surfactant proprietary liquid cleaner (**Memclean** EXA). When this cleaner alone was not successful in reducing transmembrane pressure (TMP) to desired levels, it was supplemented with a separate cleaning using citric acid.

A process flow schematic for the Memcor system is shown in figure 3.2. Photographs of the Memcor system are presented in appendix A.

3.5 ZeeWeed Treatment System

The ZeeWeed model MSTD ZW-4 MF system has a nominal capacity of 3 **gpm** (0.19 L/s). The system consists of a supply pump, **180-gallon** (681 Liter) process tank, one membrane module containing 150 ft² (13.9 m²) of hollow fiber membranes with a nominal pore size of 0.1 micron, a process pump, and a blower. In contrast to the Memcor system, whose membrane module consists of a bundle of fibers encased in a pressure vessel, the ZeeWeed membrane module consists of loose fibers connected to a manifold system at either end, with the module suspended in the process tank and submerged in the liquid to be treated. Treatment occurs when a centrifugal (process) pump applies a vacuum of 3 to 9 psig (6 to 18 inches of Hg) to the filtrate side of the fibers. The vacuum causes water in the stream (secondary effluent or mixed liquor) to flow from the feed side to the filtrate side of the membrane in a direct filtration mode under a positive transmembrane pressure.

Solids buildup on the outside surface of the membrane fibers and related increases in filtrate side vacuum is controlled in two ways. First, a blower is used to introduce air (in the form of coarse bubbles) into the bottom of the process tank directly beneath the membrane fibers. The air bubbles flow upward, parallel to and between the vertically oriented fibers, causing the fibers to agitate against one another. This results in mechanical cleaning. Secondly, the fibers are backflushed every 6 to 12 minutes with filtrate (hydraulic cleaning). Typically, a low concentration of chlorine (<5 parts per million [**ppm**]) is maintained in the backflush water to inactivate and remove microbes (primarily **bacteria**) that colonize the outer membrane surface. For this study, no chlorine was used in order to minimize formation of **THMs** and **HAAs** in the filtrate. Backflushing is accomplished using discharge head from the process pump. Unlike Memcor backwashing, backflush water is retained in the process tank. To control the buildup of solids in the process tank, a percentage of the tank volume is continuously

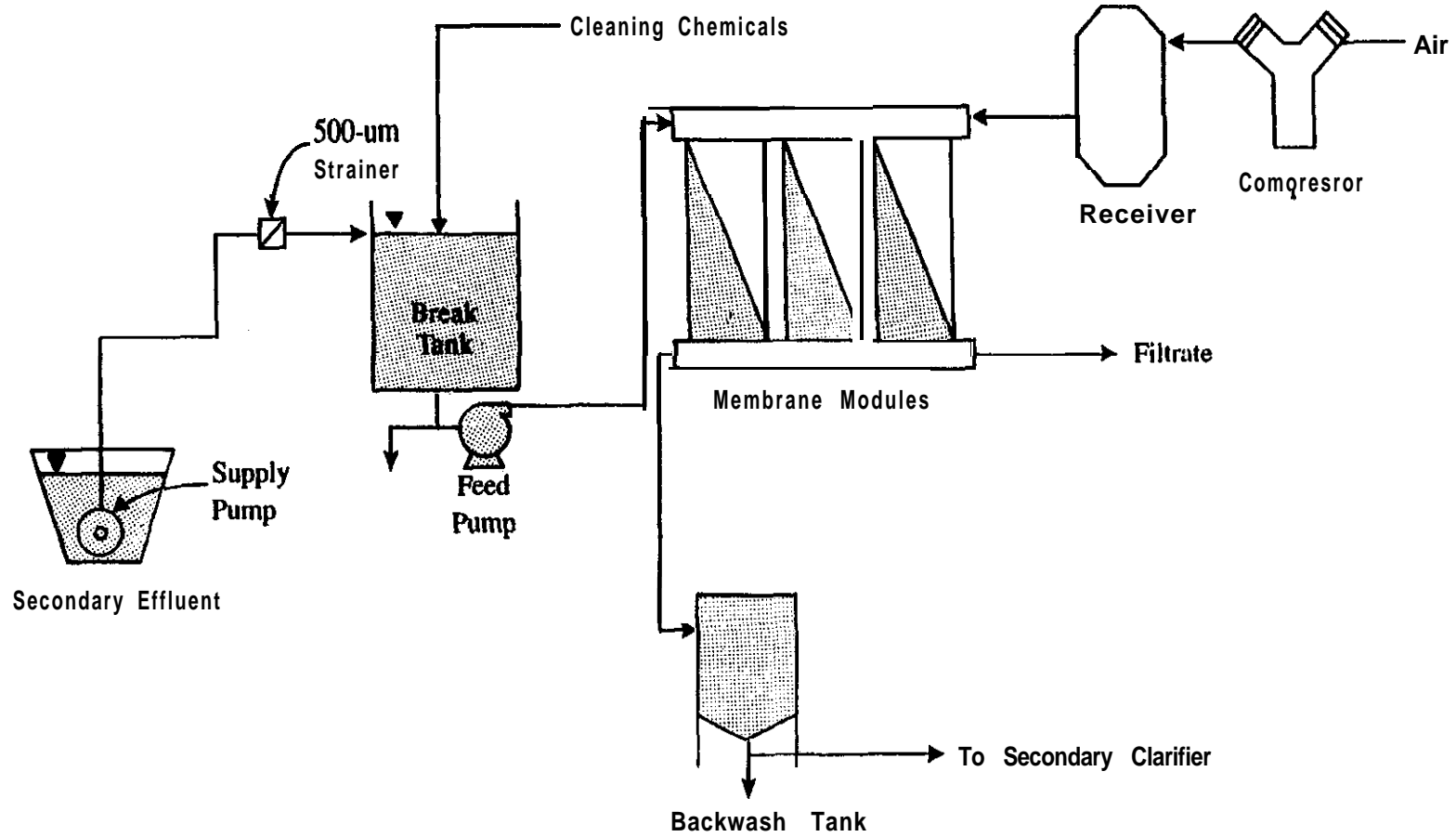


Figure 3.2 Process Flow Schematic for Memcor Microfiltration System

extracted using a peristaltic pump. The actual volume of backwash varies depending on the backpulse frequency and duration, but is typically equal to 5 to 15 percent of the filtrate flow from the unit.

ZeeWeed feedwater (either DDE or screened, de-gritted wastewater) was pumped to a 55-gallon (208-Liter) balance tank using a submersible pump. A grinder-type submersible pump located in the bottom of the balance tank transferred the raw water to the ZeeWeed process tank. Excess flow from the balance tank was recycled by gravity back to the secondary clarifier along with blowdown from the process tank and filtrate.

Like the Memcor system, mechanical and hydraulic cleaning does not completely prevent fouling and after some period of operation, filtrate-side vacuum reaches a terminal value (17 to 19 inches of Hg). At this point, the membranes are chemically cleaned with filtrate containing a high concentration of free chlorine (typically 200 ppm). In this pilot study, the ZeeWeed module was not cleaned until the termination of each testing phase.

Some of the filtrate extracted from the module by the process pump is discharged from the system to the secondary clarifier. The remainder is returned to the process pump. This permits separate control of membrane flux and hydraulic retention time (HRT) of feedwater in the tank. When treating secondary effluent, control of HRT is not critical. A process flow schematic for the ZeeWeed system is shown in figure 3.3. Photographs of the ZeeWeed MF system are presented in appendix A.

3.6 ZenoGem Operation

Operation of the ZeeWeed unit as part of the ZenoGem process is similar to that described in subsection 3.5 except that (1) the rate of filtrate discharge to the secondary clarifier is controlled to achieve the desired HRT in the process tank (bioreactor) and (2) solids buildup in the bioreactor is controlled through once-per-day manual wasting to achieve the desired solids retention time (concentration of mixed liquor suspended solids) in the bioreactor. Proper HRT control is required to achieve the desired degree of CBOD, and ammonia removal by the biomass maintained in the bioreactor. Unlike a conventional wastewater treatment plant that operates at MLVSS levels of 2,000 to 3,000 mg/L, the ZenoGem process is designed to operate at MLVSS levels of 10,000 to 15,000 mg/L. This allows for greater concentration of wastewater microorganisms in the treatment system.

3.7 Criteria for Treatment System Operation

Table 3.1 presents criteria that were established for operation of the two MF systems during the pilot testing. Table 3.2 presents additional criteria used during testing of the ZenoGem process. These criteria reflect the individual manufacturer's experience with

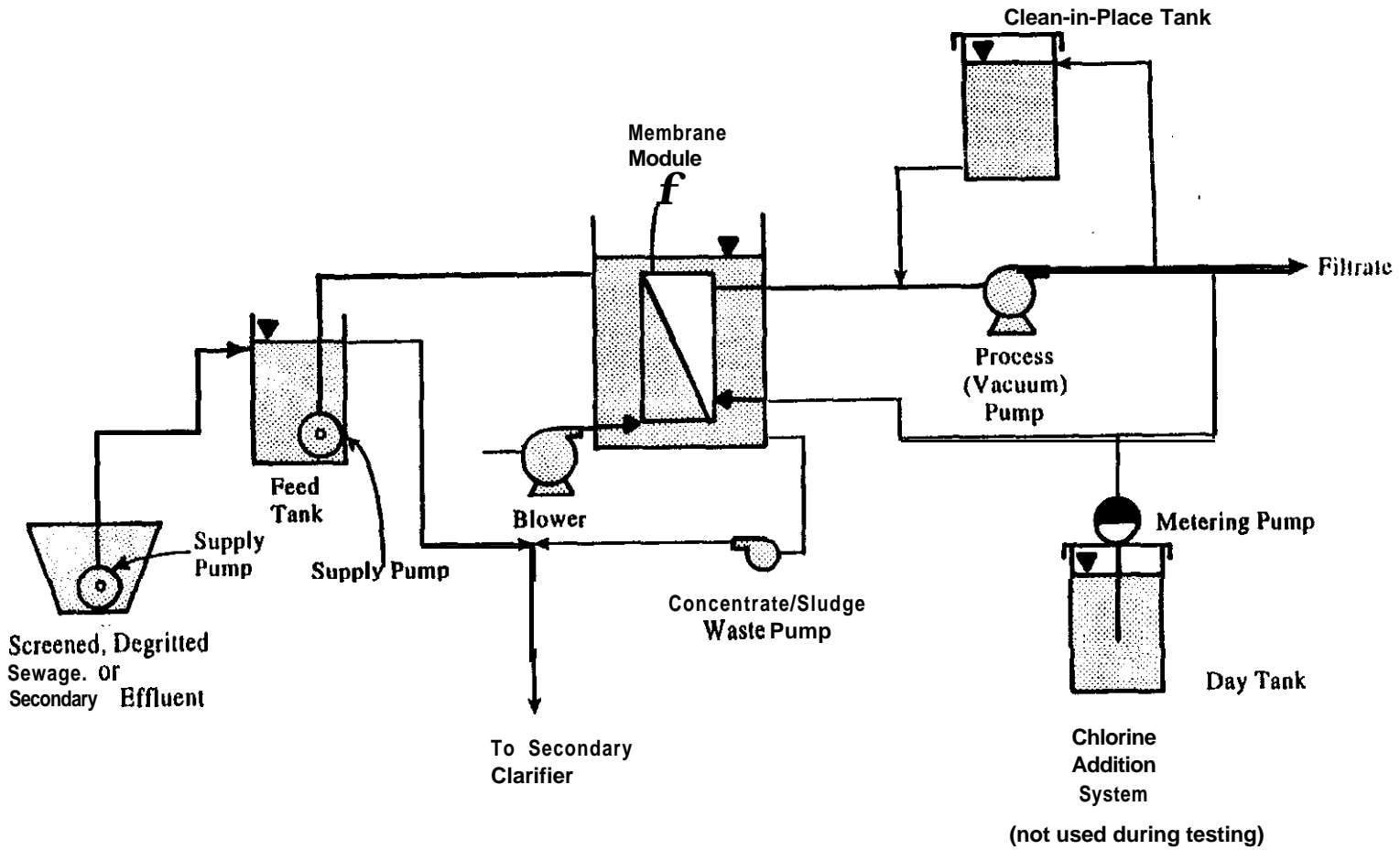


Figure 3.3. Process Flow Schematic for ZeeWeed System

Table 3.1 .-Criteria for Memcor CMF and ZeeWeed MF System Operation

Parameter	Units	Memcor CMF	ZeeWeed MF
Transmembrane Pressure	psi	3 to 20	3 to 9
Membrane Flux	gfd ¹	35	20 to 40
Backwash/Backpulse Frequency	minutes	15 to 20	6 to 12
Backwash/Backpulse Duration	seconds	90	10
Cleaning Frequency	days	3 to 5	20 to 30

¹gfd • gallons per day per square foot of membrane filtering surface

Table 3.2.—Biological Treatment Criteria for ZenoGem Process

Parameter	Units	ZenoGem
Mixed Liquor Volatile Suspended Solids (MLVSS)	mg/L	10,000
Dissolved Oxygen	mg/L	>2
Hydraulic Retention Time	days	2 - 4

DDE and (for ZenoGem) screened, de-gritted wastewater. Some of the criteria were modified **during** the study in response to the actual fouling characteristics of the two feed streams from the WWTP. The actual operating criteria are discussed in section 5

4. TESTING APPROACH

The two treatment systems (**Memcor** and **ZeeWeed**) were operated 24 hours a day, 7 days a week except for cleaning downtimes or planned and unplanned maintenance. The pilot testing program was divided into two phases:

Phase I: Operation of **Memcor** MF and **ZeeWeed** MF systems on DDE from **McAllen** WWTP No. 2.

Phase II: Continued operation of **Memcor** MF system on DDE; operation of **ZeeWeed** MF system as part of the **ZenoGem** process on screened, degrittled wastewater.

4.1 Pre-Phase I Activities

Prior to beginning operation of the treatment systems, several preliminary activities were necessary, including characterization of the quality of **McAllen's** current raw water supply and the chlorinated byproduct content of the secondary effluent. These activities are described below.

4.1.1 Raw Water Supply Characterization

The overall goal of IPR is to produce a reclaimed water of suitable quality for supplementing **McAllen's** current raw water supply. Thus, as part of this study, it was desirable to characterize the quality of the raw water supply and to compare it to **the** quality of reclaimed water produced by MF treatment (but prior to RO treatment).

Raw water characterization was conducted both prior to and during the operation of pilot equipment. A listing of water quality parameters selected for analysis and the laboratory responsible for analysis of each parameter are shown in table 4.1. Analyses were performed by **CH2M HILL's** Applied Sciences Laboratory and the **McAllen** wastewater laboratory. Particle counts were measured using a Met-One model WGS-267 grab sample type particle counter.

4.1.2 MF Feedwater Selection

During Phase 1 operation, both MF units were to operate on secondary effluent from the WWTP. Feedwater could be abstracted from one of three sources following secondary treatment. These sources would provide unchlorinated secondary effluent, chlorinated secondary effluent, or dechlorinated secondary effluent. As discussed in section 3, proper feedwater selection required that the levels of selected **DBPs** in the chlorinated secondary effluent be quantified.

Table 4.1 .-Source Water Charaterization

Parameter	No. Of Samples	Analytical Method	Responsible Laboratory
Inorganics			
Bromide	2	EPA 300	McAllen
Barium	2	EPA 200.7	McAllen
Calcium	2	EPA 200.7	McAllen
Magnesium	2	EPA 200.7	McAllen
Strontium	2	EPA 200.7	McAllen
Potassium	2	EPA 200.7	McAllen
Sodium	2	EPA 200.7	McAllen
Iron	2	EPA 200.7	McAllen
Manganese	2	EPA 200.7	McAllen
Aluminum	2	EPA 200.7	McAllen
Bicarbonate	2	EPA 310.1	McAllen
Carbonate	2	EPA 310.1	McAllen
Chloride	2	EPA 300	McAllen
Fluoride	2	EPA 300	McAllen
Sulfate	2	EPA 300	McAllen
Nitrate	2	EPA 300	McAllen
Phosphorous	2	EPA 365.1	McAllen
Silica	2	EPA 200.7	McAllen
TDS	2	SM 52108	McAllen
Organics			
TOC	2	EPA 110.2	CH2M HILL
Color	2	EPA 415.1/2	CH2M HILL
UV Absorbance	2	SM 5910 A	CH2M HILL
THMFP (96-hr)	2	SM 5710 D	CH2M HILL
HAAFP (96-hr)	2	SM 5710 D	CH2M HILL
Physical/Chemical			
Temperature	2	Not Applicable	McAllen
pH	2	SM 4500 H	McAllen
Turbidity	2	SM 2130 B	McAllen
SDI	2		McAllen
Particle Count	2	Met-One Model 567 Particle Counter	McAllen
Microbial			
Total Coliform	2	SM 9222 D	McAllen
Fecal Coliform	2	SM 9222 D	McAllen
HPC	2	SM 9215 B	McAllen

To evaluate DBP levels, a sample of DDE was collected on February 25, 1997, and analyzed for levels of **THMs** and **HAAs**. (Disinfected secondary effluent at the McAllen WWTP is dechlorinated prior to discharge to conform to requirements of their National Pollution Discharge Elimination System [NPDES] permit.) A sample of unchlorinated secondary effluent was also analyzed to determine the levels of these contaminants before chlorination. Analyses were performed by the **CH2M HILL** Applied Sciences Laboratory. The results, which are presented and discussed in section 5.0, indicated low levels of both byproducts in the chlorinated secondary effluent and supported the use of DDE for MF feedwater.

4.2 Phase I

Phase I testing was conducted from April 10 through June 18, 1997, for the Memcor system and from April 14 through June 15, 1997, for the ZeeWeed system. Both MF systems were operated on a common raw water supply of DDE.

The objectives of Phase I were to:

Confirm the applicability of the Memcor MF system for RO pretreatment of secondary effluent from the **McAllen** WWTP.

Compare the ability of ZeeWeed, a novel microfiltration technology, to provide an RO feedwater of quality equivalent to Memcor filtrate when processing secondary effluent from the **McAllen** WWTP.

The focus during Phase I was to first establish and maintain system operation at the manufacturer's recommended criteria, observe resulting performance, and then, using these results, optimize operating conditions. The following response variables were monitored and evaluated during the initial period of operation and used to perform the optimization:

Filtrate quality (as measured by turbidity, SDI, and level of indicator microorganisms).

Rate of TMP increase with operating time, initially and following each chemical cleaning.

Effectiveness of cleaning in reducing membrane fouling as measured by reduction in TMP.

4.3 Phase II

Phase II testing was conducted from June 19 through August 15 for both treatment systems. The specific objectives of this phase of testing were to:

Evaluate the ability of ZeeWeed MF, when used in conjunction with the **ZenoGem** process, to directly treat screened, de-gritted wastewater to a quality suitable for direct processing by RO, and compare **ZenoGem** filtrate quality to that of ZeeWeed and Memcor MF treated secondary effluent.

Compare the operating characteristics of the ZeeWeed MF when used:

1. To directly treat secondary effluent.
2. In conjunction with the ZenoGem process to treat screened, de-gritted wastewater.

Compare the wastewater treatment efficiency of the ZenoGem process to that of extended aeration as performed at the **McAllen** WWTP by measuring the removal of CBOD,, TSS, and ammonia nitrogen.

The ZenoGem process incorporates ZeeWeed for retention and clarification of biological solids used for secondary treatment. In this phase, testing of the ZenoGem system has two goals:

Biologically treat the screened, de-gritted wastewater to produce a “secondary effluent” meeting or exceeding the quality requirements of the City. These requirements include producing an effluent that meets all the requirements of the City’s **NPDES** permit for surface discharge.

Microfilter the “secondary effluent” to a quality suitable for use as RO feedwater and equivalent to that produced by the Memcor and ZeeWeed MF systems when treating secondary effluent (demonstrated during Phase I).

The Memcor system operation continued as in Phase I. The ZeeWeed system was operated on screened, de-gritted wastewater.

Response variables for Memcor and the ZeeWeed MF system are as listed under Phase 1. Response variables for the biological treatment portion of the ZenoGem process are as follows:

- Oxygen uptake rate (OUR)
- Filtrate CBOD,
- Filtrate TSS
- Filtrate nutrients (nitrogen species and total phosphorus)

The results of Phase I and Phase II testing are discussed in section 5.0.

4.4 Treatment System Monitoring

During the testing phases, various performance parameters were monitored to evaluate operation of the treatment systems and the quality of the water fed to and produced by the systems. The parameters that were monitored are presented in the following sections.

4.4.1 Microfiltration System Operating and RO Feedwater Quality Parameters

Operating parameters for the MF systems were monitored on a daily basis by McAllen personnel to evaluate the treatment systems. Additionally, the effluents from the MF systems were monitored on a daily basis to evaluate the suitability of the effluent for processing by RO.

The operating parameters that were monitored are presented in table 4.2. The RO feedwater quality parameters, the monitoring frequency, responsible analytical party, and analytical methods are presented in table 4.3. All water quality samples were collected by McAllen personnel.

Table 4.2.—Monitored Operating Parameters for MF Systems
ZeeWeed and memcor Phases 1 and II

Parameter	Unit	Memcor	ZeeWeed
Feed Pressure	psig	X	
Filtrate Pressure	psig	X	
Filtrate Vacuum	in. Hg		X
Feed Flow	gpm	X	
Filtrate Temperature	deg C.	X	X
Filtrate Flow	gpm	X	X
Backwash (pulse) Frequency	min	X	X
Backwash Duration	sec	X	X
Process Tank Waste Rate	qpm		X

Table 4.3.—Monitored RO Feedwater Quality Parameters
ZeeWeed and Memcor Phases I and II

Parameter	Analytical Laboratory	Feedwater ¹	Monitoring Frequency	
			ZeeWeed Filtrate	Memcor Filtrate
Turbidity	McAllen	1/day		
Silt Density index	McAllen	None	1/day	1/day

¹ Feedwater to ZenoGem process during Phase II not monitored for these parameters

4.4.2 ZenoGem Process Operating and Water Quality Parameters

Additional parameters were measured in the bioreactor to control operations in the biological treatment portion of the ZenoGem process. Additional water quality parameters were also **monitored** to evaluate the effectiveness of the ZenoGem process for biological treatment. All samples were collected by McAllen personnel on a weekly basis. The biological treatment operating and water quality parameters are presented in tables 4.4 and 4.5, respectively.

Table 4.4.—Monitored Biological Treatment Operating Parameters
ZenoGem Process Phase II

Parameters	Analytical Laboratory	Monitoring Frequency
Dissolved Oxygen	McAllen	1/week
Mixed Liquor Suspended Solids	McAllen	1/week
Oxygen Uptake Rate ¹	CH2M HILL	1/week
Mixed Liouor Volatile Suspended Solids	McAllen	1/week

¹ OUR is a calculated value. the equation for calculating OUR is:

$$OUR \text{ (mg/L/hr)} = \text{Average DO (mg/L/min)} \times 60 \text{ min/hour}$$

Table 4.5.—Monitored Biological Treatment Water Quality Parameters
ZenoGem Process Phase II

Parameters	Analytical Laboratory	Analytical Method	ZenoGem Feed	Z e n o G e m Filtrate	WWTP Feed	W W T P Effluent
CBOD ₅	McAllen	SM 521 OB	X	X	X	X
Ammonia Nitrogen (NH ₃ -N)	McAllen	SM 4500-NH ₃ -F	X	X	X	X
Total Kjeldahl Nitrogen (TKN)	CH2M HILL	EPA 351.4	X	X		
Nitrite and Nitrate Nitrogen	CH2M HILL	EPA 353.2	X	X		
Total Phosphorus	CH2M HILL	EPA 365.1	X	X		

4.4.3 Other Water Quality Parameters

Additional water quality parameters were monitored for the Memcor and ZeeWeed MF systems to evaluate the operation and effectiveness of the MF systems relative to overall water goals for IPR. These are presented in table 4.6 along with the monitoring frequency, responsible analytical laboratory, and analytical method. All samples for water quality analysis were collected by McAllen personnel.

4.5 Data Evaluation

Several of the operating parameters and water quality parameters presented above, as well as some of the operating criteria presented in section 3.0 were compiled, reduced, and analyzed to evaluate operation of the treatment systems.

The MF system operating parameters and RO feedwater quality parameters that were used to evaluate and compare the MF systems are presented in table 4.7 and discussed below. In addition to the parameters presented in table 4.7, all of the water quality parameters presented in table 4.6 were used to evaluate the MF systems. Additionally, operating and water quality parameters presented in tables 4.4 and 4.5 were used to evaluate the biological treatment portion of the ZenoGem process.

Table 4.6.—Other Monitored Water Quality Parameters for MF Systems
Memcor and ZeeWeed Phase I and II

Parameter	Analytical Laboratory	Analytical Method	Feedwater	ZeeWeed Filtrate	Memcor Filtrate
Total Dissolved Solids	McAllen	SM 521 OB	1/month	1/month	1/month
Conductivity	McAllen	SM 521 OB	1/day	1/day	1/day
Total Organic Carbon	CH2M HILL	EPA 110.2	2/ month	1/week	1/week
Color	CH2M HILL	EPA 415.112	2/ month	1/week	1/week
UV Absorbance @ 254nm	McAllen	SM 5910A	1/week	3/week	3/week
THMs	CH2M HILL	SM 5710.D	1 /test period	1/test period	1/test period
HAAs	CH2M HILL	SM 5710.D	1 /test period	1/test period	1/test period
pH	McAllen	SM 4500H	1/day	1/day	1/day
Particle Count	McAllen/MetOne	NA ¹	None	3/test period	3/test period
Heterotrophic Plate Count	McAllen	SM 92158	None	1/test period	1/test period
Total Coliform	McAllen	SM 9222D	None	1 /test period	1/test period
Fecal Coliform	McAllen	SM 9222D	None	1/test period	1/test period

¹ A Met-One model WG-267 on-line particle counter was used to measure particle counts in the filtrate.

Table 4.7.—Microfiltration System Operating and RO Feedwater Quality Output Parameters
Memcor and ZeeWeed MF Systems

Operating Parameter
Filtrate Flow
Membrane Flux
Transmembrane Pressure
Feedwater Recovery
Feedwater Turbidity
Filtrate Turbidity
Filtrate SDI

Filtrate Flow and Membrane Flux. Filtrate flow and membrane flux target levels were established by the manufacturers at the start of Phase I. These target levels were controlled as closely as practical during the testing period by manual adjustment of the filtrate flow control valve on each unit. Membrane flux is directly proportional to filtrate flow based on equation 1:

$$J = (Q_f \times 1440)/A_m \quad (1)$$

where:

$$\begin{aligned} J &= \text{membrane flux in gallons per day per ft}^2 \text{ (gfd)} \\ Q_f &= \text{filtrate flow in gpm} \\ A_m &= \text{membrane filtering surface area, ft}^2 \end{aligned}$$

Transmembrane Pressure. TMP represents two factors: the resistance to the flow of water of (1) the membrane and (2) materials in the feedwater (foulants) that accumulate at the membrane surface or within the membrane pores. TMP at the start of the test (with a clean membrane) represents only the resistance of the membrane. As **foulants** accumulate and cannot be effectively removed by **backwashing/pulsing**, the TMP increases in relation to the resistance to flow exerted by the foulants. Thus, the rate of increase in TMP is directly proportional to the rate of membrane fouling.

Feedwater Recovery. Feedwater recovery represents the percentage of treated feedwater that; is converted to filtrate. For the Memcor unit, recovery is defined according to equation 2:

$$Y = [(Q_f \times T_{fc}) / (Q_f \times T_{fc} + V_b)] \times 100 \quad (2)$$

where:

$$\begin{aligned} Y &= \text{recovery, expressed as a percentage} \\ Q_f &= \text{filtrate flow, gpm} \\ T_{fc} &= \text{filtration interval (time between backwashings), minutes} \\ V_b &= \text{volume of backwash water, gals} \end{aligned}$$

Feedwater recovery for the **ZeeWeed** unit is defined according to equation 3:

$$Y = [(Q_f \times T_{fc}) / (Q_f \times T_{fc} + V_b)] \times 100 \quad (3)$$

where:

$$\begin{aligned} Y &= \text{recovery, expressed as a percentage} \\ Q_f &= \text{filtrate flow, gpm} \\ T_{fc} &= \text{filtration interval (time between bioreactor tank liquid wasting), minutes} \\ V_b &= \text{volume of liquid wasted from the bioreactor tank, gals} \end{aligned}$$

The liquid volume wasted from the bioreactor tank is synonymous with the sludge volume wasted as discussed later in this report.

Turbidity and SDI. The primary water quality parameters used to judge the effectiveness of the MF treatment processes in producing a high quality RO feedwater are turbidity and silt density index (SDI). Traditionally, the RO membrane manufacturers have established the following as criteria for efficient RO operation:

turbidity: ≤ 0.2 NTU

SDI: ≤ 3 (based on 15-min test interval)

SDI is defined by equation 4:

$$SDI = 100 \times [1 - T_f/T_i]/T_t \quad (4)$$

where:

T_i = time to filter initial 500 ml of Memcor/ZeeWeed filtrate, min
 T_f = time to filter final 500 ml of Memcor/ZeeWeed filtrate, min
 T_t = time between from start of T_i to start of T_f , min

5. PILOT TESTING RESULTS

This section presents the results of Phase I and Phase II testing. All data collected during the study are presented in appendix B as follows:

Operating data for Memcor, Phases I and II:	Table B-1
Operating data for ZeeWeed (ZenoGem), Phase II:	Table B-3
Water quality data for Memcor, Phases I and II:	Table B-4
Water quality data for ZeeWeed, Phase I:	Table B-5
Water quality data for ZeeWeed, Phase II:	Table B-6

CH2M HILL laboratory reports containing analytical data and quality assurance/quality control information are presented in appendix C. Results for water quality parameters analyzed by the McAllen water and wastewater laboratories were communicated to CH2M HILL by facsimile on daily or weekly sampling logs. These data, along with CH2M HILL laboratory data were tabulated and incorporated into tables B-4 through B-6 in appendix B.

5.1 DBP Characterization of Disinfected, Dechlorinated, Secondary Effluent

As described in Section 4, samples of unchlorinated secondary effluent and DDE were collected prior to the start of testing and analyzed for THMs and HAAs to assess the potential for regulated DBPs to be present in the reclaimed water. The results, shown in table 5.1, indicate very low levels of both THMs and HAAs (around 10 µg/L or less) in both sources. The low levels in the unchlorinated effluent indicate that any DBPs present in the City's finished water have degraded between distribution and collection as wastewater. The low levels of DBPs present in the DDE reflect the presence of sufficient ammonia in the secondary effluent at the time of sample collection (0.68 mg/L as N) to react with and convert the free chlorine to combined chlorine (chloramines), thereby inhibiting the formation of THMs and HAAs. Ammonia levels vary significantly in the secondary effluent (from <0.1 to >8 mg/L) and DBP analysis of samples collected where ammonia levels are lower would most probably show greater DBP concentrations. Full-scale implementation of IPR may require that a minimum ammonia level, be maintained prior to disinfection to minimize DBPs in the reclaimed water.

5.2 Source Water Characterization

Two sets of samples were to be collected from McAllen's raw water reservoir prior to Phase I operations. These samples were to be analyzed for inorganics, organics, physical/chemical parameters, and microbial parameters to characterize the quality of the existing raw water supply. The first set of samples was collected during the first

quarter on March 11, 1997, and shipped to the CH2M HILL laboratory for analysis of **inorganics** and **organics**. However, due to a communications error, no samples were collected for analysis of physical/chemical or microbial parameters.

Table 5.1 .—DBP Concentrations in Unchlorinated and Disinfected/Dechlorinated Secondary Effluent

Source	THM Concentration (µg/L)	HAAs Concentration (µg/L)
Unchlorinated effluent	¹ <2	4.2
Disinfected/dechlorinated effluent (DDE)	² <5	6.3

¹ Level of each of four THM species was less than 1-µg/L detection limit.

² Levels of three of four THM species were less than 1-µg/L detection limit.

Fourth species was measured at 1.9 µg/l.

Additional samples were collected on June 2 through June 4, 1997. The June 2 samples, representing the second sampling event, were analyzed for inorganic compounds and physical/chemical parameters. A second set of samples was collected on June 4 and analyzed for **physical/chemical** parameters only (to account for the omission of sampling for these parameters on March 11, 1997). However, no samples were collected as scheduled on June 2 and 4 for analysis of microbial parameters. Therefore, additional samples were collected on September 3 and September 25 for analysis of microbial parameters.

Particle counts were obtained on samples collected on June 3 and June 4, using a grab sample particle counter provided by Met-One and installed temporarily at Water Treatment Plant No. 2.

Source water characterization data are presented in tables 5.2 through 5.4. The data indicate that, **McAllen's** raw water source:

- Is moderately turbid
- Contains high levels of dissolved solids, especially hardness and sulfate
- Contains moderate levels of organic matter, particularly compounds that form **THMs** when exposed to free chlorine
- Shows evidence of pollution, e.g., low but measurable concentrations of nitrate and phosphorus and fecal and total coliforms
- Has high RO membrane fouling and scaling potential as evidenced by high turbidity, **SDI** and particle counts, and elevated concentrations of the sparingly soluble salts, barium, calcium, strontium, bicarbonate, and sulfate

Table 5.2.—Source Water Characterization • Inorganic, Organic and Physical/Chemical Parameters

Parameter	Result			Units
	3/11/97	6/2/97	6/4/97	
Inorganics				
Alkalinity	130	106	NS ¹	mg/L ^{2,3}
Bicarbonate	159	129	NS	mg/L
Carbonate	1	<2.0 ⁴	NS	mg/L
Bromide	0.1	0.54	NS	mg/L
Chloride	155	207	NS	mg/L
Color, Apparent	17	10	NS	color units
UV-254	0.112	0.092	NS	1/cm
Fluoride	0.59	0.99	NS	mg/L
Nitrate	0.58	<0.10	NS	mg/L
Total Phosphorus	0.05	co.05	NS	mg/L
Silica-Reactive	6	13.55	NS	mg/L
TDS	720	772	NS	mg/L
Sulfate	247	262	NS	mg/L
Aluminum	1.22	0.248	NS	mg/L
Barium	0.127	0.124	NS	mg/L
Calcium	77	77.7	NS	mg/L
Iron	0.77	0.171	NS	mg/L
Magnesium	22.1	27.9	NS	mg/L
Manganese	0.025	0.018	NS	mg/L
Potassium	9	9.58	NS	mg/L
Silicon	6.94	6.3	NS	mg/L
Sodium	102	140	NS	mg/L
Strontium	2.05	2.4	NS	mg/L
Total Hardness	285	311	NS	mg/Lc
Organics				
TOC	3.7	3.9	NS	mg/L
SDS HAAS ⁶	58	72	NS	µg/L
SDS THM ⁷	236	215	NS	µg/L
Physical/Chemical				
Temperature	NS	28	28	°C
pH	NS	8.1	8.1	Units
Turbidity	NS	11.2	18	NTU
Silt Density Index	14.6	15.6	NS	unitless

¹ NS • Not sampled for this parameter

² mg/L • milligrams/liter

³ Alkalinity and total hardness results reported as CaCO₃

⁴ <X.X • Compound not detected above laboratory detection limit presented.

⁵ Calculated value

⁶ SDS HAAS • Simulated distribution system haloacetic acids (5 species)

⁷ SDS THM • Simulated distribution system trihalomethanes

Table 5.3.—Source Water Characterization - Microbial Parameters

Parameter	9/3/97	9/25/97	Units
Total Coliform	20	20	CFU/1 00 ml
Fecal Coliform	4	6	CFU/1 00 ml
HPC	1,200	1,100	CFU/ml

Table 5.4.—Source Water Characterization - Panicle Counts

Panicle Size (microns)	6/3/97			6/4/97		
	Mean	Minimum	Maximum	Mean	Minimum	Maximum
2.0 to 3.0	1,257	1,126	1,345	999	917	1,126
3.0 to 5.0	5,788	5,012	6,226	4,968	4,578	5,435
5.0 to 8.0	7,919	7,022	8,376	8,155	7,824	8,545
8.0 to 10.0	2,659	2,442	2,832	3,551	3,143	3,827
10.0 to 15.0	1,965	1,040	2,319	3,087	2,573	3,604
> 15.0	658	348	1,366	713	537	966
Total ¹	21,063	19,466	20,983	21,472	20,978	21,950

¹ All particles > 2.0 microns in diameter.

Comparison of results between sampling events indicates that the raw water quality is quite consistent over a 3-month period.

5.3 Phase I Testing

5.3.1 Objectives

The objectives for Phase I were to:

Confirm the applicability of the Memcor MF system for RO pretreatment of secondary effluent from the **McAllen** WWTP.

Compare the ability of **ZeeWeed**, a novel microfiltration technology, to provide an RO feedwater of quality equivalent to Memcor filtrate when processing secondary effluent from the **McAllen** WWTP.

5.3.2 Operations

The Memcor and **ZeeWeed** MF systems operating on DDE were commissioned during the week of April 7, 1997. Field service representatives from the two manufacturers were **onsite** during this period to start-up their respective systems and train **CH2M**

HILL and McAllen personnel regarding operation and maintenance requirements. Phase I operations officially commenced on April 14 and were completed for the Memcor and ZeeWeed systems on June 18 and 16, respectively. Operation of each of the MF systems is discussed below.

ZeeWeed. The ZeeWeed system achieved steady-state operation (concentration of secondary effluent to 95 percent recovery in process tank) on April 11. From April 14 through June 16, the unit accumulated 1,492 operating hours out of a total of 1,493 available hours for an on-line factor of nearly 1 (100 percent). This on-line factor does not account for the three separate periods when the unit was off-line because of a high process pump discharge pressure condition that occurred during backpulsing when the pilot plant operator was not present (off hours). This condition was easily rectified by adjusting a pressure control valve and is not considered a process failure. The one hour of unavailability was a result of the need to replace a section of tubing on the peristaltic pump used to withdraw concentrate from the process tank (three separate events).

No chemical cleanings were conducted on the ZeeWeed MF system during Phase I. The ZeeWeed MF unit was cleaned and prepared for Phase II operation at the end of Phase I. Cleaning activities were performed by a **Zenon** representative on June 16 and June 17, 1997. The **Zenon** representative noted a significant amount of green algae in the system and also observed that the membranes were very dirty and contained a brown slime. The cleaning procedures that were followed are presented in appendix D.

Water fluxes were performed on the membranes prior to the cleaning operations and between each cleaning step. The results of each water flux are presented in table 5.5. The results indicate that the first two cleanings were only partially effective in restoring flux to "clean" conditions and that an overnight soak was needed to fully reverse the effects of membrane fouling.

Memcor. The Memcor system was placed into service at design conditions on April 10. From April 14 through June 18, the Memcor unit accumulated nearly 1,459 operating hours out of a total of 1,566 available for an on-line factor of 0.93. The unit was removed from service by the pilot plant operator on April 24, April 29, and June 10 to perform a series of chemical cleanings in an attempt to reverse increases in TMP resulting from membrane fouling. Cleaning was conducted on April 24 using Memclean EXA (proprietary blend of caustic and surfactant) followed by sequential cleaning with citric acid and Memclean EXA on April 29. This series of cleanings was only partially successful and on May 13, a Memtec service technician removed the unit from service and subsequently weighed modules to determine mass of **foulant** accumulated, removed fibers for off-site **foulant** analysis, performed two additional cleanings, and re-programmed the cleaning cycle in the PLC. Memclean EXA was used during both cleanings, however an overnight soak was incorporated into the first cleaning. These cleanings were effective in reducing the TMP to near initial levels. The June 10 cleaning was conducted using Memclean EXA and it, too, was effective in reducing the TMP to near initial levels. Table 5.6 summarizes available data for each cleaning conducted during Phases I and II.

Table 5.5.—Results of ZeeWeed MF System Cleaning After Phase I Operations

Activity	Filtrate flow		Vacuum		Temperature (°F)
	Before backwash (Lpm)	After backwash (Lpm)	Before backwash (inches Ho)	After backwash (inches Hg)	
Water flux before cleaning	12	13	15	13.5	32
Clean water flux after initial flushing of process tank	12	13	15	13.5	32
Clean water flux after first NaOCl cleaning	10	10	11	10	30
Clean water flux after second NaOCl cleaning	12	12	10	10	30
Clean water flux after NaOCl overnight soak	NA	15	NA	4.5	28

Additional measurements include: Flux at 28°C = 38.04 GFD
 Flux at 25°C = 37.30 GFD
 Permeability at 25°C = 14.92 GFD/psig

Table 5.6.—Phase I and II Memcor MF System Cleanings

Date	Operating Time (hours)	TMP before Cleaning (psi)	TMP after Cleaning (psi)	Cleaning Chemical(e)	Soak Duration
4/25/97	325	16.0	11.9	1. Memclean EXA 2. Citric Acid	1. 1.5 hours 2. 2 hours
4/29/97	417	13.3	11.6	1. Citric Acid 2. Memcor EXA	1. 1.5 hours 2. 2 hours
5/13/97	721	12.5	6.3	1. Memclean EXA 2. Sodium Hydroxide	1. 1 hour 2. 2 hours
6/10/97	1370	19.7	11.2	Memclean EXA	Not Recorded
6/24/97	1684	11.4	6.6	Memclean EXA	2 hours
7/17/97	2215	17.1	6.5	Memclean EXA	3 hours
8/2/97	2563	17.4	7.7	Memclean EXA	2 hours

5.3.3 Operating Conditions

ZeeWeed. Table 5.7 presents the operating conditions for the two systems, both as planned and as achieved during the reporting period. The ZeeWeed unit was operated according to plan except for backpulse frequency, which was performed every 5 minutes

instead of every 6 to 10 minutes, as planned. The change was made between Work Plan preparation and plant commissioning following additional discussions with Zenon technical representatives regarding the need to minimize the formation of DBPs in the filtrate. To address this need, Zenon recommended eliminating chlorine during back pulse and increasing the back pulse frequency to compensate for the absence of chlorine. Cleaning frequency was undetermined because no cleanings were performed.

Table 5.7.—Planned and Actual Operating Parameters for MF Systems

Parameter	Unit	ZeeWeed		Memcor	
		Planned	Actual	Planned	Actual
Filtrate Flow	gpm	2.1 - 4.2	2.6 - 3.8	19.8 - 22.5	15.2 - 20.3
Transmembrane Pressure	psi	3 - 9	3 - 8.6	6 - 17	7.7 - 19.7
Membrane Flux	gfd ¹	20 - 40	25.4 - 36.8	26 - 30	20.2 - 27.0
Back Wash/Pulse Frequency	minutes	6 - 12	5	15 - 20	20
Back Wash/Pulse Duration	seconds	10	10	90	90
Back Wash/Pulse Chemical Addition	not applicable	chlorine	none	none	none
Cleaning Frequency	days	20 - 30	>48	3 - 5	14.1

¹ gfd = gallon/square foot/day

Memcor. The Memcor unit was operated at lower than planned flux during all but the initial 200 hours of Phase I operation. Flux was reduced after this period in response to rapid membrane fouling and at the recommendation of the manufacturer. (See further description of fouling in section 5.3.4.1, below.)

The Memcor unit achieved a greater than planned interval between cleanings during Phase I. Other operating parameters were as planned.

5.3.4 Phase I Testing Results

The following sections present the testing results for the Memcor and ZeeWeed MF systems during Phase I. Results for MF system operating parameters, feed and filtrate turbidity, and filtrate SDI are presented graphically and discussed in the following sections. All other water quality data are shown in table 5.8 as mean, minimum, and maximum values based on all data collected during this phase. Turbidity and SDI data are also presented in this manner in table 5.8.

Table 5.8.—Phase I Microfiltration Water Quality Parameter Results
Memcor and ZeeWeed MF Systems - Phase

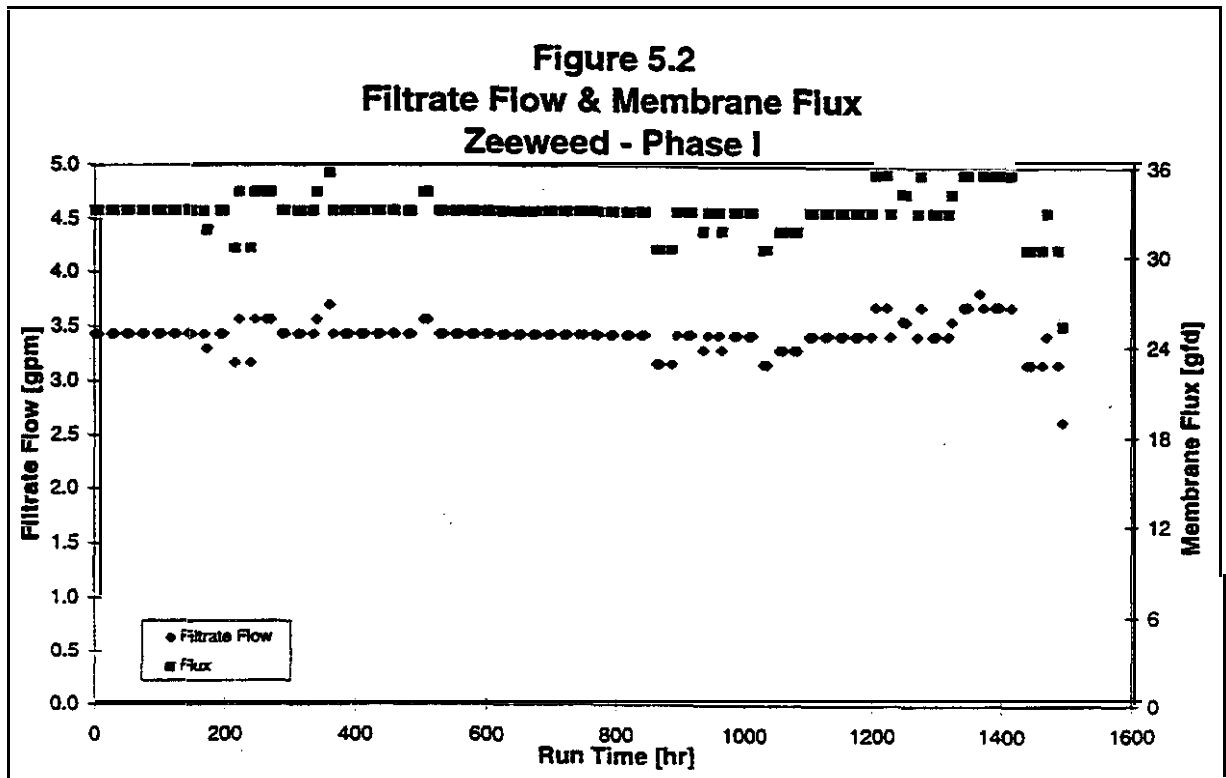
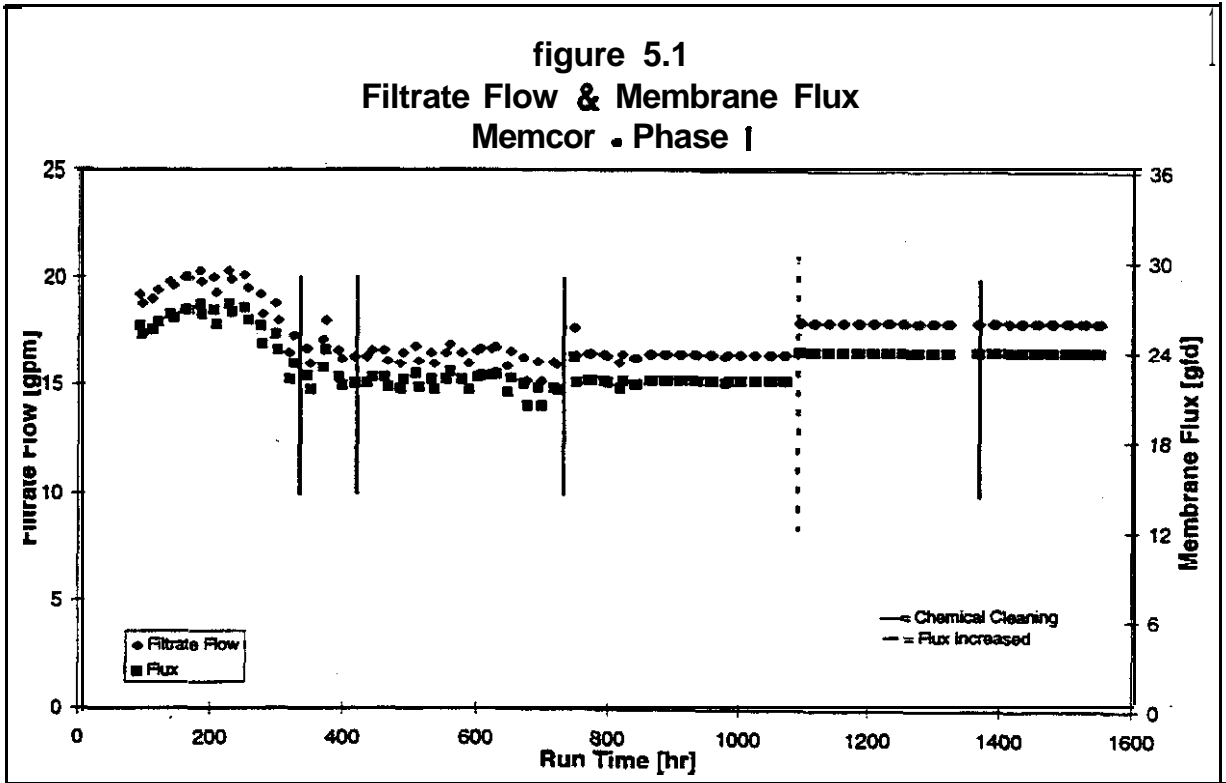
Parameter	O. of Samples		Feedwater			ZeeWeed MF Filtrate			Memcor MF Filtrate		
	Feed	Filtrate	Mean	Min	Max	Mean	Min	Max	Mean	Min	Max
TDS (mg/L)	5	4-6	1,191	964	1,407	1,216	975	1,410	1,211	977	1,411
Conductivity (μ S/cm)	63	63	1,970	1,520	2,500	2,027	1,575	2,625	2,002	1,560	2,410
TOC (mg/L)	3	6	7.6	6.9	6.4	7.4	6.7	6.1	7.5	6.9	6.1
Color (color units)	3	5	10.17	2.5	23	7.6	0.0	15.0	7.0	0.0	17.0
UV Absorbance @ 254 (1/cm)	8	12-1:	0.117	0.106	0.147	0.120	0.106	0.142	0.117	0.101	0.139
SDS THM (μ g/L)	1	1	333.7	333.7	333.7	269.4	269.4	269.4	324.4	324.4	324.4
SDS HAA (μ g/L)	1	1	127.4	127.4	127.4	127.0	127.0	127.0	130.6	130.6	130.6
pH (μ g/L)	63	63	7.06	6.67	7.41	6.07	6.97	6.36	7.13	6.66	6.16
Turbidity (NTU)	65	63	2.94	1.00	26.0	0.13	0.03	0.57	0.13	0.03	0.53
SDI	0	41-4:	NS	NS	NS	2.66	0.13	6.10	2.46	0.40	7.60
HPC (CFU/ml)	7	3-7	4,682	676	16,100	3,216	400	13,000	1,655	264	2,600
Total Coliform (CFU/100 ml)	7	3-7	17	3	31	8	1	16	ND	ND	ND
Fecal Coliform (CFU/100 ml)	7	5-7	23	2	50	14	1	44	ND	ND	ND

¹ When the number of samples varied for Memcor and ZeeWeed filtrate due to reasons such as equipment downtime, a range is presented.

5.3.4.7 Operating and RO Feedwater Quality Parameters

Filtrate Flow and Membrane Flux. Figures 5.1 and 5.2 present the filtrate flow and membrane flux for the Memcor and ZeeWeed MF systems, respectively.

Memtec personnel directed system operators to reduce the Memcor filtrate flow from target levels after 190 hours of operation in an attempt to reduce the rate of membrane fouling. The rapid fouling was attributed to inefficient sweeping of solids out of the membrane module during backwashing. The cause of the inefficiency was attributed to a clogged wye strainer on the suction side of the feed pump that restricted flow to the modules during the sweep portion of the backwash. Wye strainer clogging resulted when a strainer basket having openings of one-eighth inch was inadvertently used instead of the correct 500- μ m basket during the first 2 days of operation. This mistake allowed larger particles to pass through the pre-screen. The clogged suction strainer condition was recognized and rectified. Filtrate flow and flux were increased back to target levels at approximately 1,125 operating hours following the field visit by Memtec's technician and successful cleaning of the membranes.



ZeeWeed **unit** filtrate flow and membrane flux were stable and effectively maintained at target levels during the **first** 1,400 hours of Phase I, although the parameters began a sharp decrease at that point that continued for the remainder of Phase I. The decrease occurred when the filtrate vacuum reached its maximum value and additional TMP could not be attained, resulting in a drop in filtrate flow as the membranes continued to foul.

Transmembrane Pressure. Figure 5.3 presents the TMP values for the Memcor and ZeeWeed MF systems during Phase I as a function of operating time. The following can be concluded from an examination of the figure:

Initial TMP for the ZeeWeed **MF** system is approximately 3 psi (0.2 bar) compared to approximately 5 psi (0.33 bar) for the Memcor MF system. Initial TMP would be even greater for Memcor if the unit were operated at the higher flux used with ZeeWeed. These results indicate that the ZeeWeed membrane has a higher permeability (lower resistance to water flow) than the Memcor membrane.

The rate of fouling of the Memcor membrane is significantly greater than for the ZeeWeed membrane even after the backwashing difficulties with Memcor MF system were rectified. The rate of TMP increase for Memcor during the period following the field technician's visit and related cleaning (best performance period) was 0.24 psi/day (1.68 **kPa/day**) versus 1.46 **psi/day** (10.2 **kPa/day**) for the entire operating period of ZeeWeed operation.

The lower ZeeWeed fouling rate suggests the combination of continuous mechanical agitation and periodic hydraulic back flushing are **more** effective for controlling build-up of material on the membrane surface than the method of intermittent backwashing with air and feedwater method used with Memcor. A second factor may be differences in the surface characteristics of the two membrane materials (Memcor membrane is polypropylene; ZeeWeed membrane is proprietary and its material is not known).

As described previously, membrane cleanings conducted with Memcor in April were largely ineffective in reducing fouling. This is clearly illustrated in figure 5.3, where TMP was reduced only to between 10 and 12 psi (0.7 bar and 0.8 bar) after cleaning. In contrast, the more effective cleanings conducted on May 13 (after 721 hours of operation) reduced TMP to 8 psi (0.5 bar), much closer to the initial TMP of 5 psi (0.3 bar). The June 10 standard cleaning (after 1,370 hours of operation) reduced TMP to only 10 psi, again indicating that longer soak times, separate cleaning with citric acid, or both are required to achieve optimal results.

Feedwater Recovery. Figure 5.4 presents feedwater recovery data for the Memcor and ZeeWeed MF units during Phase I. Feedwater recovery achieved by the Memcor MF system was between 89 and 90 percent compared to greater than 96 percent for the ZeeWeed MF system during most of the test period. Expressed differently, ZeeWeed produced **less** than 50 percent of the waste flow generated by Memcor. In general, higher recovery is beneficial because it results in a greater availability of high quality water for reuse and potentially lower costs associated with conveyance and treatment

Figure 5.3
 Transmembrane Pressure
 Memcor and ZeeWeed - Phase I

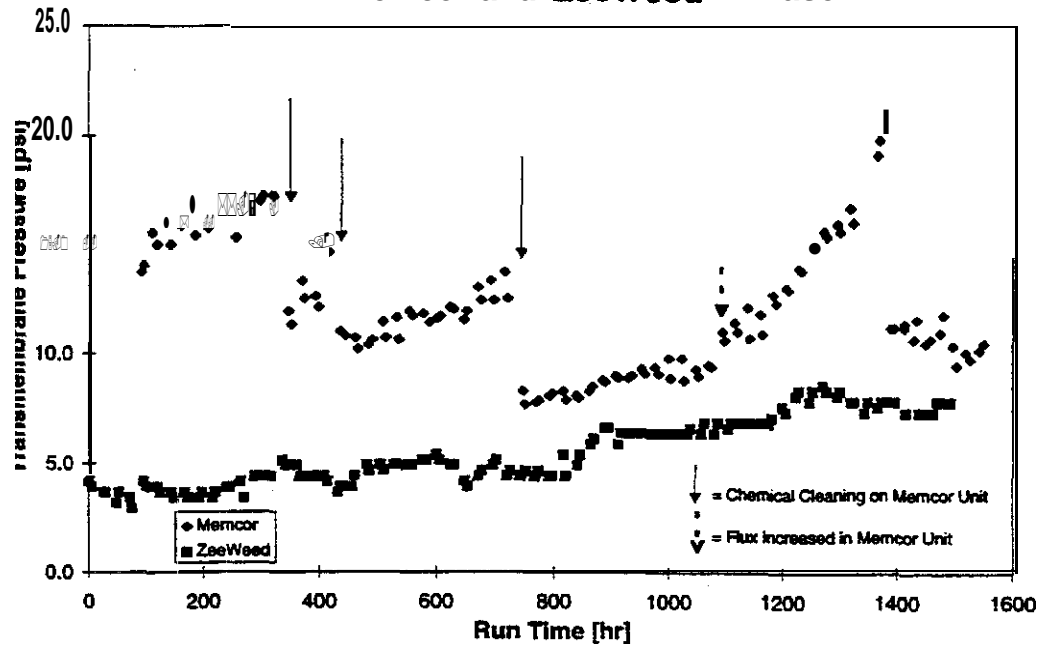
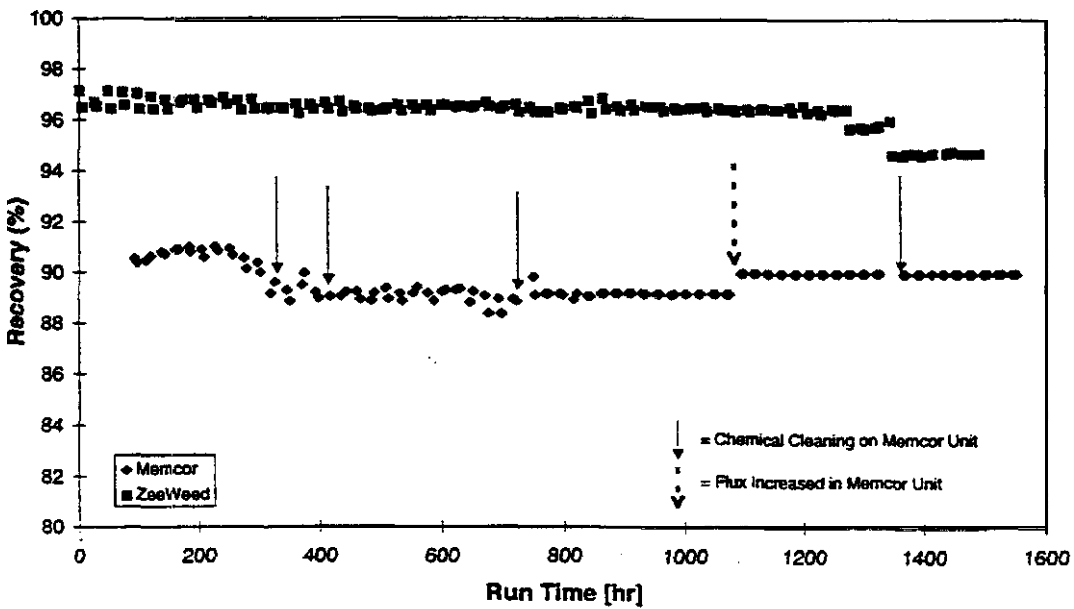


Figure 5.4
 Recovery
 Memcor and ZeeWeed - Phase I



of the waste stream. ZeeWeed recovery decreased to approximately 94 percent after 1,350 hours of operation as filtrate flow rate decreased due to high TMP (vacuum).

Turbidity and SDI. The mean filtrate turbidity and **SDI** values presented in table 5.8 are well below the RO manufacturer's criteria of 0.2 NTU for turbidity and 3.0 for SDI, and are consistent with results obtained from other water reuse studies employing these technologies (Leslie, 1996). Such a result indirectly demonstrates that both ZeeWeed and Memcor are capable of producing an effluent that can be efficiently processed by RO.

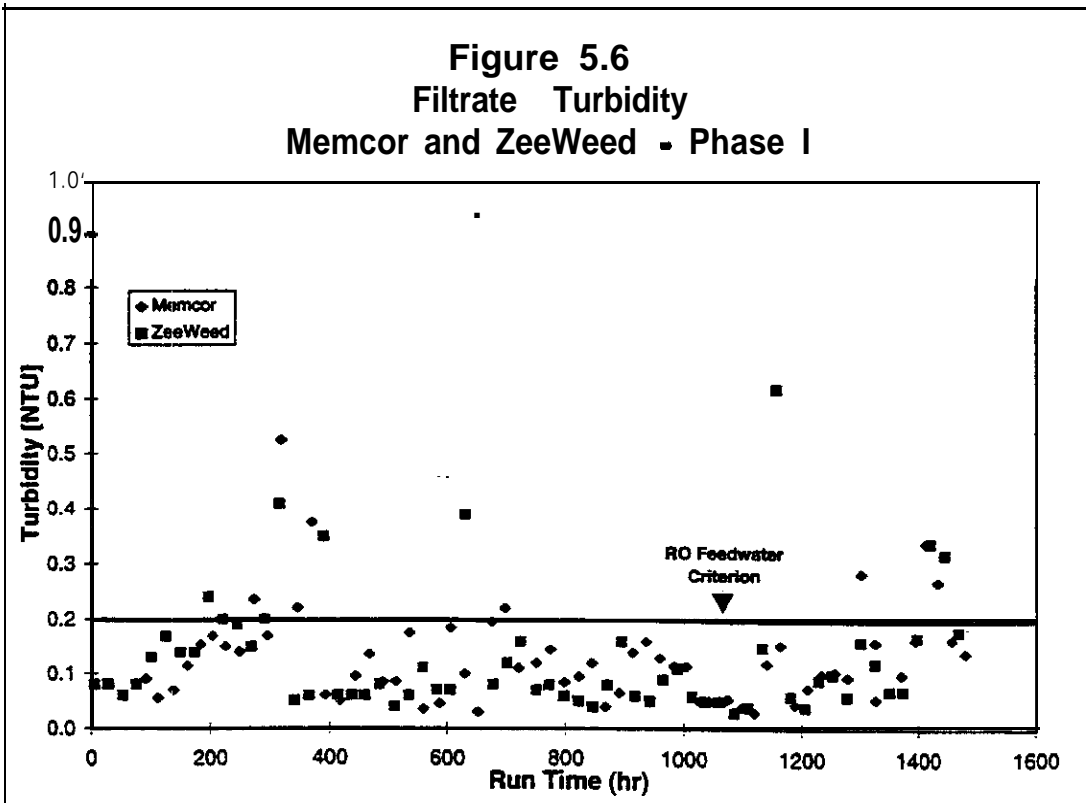
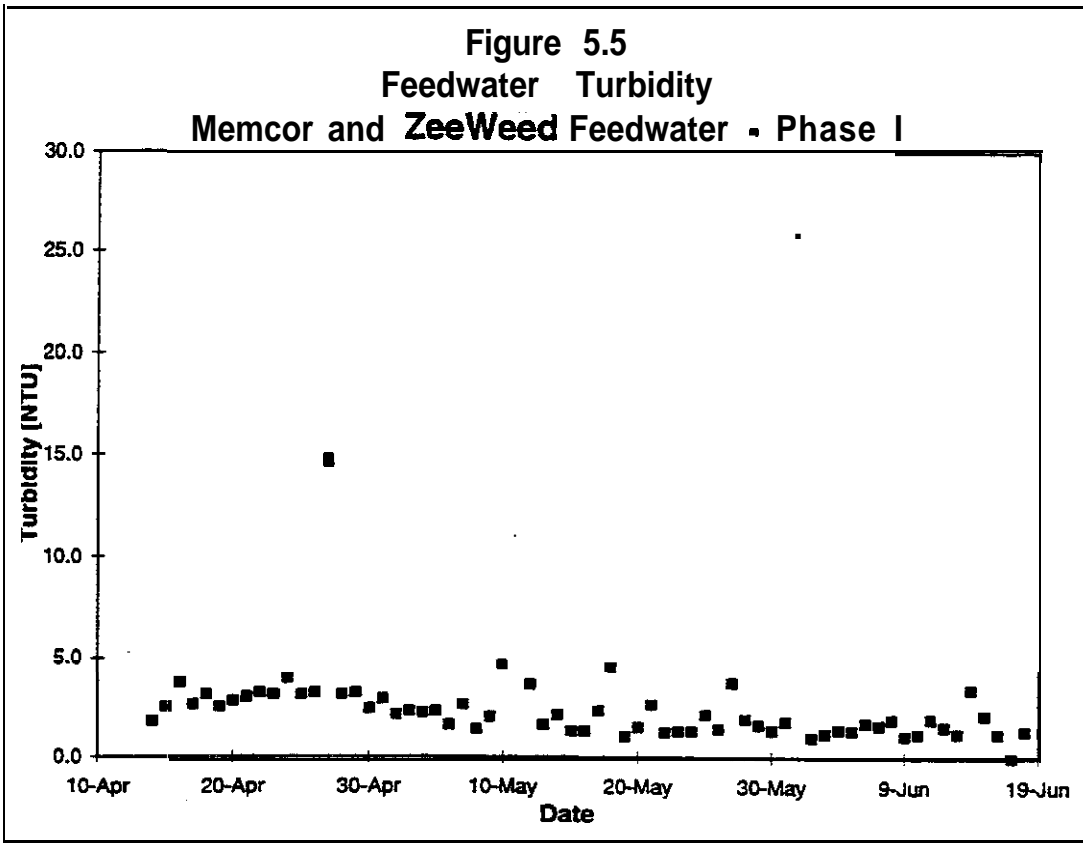
Turbidity values for the MF system feedwater (DDE) and filtrates are presented in figures 5.5 and 5.6, respectively. The data in figure 5.5 illustrate that, for the most part, DDE turbidity is consistently less than 5 NTU. For an unfiltered secondary effluent, this level of turbidity is typical, if not slightly **low**. On three occasions, DDE turbidity spiked to above 10 NTU.

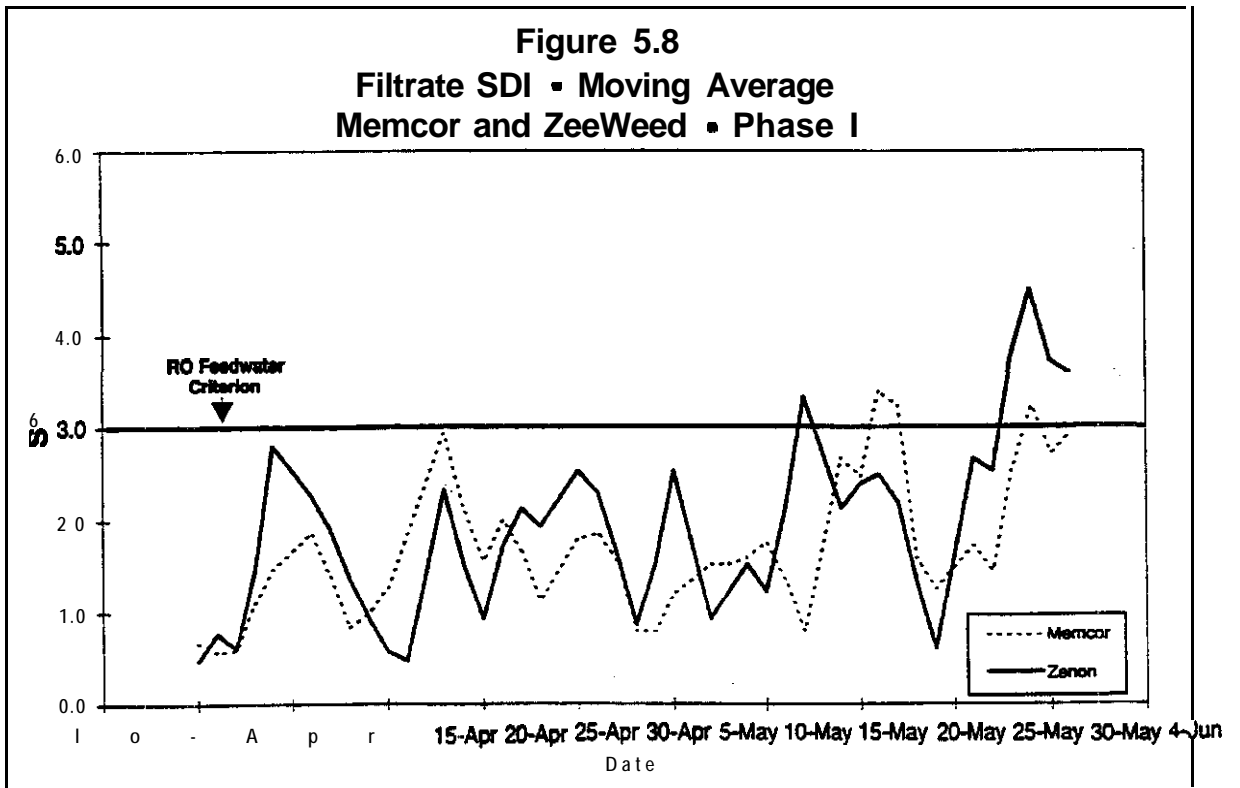
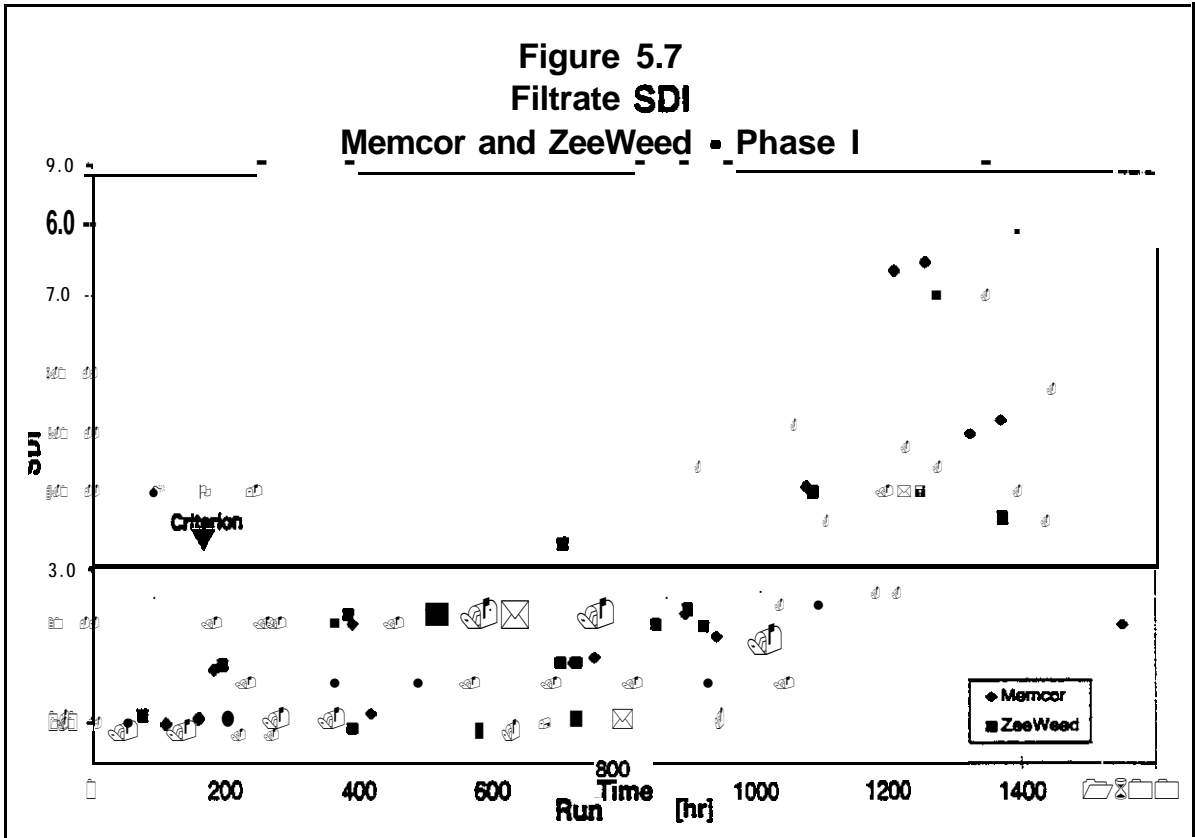
Manufacturers of the spiral-wound RO modules used for IPR recommend a maximum of 0.2 **NTU feedwater** turbidity to minimize RO membrane fouling and cleaning frequency. For the most part, Memcor and ZeeWeed filtrate turbidity was below this criterion, although spikes up to 1 NTU were observed. There is no clear explanation for this variability. Figure 5.6 does not indicate any trends in filtrate turbidity for either MF system during Phase I.

Phase I **SDI** results for the filtrate from each MF system are presented in figure 5.7. To better show trending, a moving average of the **SDI** values for each MF system is presented in figure 5.8. For the same reasons described for turbidity, RO manufacturers recommend that **SDI** for RO feedwater be less than or equal to 3. Although the results have significant variability (see table 5.8), nearly all values are less than 3 until the latter part of the test period. Figure 5.7 shows a slightly increasing trend in **SDI** values after 800 hours of operation. The increase was caused by the growth of algae in the translucent tubing used to sample filtrate from both units as well as in **the** translucent filtrate tubing and back flush tank used on the ZeeWeed tank. The **manufacturer** provided translucent tubing with the equipment. Algae growth continued unabated in these locations through the end of Phase 1 and into the beginning of Phase II. It was rectified on June 29.

The author **did** not have previous experience with algal growth in wastewater reuse studies. **Consequently**, it **was** not recognized at the start of the study that the tubing would be problematic. The use of chlorinated water during ZeeWeed backwash would be expected to control this growth.

Particle Counts. No particle count data were collected during Phase I. Quantitative conclusions comparing ZeeWeed and Memcor MF operating and RO feedwater quality parameters are presented in Section 1.5.2.





5.3.4.2 Other Water Quality Parameters

Results for the following water quality parameters on the feedwater and MF system filtrates were presented in table 5.8 as mean, maximum, and minimum values:

Physical/chemical: TDS, conductivity, pH

Organics: Total Organic Carbon (TOC), color, ultraviolet absorbance at 253.7 nanometers (UVA-254)

Microbiological: Total and fecal coliforms, heterotrophic plate counts (HPCs)

The following conclusions can be drawn from an examination of the results:

1. Neither MF process reduces either the dissolved inorganic or organic content of the secondary effluent as measured by TDS and conductivity. This was the expected outcome as the pore size of the MF membranes is much larger than the dissolved ions and organic compounds present in the effluent.
2. The small reduction in apparent color provided by the two MF processes is most likely attributed to color generated from suspended matter that is filtered out during treatment. No true (i.e., dissolved) color removal would be expected.
3. It cannot be determined if the 15 percent difference in simulated distribution system (SDS) THM between the ZeeWeed filtrate and MF feedwater is significant. Only one sample was analyzed for the filtrates and thus no statistical analysis can be made regarding any apparent differences. No difference was observed between these two sources for either SDS HAA or UVA-254, **which, along** with SDS THM, are indirect measures of the amount of DBP precursor material.
4. During treatment with ZeeWeed, pH increases. The increase most likely results from the stripping of carbon dioxide from the secondary effluent by the aeration in the process tank.
5. ZeeWeed filtrate has consistently shown positive levels of both fecal and total coliforms whereas neither has been detected in the Memtec filtrate. Aerobic and facultative bacteria (as measured by the heterotrophic plate count method) are present in both filtrates; however, levels are greater in the ZeeWeed filtrate.

6. Control of suspended solids and algae is critical to successful performance and monitoring of the water treatment system.

The difference in nominal pore size between the Memcor membrane (0.2 μm) and ZeeWeed membrane (0.1 μm) is not significant relative to the removal of the dissolved species or coliforms. The former are orders of magnitude smaller than this pore size range, while the latter can be effectively retained by a 0.45- μm membrane filter.

Regarding conclusion (5), the ongoing presence of **coliforms** in the ZeeWeed filtrate is surprising, given that intact ZeeWeed membranes have pores too small to pass these and other bacteria. Two causes for this result can be hypothesized: (1) bacteria are “leaking” into the filtrate caused by one or more damaged fibers or seals in the module potted regions, or (2) there are significant dead legs in the filtrate piping that are allowing bacteria introduced through contamination of the piping to be proliferating. Integrity testing of the membrane module was conducted by **Zenon** at their factory prior to unit shipment so any leakage may have been caused by shipping or operation.

5.4 Phase II Testing

Phase II officially commenced with the beginning of operation of the ZeeWeed system on screened, de-gritted wastewater on June 19, 1997. Phase II testing continued through August 15, 1997.

As stated previously, during Phase II, the Memcor MF system continued to operate on DDE. However, for Phase II, the raw water supply piping to the ZeeWeed system was reconfigured to provide screened, de-gritted wastewater as the feedwater. The ZeeWeed system had two process functions for treating this source:

Biologically treat the screened, de-gritted wastewater to produce a “secondary effluent” meeting or exceeding the quality requirements of the City of **McAllen (ZenoGem** process). These requirements include producing an effluent that meets all the requirements of the **City’s** NPDES permit for surface discharge.

From the perspective of RO feedwater, microfilter the “secondary effluent” to a quality equivalent to that produced by the Memcor and ZeeWeed MF systems treating secondary effluent (Phase I).

The objectives for Phase II were:

Evaluate the ability of ZeeWeed MF, when used in conjunction with the ZenoGem process, to directly treat screened, de-gritted wastewater to a quality suitable for direct processing by RO, and compare ZenoGem filtrate quality to that of ZeeWeed and Memcor MF treated secondary effluent.

Compare the operating characteristics of the ZeeWeed MF when used:

1. To directly treat secondary effluent
2. In conjunction with the ZenoGem process to treat screened, de-gritted wastewater.

Compare the wastewater treatment efficiency of the ZenoGem process to that of extended aeration as performed at the McAllen WWTP by measuring the removal of CBOD, TSS, and ammonia nitrogen.

The results from Phase II, including a comparison of the Phase I and Phase II results of the Memcor MF system and discussion of the results of the ZenoGem process, are presented in the following sections.

5.4.1 Memcor MF System Phase II Testing and Operations

Based on the lack of removal of dissolved constituents from the DDE by Memcor, it was decided that there was no real value to continue monitoring dissolved constituents in the Memcor feedwater during Phase I. Consequently, the following water quality parameters were measured only in the MF filtrate and not in the feedwater during this phase:

TDS
Conductivity
pH
Color
UVA absorbance @ 254 nm

This section presents the results obtained during Phase II testing and compares Phase I operations of the Memcor MF system to Phase II operations. (It should be noted that the designations of Phase I and Phase II relative to the Memcor system operation are somewhat arbitrary because no real changes in feedwater source nor operation, other than flux changes, were instituted between phases.)

5.4.1.1 Operations

During Phase II, the Memcor MF system accumulated 1,297 hours of operation out of a possible 1,350 hours for an on-line factor of 0.96. The on-line factor is considerably higher for this phase because of the correction of operational issues in the beginning of Phase I that caused several downtimes.

During Phase II (June 24, July 17, and August 2), the system was removed from service by the pilot plant operator to reverse increases in TMP. TMP increased because solids from the modules fouled the membrane. The membrane was cleaned with Memclean EXA cleaning solution. As presented previously in table 5.6, the cleanings, which incorporated longer soak times, were effective in reducing TMP

At the end of Phase II, the Memcor MF unit was cleaned by McAllen WWTP personnel according to Memtec's requirements. The procedure followed is provided in appendix D.

5.4.1.2 Operating Conditions

Table 5.9 presents the Memcor operating criteria established for the Memcor MF system in the Research Work Plan and the values achieved for each phase of testing as well as for the combination of both phases.

Table 5.9.—Memcor Planned and Actual Operating Criteria Phase I and Phase II Operations

Parameter	Unit	Planned	Actual			
			Combined Phases I and II	Phase I only	Phase II only	
Membrane Flux	gfd ¹	26-30	20.2 - 27.0	20.2 - 27.0	23.8 - 26.6	
Filtrate Flow	gpm	19.8 - 22.5	15.2 - 20.3	15.2-20.3	17.9-20.0	
Transmembrane Pressure	psi	6 - 17	7.7 - 19.7	7.7-1 9.7	7.7-1 7.0	
Back Wash/Pulse Frequency	minutes	15-20	20	20	20	
Back Wash/Pulse Duration	seconds	90	90	90	90	
Back Wash/Pulse Chemical Addition	NA ²	none	none	none	none	
Cleaning Frequency	days	3 - 5	15	14.2	15.8	

¹ gfd- gallons/square foot/day

² Not applicable

During both phases, the Memcor system operated at a lower than planned flux, although the flux was more consistent during Phase II. The cleaning intervals during Phase I were slightly shorter than during Phase II because of the unanticipated membrane fouling problems discussed previously.

For the combined testing period, the Memcor system operated at lower than planned flux but achieved a greater than planned interval-between-cleaning during the study. Additionally, the TMP had wider variations than planned because the manufacturer directed TMP be increased to maximum to compensate for a higher rate of fouling during Phase I. The lower-than-planned flux operation reflects the fouling problems experienced during Phase I.

5.4.2 Memcor MF System Phase I and Phase II Results

The operating and RO feedwater quality parameters for the Memcor MF system during Phase I and Phase II are discussed in the following sections.

5.4.2.1 Operating and RO Feedwater Quality Parameters-Memcor Phases I and II

Filtrate Flow and Membrane Flux. Filtrate flow and membrane flux for the Memcor unit for Phases I and II are presented in figure 5.9. Phase II began at approximately 1,567 hours of operation. During the initial portion of Phase II, membrane flux was controlled at approximately 24 gfd ($40.8 \text{ L/m}^2/\text{hr}$) as established during the latter part of Phase I. At approximately 2,000 hours of operation, flux was increased to 26.6 gfd ($45.2 \text{ L/m}^2/\text{hr}$) to determine the effect of a higher solids loading on the rate of TMP increase and frequency of chemical cleanings. (The impacts of this change are discussed in the following section.)

The flux rate attained during Phase II is quite representative of the design flux rate determined for the Memcor process at other locations where the technology is being employed for RO pretreatment of secondary effluent (see table 5.10).

Transmembrane Pressure. Figure 5.10 presents the TMP for the Memcor MF system during Phases I and II. The plot shows that chemical cleanings implemented during Phase II were very effective for removing accumulated solids and restoring TMP to the target level of 7 to 8 psi (0.46 to 0.53 bar). It appears that the cleaning regime used during Phase II was capable of removing additional solids with each successful cleaning as evidenced by a slightly lower TMP after each cleaning.

Figure 5.9
Filtrate Flow & Membrane Flux
Memcor - Phases I and II

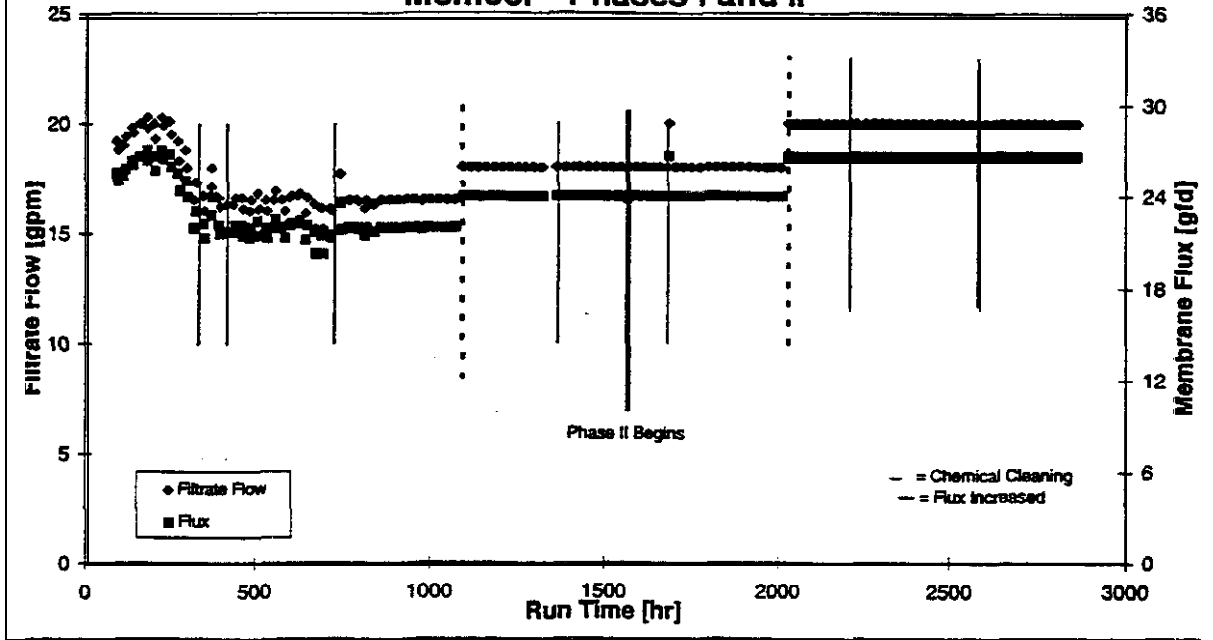


Figure 5.10
Transmembrane Pressure
Memcor - Phases I and II

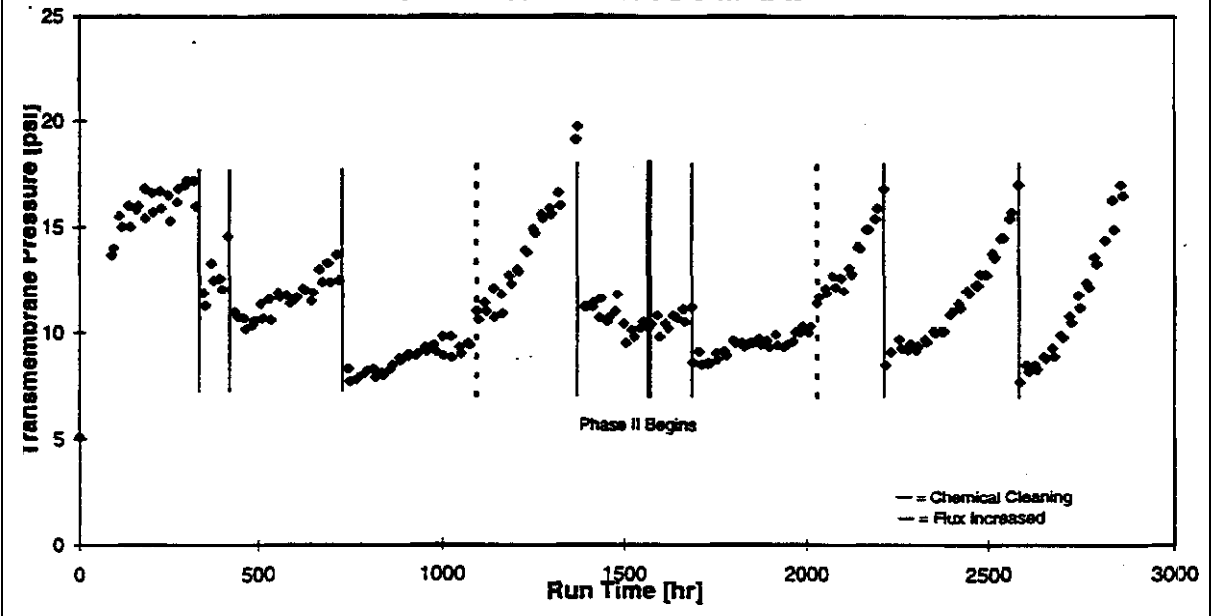


Table 5.10.—Comparison of Memcor Performance at McAllen with Performance at Other Sites

Location	Flux (gfd)	Recovery (%)
McAllen	27	91
West Basin, California	27	91
Livermore, California	24	90
San Diego, California	28	92
WF-21, California	23	90

The best method of examining the impact of flux on membrane fouling rate is by calculating the rate of change in TMP with operating time. As shown in table 5.11, the average rate of TMP change for the three operating periods at 26.6 gfd (45.2 L/m²/hr) was 0.64 psi/day (4.47 kPa/day). This compares to an average rate of 0.31 psi/day (2.13 kPa/day) for operation at 24 gfd (40.8 L/m²/hr). This difference indicates that the Memcor process is quite sensitive to fouling in this flux range in that an 11 percent increase in flux resulted in a doubling of the fouling rate. If one were to assume each filtration cycle starts and ends at equivalent TMP values, operating at 26.6 gfd (45.2 L/m²/hr) should produce a 50 percent shorter filtration cycle. Operating intervals between cleanings shown in figure 5.10 do not reflect this difference clearly because cleanings at the lower flux were performed prior to terminal TMP (17 to 18 psi, or 1.1 to 1.2 bar).

Table 5.11 .-Membrane Flux Rate and Associated Rate of TMP Change

Flux (gfd)	Operating Interval (hours)	Rate of TMP increase (psi/day)	Average Rate of TMP Increase (psi/day)	Comment
25.63	14.3	0.76	0.76	
22.33	3.2	0.84		
21.70	12.2	0.12		
22.04	15.0	0.18	0.38	No cleaning; average over previous 3 operating intervals (flux = 21.7 • 22.33)
23.97	12.0	0.73		Flux increased
23.96	13.0	0.00		
23.97	14.7	0.19	0.31	No cleaning; average over previous three operating intervals (flux = 23.97)
26.63	7.8	0.66		Flux increased
26.63	15.7	0.54		
26.63	12.0	0.73	0.64	Average over previous three operating intervals (flux = 26.63)

Feedwater Recovery. Figure 5.11 presents feedwater recovery data for the Memcor MF system for Phases I and II. Recovery for the Memcor MF system during Phase I varied from a minimum of about 88 percent to a high of approximately 90 percent. However,

during Phase II, feedwater recovery was consistently at 90 percent until the filtrate flow was increased to 20 gpm (1.26 L/s), at which time the recovery rose to approximately 91 percent.

The increase in recovery at higher flux reflects a greater volume of filtrate produced per volume of backwash water generated. (Backwash frequency and volume were not changed during testing). In other words, recovery increases in proportion to flux given a constant backwash interval.

Turbidity and SDI. Combined Phase I and Phase II turbidity results for the Memcor system feedwater and filtrate are presented in figures 5.12 and 5.13, respectively. Filtrate **SDI** values for both phases are shown graphically in figure 5.14. Minimum, maximum, and average (mean) values for these parameters are presented in table 5.12. Turbidity and **SDI** results shown in table 5.12 represent combined data for both phases of testing. No turbidity values were collected between July 18 and August 4 because of a malfunction of the **McAllen** WWTP turbidimeter. Turbidity values reported for the period beginning August 5 through the end of testing were measured using a **Hach 2100N** portable turbidimeter provided by **CH2M HILL**.

Filtrate turbidity values from June 5 to June 29 are considered unrepresentative. Algae growth in the clear filtrate sampling tubing caused sample contamination during this period. The clear tubing was replaced with opaque tubing on June 29.

Feedwater turbidity during Phase II was similar to Phase I turbidity. Phase I and II mean turbidity levels were 0.12 and 0.05 NTU, respectively. Filtrate levels during Phase II were much less variable, reflecting the elimination of algal contamination from the filtrate sample line. Mean filtrate turbidity for Phase II was 0.05 NTU compared with 0.12 NTU for Phase I and was significantly less than the RO feedwater criterion of 0.2 NTU. It cannot be determined if algae growth prior to June 5 contributed to the increased variability in the turbidity data during Phase I.

Figure 5.14 presents the **SDI** values for the Memcor MF system during Phase I and Phase II. It is clear from figure 5.14 that algae growth in the filtrate sample line contributed to high **SDI** values. **SDI** filter pads from this period are greenish, whereas a light yellow hue is typical. Excluding data from the June 5 to 29 period, mean **SDI** values for Phase I and II were similar (2.02 versus 1.72). For the relevant period, nearly all results are lower than the RO feedwater criterion of 3.0.

Figure 5.11
Recovery
Memcor - Phases I and II

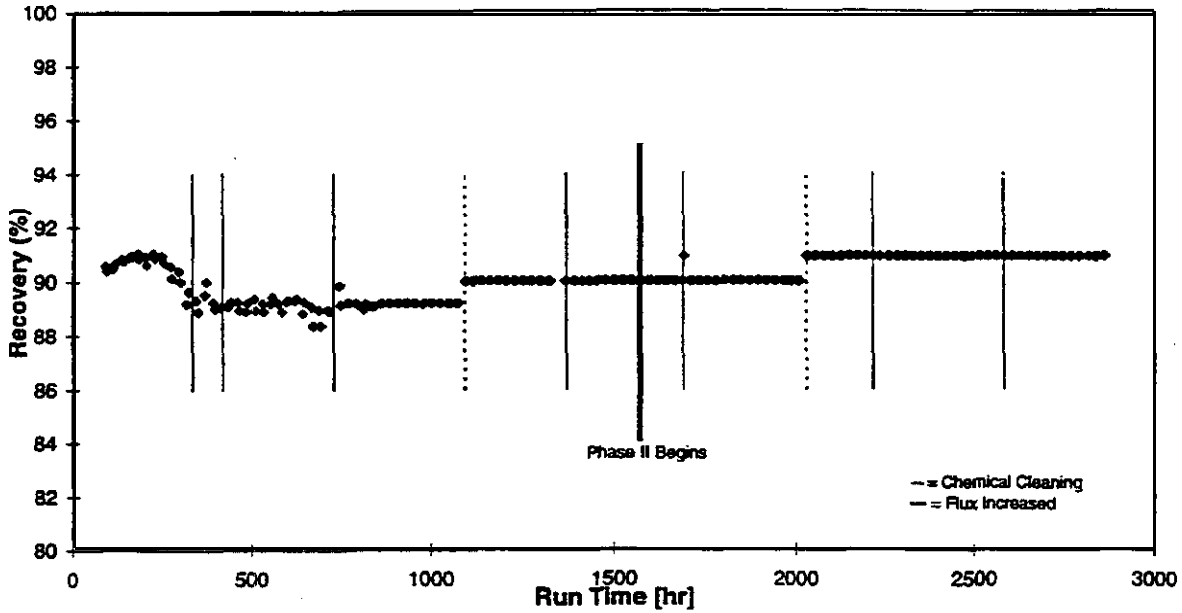


Figure 5.12
Feedwater Turbidity
Memcor - Phases I and II

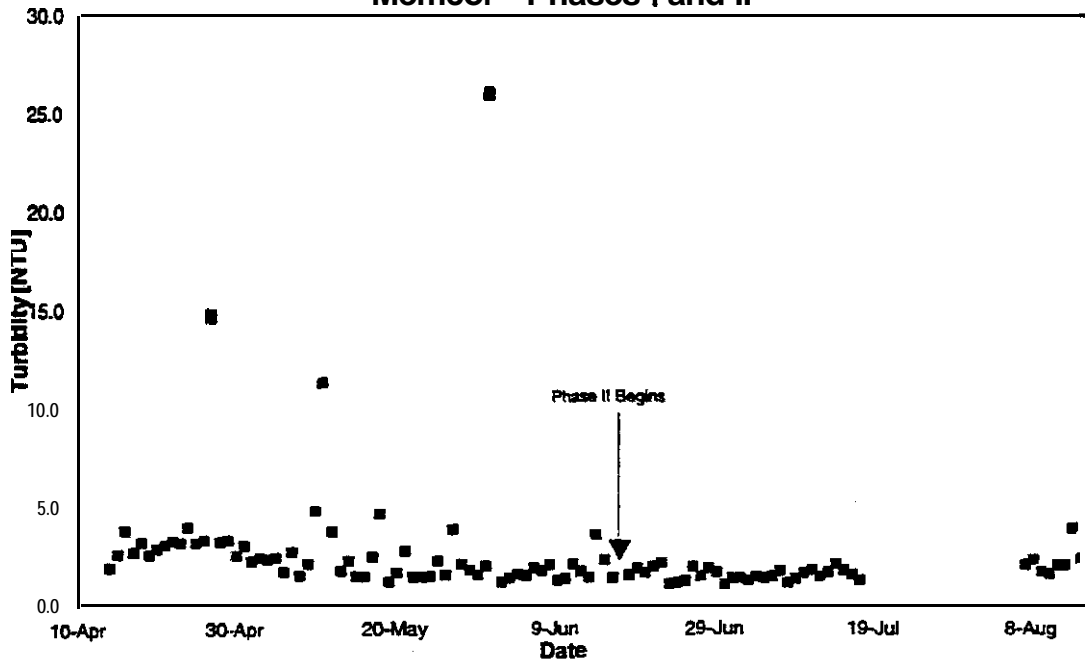
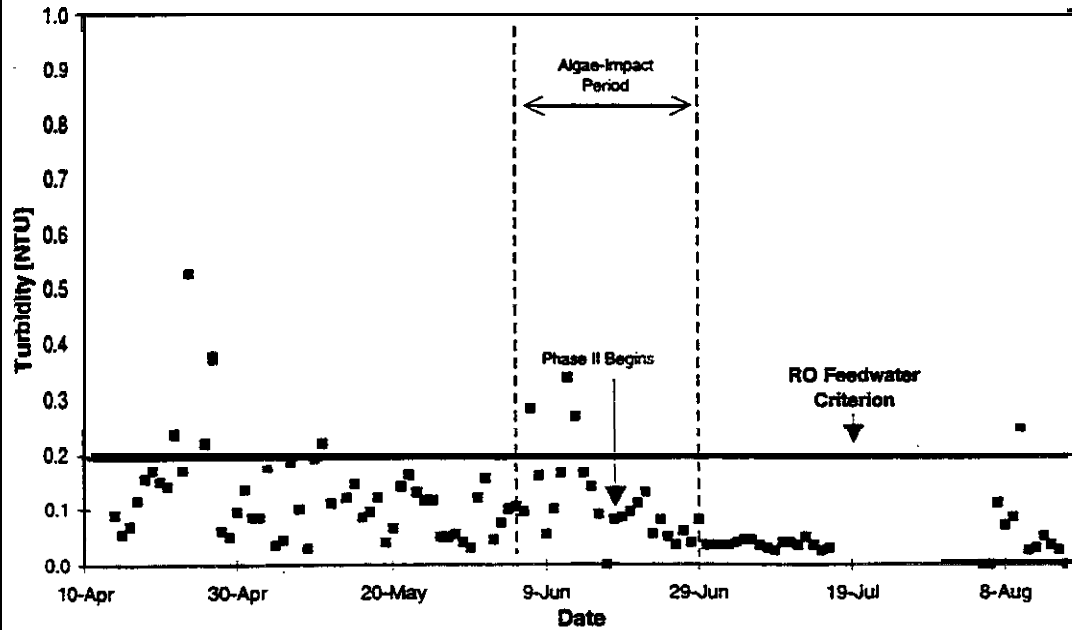


Figure 5.13
Filtrate Turbidity
Memcot Phases I and II



Note: No turbidity measurements were collected from July 18th through August 4th due to equipment malfunction

Figure 5.14
Filtrate SDI
Memcor Phases I and II

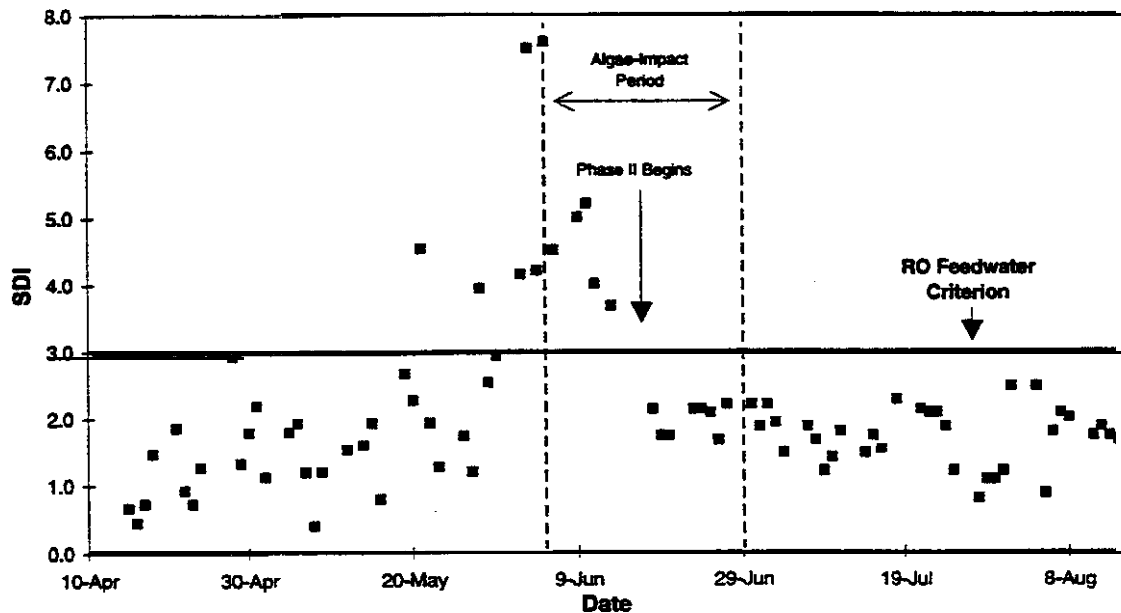


Table 5.12.—Results for Primary and Secondary Water Quality Parameters
Feedwater and Filtrate Quality for Memcor System Phases I and Phase II

Parameter	No. of Samples		Memcor Feedwater ¹			Memcor Filtrate ¹		
	Feed	Filtrate	Mean	Minimum	Maximum	Mean	Minimum	Maximum
TDS (mg/L)	5	11	1,191	984	1,407	1,139	977	1,411
Conductivity (µs/cm)	63	242 ⁵	1,970	1,520	2,500	1,789	755	2,410
TOC (mg/L)	3	15	7.8	6.9	8.4	6.9	5.3	8.1
Color (color units)	3	14	10.17	2.50	23.0	9.6	ND ^{2,3}	20.0
UV Absorbance @ 254 (l/cm)	8	30	0.12	0.11	0.15	0.11	0.09	0.14
SDS THM (µg/L)	2	2	325.4	317.4	333.7	317.4	310.3	324.4
SDS HAA (µg/L)	2	2	123.4	119.4	127.4	129.5	128.3	130.6
pH	63	121	7.06	6.87	7.41	7.09	6.86	8.16
Turbidity (NTU)	103	206 ⁵	2.40	0.90	26.0	0.10	0.03	0.53
TSS (mg/L)	20	18	2.6	0.8	8	0.3	0.2	1.0
SDI	0	a2	NS ⁴	NS	NS	2.11	0.40	7.60
HPC (CFU/ml)	13	10	6,490	576	19,900	3,516	264	12,000
Total Coliform (CFU/100 ml)	13	10	22	3	50	5	ND	15
Fecal Coliform (CFU/100 ml)	13	10	23	2	59	ND	ND	ND

¹ Phase I only for TDS, conductivity, pH, TOC, and color

² Phases I and II combined.

³ ND - Not Detected.

⁴ NS - Not Sampled.

⁵ Includes morning and afternoon samples. Average daily results were reported in spreadsheets.

5.4.2.2 Other Wafer Quality Parameters

Additional testing results for other water quality parameters monitored for the Memcor system were presented in table 5.12 as mean, minimum, and maximum values. Table 5.12 contains combined Phase I and II results for the effluent from the Memcor MF system as well as the feedwater to the systems during Phase I and Phase II.

As described for Phase I, the Memcor system had little or no effect on the following dissolved constituents in the DDE: TDS, conductivity, UV absorbance at 254 nm, DBPs, and pH. On the average, Memcor reduced TOC by 10 percent, most likely removing the particulate portion of the organic carbon. Filtrate TSS levels were consistently lower than 1 NTU. As observed during Phase I, no fecal coliforms were detected in the filtrate. Total coliforms were detected on two occasions at 1 and 15 CFU/ml, however

there was no trend in these results to indicate whether the **coliforms** passed the membrane or were a result of sample contamination. Pressure hold testing conducted with the Memcor system during this period showed no indication of membrane or module seal leakage. Taken together, these results are consistent with **performance** anticipated for a microfiltration process having a nominal membrane pore size of **0.2** microns in diameter.

5.4.3 ZenoGem Process Testing and Operations

Operating characteristics of the ZenoGem process that were monitored during **Phase II** include characteristics that were determined by monitoring feed and filtrate water, e.g., biological operating parameters and effluent water quality.

5.4.3.1 Commissioning and Operations

ZeeWeed unit commissioning was performed by the **Zenon** field technician on June 17 and 18, 1997. Commissioning included first seeding the process tank with return activated sludge from one of the WWTP clarifiers and then concentrating this material to approximately 12,000 **mg/L** mixed liquor suspended solids (**MLSS**) concentration. The unit began operation on screened, degrittied wastewater with a filtrate flow of 7.5 Lpm and a vacuum of 3 inches of Hg to begin Phase II operation.

Official ZenoGem operation on screened, de-gritted wastewater commenced on June 19, 1997. From June 19 through August 14, the system accumulated 1,373 operating hours with no down time for an on-line factor of 1 (100 percent). No chemical cleanings were needed nor performed during this **9-week** period.

At the end of Phase II, the ZeeWeed MF module was cleaned by **McAllen** WWTP personnel according to the procedure provided by **Zenon**. A description of the procedure is presented in appendix D.

Results of Post-Phase II Chemical Cleanings

The procedure described in appendix C includes performing flux tests with clean (**tap**) water prior to and following each chemical cleaning to determine cleaning efficiency. The results of the flux tests, shown in table 5.13, show that a sequential cleaning, **first** with chlorine followed by acid, was needed to restore filtrate flow to levels observed prior to Phase II operation.

Table 5.13.—Results of Final ZeeWeed Cleaning

Activity	Filtrate Flow (gpm)	Vacuum (inches Hg)	Temperature (°F)
Water flux before cleaning	1.75	10	83
Clean water flux after first NaOCl cleaning	4.4	10	88
Clean water flux during HCl cleaning	5.50	10	89
Clean water flux after second NaOCl cleaning	4.50	10	85

5.4.3.2 ZenoGem Process MF Operating Conditions

Table 5.14 presents the operating criteria that were established for the ZeeWeed MF portion of the ZenoGem process. Table 5.14 also presents the values that were achieved for these criteria during Phase II. Plots of MF filtrate flow, flux, TMP, and recovery, all as a function of operating time, are presented in this subsection.

Performance of the ZeeWeed MF module conformed to planned levels for the above criteria, with some exceptions, as discussed below:

Filtrate Flow and Membrane Flux • Target flow and flux for ZeeWeed module operation during Phase II were reduced to 2 gpm (0.13 L/s) and 20 gfd (34.0 L/m²/hr) respectively, based on the **high** solids levels present in the bioreactor. These levels were maintained more than 90 percent of the time. Excursions were caused by a vacuum pressure switch on the filtrate header.

Table 5.14.—Planned and Actual Operating Criteria • ZenoGem Phase II ZeeWeed MF

Parameter ¹	Unit	Planned	Actual
Filtrate Flow	gpm	2.1 • 4.2	1.6-3.2
Transmembrane Pressure	psi	3 - 9	1.5-5.2
Membrane Flux	gfd ²	20-40	15.2 -30.4
Back Wash/Pulse Frequency	minutes	6-12	10-20
Back Wash/Pulse Duration	seconds	10	10-20
Back Wash/Pulse Chemical Addition	NA ³	chlorine	none
Cleaning Frequency	days	20-30	>45

1 TMP and cleaning frequency are dependent variables; the remainder are control variables

2 gfd • gallons/square foot/day

3 Not applicable

Filtrate Flow and Membrane Flux. Plots of filtrate flow and membrane flux as a function of operating time for both phases of ZeeWeed operation are presented in figures 5.15 and 5.16. The filtrate flow and membrane flux were fairly stable during each phase of operation. However, the flow and flux did begin to decrease at the end of Phase II. Additionally, flow and flux were approximately 1.4 times higher during Phase I.

Transmembrane Pressure. TMP for the ZeeWeed MF module during each phase of operation is presented in figure 5.17. The rate of TMP increase over time was significantly lower during Phase II. Average rate of increase was 0.068 psi/day (0.47 kPa/day) for Phase I versus 0.056 psi/day (0.39 kPa/day) for Phase II. These results indicate a lower rate of membrane fouling when filtering the high concentration of biological solids (>10,000 mg/L) versus filtration of low solids (<10 mg/L) present in the DDE. The lower rate may be the result of either or both of the following:

- A lower rate of solids loading at the surface of the membrane (lower flux)

- A greater degree of mechanical cleaning of the membrane surface provided by the higher solids level.

Recovery. Figure 5.18 presents feedwater recovery for the ZeeWeed MF system during each phase of testing. The higher recovery achieved during Phase II (>99 percent) was a direct outcome of maintaining the desired solids retention time necessary for biological treatment (See section 5.4.4.1 for a discussion of SRT.) Phase II recovery was approximately 2 to 4 percent higher than that observed during Phase I. Additionally, Phase II recovery was very consistent, while Phase I recoveries were more variable and began a sharp decrease toward the end of Phase I testing.

Turbidity and SDI. Figures 5.19 and 5.20 present filtrate turbidity and SDI, respectively, for both phases of testing. Turbidity was higher during Phase II, with an average of 0.18 NTU versus 0.13 NTU for Phase I. Although the average turbidity values were below the recommended value of 0.2 NTU, some values were above 0.2 NTU in each phase. Phase I SDI values were much lower than those obtained during Phase II. Average SDI during Phase I was 1.92 compared to 5.02 for Phase II.

TMP • The ZeeWeed MF module had an initial TMP of 1.5 psi (0.1 bar) during Phase II compared to an anticipated minimum of 3 psi (0.2 bar). The lower initial TMP directly reflects lower resistance of the membrane to water flow at the lower flux used during Phase II (Phase I was operated at 33 gfd [56.0 L/m²/hr] average flux).

Back Pulse Characteristics (frequency, duration, and chemical use) • Following discussions with Zenon, operating values were established in the research work plan. These values were later modified. As described for Phase I, the changes reflect the approach of not chlorinating the back pulse fluid to minimize DBP formation and compensating for the absence of a disinfectant by increasing duration of backpulse flow.

Figure 5.15
 Filtrate Flow
 Zeeweed - Phases I & II

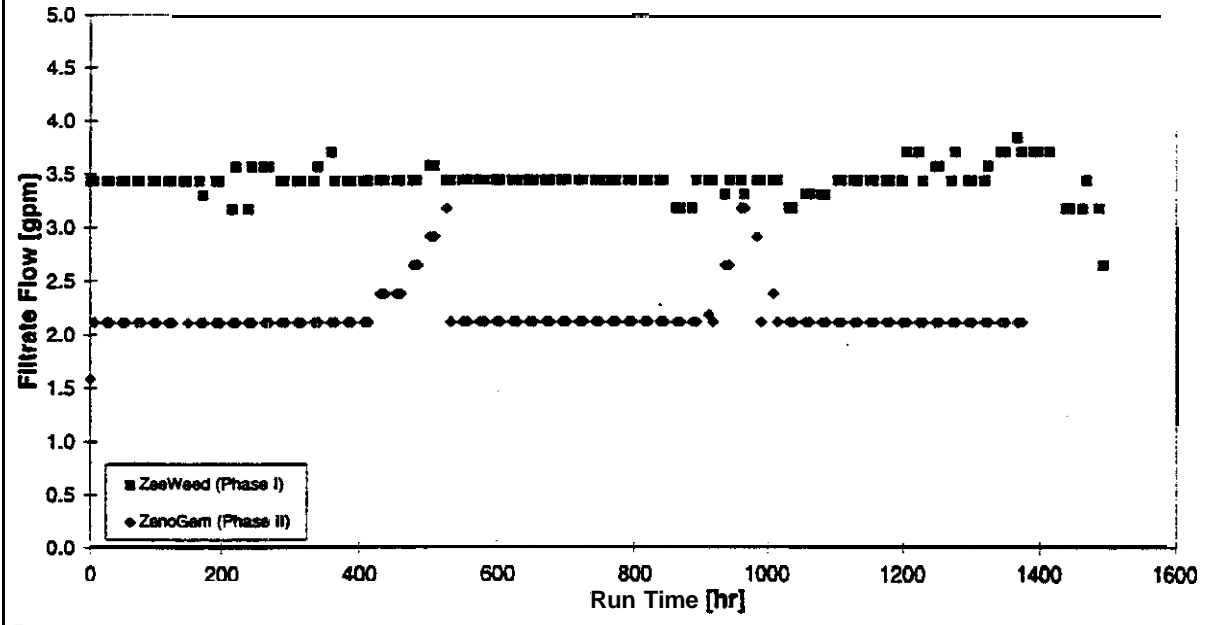


Figure 5.16
 Membrane Flux
 Zeeweed - Phases I & II

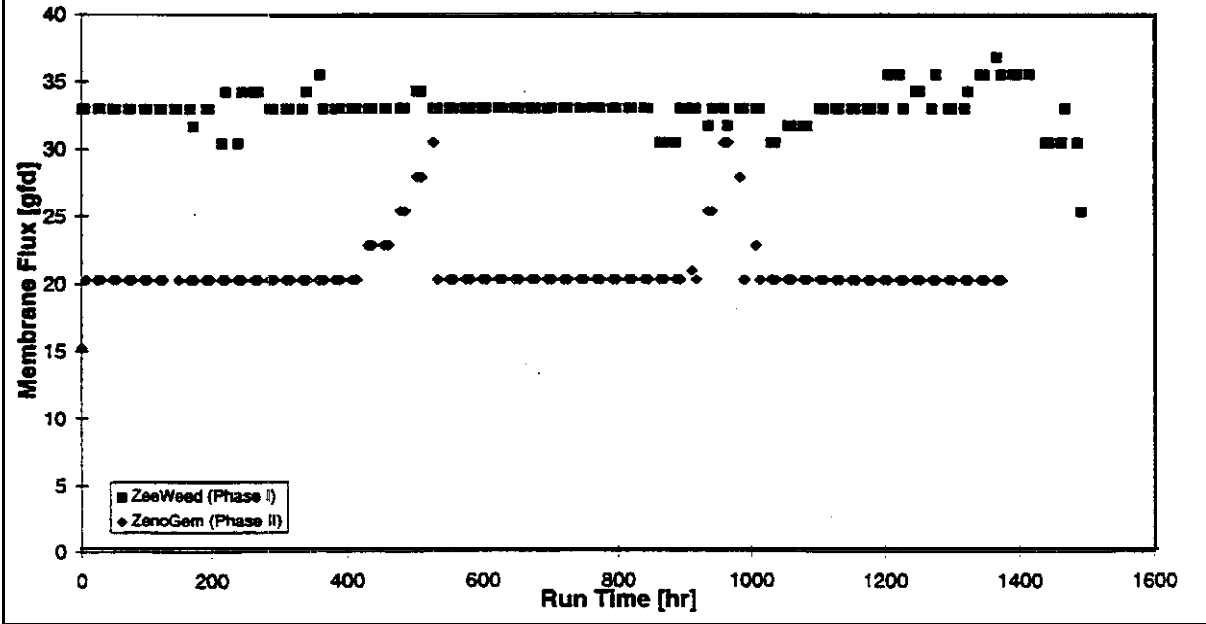


Figure 5.17
Transmembrane Pressure
ZeeWeed - Phases I & II

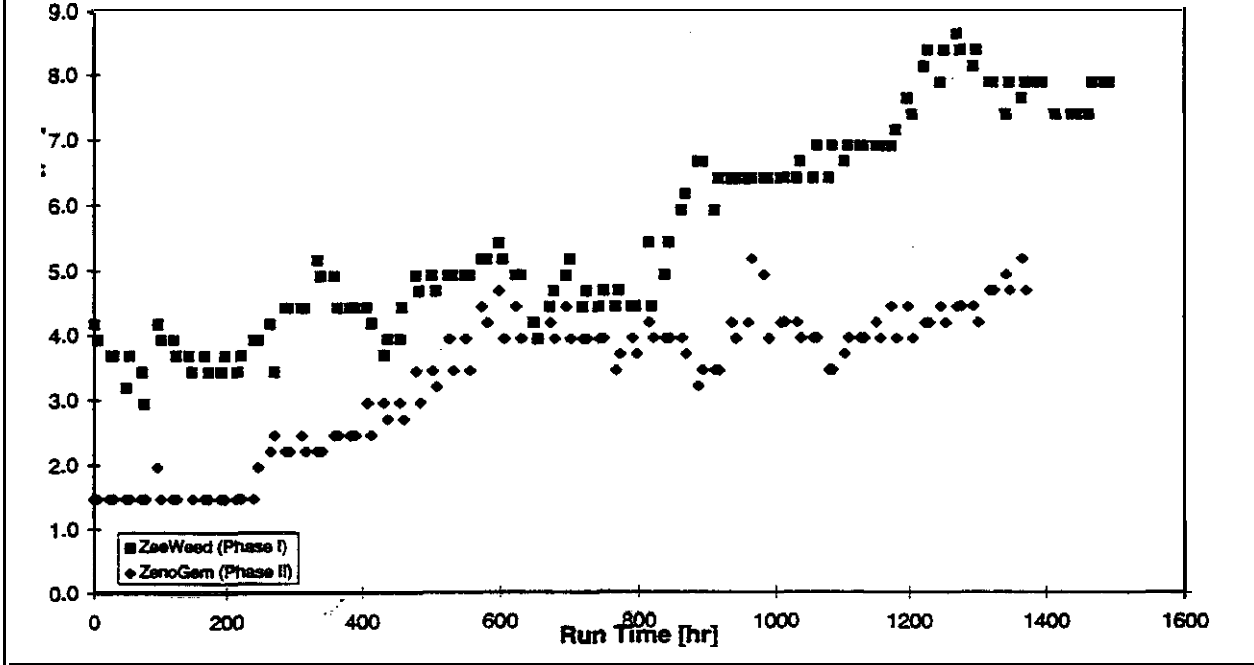


Figure 5.18
Recovery
ZeeWeed - Phases I & II

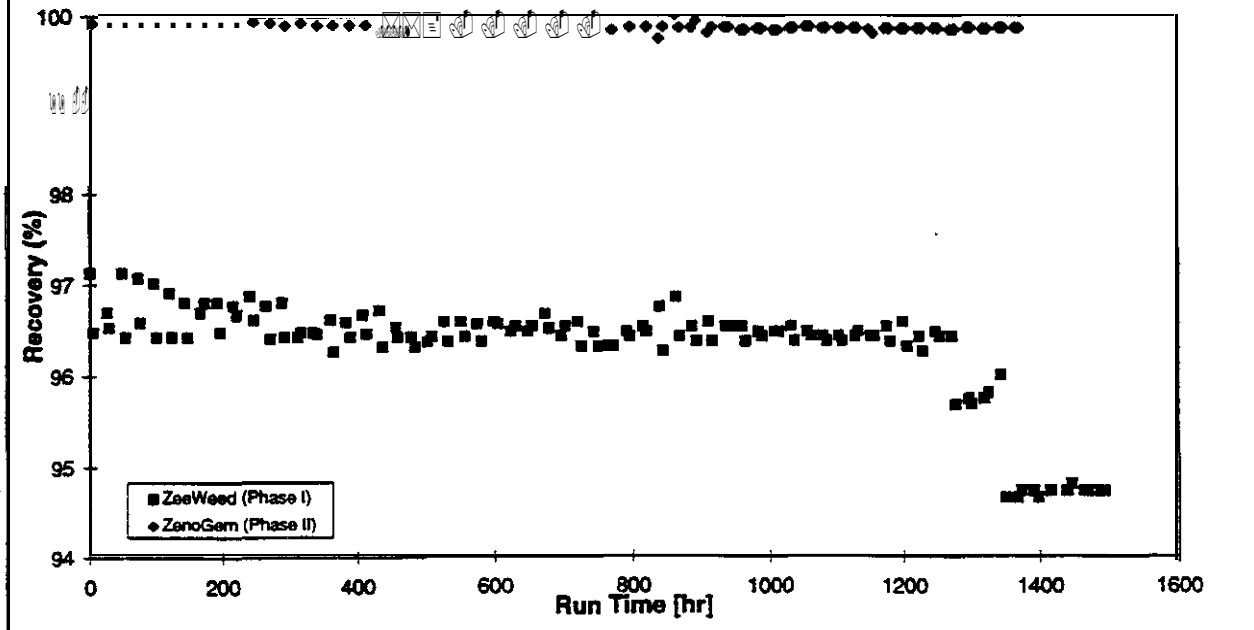
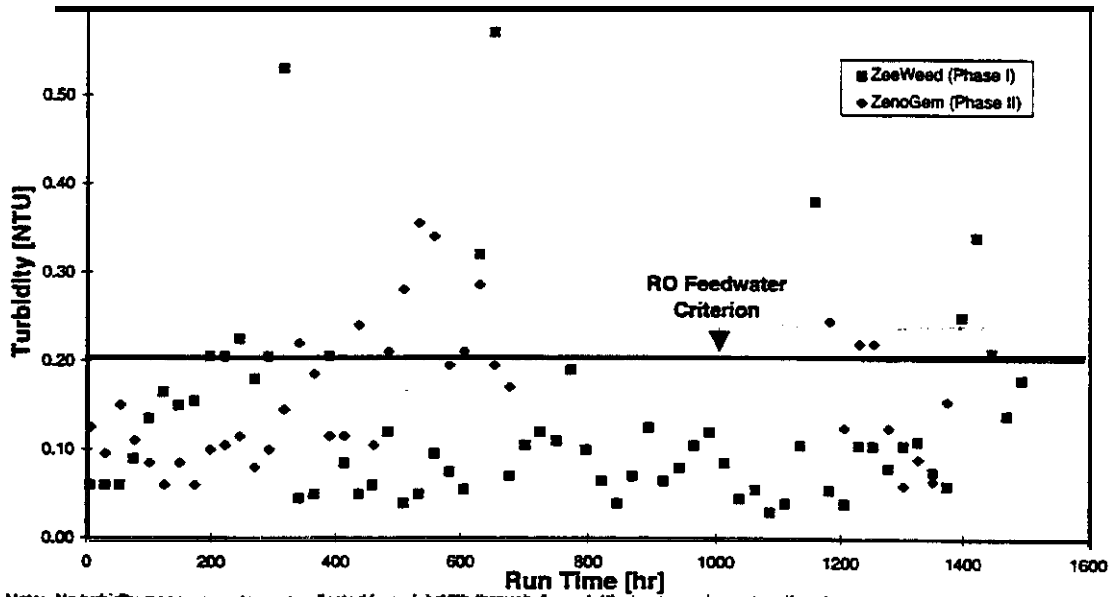
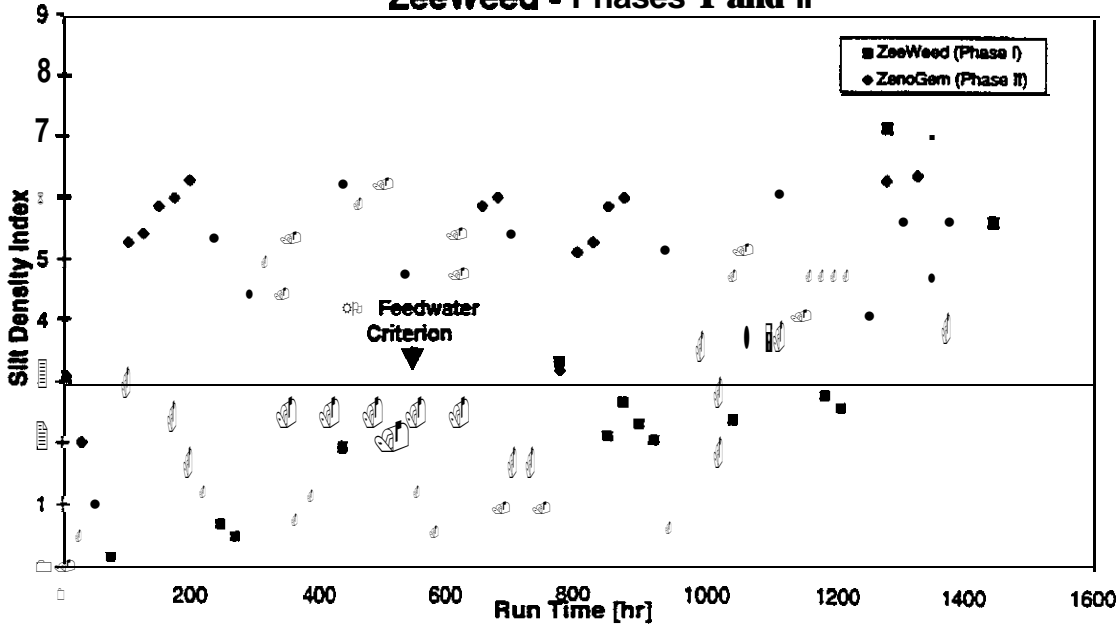


Figure 5.19
Filtrate Turbidity
ZeeWeed - Phases I and II



Note: No turbidity measurements were collected from July 18th through August 4th due to equipment malfunction

Figure 5.20
Filtrate SDI
ZeeWeed - Phases I and II



5.4.3.3 ZenoGem Process Biological Treatment Operating Conditions

Operating criteria established for the biological treatment portion of the ZenoGem process, along with the values that were achieved during the reporting period, are presented in table 5.15.

Table 5.15.—Planned and Actual Biological Treatment Operating Criteria
ZenoGem Process • Phase II

Parameter	Unit	Planned	Actual
MLVSS	mg/L	10,000	8,900 • 14,033
Dissolved Oxygen	mg/L	>2	0.5 • 4.60
Hydraulic Retention Time	days	2-4	2.92 • 5.84

The target MLVSS concentration was 10,000 mg/L. The average MLVSS was 11,400 mg/L. The high degree of variability in MLVSS levels reflects the imprecision of controlling this parameter through the daily measurement of MLSS levels and adjusted sludge blowdown volume based on a single MLSS result. Target HRT was 2 to 4 hours. The actual operating range was 2.9 to 5.8 hours. The HRT was controlled at 2.9 hours for all but the last 10 days of operation when it was increased to improve nitrification efficiency.

5.4.4 Comparison of ZenoGem and McAllen WWTP Performance

The wastewater treatment performance of the ZenoGem system and McAllen WWTP No. 2 was compared to assess relative efficiency of the two processes. The WWTP employs extended aeration using surface aerators. As is typical for most conventional design wastewater plants, activated sludge is removed from the aeration basin and a portion is recycled back to the aeration basin as return activated sludge (RAS) to maintain the desired level of biological solids (MLVSS). The remainder is wasted from the system (waste activated sludge or WAS) to sludge drying beds. Operating characteristics and related water quality parameters for ZenoGem and WWTP are presented and discussed in the following sections.

5.4.4.1 Biological Treatment Operating Characteristics

Table 5.16 presents biological treatment operating characteristics for both processes. Data from the McAllen WWTP was obtained from the plant sludge control logs for the east aeration basin during the Phase II testing period.

Table 5.1 &--Biological Treatment Operating Characteristics
ZenoGem Process and City of McAllen WWTP

Parameter	ZenoGem Bioreactor			WWTP East Aeration Basin		
	Mean	Min	Max	Mean	Min	Max
Dissolved Oxygen (mg/L)	2.62	0.50	4.60	2.65	1.40	4.00
MLSS (mg/L)	15,119	12,300	19,400	3241	2620	4000
MLVSS (mg/L)	11,022	8,900	14,033	2333	1840	2980
Hydraulic Retention Time (hr)	3.61	2.92	5.84	29.8	23.0	37.0
Solids Retention Time (days)	16.4	10.3	26.4	12.4	5.00	23.0
Oxygen Uptake Rate (mg/L-hr)	36.9	7.80	89.4	NAa	NA	NA
Sludge Yield (g/g)	0.74	NC ^b	NC	0.73	NC	NC

a NA • Information not available. b NC • Not calculated

Hydraulic and Solids Retention Time. Figures 5.21 and 5.22 present the hydraulic and solids retention time, respectively, for the ZenoGem bioreactor and the **McAllen** WWTP during Phase II. The data in figure 18 indicate that the ZenoGem process was consistently operated at much lower HRT than the WWTP. The average HRT for the ZenoGem process was 3.6 hours compared with 30 hrs for the aeration basins. The ZenoGem process can operate at the much shorter HRT because the greater concentration of microorganisms assimilate and reduce the BOD of the wastewater at a much more rapid rate. SRT levels in the two processes were comparable. The average SRT of 13 hours for the WWTP is at the low range of values representative for extended aeration plants (15 to 30 days). The ZenoGem process has the capability to be operated with longer SRT than conventional wastewater processes because it is not limited by sludge bulking that typically occurs at very long detention times.

Mixed Liquor Suspended and Volatile Suspended Solids. The **McAllen** WWTP and the ZenoGem system use the suspended growth process (activated sludge) to achieve biological treatment. Removal of carbonaceous organic matter in a suspended growth process depends directly on the concentration of bacteria present in the mixed liquor (activated sludge). Bacterial levels can be estimated by measuring the concentration of either the MLVSS or MISS in the treatment reactor. The latter is more practical for maintaining proper bacterial levels because it is an easier and more rapid method. MLVSS is a more accurate measure of bacterial content because it excludes the inert fraction of the suspended solids; however, it requires an additional drying and weighing step, which adds time and effort. MLVSS levels can be estimated from **MLSS** measurements. A ratio of 0.7 to 0.9 for MLVSS to MISS is typical.

MLSS and MLVSS levels measured in the ZenoGem bioreactor tank and the WWTP east aeration basin are shown in figures 5.23 and 5.24, respectively, as a function of calendar date during Phase II. It is clear from the figures that, as designed, bacterial levels were **maintained** at significantly higher levels in the ZenoGem process than in

Figure 5.21
Hydraulic Retention Time
ZenoGem and McAllen WWTP- Phase II

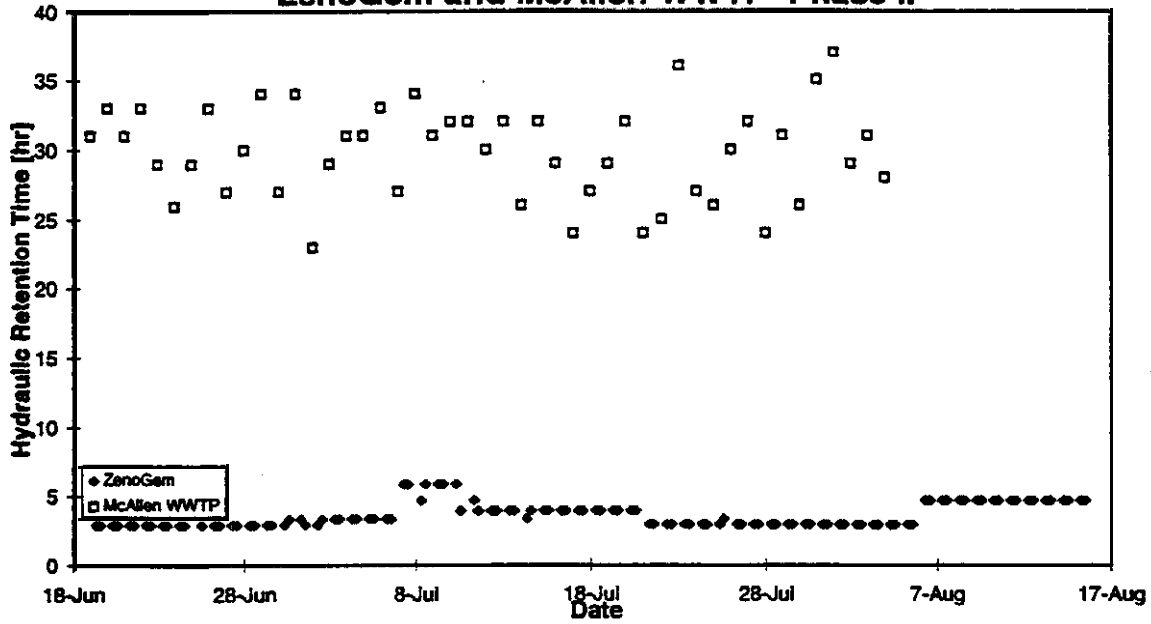


Figure 5.22
Solids Retention Time
ZenoGem and McAllen WWTP - Phase II

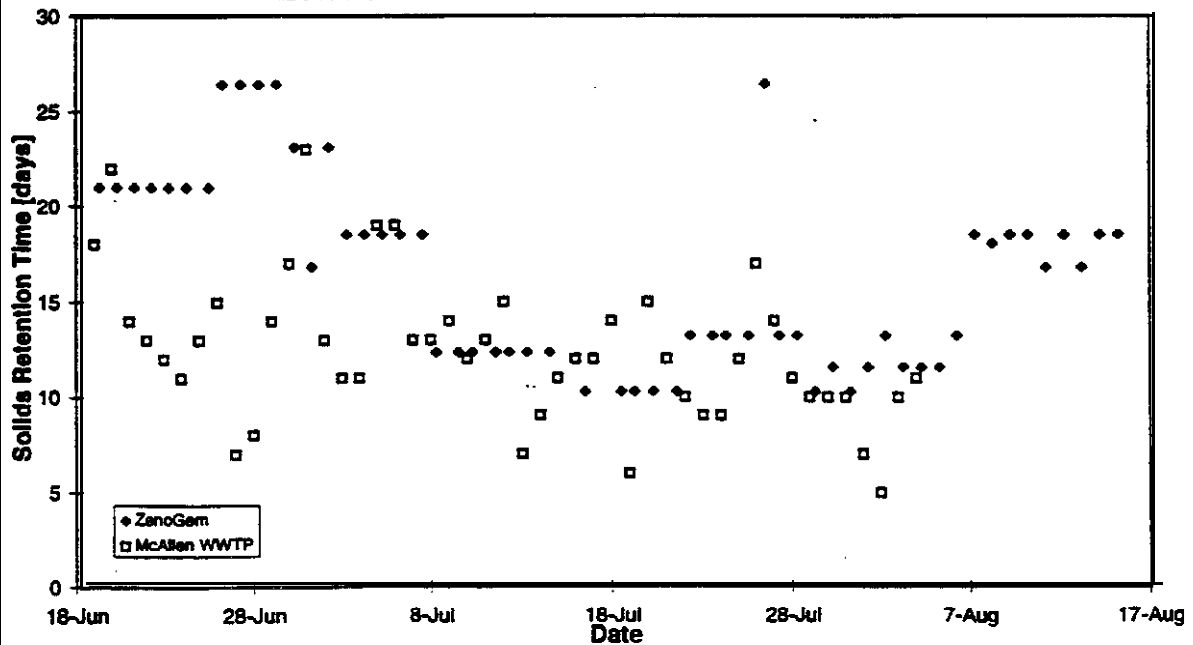


Figure 5.23
Mixed Liquor Suspended Solids (MLSS)
ZenoGem and McAllen WWTP - Phase II

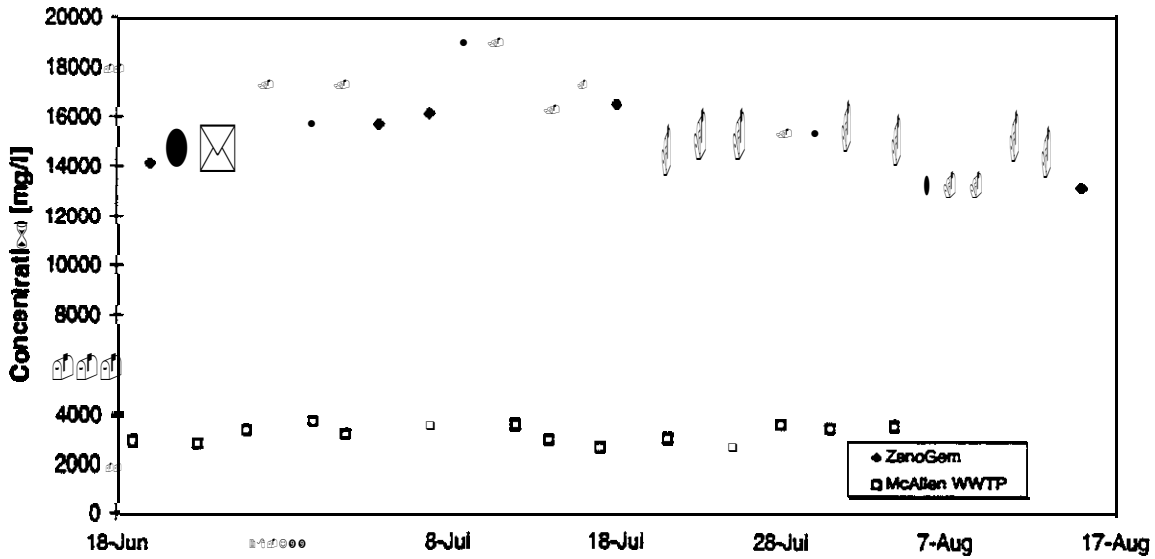
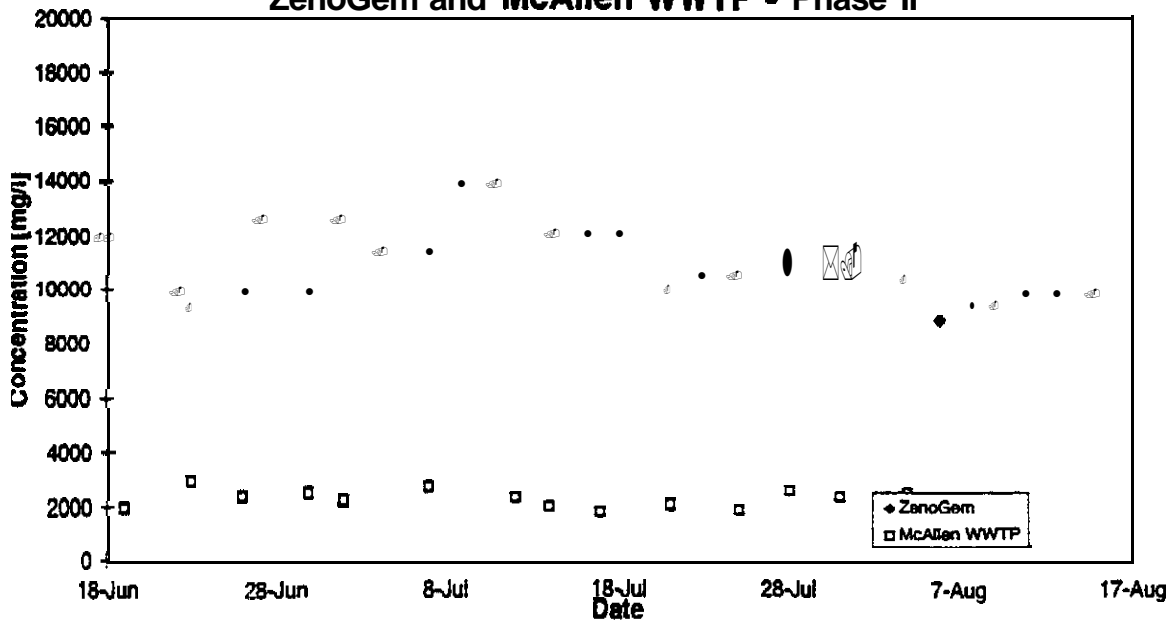


Figure 5.24
Mixed Liquor Volatile Suspended Solids (MLVSS) for
ZenoGem and McAllen WWTP - Phase II



the WWTP. Average MLVSS concentration for ZenoGem was 11,000 **mg/L** compared to 2,300 **mg/L** for the WWTP, or a factor of 4.8 higher for ZenoGem. The most common range of MLVSS values for conventional air activated sludge systems is 2,000 to 2,500 **mg/L** (Water Environment Federation, 1991). Although air based conventional systems can operate at somewhat higher MLVSS levels (up to 3,000 **mg/L** in practice), sludge settleability decreases as levels decrease. Settleability is not an issue for the ZenoGem process because separation does not depend on gravity but rather on the ZeeWeed membrane.

The significance of the greater MLVSS levels is that the ability to remove **CBOD₅** is directly proportional to bacterial density in the activated sludge tank (or bioreactor). By maintaining higher MLVSS concentrations, the ZenoGem process can attain comparable reduction in BOD, at a much lower hydraulic detention time for the bacterial cells (mean cell residence time). This is clearly illustrated in table 5.16, where the average HRT for ZenoGem is 3.61 hours versus 29.8 hours for the WWTP. In other words, the same degree of treatment can be accomplished in roughly one-tenth of the time or volume needed by the extended aeration process used at McAllen. Assuming similar depths for an aeration basin and ZenoGem bioreactor, the tankage area of the ZenoGem process would require only 10 percent of the land area required for the extended aeration basins.

The ratio of MLVSS to MLSS for ZenoGem and the WWTP was 0.73 and 0.72, respectively. This is at the lower end of the typical range and reflects the lack of inert settling in primary treatment, which was not employed with either process evaluated.

Dissolved Oxygen. Proper dissolved oxygen (DO) levels must be maintained in the activated sludge process to enable efficient degradation of both carbonaceous organic matter and organic nitrogen. Generally, DO levels in the activated sludge process should be maintained around 2.0 **mg/L** or greater to ensure that sufficient oxygen is present to achieve effective BOD₅ removal and **nitrification** (Water Environment Federation, 1990). Lower levels will impede **nitrification**.

DO levels, as measured in the two treatment systems during Phase II, are presented in figure 5.25. DO levels in the aeration basin were generally maintained between 1.5 and 3.5 **mg/L**, where both carbonaceous and nitrogenous BOD removal was desired and achieved. For ZenoGem, DO levels were typically greater than 2 **mg/L** except during the initial period of operation (from June through July 3, 1997) when the pilot plant blower was set to deliver insufficient air flow. Air delivery levels were increased on July 3, from 8 to 10 cubic feet per minute (cfm). As discussed later in this section, the lower initial DO levels for the ZenoGem system caused reduced ammonia removal. During the entire Phase II period, average DO contents for ZenoGem and the WWTP were similar (2.62 **mg/L** for ZenoGem versus 2.65 **mg/L** for the WWTP).

Oxygen Uptake Rate. Oxygen uptake rates in the ZenoGem bioreactor were generally greater than 40 **mg/L-hr**. The oxygen uptake rates and the excellent BOD₅ removals that were achieved indicate good biological activity.

Sludge **Yield**. Sludge yield coefficient, Y, is a measure of the amount of biological solids produced by a wastewater treatment process relative to the amount of organic matter removed. Ideally, the sludge yield should be as low as possible to minimize the need to dispose of sludge. For the extended aeration process used at the WWTP, Y is typically low because the microorganisms in the activated sludge operate in the endogenous phase based on the long mean cell residence time (**SRT**) of this type of system. Y values for the ZenoGem system should be comparable to those for the WWTP because both operated at similar **SRTs**. The average sludge yield for the ZenoGem process was 0.74 g of sludge produced per gram of CBOD₅ removed. This value is less than the typical value for **activated** sludge systems and suggests that the long **SRTs** used in this study reduced sludge production. An accurate determination of sludge yield for the ZenoGem process requires a longer operating period than was employed in this study. Based on the data available from the **McAllen** WWTP control logs, sludge yield for the McAllen WWTP was 0.73. This is comparable to that obtained for the ZenoGem process.

5.4.4.2 *Biological Treatment Water Quality Parameters*

Several water quality parameters were measured to monitor the effectiveness of the biological treatment portion of the ZenoGem process and the McAllen WWTP. Each of these parameters is presented in table 5.17 as a mean, minimum, and maximum value and is discussed below.

Carbonaceous Biochemical Oxygen Demand (CBOD₅). Reduction in CBOD₅ levels across the biological treatment process is used to evaluate the efficiency of the activated sludge process for reducing the level of organic matter in the raw waste-water. (BOD₅ is also used to measure treatment efficiency; however, it includes both carbonaceous and nitrogenous BOD.) Figure 5.26 presents the **CBOD₅** results for ZenoGem filtrate and WWTP effluent, during Phase II. (Filtrate/effluent levels are shown in lieu of percent **CBOD₅ removal** because **influent** CBOD₅ concentrations to each process were assumed to be equivalent.) The following can be concluded from the data in table 5.17 and **figure 5.26**:

- The ZenoGem process produced a filtrate having a CBOD₅, consistently below 1 mg/L.

The ZenoGem process was more efficient at removing CBOD₅ from the raw wastewater than was the WWTP, despite operating with one-tenth the hydraulic retention time.

The ZenoGem process is more than capable of producing an effluent meeting **McAllen's** current effluent discharge limit of 15 mg/L CBOD₅.

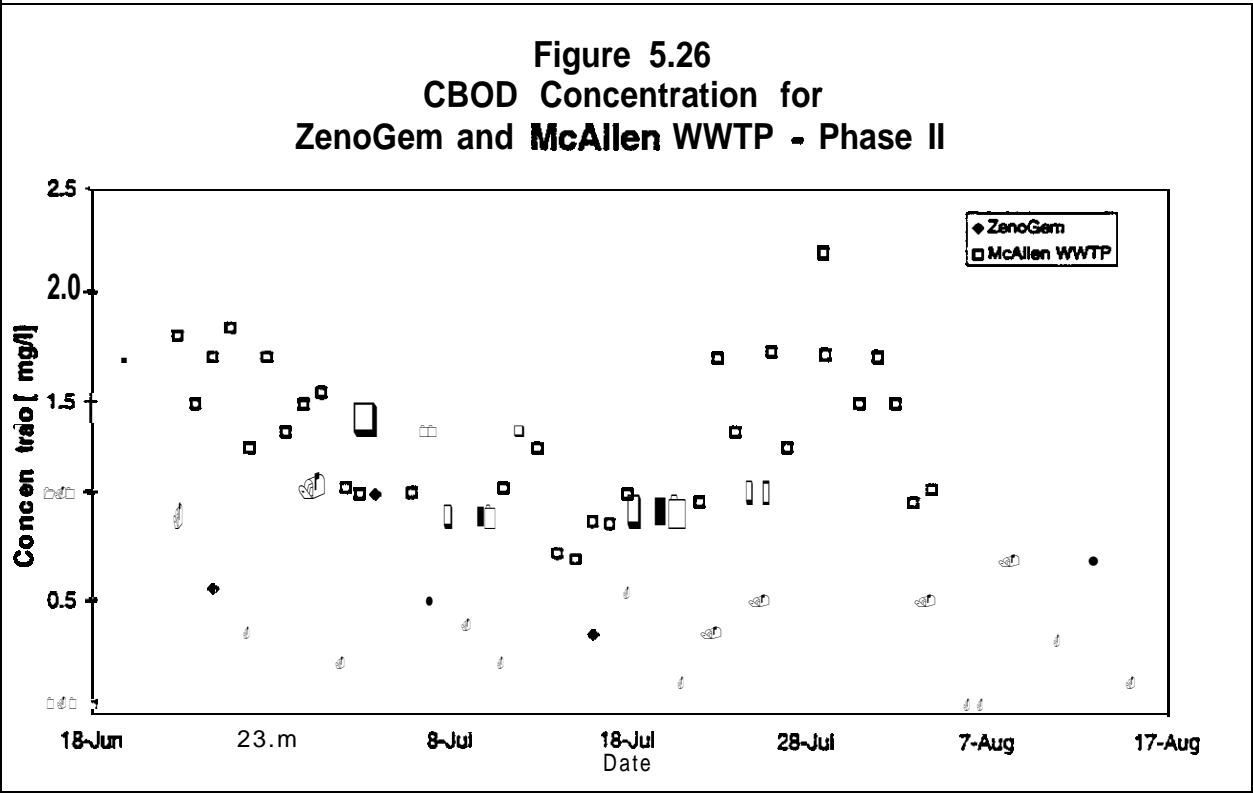
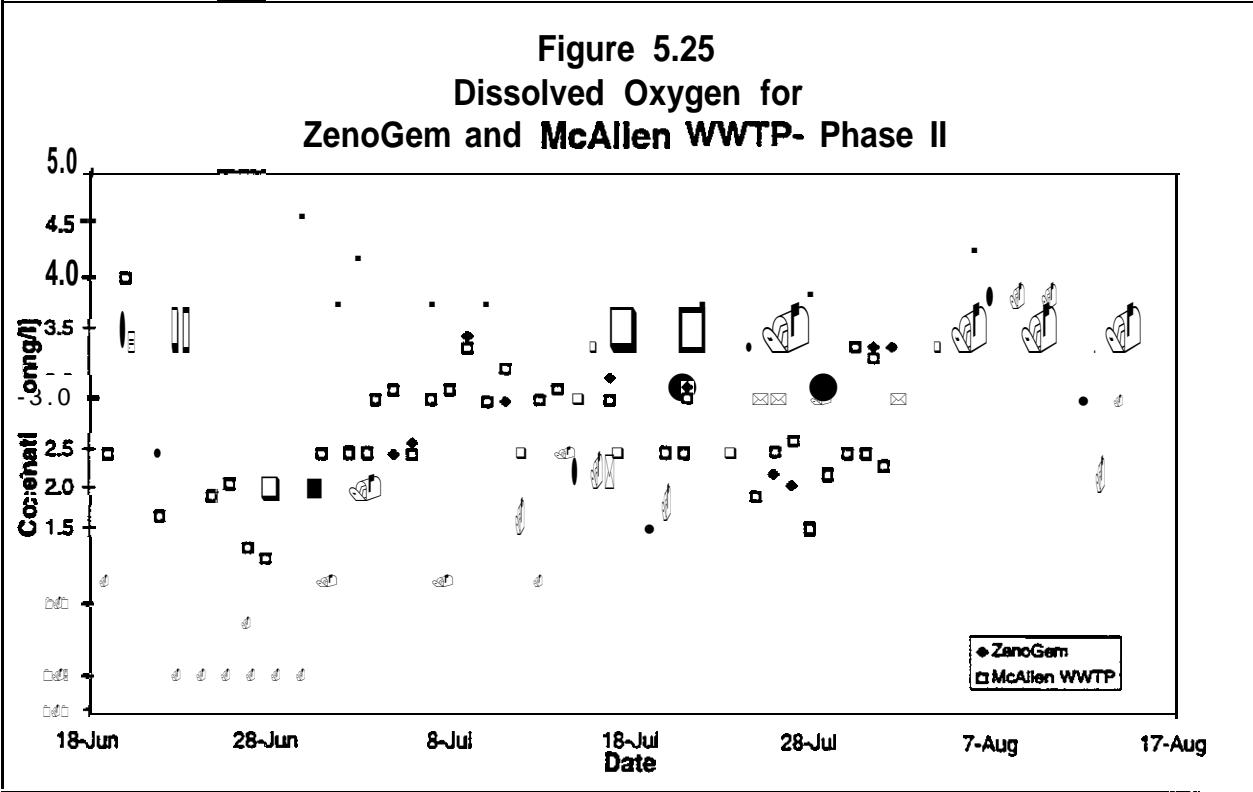
Total Suspended Solids (TSS). As anticipated and as shown in table 5.17, TSS concentrations in the ZenoGem filtrate were less than or equal to 1.0 mg/L throughout the

TABLE 5.17
Biological Treatment Water Quality Parameters
ZenoGem Process, Phase II

	No. of data values collected			ZenoGem/WWTP Feedwater* (De-gritted Wastewater)			ZenoGem Filtrate			WWTP Effluent		
	Feed	ZenoGem	WWTP	Mean	Min	Max	Mean	Min	Max	Mean	Min	Max
Ammonia Nitrogen (mg/L)	16	22	54	27.0	22.9	32.9	3.08	0.04	18.8	0.24	0.01	1.5
TKN (mg/L)	9	9	0	63.1	2.00	109	8.3	1.30	20.8	NS ^b	NS	NS
Nitrite and Nitrate Nitrogen (mg/L)	9	9	0	0.74	0.02	2.94	8.06	0.01	19.10	NS	NS	NS
Total Phosphorus (mg/L)	9	9	0	11.3	0.12	41.0	2.02	0.05	7.00	NS	NS	NS
CBOD ₅ (mg/L)	58	22	54	189	132	679	0.55	0.04	1.63	1.32	0.78	2.2
Total Suspended Solids	46	8	0	203	116	473	0.6	0.2	1.0	NS	NS	NS

^a Notes: Data for ammonia nitrogen, TSS and CBOD₅ from City of McAllen WWTP routine sampling.

^b NS . Not Sampled



Phase II period and well below the regulatory discharge limit of 5 mg/L. TSS levels in the WWTP are not presented; however, they typically range from 1 to 4 mg/L, higher than in the ZenoGem filtrate.

Nitrogen Species. Figure 5.27 presents ammonia nitrogen concentrations for the ZenoGem/ WWTP influent, ZenoGem filtrate and WWTP effluent. The WWTP achieved nearly complete nitrification during the test period (mean ammonia nitrogen concentration was 0.24 mg/L). In contrast, nitrification was not complete during most of ZenoGem unit operation and ammonia nitrogen levels in the ZenoGem filtrate did not reach similarly low levels until the last two weeks of operation. Incomplete nitrification was the result of two factors:

During the first 3 weeks of operation, DO levels in the bioreactor tank were insufficient (generally less than 2 mg/L).

During the period July 9 through August 5, DO levels were in the appropriate range; however, **nitrification** was less than complete and **was** limited by the ability to transfer sufficient oxygen from the bulk fluid to the organisms within the **flocs**. This was caused by low solubility of oxygen at the temperatures in the bioreactor (85 to 95 °F). When bioreactor HRT was increased from 2.9 to 4.7 hours on August 6 (effectively reducing oxygen demand by the **nitrifiers**), ammonia levels decreased to <0.2 mg/L.

Total Kjeldahl nitrogen (TKN) and nitrate/nitrite levels in the ZenoGem filtrate are shown in figure 5.28. TKN levels were elevated during the **first** half of testing but decreased steadily to near zero by the last week of operation. In contrast, inorganic nitrogen levels in the filtrate were very low during the first half of testing but **increased** to nearly 20 mg/L during the latter part of operation. These results are consistent with the earlier observation that **nitrification** was inhibited during the early periods of testing, improved dramatically as DO levels were increased and was optimum when DO levels were sufficient and HRT was reduced.

Nitrification Rate. Nitrification rates were **calculated** for the ZenoGem process and the McAllen WWTP. Assuming an average water temperature of 31 degrees Celsius (observed during the Phase II activities) and a **nitrifier** fraction of 0.054 (based on the BOD/TKN ratio), the specific **nitrification** rate for the ZenoGem process and the McAllen WWTP were 0.26 g NH₃-N/g NVSS and 0.17 g NH₃-N/g NVSS.

Total Phosphorus. A comparison of phosphorus removal by the two treatment processes was not made during the study. There is no phosphorus limit imposed on discharge of effluent by the WWTP. On average, the ZenoGem process removed 76% of the phosphorus from the raw wastewater to about 2 mg/L. This level is typical for wastewater treatment plants using the activated sludge process where no chemical precipitation of phosphorus is practiced. Zenon is currently operating the ZenoGem process at selected locations to achieve phosphorus levels below 0.1 mg/L using alum as a precipitant (Lozier, 1997a).

Figure 5.27
 Ammonia as Nitrogen for
 ZenoGem and McAllen WWTP- Phase II

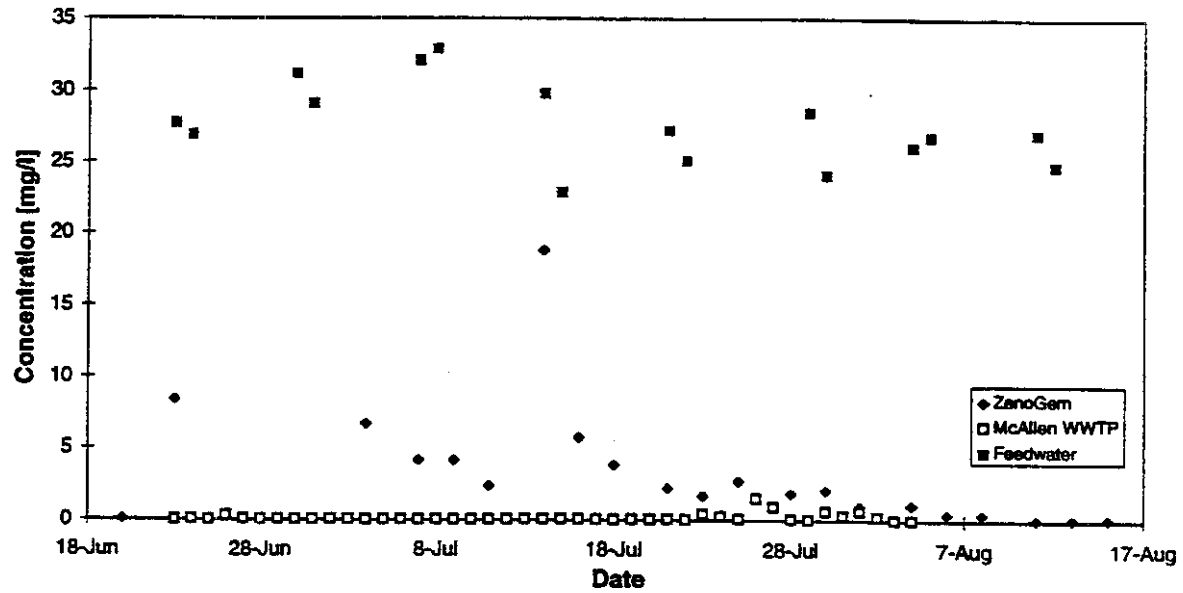
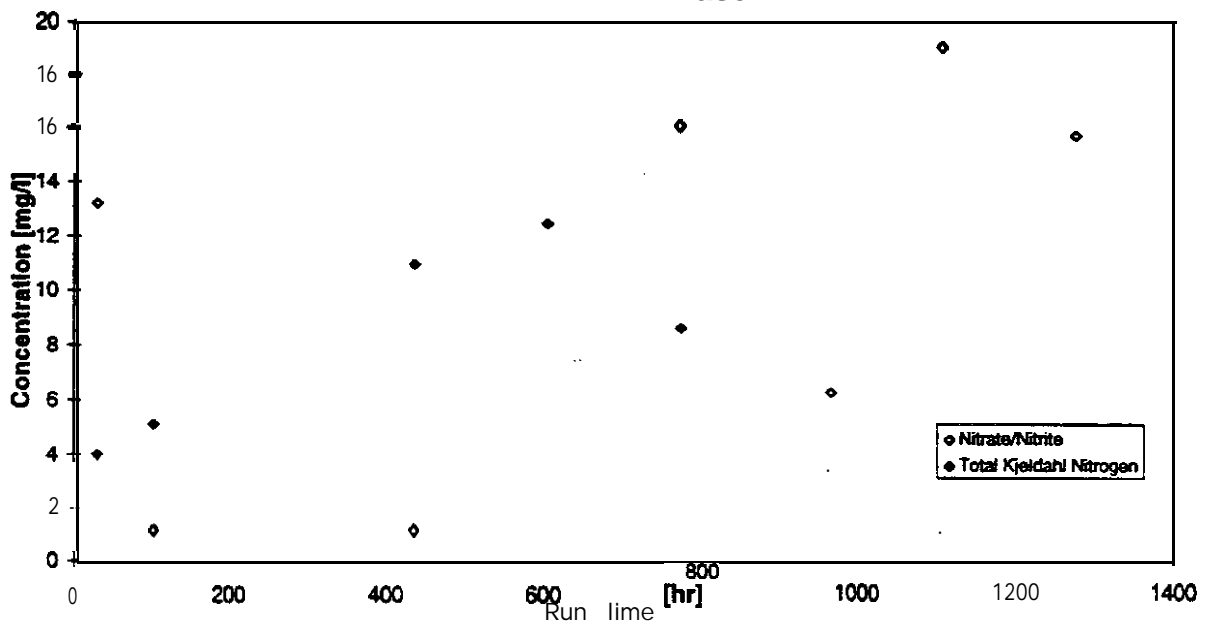


Figure 5.28
 Total Kjeldahl Nitrogen
 ZenoGem - Phase II



5.4.4.3 Conclusions

ZenoGem can treat McAllen's raw wastewater to a quality comparable to the City's existing WWTP effluent more efficiently than the existing WWTP. By operating the activated sludge process at an average mixed liquor volatile suspended solids (MLVSS) concentration of 11,000 mg/L and at solids retention times of 3 to 5 hours, ZenoGem requires only one-tenth the hydraulic retention time, or "footprint," to achieve the same degree of BOD₅ and ammonia removal as the existing WWTP. The WWTP operates with an average MLVSS concentration of 2,333 mg/L and a hydraulic retention time of 29.8 hours. The nitrification rate for the ZenoGem process was 0.26 g NH₃-N/g nitrified volatile suspended solids (NVSS)-day compared to 0.17 g NH₃-N/g NVSS-day for the McAllen WWTP.

5.4.5 ZenoGem Process vs. ZeeWeed MF System

This section compares the operating characteristics of the ZeeWeed membrane used to directly filter secondary effluent to its use as part of the ZenoGem system. Such a comparison allows a determination of (1) the relative economics of ZeeWeed operation under the two treatment scenarios and (2) whether filtrate quality from ZenoGem operation is comparable relative to quality requirements for the RO process.

5.4.5.1 Treatment Economics

Filtrate flow and membrane flux were presented in figures 5.15 and 5.16, respectively, for the ZeeWeed MF system during Phase I and during Phase II. Flow and flux, both control variables during the study, were approximately 67 percent higher for ZeeWeed operation on secondary effluent. Flow and flux were controlled at the indicated levels based on Zenon's experience with their MF process operating on the two different feedstreams. This resulted in the ZeeWeed unit operating at 67 percent higher flux on secondary effluent, translating into a substantially greater capital cost for ZeeWeed for raw wastewater treatment. However, this cost difference could be mitigated by the following factors:

- Where new wastewater and reuse facilities are needed, ZenoGem could be used in place of both primary and secondary treatments as well as MF treatment of the secondary effluent.

Where an existing wastewater treatment plant uses concrete structures for either suspended growth secondary treatment and/or activated sludge clarification, the ZeeWeed modules can be installed directly into these structures (for the ZenoGem process), thereby deferring the cost of building new basins or tanks to house the modules as would be required for ZeeWeed MF of secondary effluent.

Further, the lower rate of membrane fouling experienced during Phase II operation (see figure 5.17) suggests that the ZeeWeed modules can be operated at a higher flux to provided comparable cycle times between chemical cleanings. (Conversely, the modules could be **operated** at lower flux rates when treating secondary effluent to provide comparable cycles.) This would further mitigate capital cost differences.

5.4.5.2 RO Feedwater Quality

Figures 5.19 and 5.20 presented a comparison of filtrate turbidity and **SDI** for ZeeWeed operation during the two phases. Statistical information on these parameters is also presented in table 5.18; data values were excluded for the latter part of Phase I where ZeeWeed filtrate quality was adversely impacted by algal growth in the filtrate piping and sample lines. No turbidity values were collected between July 17 and August 4 (Phase II) because of a malfunction of the **McAllen** WWTP turbidimeter. Filtrate turbidity values were generally comparable for the two phases, with ZenoGem filtrate having a slightly higher mean (0.13 NTU for Phase I versus 0.16 NTU for Phase II.) However, ZenoGem filtrate turbidity levels were consistently lower than the 0.2 NTU RO feedwater criterion. The minimal turbidity difference underscores the ability of the ZeeWeed **membrane** to act as a physical barrier to solids, given that the concentration of solids on the feed side of the membranes averaged 15,000 **mg/L** during Phase II versus 3.6 **mg/L** during Phase I.

In contrast, filtrate **SDI** values for Phase II were significantly and consistently higher than during Phase I. Mean **SDIs** were 5.0 and 2.6, respectively. The data in figure 5.20 show a trend of increasing values for Phase I after 1,000 hours. As discussed previously, however, the increases were caused by increased particle loading from algal growth and sloughing in the filtrate piping and sampling lines and are not considered representative. If values from 1,000 hours onward are excluded, the mean **SDI** for Phase I is 1.6. No trending was evident for Phase II filtrate, hence the mean value of 5.0.

Theoretically, there should be no particles present in the ZenoGem **filtrate** large enough¹ to **cause** fouling of the 0.45- μm nominal pore size **SDI** filter pad. It is hypothesized, **instead**, that the observed differences in **SDI** values is a function of differences in the content and level of large molecular weight, ionized, organic compounds adsorbed onto the **SDI** filter pad causing pore blocking and a reduction in flow through the **SDI** filter. The amount of these compounds appears to be a function of SRT in the ZenoGem bioreactor. Research conducted at Orange County Water District's Water Factory 21 (**WF-21**) and the Sanitation District of Orange County, California, support this hypothesis (**Lozier**, 1997b). **SDIs** greater than 5 were observed during ZenoGem operation on primary effluent when **SRTs** were greater than 5 days.

¹ larger than 0.2 microns in diameter

**Table 5.18.—Water Quality Parameters
ZeeWeed Phase I and ZenoGem Phase II**

Parameter	No. Of Samples		ZeeWeed MF Filtrate (Phase I)			ZenoGem Filtrate (Phase II)		
	ZeeWeed	ZenoGem	Mean	Min	Max	Mean	Min	Max
TDS(mg/L)	4	4	1,216	975	1,410	943	861	1,022
conductivity (us/cm)	63	18	2,027	1,575	2,525	1,532	1,320	1,700
TOC(mg/L)	6	6	7.4	6.7	8.1	7.7	6.6	9.3
Color (color units)	5	6	7.6	0.0	15.0	17.6	10.0	25.0
UV Absorbance @ 254 (l/cm)	12	16	0.120	0.106	0.142	0.14	0.11	0.16
SDS THM (mg/L)	1	2	269.4	269.4	269.4	21.9	21.9	21.9
SDS HAA (mg/L)	1	2	127.0	127.0	127.0	56.7	56.7	56.7
pH (units,	63	59	6.07	6.97	6.36	7.34	6.90	7.77
Turbidity (NTU)	63	62	0.13	0.03	0.57	0.16	0.06	0.36
SDI	41	43	2.55	0.13	6.10	4.99	1.67	6.40
HPC (CFU/ml)	3	6	3,215	400	13,000	6,125	1,500	11,200
Total Coliform (CFU/100 ml)	3	7	6	1	16	7	3	11
Fecal Coliform (CFU/100 ml)	3	7	14	1	44	3	1	7

At the Sanitation District of Orange County, ZenoGem operation on the same primary effluent at **SRTs** less than 5 have produced filtrate **SDIs** less than 2. Additional testing at WF-21 showed that as the SRT was allowed to increase, the **SDI** values increased. Although **SDI** values from ZenoGem operation were greater than the RO feedwater criterion of 3, it is not known if the higher **SDIs** will result in a greater rate of RO membrane fouling. Additional research is necessary to better define (1) the relationship between ZenoGem process operational characteristics (**MLVSS**, **HRT** and **SRT**) and **filtrate SDI**, (2) what compounds present in the ZenoGem and ZeeWeed filtrates are responsible for causing flow reductions in the **SDI** filter, and (3) what correlation **filtrate SDI** values have to actual fouling rates of RO membranes operated on either ZeeWeed or ZenoGem filtrate.

Within the level of accuracy of the analytical method used, total and fecal **coliform** levels in the filtrate were comparable for the two Phases of ZeeWeed operation. Again, positive counts were observed during Phase II. A membrane integrity test was performed following the conclusion of Phase I testing and chemical cleaning to **confirm** that there were no leaky or broken fibers or compromised areas where the fibers are potted into the module heads. To check integrity, the process tank was filled with potable water and compressed air was applied to the interior of the fibers. No air bubbles were observed in the tank that would signal a compromise of the membranes or potted areas. Consequently, a firm conclusion cannot be drawn regarding the presence of low numbers of coliforms in the ZeeWeed filtrate during both test phases. Possible causes include sample contamination and growth of coliforms within the filtrate piping and sampling system (filtrate was not disinfected during either phase of operation).

5.4.6 ZenoGem Process vs. Memcor MF System

Filtrate characteristics of the ZenoGem process and Memcor system were compared based on results obtained during Phase II relative to RO feedwater requirements and for other selected water quality parameters. A similar comparison was described earlier in this report for ZeeWeed and Memcor systems based on Phase I testing.

The water quality parameters for the effluent from Memcor MF system were nearly equal during Phase I and Phase II testing. Therefore, it is considered appropriate to directly compare results for the ZenoGem process to the Memcor MF system Phase II results. Table 5.19 presents the Memcor MF system and ZenoGem process water quality parameters and the results obtained during Phase II testing. These parameters are discussed below:

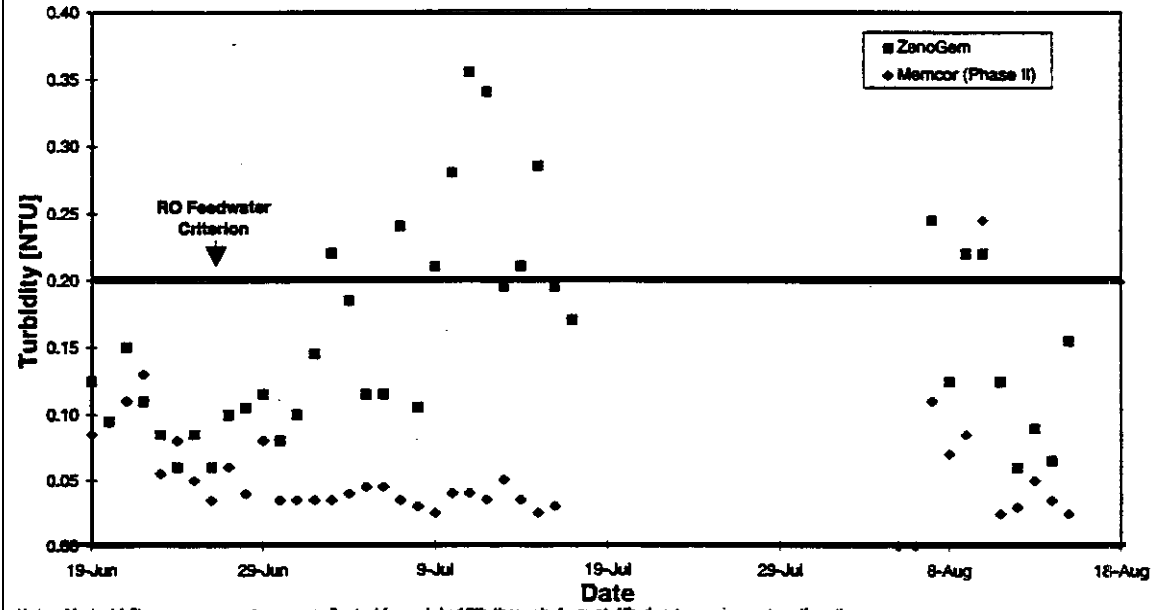
Table 5.19.—Water Quality Parameters
ZenoGem Process and Memcor MF System • Phase II

Parameter	No. of Samples		ZenoGem Filtrate			Memcor MF Filtrate		
	ZeeWeed	Memcor	Mean	Min	Max	Mean	Min	Max
TDS (mg/L)	4	2	943	881	1,022	1,139	977	1,411
Conductivity (μ S/cm)	18	58	1,532	1,320	1,700	1,789	755	2,410
TOC (mg/L)	8	9	7.7	6.6	9.3	6.9	5.3	8.1
Color (color units)	8	9	17.8	10.0	25.0	9.6	0	20.0
UV Absorbance @ 254 (1/cm)	16	17	0.14	0.11	0.18	0.11	0.09	0.14
THM (mg/L)	2	2	21.9	21.9	21.9	317.4	310.3	324.4
HAA (mg/L)	2	2	56.7	56.7	56.7	129.5	128.3	130.6
pH ("nits)	59	58	7.34	6.90	7.77	7.09	6.86	8.16
TSS (mg/L)	8	9	0.57	0.20	1.00	0.30	ND ¹	1.00
Turbidity (NTU)	82	78	0.16	0.06	0.36	0.10	ND	0.53
SDI	43	40	4.99	1.67	6.40	2.11	0.40	7.60
HPC (CFU/ml)	8	7	6,125	1,500	11,200	3516	264	12,000
Total Coliform (CFU/100 ml)	7	7	7	3	11	5	ND	15
Fecal Coliform (CFU/100 ml)	7	7	3	1	7	ND	ND	ND

¹ ND-Not Detected

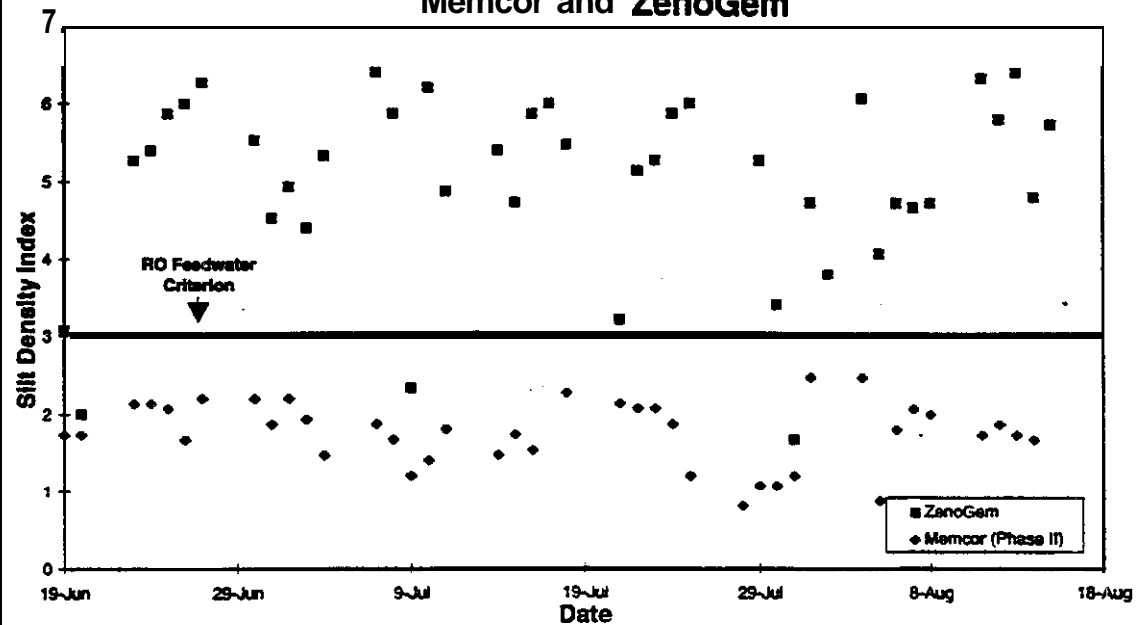
Turbidity and SDI. Figures 5.29 and 5.30 present filtrate turbidity and SDI for the Memcor MF system and the ZenoGem process for Phase II. No turbidity values were collected between July 18 and August 4 because of a malfunction of the McAllen WWTP turbidimeter. Filtrate turbidity for ZenoGem was greater than for Memcor but still averaged below the RO feedwater criterion. As discussed in section 5.4.5.2 which compared ZeeWeed Phase I and ZenoGem filtrate SDI results, filtrate SDI values during Phase I were significantly greater for ZenoGem than for the ZeeWeed system. Mean SDI for ZenoGem was 5.0 versus 2.1 for Memcor during Phase II.

Figure 5.29
Phase II Filtrate Turbidity
Memcor and ZenoGem



Note: No turbidity measurements were collected from July 18th through August 4th due to equipment malfunction.

Figure 5.30
Phase II Filtrate SDI
Memcor and ZenoGem



In general, discussions regarding comparison of filtrate quality for ZeeWeed MF operation on secondary effluent and ZenoGem operation are relevant here.

5.5 MF System Water Quality vs. Source Water Quality

The primary goal of IPR is to produce an effluent that is equivalent to or better than the quality of the raw water supply which it will supplement. Table 5.20 presents data for selected parameters of the source water that were also monitored in the three filtrate streams evaluated during this testing (Memcor filtrate, ZeeWeed filtrate, and ZenoGem filtrate). Table 5.21 presents particle count data that were obtained during the study. Counts in the size range greater than 10 to 15 microns were not measured. The following can be concluded from an examination of the data in tables 5.20 and 5.21:

MF treatment, in any form evaluated, is not capable of reducing the levels of dissolved parameters to match those present in McAllen's current raw water supply (source water). MF treatment has no effect on dissolved constituents and, hence, some other treatment process will be needed to provide the necessary reduction in TDS, TOC, UVA-354, and compounds responsible for the formation of THMs and HAAs. As described in section 1.0, this process will be reverse osmosis.

Although a measure of dissolved constituent, pH does not require additional treatment to be acceptable. (RO will reduce pH, however.)

All MF technologies evaluated can reduce turbidity and SDI to significantly lower levels than measured in the source water.

All MF technologies can produce filtrates with coliform characteristics similar to that of the source water. None appears capable of reducing HPCs to levels present in the source water, however. Again, additional and substantial reduction in these bacterial measurements can be anticipated with RO treatment of the MF filtrate.

Particle counts in the filtrate from all three MF systems are significantly lower than counts in the source water. Filtrate counts, however, were higher than what was anticipated. Other studies where Memcor and ZeeWeed technologies are used to treat surface water supplies to directly produce drinking water typically have particle counts of less than 5 per ml where care is taken to remove air bubbles from the stream prior to measurement. The higher counts observed in this study are attributed to (1) sample contamination caused by particle sloughing from growth in the filtrate piping and, sample tubing, and (2) entrained air in the samples not removed prior to introduction into the counter sensor.

Table 5.20.—RO Feedwater Quality Parameters
ZeeWeed and Memcor Phases I and II

Parameter	Average Result				Units
	Source Water ¹	Memcor Phase I and II Filtrate	ZeeWeed Filtrate Phase I	ZenoGem Filtrate Phase II	
Inorganics					
UV-254	0.102	0.11	0.120	0.14	1/cm
TDS	746	1,139	1,216	943	mg/l
TOC	3.8	6.9	7.4	7.7	mg/l
SDS HAAs	65	129.5	127	56.7	µg/l
SDS THMs	226	317.4	289.4	21.9	µg/l
pH	8.1	7.09	8.07	7.34	Units
Turbidity	14.6	0.10	0.13	0.16	NTU
Silt Density Index	15.1	2.11	2.55	4.99	unitless
Total Coliform	20	5	8	7	CFU/100 ml
Fecal Coliform	5	ND	14	3	CFU/100 ml
HPC	1150	3,516	3,215	6,125	CFU/ml

¹ Based on an average of two samples.

Table 5.21.—Source Water and Filtrate Particle Counts Phase I and Phase II

Particle Size (microns)	Average Particle Count			
	Source Water	Memcor Phases I and II Filtrate	ZeeWeed Phase I Filtrate	ZenoGem Phase II Filtrate
2.0 to 3.0	1128	49.2	65.0	34.5
3.0 to 5.0	5378	80.3	117.3	51.5
5.0 to 8.0	8037	63.4	127.0	30.1
8.0 to 10.0	3105	26.9	106.7	19.6
10.0 to 15.0	2526	Not Measured	Not Measured	Not Measured
> 15.0	686	Not Measured	Not Measured	Not Measured
Total ¹	17,648	219.8	416	135.7

¹ All particles from 2.0 to 8.0 microns in diameter.

6. COST ESTIMATES FOR IPR USING LIME AND MICROFILTRATION TREATMENT

This section presents cost estimates for advanced treatment systems to provide 6.8 mgd (25.7 ML/day) of reclaimed water that would serve as a supplemental source of raw water for the City of McAllen's drinking water supply. Cost estimates were developed for the following two alternative approaches to treating secondary effluent from the City's SWWTP to a quality suitable for discharge to a new raw water storage reservoir:

High-pH lime clarification, recarbonation, high-rate gravity filtration and RO and ultraviolet light (UV) disinfection.

Memcor MF, RO, and UV disinfection.

As presented above, both alternatives incorporate RO and UV disinfection. High-pH lime clarification was selected because it is the traditional method of clarification of secondary effluent prior to RO treatment and has been in use for this purpose since 1977, as described in section 1 of this report.

6.1 Cost Assumptions

Figures 6.1 and 6.2 present flow schematics for integrated IPR treatment systems using these process alternatives.

The cost estimates were prepared at an order-of-magnitude level, which is defined by the American Association of Cost Engineers as an approximate estimate made without detailed engineering data. The estimates were prepared to provide a relative cost comparison of the alternatives and are based on information available at the time; final costs for each of the alternatives will depend on actual labor and material costs, market conditions, project scope, implementation schedule, and other factors and will differ from the estimates presented. All costs are presented in present day dollars. Total annual unit costs are based on a product water flow of 6 mgd.

RO recovery is assumed to be 85 percent for each system, therefore, 15 percent of the RO inflow must be disposed. No costs for disposal have been included in these estimates. However, this cost can be substantial if mechanical evaporation is used. The cost for mechanical evaporation can nearly equal the cost for the liquid-side treatment facility. Costs for the chemical sludge generated by the lime/RO system have been reflected in the cost estimate.

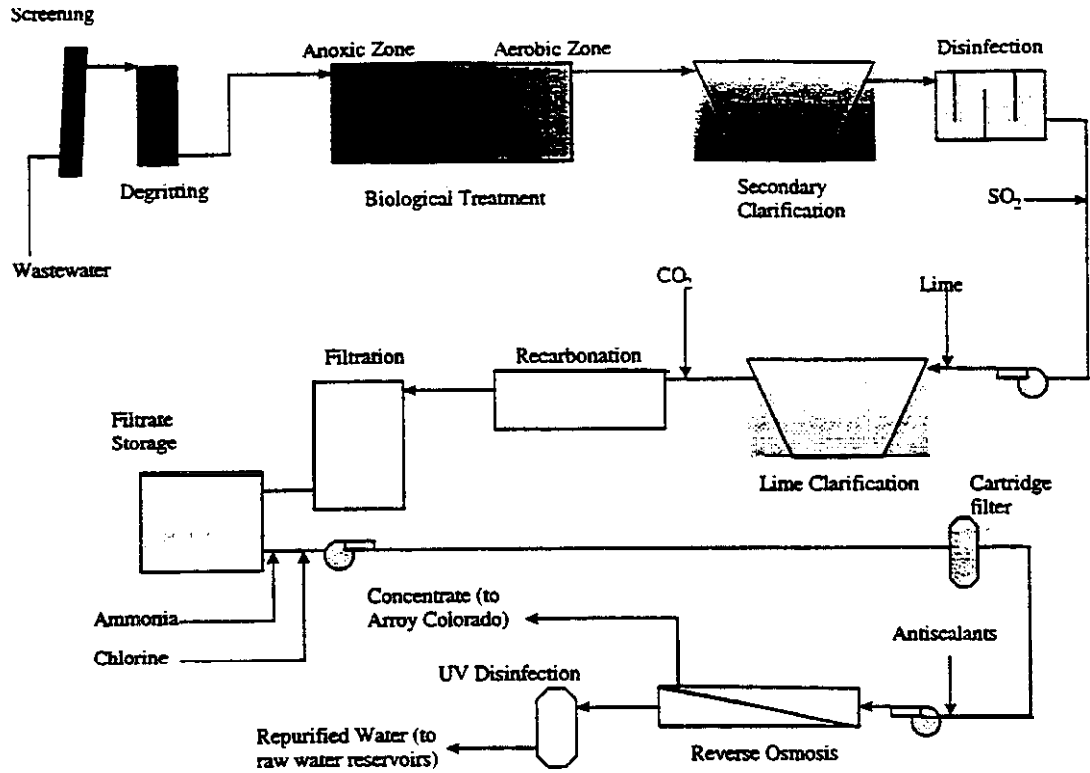


Figure 6.1. Process Flow Diagram for Lime-based IPR Treatment System

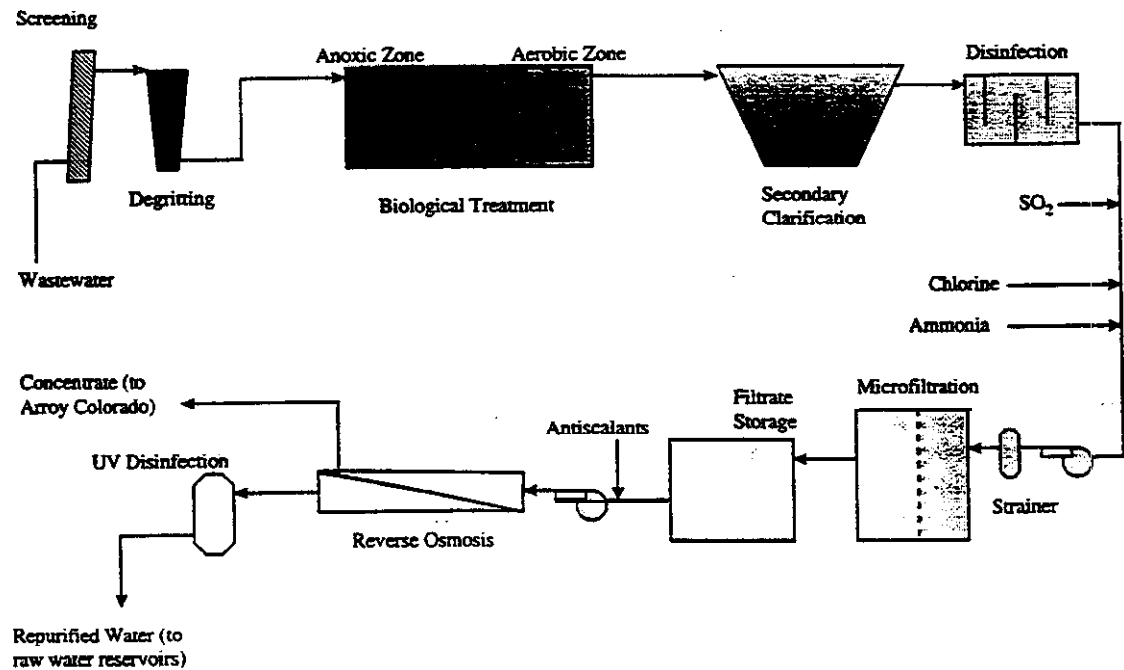


Figure 6-2. Process Flow Diagram for W-based IPR Treatment System.

6.2 Cost Estimates

Estimates were prepared for the following cost categories:

Installed equipment, total construction, total capital, total unit capital, and amortized capital

Total operation and maintenance (O&M), total O&M unit

Total annual and total annual unit

Table 6.1 presents the cost estimates for the two alternatives. The table also lists the fundamental **assumptions** necessary to develop design and O&M criteria for each unit operation and process. **CH2M HILL** and third party reference materials that were used, where appropriate, in developing the estimates are also shown in the Table 6.1.

The estimates indicate that the MF-based alternative has a slightly greater estimated capital cost, but a significantly lower estimated **O&M** cost relative to the lime-based alternative. As a result, the estimated total annual cost for the MF-based alternative is approximately 10 percent lower than for the lime-based alternative. Within the accuracy of the estimating method, this difference is not considered significant. However, it does indicate that **MF-based** IPR treatment is cost-competitive with **lime-based** treatment, if not potentially cheaper. The MF process is much simpler to operate and requires significantly less chemical handling and chemical sludge disposal.

6.3 ZeeWeed/ZenoGem Costs

Costs are not presented for a ZeeWeed MF system because they were not included in the Scope of the Original Proposal. In order to compare Memcor and ZeeWeed MF systems on a cost basis, the following items would need to be addressed:

Major process equipment for each system

Building area requirements

MF feedwater screening

MF feedwater disinfection (chlorine and ammonia for Memcor, possibly nothing for ZeeWeed)

Although costs were not developed for the ZeeWeed system, capital costs for the ZeeWeed unit are estimated to be higher when the system is operated on raw wastewater (Phase II) as opposed to secondary effluent (Phase I). This is due to the ZeeWeed unit operating at a higher flux on secondary effluent during the study. However, this cost difference is mitigated by the following factors:

Table 6-1.				
Order-of Magnitude Cost Estimates for Lime- and MF-based Treatment Alternatives				
	MF-based Alternative	Lime-based Alternative	Fundamental Assumptions	Cost Reference
CAPITAL COST OPINION				
Unit Process Component Installed Cost				
WWTP BNR Retrofit	\$2,000,000	\$2,000,000	10 mgd, baffle addition, anoxic mixers, 6:1 recycle pumping	SDA BNR Manual pp. 51-59
Lime Influent Pumping		\$170,000	3-3.825 mgd pumps @ 15 psig	West Basin Sch. of Values
Lime Clarification		\$1,000,000	2-3.825 mgd clarifiers, 1 gpm/sf SOR, 2 thickeners	IDI Densadeg Quote
Hydrated Lime Storage & Feed		\$220,000	7.25 mgd, 300 mg/l lime dose	EPA Est. WTP Costs p. 53
Polymer Storage & Feed		\$80,000	7.25 mgd, 5 mg/l polymer dose	EPA Est. WTP Costs p. 53
Unthickened Lime Sludge Pumping		\$105,000	2.2 lb solids/lb lime, 2% solids, 168 gpm	EPA Est. WTP Costs p. 351
Lime Sludge Gravity Thickening		\$340,000	40,000 lb solids/d, 20 lb/s/d SLR, 2 thickeners	EPA Est. WTP Costs p. 370
Thickened Lime Sludge Pumping		\$20,000	8% solids, 42 gpm	EPA Est. WTP Costs p. 363
Thickener Decant Pumping		\$30,000	168 gpm @ 15 psig	EPA Est. WTP Costs p. 239
Lime Sludge Drying Beds		\$525,000	10 drying cycles/yr, 2 ft. bed thickness, 2 acres	EPA Est. WTP Costs p. 414
Recarbonation Basins		\$480,000	7.25 mgd, 10 minute detention, 2 basins	Jonathan Rogers WTP Bid, West Basin Sch. of Values
Carbon Dioxide Storage & Feed		Included in above	7.25 mgd, 100 mg/l carbon dioxide dose	Jonathan Rogers WTP Bid, West Basin Sch. of Values
Granular Media Filtration		\$1,920,000	7.25 mgd, 4 gpm/sf SLF, 4-420 sf filters	Jonathan Rogers WTP Bid, West Basin Sch. of Values
Filter Backwash Recovery System		\$200,000	4-filter backwash volumes, 20 gpm/sf for 10 minutes, decant recycle, underflow to lime thickeners	IDI Densadeg Quote
Sodium Hypochlorite Storage & Feed	\$220,000	\$220,000	8 mgd, 3 mg/l dose	Central Wyoming Prelim. Engr. Estimate
Aqua Ammonia Storage & Feed	\$35,000	\$35,000	8 mgd, 1 mg/l dose	EPA Est. WTP Costs p. 95
MF Influent Pumping	\$554,000		3.4 mgd pumps @ 45 psig	West Basin Sch. of Values
MF Pre-screening	\$120,000		3.4 mgd self-backwashing units	S.P. Kinney Quote
MF System	\$4,540,000		2 trains of 4-90M10C units, 0.45 gpm/m ² flux, 90% recovery	Memcor Quotes
MF Building	\$710,000		1 sf per kgal product capacity	\$100/sf bldg.
MF Backwash Recovery System	\$280,000		0.75 mgd clarification system, underflow to existing solids handling	IDI Densadeg Quote
Filtrate Storage	\$1,200,000	\$1,200,000	7.1 mgd, 4 hour detention	Jonathan Rogers WTP Bid, West Basin Sch. of Values
RO System & Building ¹	\$4,850,000	\$4,850,000	3.2 mgd trains, 10.4 gpd flux, 85% recovery, PA membranes, feed pressure 225 psig	West Basin Sch. of Values
UV Disinfection System	\$1,400,000	\$1,400,000	2-3 mgd channels, 80% UV transmittance, 120,000 uW-s/cm ² UV dose, UV lamp intensity = 5,145 uW/cm ² , 24 s detention, 1,668 gal, 2 gal/temp, 894 lamps, 0.25kV/amp	SAWPA RIX Prelim. Engr. Estimate
Installed Costs Subtotal	\$15,889,000	\$14,795,000		
Unit Process Noncomponent Costs				
Yard Piping Allowance (10%)	\$1,588,900	\$1,479,500		
Site Electrical Allowance (8%)	\$1,271,120	\$1,183,600		
Site I&C Allowance (5%)	\$794,450	\$739,750		
Site Civil Allowance (5%)	\$794,450	\$739,750		
Unit Process Subtotal	\$20,337,920	\$18,937,600		
Contingency (20%)	\$4,067,584	\$3,787,520		
Contractor Overhead & Mark-Up (10%)	\$2,033,792	\$1,893,760		
Total Construction Cost	\$26,439,296	\$24,618,880		
Engineering & Administration (15%)	\$3,965,894	\$3,692,832		
Total Capital Cost	\$30,405,190	\$28,311,712		
Total Capital Unit Cost	\$5.07	\$4.72		
Amortized Capital Cost (20 yr @ 7%)	\$2,979,256	\$2,672,628		

Table 6-1.

Order-of Magnitude Cost Estimates for Lime- and MF-based Treatment Alternatives

ANNUAL O&M COST OPINION	MF-based Alternative	Lime-based Alternative	Fundamental Assumptions	Cost Reference
Major Chemical Costs				
Lime		\$331,000	\$100/ton	
Polymer		\$83,000	\$1,500/ton	
Carbon Dioxide		\$110,000	\$100/ton	
Sodium Hypochlorite	\$44,000	\$39,000	\$1,200/ton	
Ammonia	\$2,400	\$2,100	\$200/ton	
Scale Inhibitor	\$97,000		\$3,000/ton, 3 mg/l dose	
Major Power Costs				
			\$0.06/kwh	
BNR Anoxic Zone Mixing	\$49,000	\$49,000	6 hr detention, 50 HP/MG Basin	
BNR Recycle Pumping	\$31,000	\$31,000	3:1 Ratio = 30 mgd @ 10 ft. TDH	
Lime Influent Pumping		\$26,000		
MF Influent Pumping	\$85,000			
RO Influent Pumping	\$378,000	\$508,000	Additional 80 psig feed pressure for Lime/RO compared to MF/RO	
UV Disinfection	\$12,000	\$12,000		
Major Membrane Maintenance Costs				
Membrane Cleaning Costs	\$22,000	\$25,000	\$0.03/kgal for MF/RO; \$0.03/kgal for Lime/RO	
Cartridge Filter Replacement		\$18,000	12 per year, 5 gpm/cartridge, \$1.35/cartridge	
MF Membrane Replacement	\$94,000		Replacement frequency 5 yrs, \$850/module	
RO Membrane Replacement	\$198,000	\$245,000	Replacement frequency: 5 yrs MF/RO, 4 yrs Lime/RO; \$850/element, 500 sf/element	
UV Lamp Replacement	\$7,000	\$7,000	Replacement frequency 5 yrs, \$41/lamp	
Lime Sludge Disposal		\$230,000	\$31.5 per dry ton	
Additional Labor Requirement	\$32,000	\$63,000	3 FTE for Lime/RO, 1.5 FTE for MF/RO at \$21,000/FTE	
Annual General Maintenance Costs	\$304,052	\$283,117	1% of total capital cost	
Total Annual O&M Cost	\$1,351,462	\$2,101,217		
Total Annual O&M Unit Cost	\$0.62	\$0.66		
Total Annual Cost	\$4,221,702	\$4,773,643		
Total Annual Unit Cost	\$1.93	\$2.16	Based on 6 MGD product water flow	

Costs do not include admin./operation/maintenance bldgs., RO concentrate piping.

¹ Includes building leadwater chem. conditioning, cartridge filtration, high pressure pumps, vessels/piping, cleaning system, product water stabilization, and controls.

ZenoGem could be used in place of both primary and secondary treatment systems as well as for MF treatment of the secondary effluent.

ZeeWeed modules could be installed directly into existing concrete structures for the **ZenoGem** process, deferring the cost of new tanks which would be required for the ZeeWeed MF unit if treating only secondary effluent.

The lower rate of membrane fouling experienced during Phase II, suggests that the ZeeWeed modules may be capable of operating at a higher flux to provide comparable cycle times between chemical cleanings.

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Appendix A. Photographs of Pilot Plant
Facilities and Associated Equipment

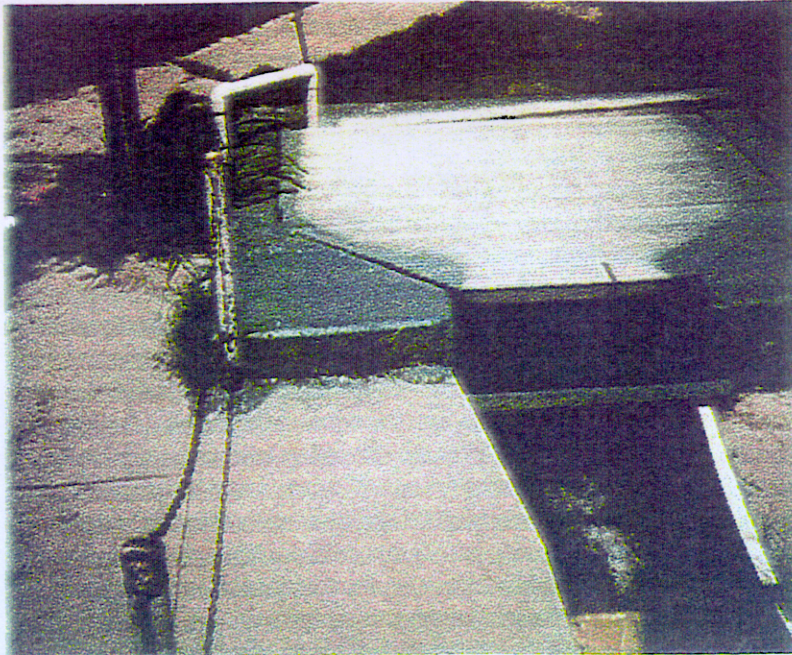


Exhibit A-1. Extraction point for disinfected, dechlorinated effluent.

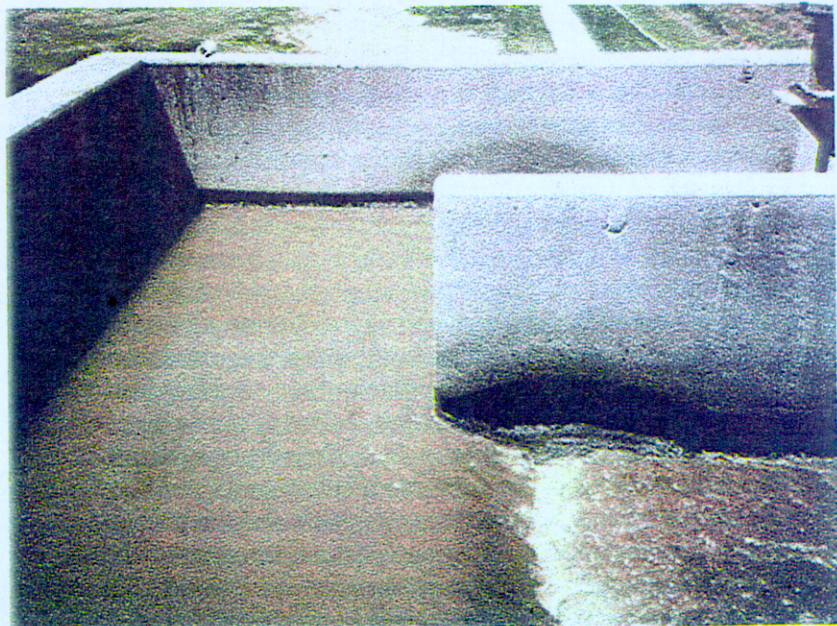


Exhibit A-2. Extraction point for screened, de-gritted wastewater splitter box.

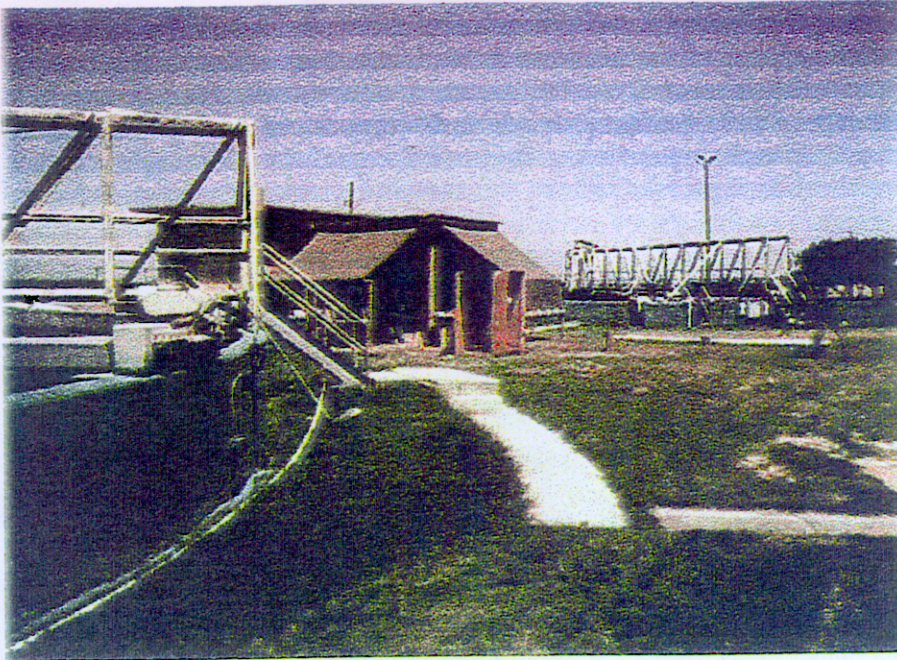


Exhibit A-3. Location of Pilot Plant (located between secondary clarifiers).

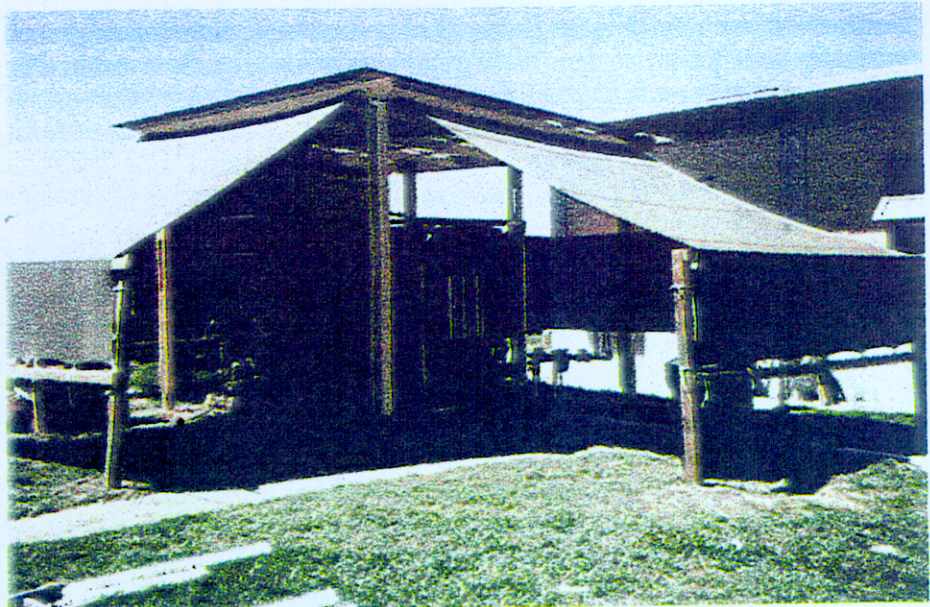


Exhibit A-4. Pilot plant facility (located to the east of sludge pump house).

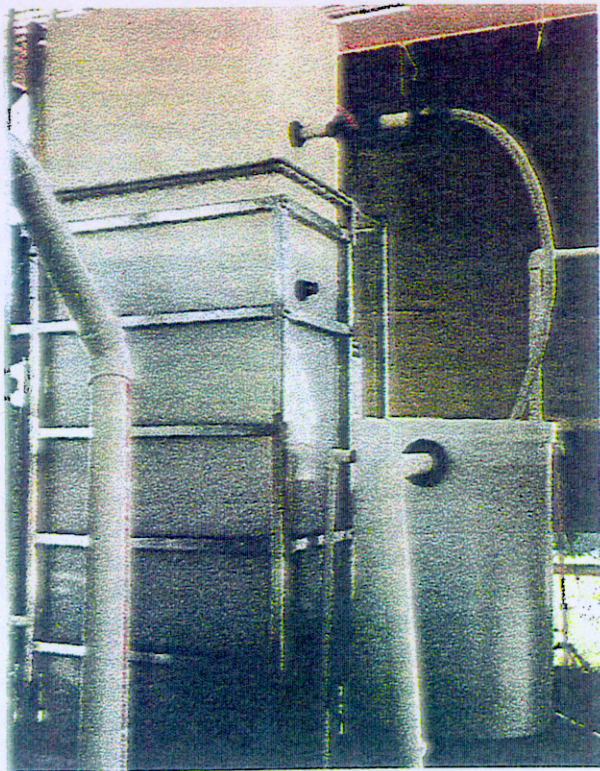


Exhibit A-5. Feed and process tanks for Zeeweed MSTD 2W-4 MF unit.

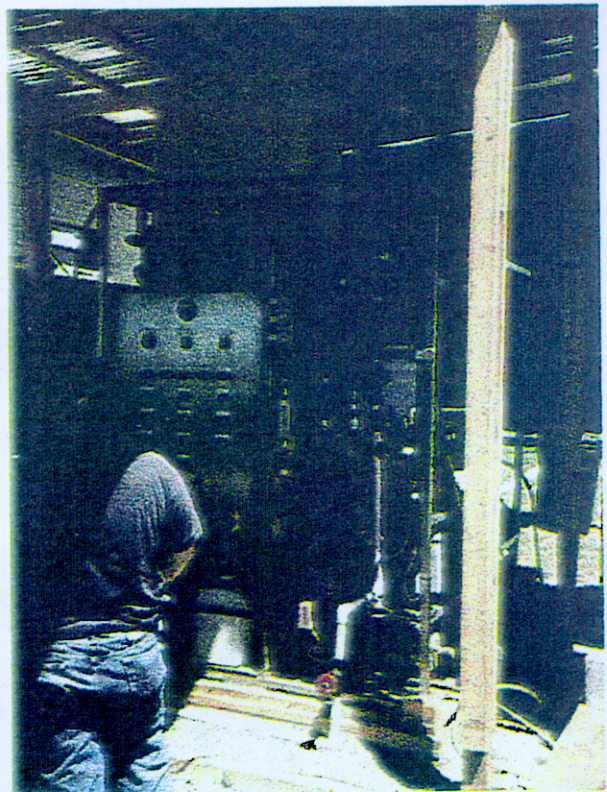


Exhibit A-6. Panel-side view of Zeeweed MSTD 2W-4 MF unit (field technician in foreground).

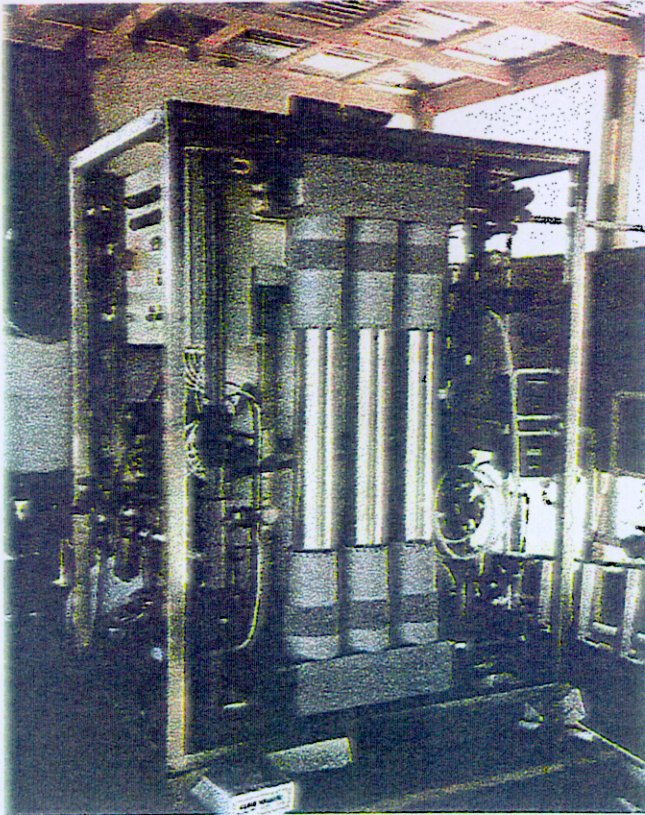


Exhibit A-7. Memcor 3M10C unit showing membrane modules.



Exhibit A-8. Extended basins at McAllen WWTP.

Appendix B. Phase I and Phase II
Operating and Water Quality Data

**TABLE B-1
OPERATING DATA
MEMCOR - PHASES I AND II**

Date & Time	Recorded Data										Calculated Data		
	Cumulative Operating Time [hrs]	Hour Run Meter	Feed Pressure [psl]	Recirculation Pressure [psl]	Filtrate Pressure [psl]	· TMP [psl]	Feed Flow [gpm]	Filtrate Flow [gpm]	Totalized* Filtrate Flow [gal]	Flow Totalizer	Water Temperature [°F]	Flux [gpd/ft ²]	Recovery %
Thu 4/10/97 8:45		4,269.1	22.2	20	17.1	5.1	19.5	19.5			70	25.97	90.70
Mon 4/14/97 9:00	91.50	4,360.6	25.9	23.7	12.2	13.7	19.2	19.2	105,408	11,302	56	25.57	90.57
Mon 4/14/97 13:30	95.80	4,364.9	25.8	23.5	11.8	14.0	18.8	18.8	110,258	11,762	64	25.03	90.38
Tue 4/15/97 10:00	111.40	4,380.5	26.0	22.8	10.5	15.5	19.0	19.0	128,042	13,983	60	25.30	90.48
Tue 4/15/97 13:30	118.90	4,388.0	25.9	22.6	10.9	15.0	19.4	19.4	136,772	14,310	73	25.83	90.65
Wed 4/16/97 8:30	137.30	4,406.4	27.4	24.1	11.4	16.0	19.8	19.8	158,632	16,352	72	26.37	90.83
Wed 4/16/97 13:30	143.00	4,412.1	26.0	22.7	11.0	15.0	19.6	19.6	165,335	16,875	73	26.10	90.74
Thu 4/17/97 8:15	160.30	4,429.4	27.3	22.3	11.5	15.8	20.0	20.0	186,095	18,856	74	26.63	90.91
Thu 4/17/97 13:30	165.90	4,435.0	27.6	22.3	11.6	16.0	20.0	20.0	192,815	19,426	74	26.63	90.91
Fri 4/18/97 8:00	183.30	4,452.4	27.8	22.5	16.0	16.8	20.3	20.3	214,008	21,371	62	27.03	91.03
Fri 4/18/97 13:45	185.20	4,454.3	26.1	21.1	10.7	15.4	19.8	19.8	216,265	21,579	74	26.37	90.83
Sat 4/19/97 8:30	203.90	4,473.0	27.4	22.1	10.8	16.6	20.0	20.0	238,705	23,564	73	26.63	90.91
Sat 4/19/97 12:35	207.30	4,476.4	25.9	20.7	10.2	15.7	19.3	19.3	242,842	23,970	76	25.70	90.61
Sun 4/20/97 8:00	226.20	4,495.3	27.8	22.4	11.1	16.7	20.3	20.3	265,663	26,045	76	27.03	91.03
Sun 4/20/97 12:30	230.90	4,500.0	28.3	21.5	10.4	15.9	19.9	19.9	271,274	26,513	78	26.50	90.87
Mon 4/21/97 8:00	249.80	4,519.0	27.3	22.7	10.8	16.5	20.1	20.1	294,188	28,636	75	26.77	90.95
Mon 4/21/97 14:00	255.10	4,524.2	25.4	20.6	10.1	15.3	19.5	19.5	300,272	29,214	82	25.97	90.70
Tue 4/22/97 9:30	274.20	4,543.3	26.3	21.6	10.1	16.2	19.2	19.2	322,276	31,288	78	25.57	90.57
Tue 4/22/97 13:30	277.90	4,547.0	25.4	20.5	8.6	16.8	18.3	18.3	326,338	31,682	85	24.37	90.15
Wed 4/23/97 8:45	296.90	4,566.0	27.7	23.2	10.7	17.0	18.8	18.8	347,770	33,584	74	25.03	90.38
Wed 4/23/97 13:45	301.30	4,570.4	21.2	21.7	9.0	17.2	18.0	18.0	352,522	34,053	80	23.97	90.00
Thu 4/24/97 9:00	319.70	4,588.8	27.7	23.3	10.5	17.2	16.5	16.5	370,738	35,860	74	21.97	89.19
Thu 4/24/97 15:20	325.20	4,594.3	26.0	21.6	10.0	16.0	17.3	17.3	376,447	36,255	78	23.04	89.64
Fri 4/25/97 8:00	325.20								376,447				
Fri 4/25/97 14:30	325.20								376,447				
Sat 4/26/97 8:00	346.20	4,615.3	27.8	23.5	15.9	11.9	16.7	16.7	5,000,978	37,991	74	22.24	89.30
Sat 4/26/97 12:30	350.90	4,620.0	25.3	21.1	14.0	11.3	16.0	16.0	5,005,490	38,396	77	21.31	88.89
Sun 4/27/97 8:30	370.00	4,639.1	28.0	23.6	15.3	13.3	17.1	17.1	5,025,086	40,226	71	22.77	89.53
Sun 4/27/97 12:30	373.60	4,642.7	25.1	21.2	13.6	12.5	18.0	18.0	5,028,974	40,572	72	23.97	90.00
Mon 4/28/97 8:00	392.90	4,662.0	28.0	23.3	15.4	12.6	16.6	16.6	5,048,197	42,408	68	22.11	89.25
Mon 4/28/97 13:00	397.90	4,667.0	25.4	21.1	13.3	12.1	16.2	16.2	5,053,057	42,858	80	21.57	89.01
Tue 4/29/97 9:00	416.90	4,686.0	26.2	22.0	11.6	14.6	16.3	16.3	5,071,639	44,652	73	21.71	89.07
Wed 4/30/97 8:30	435.20	4,704.3	25.7	22.0	14.7	11.0	16.3	16.3	5,089,537	46,362	76	21.71	89.07
Wed 4/30/97 14:00	443.10	4,712.2	26.9	22.9	16.1	10.8	16.6	16.6	5,097,405	46,842	80	22.11	89.25
Thu 5/1/97 8:00	460.90	4,730.0	27.7	23.8	17.0	10.7	16.6	16.6	5,115,134	48,433	77	22.11	89.25
Thu 5/1/97 14:00	466.20	4,735.3	25.1	21.5	14.9	10.2	16.1	16.1	5,120,254	48,966	81	21.44	88.95
Fri 5/2/97 8:30	484.90	4,754.0	25.5	21.8	15.1	10.4	16.0	16.0	5,138,206	50,665	79	21.31	88.89
Fri 5/2/97 13:30	489.20	4,758.3	26.1	22.2	15.5	10.6	16.5	16.5	5,142,463	51,096	82	21.97	89.19
Sat 5/3/97 8:30	507.70	4,776.8	27.8	23.7	16.4	11.4	16.8	16.8	5,161,111	52,801	70	22.37	89.36
Sat 5/3/97 11:30	512.10	4,781.2	25.9	22.0	15.2	10.7	16.1	16.1	5,165,361	53,029	76	21.44	88.95
Sun 5/4/97 8:00	530.90	4,800.0	27.9	24.0	16.3	11.6	16.5	16.5	5,183,973	54,862	74	21.97	89.19
Sun 5/4/97 12:30	534.90	4,804.0	24.8	21.0	14.2	10.6	16.0	16.0	5,187,813	55,237	79	21.31	88.89

APP-5

**TABLE B-1
OPERATING DATA
MEMCOR - PHASES I AND II**

Date & Time	Cumulative Operating Time [hrs]	Hour Run Meter	Feed Pressure [psi]	Recirculation Pressure [psi]	Filtrate Pressure [psi]	Feed Flow TMP [psi] [gpm]	Filtrate Flow [gpm]	Totalized* Filtrate Flow [gal]	Flow Totalizer	Water Temperature [°F]	Flux [gpd/ft ²]	Recovery %
Mon 5/5/97 7:30	553.20	4,822.3	28.2	24.6	16.3	11.9	16.5	5,205,930	56,958	73	21.97	89.19
Mon 5/5/97 13:30	558.90	4,828.0	27.5	23.6	15.8	11.7	16.9	5,211,710	57,473	79	22.50	89.42
Tue 5/6/97 7:30	576.90	4,846.0	28.1	24.5	16.3	11.8	16.5	5,229,530	59,084	76	21.97	89.19
Tue 5/8/97 13:30	586.90	4,858.0	25.2	21.3	13.8	11.4	16.0	5,239,130	59,570	80	21.31	88.89
Wed 5/7/97 8:00	600.10	4,869.2	26.5	22.6	14.9	11.6	16.6	5,252,277	61,220	78	22.11	89.25
Wed 5/7/97 14:00	605.90	4,875.0	26.9	23.0	15.2	11.7	16.7	5,258,089	61,708	86	22.24	89.30
Thu 5/8/97 7:30	622.90	4,892.0	27.5	23.7	15.4	12.1	16.7	5,275,123	63,277	76	22.24	89.30
Thu 5/8/97 14:00	628.90	4,898.0	28.1	24.2	16.1	12.0	16.8	5,281,171	63,834	81	22.37	89.36
Fri 5/9/97 7:30	646.00	4,915.1	26.1	22.4	14.6	11.5	15.9	5,297,484	65,371	79	21.17	88.83
Fri 5/9/97 13:00	651.20	4,920.3	27.6	23.7	15.7	11.9	16.6	5,302,663	65,839	82	22.11	89.25
Sat 5/10/97 7:30	670.50	4,939.6	28.1	23.9	15.1	13.0	16.6	5,321,539	67,552	79	21.71	89.07
Sat 5/10/97 13:10	675.50	4,944.6	25.6	22.0	13.2	12.4	15.2	5,326,099	68,013	74	20.24	88.37
Sun 5/11/97 7:30	692.20	4,961.3	28.0	24.0	14.0	13.3	16.1	5,342,231	69,508	71	21.44	88.95
Sun 5/11/97 13:30	697.60	4,966.7	25.7	21.9	13.3	12.4	15.2	5,347,156	69,955	78	20.24	88.37
Mon 5/12/97 8:00	716.30	4,985.4	26.0	23.9	14.6	13.7	16.1	5,365,220	71,628	75	21.44	88.95
Mon 5/12/97 13:30	721.40	4,990.5	25.4	21.5	12.9	12.5	16.0	5,370,116	72,070	80	21.31	88.89
Tue 5/13/97 7:30	721.40							5,370,116				
Tue 5/13/97 13:30	721.40							5,370,116				
Wed 5/14/97 8:00	747.60	5,016.7	27.7	24.4	19.4	8.3	17.7	10,697,851	74,382	78	23.57	89.85
Wed 5/14/97 13:04	751.40	5,020.5	25.7	22.4	18.0	7.7	16.4	10,701,590	74,732		21.84	89.13
Thu 5/15/97 8:00	769.50	5,038.6	26.0	23.2	18.2	7.8	16.5	10,719,509	76,415	79	21.97	89.19
Thu 5/15/97 13:00	774.30	5,043.4	25.6	22.1	17.7	7.9	16.5	10,724,261	76,820	82	21.97	89.19
Fri 5/16/97 8:00	792.70	5,061.8	27.6	24.1	19.7	8.1	16.5	10,742,477	78,559	79	21.97	89.19
Fri 5/16/97 13:00	797.60	5,066.7	25.2	21.7	17.0	8.2	16.4	10,747,299	79,012	80	21.84	89.13
Sat 5/17/97 8:00	815.70	5,084.8	27.6	23.7	19.3	8.3	16.1	10,764,784	80,648	82	21.44	88.95
Sat 5/17/97 14:00	820.90	5,090.0	25.4	21.7	17.5	7.9	16.5	10,769,932	81,124		21.97	89.19
Sun 5/18/97 8:00	838.50	5,107.6	27.9	24.3	19.8	8.1	16.3	10,787,144	82,790	79	21.71	89.07
Sun 5/18/97 13:00	843.40	5,112.5	25.6	21.7	17.6	8.0	16.3	10,791,937	83,209	82	21.71	89.07
Mon 5/19/97 8:00	861.50	5,130.6	28.6	24.6	20.3	8.3	16.5	10,809,856	84,849	80	21.97	89.19
Mon 5/19/97 13:00	866.40	5,135.5	25.9	22.1	17.4	8.5	16.5	10,814,707	85,300	82	21.97	89.19
Tue 5/20/97 8:00	884.70	5,153.8	28.6	24.8	19.8	8.8	16.5	10,832,824	87,019	78	21.97	89.19
Tue 5/20/97 13:00	889.60	5,158.7	27.4	23.5	18.7	8.7	16.5	10,837,675	87,474	80	21.97	89.19
Wed 5/21/97 8:00	907.60	5,176.7	28.5	24.4	19.5	9.0	16.5	10,855,495	89,080	79	21.97	89.19
Wed 5/21/97 13:00	912.70	5,181.8	28.7	24.4	19.8	8.9	16.5	10,860,544	89,560	82	21.97	89.19
Thu 5/22/97 8:00	930.70	5,199.8	28.2	24.3	19.3	8.9	16.5	10,878,364	91,172	79	21.97	89.19
Thu 5/22/97 13:00	935.80	5,204.9	25.6	21.7	16.7	9.0	16.5	10,883,413	91,650	82	21.97	89.19
Fri 5/23/97 8:00	954.00	5,223.1	25.8	21.9	16.5	9.3	16.5	10,901,431	93,333	78	21.97	89.19
Fri 5/23/97 13:00	958.90	5,228.0	25.8	22.0	16.7	9.1	16.5	10,906,282	93,803	80	21.97	89.19
Sat 5/24/97 8:00	977.50	5,246.6	26.1	22.2	16.7	9.4	16.4	10,924,584	95,507	82	21.84	89.13
Sat 5/24/97 14:00	982.80	5,251.9	25.4	21.8	16.3	9.1	16.5	10,929,831	96,013	84	21.97	89.19
Sun 5/25/97 8:00	1000.50	5,269.6	28.1	24.2	18.3	9.8	16.5	10,947,354	97,673	80	21.97	89.19
Sun 5/25/97 11:00	1003.40	5,272.5	27.5	23.4	18.6	8.9	16.5	10,950,225	97,939	85	21.97	89.19
Mon 5/26/97 8:00	1023.50	5,292.6	28.6	24.7	18.8	9.8	16.5	10,970,124	99,772	82	21.97	89.19

APP-6

**TABLE B-1
OPERATING DATA
MEMCOR - PHASES I AND II**

Date & Time	Cumulative Operating Time [hrs]	Hour Run Meter	Feed	Recirculation	Filtrate	Feed Flow [gpm]	Filtrate Flow [gpm]	Totalized* Filtrate Flow [gal]	Flow Totalizer	Water Temperature [°F]	Flux [gpd/ft ²]	Recovery %
			Pressure [psl]	Pressure [psl]	Pressure [psl]							
Mon 5/26/97 11:00	1026.70	5,295.8	25.7	21.7	16.9	8.8	16.5	10,973,292	100,068	85	21.97	89.19
Tue 5/27/97 8:00	1046.70	5,315.8	28.6	24.8	19.3	9.3	16.5	10,993,092	101,839	82	21.97	89.19
Tue 5/27/97 13:00	1051.60	5,320.7	28.7	24.8	19.7	9.0	16.5	10,997,943	102,299	86	21.97	89.19
Wed 5/28/97 8:00	1069.90	5,339.0	27.7	23.7	18.2	9.5	16.5	11,016,060	103,874	80	21.97	89.19
Wed 5/28/97 13:00	1074.70	5,343.8	25.5	21.7	16.1	9.4	16.5	11,020,812	104,325	83	21.97	89.19
Thu 5/29/97 8:00	1092.90	5,362.0	28.4	24.3	17.4	11.0	18.0	11,040,468	106,046	80	23.97	90.00
Thu 5/29/97 13:00	1097.60	5,366.7	25.4	21.6	14.8	10.8	18.0	11,045,544	106,537	84	23.97	90.00
Fri 5/30/97 8:00	1114.20	5,383.3	27.7	23.7	16.3	11.4	18.0	11,083,472	108,242	81	23.97	90.00
Fri 5/30/97 13:00	1119.10	5,388.2	28.0	23.9	17.0	11.0	18.0	11,068,764	108,748	84	23.97	90.00
Sat 5/31/97 8:00	1137.30	5,406.4	27.8	23.8	15.7	12.1	18.0	11,088,420	110,607	82	23.97	90.00
Sat 5/31/97 12:00	1140.70	5,409.8	25.8	21.9	15.1	10.7	18.0	11,092,092	110,939	86	23.97	90.00
Sun 6/1/97 8:00	1159.80	5,428.9	28.5	24.5	16.7	11.8	18.0	11,112,720	112,795	82	23.97	90.00
Sun 6/1/97 11:00	1163.20	5,432.3	25.6	21.7	14.7	10.9	18.0	11,116,392	113,125	87	23.97	90.00
Mon 6/2/97 8:00	1182.80	5,451.9	28.3	24.3	15.8	12.7	18.0	11,137,560	115,122	79	23.97	90.00
Mon 6/2/97 13:00	1187.90	5,457.0	28.3	24.2	16.0	12.3	18.0	11,143,068	115,639	84	23.97	90.00
Tue 6/3/97 8:00	1205.90	5,475.0	27.9	24.0	14.9	13.0	18.0	11,162,508	117,406	78	23.97	90.00
Tue 6/3/97 13:00	1210.00	5,479.1	27.4	23.4	14.5	12.9	18.0	11,166,936	117,812	84	23.97	90.00
Wed 6/4/97 8:00	1228.20	5,497.3	28.2	24.3	14.3	13.9	18.0	11,186,592	119,651	79	23.97	90.00
Wed 6/4/97 13:00	1233.20	5,502.3	25.9	22.0	12.1	13.8	18.0	11,191,992	120,156	83	23.97	90.00
Thu 6/5/97 8:00	1251.20	5,520.3	27.9	24.0	13.0	14.9	18.0	11,211,432	121,942	80	23.97	90.00
Thu 6/5/97 13:00	1256.20	5,525.3	25.8	22.1	11.1	14.7	18.0	11,216,832	122,456	84	23.97	90.00
Fri 6/6/97 8:00	1273.30	5,542.4	28.1	24.5	12.5	15.6	18.0	11,235,300	124,182	81	23.97	90.00
Fri 6/6/97 13:00	1278.30	5,547.4	28.4	24.4	13.0	15.4	18.0	11,240,700	124,690	83	23.97	90.00
Sat 6/7/97 8:00	1296.60	5,565.7	27.9	24.2	12.0	15.9	18.0	11,260,464	126,470	80	23.97	90.00
Sat 6/7/97 13:00	1301.80	5,570.9	27.8	23.9	12.0	15.6	18.0	11,266,080	126,959		23.97	90.00
Sun 6/8/97 8:00	1320.40	5,589.5	28.2	24.5	11.6	16.6	18.0	11,286,168	128,716	82	23.97	90.00
Sun 6/8/97 13:00	1325.40	5,594.5	27.6	23.9	11.6	16.0	18.0	11,291,568	129,139		23.97	90.00
Mon 6/9/97 8:00	1325.40							11,291,568				
Mon 6/9/97 13:00	1325.40							11,291,568				
Tue 6/10/97 8:00	1366.00	5,635.1	28.4	24.7	9.3	19.1	18.0	17,377,476	133,091	82	23.97	90.00
Tue 6/10/97 12:00	1369.80	5,638.9	28.4	24.6	8.7	19.7	18.0	17,381,580	133,470		23.97	90.00
Wed 6/11/97 8:00	1389.20	5,658.3	27.7	24.0	16.5	11.2	18.0	17,402,532	135,321	86	23.97	90.00
Wed 6/11/97 13:00	1394.40	5,663.5	28.3	24.6	17.1	11.2	18.0	17,408,148	135,818	94	23.97	90.00
Thu 6/12/97 8:00	1412.50	5,681.6	27.9	24.4	16.7	11.2	18.0	17,427,696	137,700	82	23.97	90.00
Thu 6/12/97 9:00	1413.10	5,682.2	28.2	24.5	16.8	11.4	18.0	17,428,344	137,752		23.97	90.00
Fri 6/13/97 8:00	1429.80	5,698.9	25.7	22.2	15.0	10.7	18.0	17,446,380	139,451	82	23.97	90.00
Fri 6/13/97 14:00	1434.10	5,703.2	27.8	24.0	17.2	11.6	18.0	17,451,024	139,982	95	23.97	90.00
Sat 6/14/97 7:00	1451.40	5,720.5	26.4	23.0	15.9	10.5	18.0	17,469,708	141,602	85	23.97	90.00
Sat 6/14/97 15:00	1458.10	5,727.2	26.3	22.7	15.6	10.7	18.0	17,476,944	142,338	96	23.97	90.00
Sun 6/15/97 7:00	1474.90	5,744.0	26.1	22.6	15.1	11.0	18.0	17,495,088	143,947	80	23.97	90.00
Sun 6/15/97 13:00	1480.10	5,749.2	26.1	22.6	14.3	11.8	18.0	17,500,704	144,474	91	23.97	90.00
Mon 6/16/97 7:00	1497.90	5,767.0	27.1	23.5	16.7	10.4	18.0	17,519,928	146,244	83	23.97	90.00
Mon 6/16/97 15:00	1504.90	5,774.0	25.9	22.6	16.4	9.5	18.0	17,527,488	146,845	91	23.97	90.00

APP-7

**TABLE B-1
OPERATING DATA
MEMCOR - PHASES I AND II**

Date & Time	Cumulative Operating Time [hrs]	Hour Run Meter	Feed Pressure [psi]	Recirculation Pressure [psi]	Filtrate Pressure [psi]	TMP [psi]	Feed Flow [gpm]	Filtrate Flow [gpm]	Totalized* Filtrate Flow [gal]	Flow Totalizer	Water Temperature [°F]	Flux [gpd/ft ²]	Recovery %
Tue 6/17/97 7:00	1520.70	5,789.8	27.7	24.7	17.6	10.1	18.0	18.0	17,544,552	148,535	85	23.97	90.00
Tue 6/17/97 15:00	1528.40	5,797.5	28.7	25.3	18.9	9.8	18.0	18.0	17,552,868	149,293	94	23.97	90.00
Wed 6/18/97 7:00	1544.40	5,813.5	28.0	22.8	15.8	10.2	18.0	18.0	17,570,148	150,868	78	23.97	90.00
Wed 6/18/97 15:00	1551.40	5,820.5	28.1	24.5	17.8	10.5	18.0	18.0	17,577,708	151,836	92	23.97	90.00
Thu 6/19/97 7:00	1567.40	5,838.5	26.2	23.0	16.0	10.2	17.9	17.9	17,594,892	153,326	85	23.84	89.95
Thu 6/19/97 15:00	1574.80	5,844.0	27.9	24.4	17.5	10.4	18.0	18.0	17,602,992	154,121	94	23.97	90.00
Fri 6/20/97 7:00	1590.90	5,860.0	27.9	24.6	17.1	10.8	18.0	18.0	17,620,272	155,774	82	23.97	90.00
Fri 6/20/97 15:00	1598.40	5,867.5	25.8	22.5	16.0	9.8	18.0	18.0	17,628,372	156,508	93	23.97	90.00
Sat 6/21/97 7:00	1613.60	5,882.7	27.8	24.6	17.4	10.4	18.0	18.0	17,644,788	158,076	81	23.97	90.00
Sat 6/21/97 15:00	1621.40	5,890.5	27.7	24.3	17.5	10.2	18.0	18.0	17,653,212	158,851	94	23.97	90.00
Sun 6/22/97 7:00	1634.40	5,903.5	28.1	24.7	17.3	10.8	18.0	18.0	17,667,252	160,542	84	23.97	90.00
Sun 6/22/97 15:00	1645.10	5,914.2	27.8	24.3	16.9	10.7	18.0	18.0	17,678,808	161,180	92	23.97	90.00
Mon 6/23/97 7:00	1660.40	5,929.5	28.0	24.7	18.9	11.1	18.0	18.0	17,695,332	162,830	79	23.97	90.00
Mon 6/23/97 13:00	1665.90	5,935.0	25.8	22.8	15.3	10.5	18.0	18.0	17,701,272	163,370	84	23.97	90.00
Tue 6/24/97 7:00	1684.00	5,953.1	27.9	24.4	16.7	11.2	18.0	18.0	17,720,820	165,115	81	23.97	90.00
Tue 6/24/97 15:00	1687.50	5,958.8	28.2	25.2	19.8	8.6	19.9	20.0	17,725,020	165,372	88	26.63	90.91
Wed 6/25/97 7:00	1704.10	5,973.2	27.8	24.4	18.7	9.1	18.0	18.0	17,742,948	167,140	81	23.97	90.00
Wed 6/25/97 15:00	1711.40	5,980.5	25.8	22.3	17.1	8.5	18.0	18.0	17,750,832	167,865	89	23.97	90.00
Thu 6/26/97 7:00	1727.50	5,996.8	26.4	23.2	12.8	8.6	18.0	18.0	17,768,220	169,500	81	23.97	90.00
Thu 6/26/97 13:00	1732.95	6,002.1	25.8	22.5	17.3	8.5	18.0	18.0	17,774,106	170,054	91	23.97	90.00
Fri 6/27/97 7:00	1750.46	6,019.6	27.8	24.5	18.8	9.0	18.0	18.0	17,793,017	171,130	82	23.97	90.00
Fri 6/27/97 13:00	1755.05	6,024.2	26.1	22.9	17.4	8.7	18.0	18.0	17,797,974	172,397	92	23.97	90.00
Sat 6/28/97 7:00	1773.83	6,042.9	26.2	23.1	17.1	9.1	18.0	18.0	17,818,256	174,201	86	23.97	90.00
Sat 6/28/97 13:00	1779.32	6,048.4	26.0	22.8	17.1	8.9	18.0	18.0	17,824,186	174,762	92	23.97	90.00
Sun 6/29/97 7:00	1797.60	6,068.7	27.5	24.2	17.9	9.6	18.0	18.0	17,843,928	176,612	86	23.97	90.00
Sun 6/29/97 13:00	1802.90	6,072.0	28.1	24.8	18.6	9.5	18.0	18.0	17,849,652	177,161	92	23.97	90.00
Mon 6/30/97 8:00	1821.10	6,090.2	28.4	25.1	18.9	9.5	18.0	18.0	17,889,308	179,046	79	23.97	90.00
Mon 6/30/97 14:00	1826.80	6,095.9	28.6	25.3	19.3	9.3	18.0	18.0	17,875,484	179,623	88	23.97	90.00
Tue 7/1/97 7:00	1843.40	6,112.5	26.4	23.2	16.9	9.5	18.0	18.0	17,893,392	181,246	81	23.97	90.00
Tue 7/1/97 13:00	1849.20	6,118.3	28.3	25.0	18.8	9.5	18.0	18.0	17,899,656	181,849	87	23.97	90.00
Wed 7/2/97 7:00	1866.60	6,135.7	26.1	23.1	16.4	9.7	18.0	18.0	17,918,448	183,569	81	23.97	90.00
Wed 7/2/97 13:00	1872.50	6,141.8	28.7	25.4	19.3	8.4	18.0	18.0	17,924,820	184,169	89	23.97	90.00
Thu 7/3/97 7:00	1889.80	6,158.9	26.3	23.1	16.7	9.6	18.0	18.0	17,943,504	185,848	82	23.97	90.00
Thu 7/3/97 13:00	1895.40	6,164.5	25.9	22.7	16.6	9.3	18.0	18.0	17,949,552	186,411	88	23.97	90.00
Fri 7/4/97 7:00	1913.00	6,182.1	26.2	23.1	16.3	9.9	18.0	18.0	17,968,560	188,219	82	23.97	90.00
Fri 7/4/97 13:00	1918.80	6,187.9	28.0	25.1	18.6	9.4	18.0	18.0	17,974,824	188,815	88	23.97	90.00
Sat 7/5/97 7:00	1937.28	6,208.4	26.8	23.9	17.3	9.3	18.0	18.0	17,994,782	190,570	81	23.97	90.00
Sat 7/5/97 15:00	1943.62	6,212.7	25.9	22.9	16.5	9.4	18.0	18.0	18,001,630	191,282	93	23.97	90.00
Sun 7/6/97 7:00	1982.00	6,231.1	26.0	23.2	16.4	9.6	18.0	18.0	18,021,480	192,864	83	23.97	90.00
Sun 7/6/97 13:00	1968.00	6,237.1	28.0	24.9	18.0	10.0	18.0	18.0	18,027,960	193,454	92	23.97	90.00
Mon 7/7/97 7:00	1982.80	6,251.9	27.9	24.9	17.9	10.0	18.0	18.0	18,043,944	195,138	81	23.97	90.00
Mon 7/7/97 13:00	1988.20	6,257.3	28.7	25.7	16.4	10.3	18.0	18.0	18,049,776	195,711	88	23.97	90.00
Tue 7/8/97 7:00	2005.80	6,274.9	26.1	23.2	16.1	10.0	18.0	18.0	18,068,784	197,447	81	23.97	90.00

APP-8

**TABLE B-1
OPERATING DATA
MEMCOR - PHASES I AND II**

Date & Time	Cumulative Operating Time (hrs)	Hour Run Meter	Feed	Recirculation	Filtrate	Feed Flow (gppm)	Filtrate Flow (gpm)	Totalized* Filtrate Flow (gal)	Flow Totalizer	Water Temperatur [°F]	Flux gpd/(ft ²)	Recovery %
			Pressure (psf)	Pressure (psf)	Pressure (psf)							
Tue 7/8/97 13:00	2011.50	6,280.6	20.2	25.2	17.9	10.3	18.0	18,074,940	196,024	89	23.07	90.00
Wed 7/9/97 7:00	2029.10	6,298.2	27.7	24.9	16.3	11.4	20.0	18,096,060	199,706	81	26.63	90.91
wed 7/9/97 13:00	2034.60	6,303.9	26.4	25.4	16.7	11.7	20.0	18,102,900	200,363	88	26.63	90.91
Thu 7/10/97 7:00	2052.30	6,321.4	27.2	24.3	15.1	12.1	20.0	18,123,900	202,260	62	26.63	90.91
Thu 7/10/97 13:00	2057.70	6,326.8	26.1	23.1	14.2	11.9	20.0	18,130,380	202,670	66	26.63	90.91
Fri 7/11/97 7:00	2075.50	6,344.6	27.4	24.6	14.7	12.7	20.0	18,151,740	204,896	81	26.63	90.91
Fri 7/11/97 13:00	2061.20	6,350.3	20.2	26.3	16.0	12.2	20.0	18,158,580	205,544	88	26.63	90.91
Sat 7/12/97 7:00	2097.40	6,366.5	26.1	25.1	15.5	12.6	20.0	18,178,020	207,412	84	26.63	90.91
Sat 7/12/97 13:00	2104.40	6,373.5	25.5	22.5	13.5	12.0	20.0	18,186,420	208,056	92	26.63	90.91
sun 7/13/97 7:00	2121.50	6,390.6	26.0	25.1	14.9	13.1	20.0	18,206,940	209,946	81	26.63	90.91
Sun 7/13/97 13:00	2127.80	6,396.7	27.0	24.7	14.6	12.8	20.0	18,214,260	210,497	92	26.63	90.91
Mon 7/14/97 7:00	2145.20	6,414.3	27.0	25.1	13.8	14.1	20.0	18,235,360	212,341	a2	26.63	90.91
Mon 7/14/97 13:00	2151.00	6,420.1	28.3	25.3	14.3	14.0	20.0	18,242,340	212,990	88	26.63	80.01
Tue 7/15/97 7:00	2166.30	6,437.4	27.6	25.0	12.0	14.9	20.0	18,263,100	214,806	91	26.63	90.91
Tue 7/15/97 13:00	2174.20	6,443.3	27.4	24.5	12.5	14.0	20.0	18,270,180	215,553	66	26.63	90.91
Wed 7/16/97 7:00	2191.70	6,460.8	27.6	24.7	12.1	15.4	20.0	18,291,180	217,467	62	26.63	90.01
Wed 7/16/97 13:00	2197.40	6,466.5	26.1	25.1	12.2	15.9	20.0	18,298,020	216,122	88	26.63	90.91
Thu 7/17/97 7:00	2214.90	6,484.0	27.7	24.0	10.9	16.6	20.0	18,319,020	220,039	01	26.63	90.91
Thu 7/17/97 15:00	2218.50	6,487.6	26.2	25.3	19.7	9.5	20.0	18,323,340	220,324	91	26.63	90.91
Fri 7/18/97 7:00	2234.30	6,503.4	27.5	25.0	16.4	9.1	20.0	18,342,300	222,067	et	26.63	90.91
Fri 7/18/97 13:00			27.1	24.3	16.0	9.1	20.0	18,358,220	222,696	88	26.63	so.91
Sat 7/19/97 7:00	2257.40	6,526.5	27.6	25.1	19.1	9.7	20.0	18,370,020	224,665	80	26.63	00.91
sat 7/19/97 13:00	2263.40	6,532.5	27.6	24.6	19.3	0.3	20.0	18,377,220	225,345	91	26.63	90.91
Sun 7/20/97 7:00	2291.10	6,550.2	27.5	24.7	18.3	9.2	20.0	18,398,460	227,410	83	26.63	90.01
sun 7/20/97 13:00	2287.40	6,556.5	27.7	24.6	16.2	9.5	20.0	18,406,020	226,129	91	26.63	90.91
Mon 7/21/97 7:00	2304.10	6,573.2	27.7	24.9	16.5	9.2	20.0	18,426,060	230,077	63	26.63	90.91
Mon 7/21/97 13:00	2309.00	6,579.0	27.7	25.2	16.3	9.4	20.0	18,433,020	230,726	69	26.63	90.91
Tue 7/22/97 7:00	2327.20	6,596.3	26.3	23.6	16.6	9.7	20.0	18,453,780	232,661	63	26.63	00.81
Tue 7/22/97 13:00	2333.10	6,602.2	29.2	25.3	16.6	0.6	20.0	18,460,860	233,333	90	26.63	90.91
Wed 7/23/97 7:00	2350.60	6,619.6	27.6	24.6	17.4	10.1	20.0	18,481,740	235,254	62	26.63	90.91
Wed 7/23/97 13:00	2356.20	6,625.3	26.2	25.3	16.2	10.0	20.0	18,488,580	235,993	88	26.63	90.91
Thu 7/24/97 7:00	2373.90	6,643.0	26.3	23.5	16.2	10.1	20.0	18,500,620	237,620	82	26.63	90.91
Th 7/24/97 13:00	2379.90	6,648.9	27.4	24.6	17.3	10.1	20.0	18,516,900	236,961	97	26.63	90.91
Fri 7/25/97 7:00	2396.00	6,666.0	27.4	24.6	16.5	10.0	20.0	18,537,420	240,296	92	26.63	90.91
Fri 7/25/97 13:00	2402.60	6,671.7	28.3	26.3	17.3	11.0	20.0	18,544,260	240,939	es	26.63	90.91
Sat 7/26/97 7:00	2420.10	6,689.2	27.7	25.0	16.3	11.4	20.0	18,565,260	242,935	92	26.63	90.91
Sat 7/26/97 13:00	2425.60	6,694.9	25.6	23.1	14.6	11.2	20.0	18,572,100	243,474	69	26.63	90.91
Sun 7/27/97 7:00	2443.40	6,712.5	27.6	25.0	15.9	12.0	20.0	18,593,220	245,501	62	26.63	80.9 I
sun 7/27/97 13:00	2446.70	6,717.8	28.1	25.3	16.2	11.9	20.0	18,599,580	246,109	69	26.63	90.81
Mon 7/28/97 7:00	2466.70	6,735.8	27.7	24.9	15.4	12.3	20.0	18,621,180	246,067	82	26.63	90.91
Mon 7/28/97 13:00	2472.20	6,741.3	26.3	25.3	16.0	12.3	20.0	18,627,780	2,448,685	es	26.63	90.91
Tue 7/29/97 7:00	2479.80	6,748.9	27.5	24.7	14.7	12.9	20.0	18,636,900	250,617	63	26.63	90.01
Tue 7/29/97 13:00	2495.20	6,764.3	26.3	23.4	13.5	12.6	20.0	18,655,380	251,221	91	26.63	90.91

APP-9

TABLE S-1
OPERATING DATA
MEMCOA • PHASES I AND II

Date & Time	Cumulative Operating Time [hrs]	Hour Run Meter	Feed Pressure [psi]	Recirculation Pressure [psi]	Filtrate Pressure [psi]	TMP [psi]	Feed Flow [gpm]	Filtrate Flow [gpm]	Totalized*		Water Temperature [°F]	Flux [gpd/ft ²]	Recovery †
									Filtrate Flow [gal]	Flow Totalizer			
Wed 7/30/97 7:00	2512.80	6,782.0	27.5	24.6	13.7	13.8	20.0	20.0	18,676,620	253,214	62	26.63	90.91
Wed 7/30/97 13:00	2518.50	6,787.8	28.2	25.3	14.6	13.8	20.0	20.0	18,683,340	253,646	89	26.63	90.91
Thu 7/31/97 7:00	2536.10	6,805.2	27.6	24.0	13.3	14.5	20.0	20.0	18,704,460	255,769	62	26.63	90.91
Thu 7/31/97 13:00	2541.60	6,810.9	27.8	24.0	13.4	14.5	20.0	20.0	18,711,300	256,418	92	26.63	90.91
Fri 8/1/97 7:00	2550.30	6,828.4	27.6	24.7	12.2	15.4	20.0	20.0	18,732,300	256,301	63	26.63	90.91
Fri 8/1/97 13:00	2564.90	6,834.0	26.2	25.6	12.5	15.7	20.0	20.0	18,739,020	256,034	88	26.63	90.81
Sat 8/2/97 7:00	2682.60	6,851.7	28	26.3	11.0	17.0	20.0	20.0	18,760,280	260,621	63	26.63	90.91
Sat 8/2/97 13:00	2566.20	6,855.3	27.9	25.2	20.2	7.7	20.0	20.0	18,764,580	261,099	67	26.63	90.91
Sun 8/3/97 7:00	2603.00	6,873.0	27.8	25.2	18.4	6.5	20.0	20.0	18,785,820	263,032	62	26.63	90.91
Sun 8/3/97 13:00	2609.30	6,878.4	26.2	26.4	20.0	6.2	20.0	20.0	18,792,300	263,711	00	26.63	90.91
Mon 8/4/97 7:00	2627.10	6,896.2	27	24.3	16.5	6.5	20.0	20.0	18,813,660	265,617	81	26.63	90.91
Mon 8/4/97 13:00	2632.60	6,901.0	26.5	25.6	20.2	8.3	20.0	20.0	18,820,500	266,252	88	26.63	90.91
Tue 8/5/97 7:00	2650.30	6,919.4	28.9	25.5	10.7	8.9	20.0	20.0	18,841,500	268,198	61	26.63	90.91
Tue 8/5/97 13:00	2655.90	6,925.0	28.5	25.6	19.7	8.8	20.0	20.0	18,848,220	268,812	88	26.63	90.91
Wed 8/6/97 7:00	2673.50	6,942.6	28.1	25.3	16.6	0.3	20.0	20.0	18,869,340	270,691	62	26.63	90.91
Wed 8/6/97 13:00	2670.30	6,948.4	26	23.3	17.1	8.9	20.0	20.0	18,876,300	271,269	91	26.63	90.01
Thu 8/7/97 7:00	2696.70	6,965.8	28.2	25.5	18.3	0.0	20.0	20.0	18,897,180	273,147	82	26.63	90.91
Thu 8/7/97 13:00	2702.40	6,971.5	26	23.2	16.2	9.8	20.0	20.0	18,904,020	273,776	01	26.63	90.91
Fri 8/8/97 7:00	2720.00	6,989.1	28.1	25.4	17.3	10.6	20.0	20.0	18,925,140	275,740	82	26.63	90.91
Fri 8/8/97 13:00	2725.50	6,994.6	26	23.3	15.5	10.5	20.0	20.0	18,931,740	276,340	81	26.63	90.91
Sat 8/9/97 7:00	2742.90	7,012.0	27.1	24.3	15.3	11.8	20.0	20.0	18,952,620	276,329	62	26.63	90.91
Sat 8/9/97 13:00	2746.40	7,017.5	27.6	24.7	16.4	11.2	20.0	20.0	18,959,220	276,071	91	26.63	90.01
Sun 8/10/97 7:00	2766.20	7,035.3	28	25.2	15.6	12.4	20.0	20.0	18,980,580	260,615	81	26.63	90.01
Sun 8/10/97 13:00	2771.90	7,041.0	20.6	25.6	16.4	12.2	20.0	20.0	18,987,420	261,453	04	26.63	90.91
Mon 8/11/97 7:00	2789.40	7,058.5	28.2	25.6	14.6	13.6	20.0	20.0	19,008,420	263,327	82	26.63	90.91
Mon 8/11/97 13:00	2785.10	7,064.2	26.5	25.6	15.2	13.3	20.0	20.0	19,015,260	283,956	69	26.63	90.91
Tue 8/12/97 7:00	2617.60	7,086.7	26.1	25.2	13.7	14.4	20.0	20.0	19,042,260	285,824	81	26.63	90.91
Tue 8/12/97 13:00	2818.30	7,087.4	26.6	25.6	14.5		20.0	20.0	19,043,100	266,456	91	26.63	90.91
Wed 8/13/97 7:00	2835.60	7,104.9	27.0	25.0	11.6	16.3	20.0	20.0	19,064,100	266,265	82	26.53	90.01
Wed 8/13/97 13:00	2641.60	7,110.7	25.0	23.0	11.0	14.9	20.0	20.0	19,071,060	288,843	91	26.63	90.91
Thu 8/14/97 7:00	2850.10	7,128.2	27.9	25.3	10.0	17.0	20.0	20.0	19,092,060	290,727	62	26.63	90.91
Thu 8/14/97 13:00	2664.70	7,133.8	26.2	23.4	9.7	16.5	20.0	20.0	19,098,780	291,339	91	26.63	90.91

APP-10

Notes:
 Flux = Filtrate flow/membrane area
 Recovery - amount of feed water converted to filtrate (product water)
 Recovery = amount of water produced / (amount of water produced + backwash)
 Recovery = Filtrate Vol / (Filtrate vol. + Backwash vol)
 Backwash Vol = sweep vol + Filtrate exhaust
 Membrane Area based on Outer diam = 33.5 m² per module

TABLE B-2
 OPERATING DATA
 ZEEWEED - PHASE I

Recorded Data		Calculated Data																		
Date & Time	Cumulative Operating Time [hrs]	Temperature [°F]	Sprayer Pump Pressure [psi]	Vacuum Before Backpouse [in Hg]	Vacuum After Backpouse [in Hg]	Permeate Rate Before Backpouse [lpm]	Permeate Rate After Backpouse [lpm]	Backpouse Pressure [psig]	Backpouse Cartridge Pressure Inlet [psig]	Backpouse Cartridge Pressure Outlet [psig]	Backpouse Frequency [min]	Backpouse Duration [sec]	Permeate Rate to Drain [lpm]	Permeate Totalizer [gal]	Bleed Rate [lpd]	Recovery %	Air Flow [scfm]	TMP [psi]	Permeate Rate Before Backpouse [gpm]	Flux [l/gpd/ft²]
Mon 4/14/97 8:30	0.00	65		8.5	8.0	13.0					5	10	6.00	2,054.5	255	97.13	8.50	4.17	3.43	32.97
Mon 4/14/97 13:30	5.00	65		8.0	8.5	13.0					5	10	6.00	2,102.1	315	96.48	7.26	3.93	3.43	32.97
Tue 4/15/97 10:00	25.50	62		7.6	6.0	13.0					5	10	8.00	2,308.6	295	96.70	6.75	3.66	3.43	32.97
Tue 4/15/97 13:30	28.00	62		7.5	6.0	13.0					5	10	6.00	2,342.4	310	96.54	7.26	3.66	3.43	32.87
Wed 4/16/97 8:30	48.00	74		6.6	6.5	13.0					6	10	6.00	2,530.2	255	87.13	7.26	3.19	3.43	32.97
Wed 4/16/97 13:30	53.00	74		7.5	5.5	13.0					5	10	6.00	2,582.3	320	86.43	7.25	3.66	3.43	32.97
Th" 4/17/97 8:30	72. w	78		7.0	6.6	13.0					6	10	6.00	2,769.3	260	87.06	7.26	3.44	3.43	32.87
Th" 4/17/97 11:45	75.25	76		6.0	6.0	13.0					5	10	6. W	2,626.0	305	86.68	7.25	2.95	3.43	32.97
Fri 4/18/97 8:30	96.00	64	26.0	6.6	6.0	13.0	13.0	7.6	15	10.0	5	10	6.00	3,009.9	265	97.02	7.75	4.17	3.43	32.97
Fri 4/18/97 13:30	101.00	76	26.0	8.0	6.0	13.0	13.0	7.3	14	10.0	5	10	6.00	3,065.1	320	86.43	7.50	3.83	3.43	32.97
Sat 4/19/97 8:30	120.00	76	27.0	8.0	6.5	13.0	13.0	7.3	15	10.0	5	10	6.00	3,259.2	275	96.92	7.50	3.83	3.43	32.87
Sat 4/19/97 12:30	124.00	79	20.0	7.5	6.5	13.0	13.0	7.4	13	9.0	5	10	6.00	3,295.5	320	96.43	7.50	3.66	3.43	32.87
Sun 4/20/97 8:00	143.50	78	27.0	7.5	6.0	13.0	13.0	7.3	14	10.0	5	10	6.00	3,490.8	265	96.61	7.50	3.66	3.43	32.97
Sun 4/20/97 12:30	148. M	80	25.0	7.0	6.0	13.0	13.0	7.3	14	9.0	5	10	6.00	3,536.0	320	88.43	7.50	3.44	3.43	32.97
Mon 4/21/97 8:00	167.50	76	25.4	7.6	3.0	13.0	13.0	7.2	15	10.0	5	10	6.00	3,732.9	295	96.70	7.75	3.66	3.43	32.97
Mon 4/21/97 13:30	173.00	84	24.0	7.0	6.0	12.6	12.5	7.2	13	6.0	5	10	6.00	3,787.2	265	86.61	7.50	3.44	3.30	31.70
Tue 4/22/97 8:45	192.25	80	25.0	7.0	6.0	13.0	13.0	7.3	14	10.0	5	10	6.00	3,981.7	265	96.61	6.00	3.44	3.43	32.97
Tue 4/22/97 13:30	197.00	84	23.0	7.5	6.6	13.0	13.0	7.3	12	7.0	5	10	6.00	4,029.6	315	96.46	6.75	3.66	3.43	32.97
wed 4/23/97 8:15	215.75	77	26.0	7.0	6.0	12.0	12.0	7.4	15	11.0	5	10	6.25	4,220.3	300	88.77	6.50	3.44	3.17	30.43
Wed 4/23/97 13:30	221.00	62	25.0	7.5	6.5	13.5	13.5	7.3	14	9.0	5	10	6.25	4,273.8	310	96.67	7.25	3.66	3.57	34.24
Thu 4/24/97 8:30	240.00	76	26.0	9.0	7.0	12.0	14.0	7.3	11	15.0	5	10	6.25	4,467.1	290	96.66	7.75	3.93	3.17	30.43
Thu 4/24/97 14:00	245.50	79	25.0	8.0	7.0	13.5	13.5	7.4	10	14.0	5	10	6.25	4,523.6	315	96.62	7.75	3.93	3.57	34.24
Fri 4/25/97 8:00	263.50	79	26.0	6.5	7.0	13.5	13.5	7.5	10	15.0	5	10	6.25	4,707.5	300	86.77	7.50	4.17	3.57	34.24
Fri 4/25/97 14:00	270.00	85	25.0	7.0	6.5	13.5	13.5	7.6	9	13.0	5	10	6.25	4,773.3	335	96.41	7.25	3.44	3.57	34.24
Sat 4/26/97 8:00	267.50	77	26.0	9.0	7.0	13.0	13.0	7.3	11	15.0	5	10	6.00	4,952.2	265	96.81	7.76	4.42	3.43	32.97
Sat 4/26/97 12:30	292.00	60	25.0	9.0	7.0	13.0	13.0	7.6	10	14.0	5	10	6.00	4,998.0	320	96.43	7.50	4.42	3.43	32.97
sun 4/27/97 8:30	312.00	70	26.0	9.0	7.0	13.0	13.0	7.5	11	15.0	5	10	6.00	5,206.5	320	96.43	7.50	4.42	3.43	32.97
Sun 4/27/97 12:30	316.00	72	26.0	9.0	7.0	13.0	13.0	7.5	10	15.0	5	10	6. W	5,233.7	315	96.48	7.50	4.42	3.43	32.97
Mon 4/28/97 8:00	335.50	71	27.0	10.5	8.0	13.0	13.0	7.7	12	16.0	5	10	6.00	5,434.1	315	96.46	7.75	6.16	3.43	32.97
Mon 4/28/97 13:00	340.50	80	24.0	10.0	7.5	13.5	13.5	8.0	9	14.0	6	10	6.25	5,465.5	330	96.46	7.00	4.91	3.57	34.24
Tue 4/29/97 8:45	360.26	74	26.0	10.0	7.5	14.0	14.0	7.6	11	16.0	5	10	6.25	5,686.1	315	96.62	6.00	4.91	3.70	35.51
Tue 4/29/97 13:30	385.00	83	24.0	a.0	7.6	13.0	13.5	6.0	9	13.0	5	10	6.00	5,735.0	335	96.27	7.00	4.42	3.43	32.97
Wed 4/30/97 8:00	363.50	79	27.0	9.0	7.5	13.0	13.0	7.6	10	15.0	5	10	6.00	5,907.2	305	96.59	7.25	4.42	3.43	32.97
Wed 4/30/97 14:00	369.60	63	25.0	9.0	7.0	13.0	13.0	7.7	9	13.0	5	10	6.00	5,962.1	320	96.43	7.25	4.42	3.43	32.87
Thu 5/1/97 8:00	407.50	82	26.0	9.0	7.0	13.0	13.0	7.6	10	14.0	5	10	6.25	6,150.7	310	96.67	7.25	4.42	3.43	32.87
Thu 5/1/97 14:00	413.50	84	25.0	6.5	7.0	13.0	13.0	7.6	8	13.0	5	10	6.25	6,211.6	330	96.46	7.50	4.17	3.43	32.97

APP-11

TABLE B-2
OPERATING DATA
ZEEWEED PHASE I

Date & Time	Cumulative Operating Time [hrs]	Temperature [°F]	Sprayer Pump Pressure [psi]	Vacuum Before Backpulse [in Hg]	Vacuum After Backpulse [in Hg]	Permeate Rate Before Backpulse [lpm]	Permeate Rate After Backpulse [lpm]	Backpulse Pressure [psig]	Backpulse Cartridge Pressure Inlet [psig]	Backpulse Cartridge Pressure Outlet [psig]	Backpulse Frequency [min]	Backpulse Duration [sec]	Permeate Rate to Drain [lpm]	Permeate Totalizer [gal]	Bleed Rate [lpcd]	Recovery %	Air Flow [scfm]	TMP [psi]	Permeate Rate Before Backpulse [gpm]	Flux [gpd/ft²]
Fri 5/2/97 8:30	432.00	85	26.0	7.5	6.5	13.0	13.0	7.6	10	14.0	5	10	6.25	13,284.5	305	96.72	7.50	3.68	3.43	32.97
Fri 5/2/97 13:30	437.00	a7	24.0	8.0	7.0	13.0	13.0	8.0	9	13.0	5	10	6.00	6,335.1	330	96.32	7.25	3.93	3.43	32.97
Sat 5/3/97 8:30	456.00	82	25.0	8.0	7.0	13.0	13.0	7.6	10	15.0	5	10	6.00	6,527.3	310	86.54	7.60	3.03	3.43	32.97
Sat 5/3/97 1 1:30	459.00	85	25.0	9.0	7.0	13.0	13.0	7.8	10	15.0	5	10	6.00	6,555.1	320	96.43	7.50	4.42	3.43	32.91
Sun 5/4/97 8:00	479.50	75	27.0	10.0	8.0	13.0	13.0	8.4	11	16.0	5	10	6. W	6,269.9	320	96.43	6.00	4.9	3.43	32.97
Sun 5/4/97 12:30	464.00	61	25.0	9.5	8.0	13.0	13.0	6.2	10	14.5	5	10	6.W	6,815.2	330	95.32	7.50	4.67	3.43	32.91
Mon 5/5/97 7:30	503.00	75	27.0	10.0	6.5	13.5	13.5	6.4	11	16.0	5	10	6.W	7, W6.8	325	86.37	8.00	4.91	3.57	34.24
Mon 5/5/97 13:30	508.00	82	25.0	8.5	6.5	13.5	13.6	8.4	10	14.0	5	10	6. W	7,069.2	320	98.43	7.50	4.67	3.57	34.24
Tue 5/8/97 7:30	527.00	79	26.0	10.0	9.0	13.0	13.0	8.1	11	15.0	5	10	6. W	7,252.5	305	85.58	7.50	4.91	3.43	32.97
Tue 5/8/97 13:30	533.00	81	25.0	10.0	9.0	13.0	13.0	6.0	10	14.0	5	10	6.00	7,313.5	325	86.37	7.25	4.91	3.43	32.91
Wed 5/7/97 8:00	551.50	80	27.0	10.0	9.0	13.0	13.0	6.1	11	15.0	5	10	6.00	7,582.7	305	96.59	7.75	4.91	3.43	32.8
Wed 5/7/97 14:00	557.50	81	26.0	10.0	9.0	13.0	13.0	6.0	10	14.0	5	10	6.00	7,583.3	320	96.43	7.50	4.01	3.43	32.97
Thu 5/8/97 7:30	575.00	78	27.0	10.5	8.0	13.0	13.0	6.2	11	15.0	5	10	6.26	7,742.4	320	96.57	7.75	5.16	3.43	32.97
Thu 5/8/97 14:00	581.50	84	26.0	10.5	8.0	13.0	13.0	8.2	10	14.0	5	10	6.00	7,803.9	325	96.37	7.50	5.15	3.43	32.81
Fri 5/9/97 7:30	599.00	62	26.0	11.0	9.5	13.0	13.0	8.2	11	15.0	5	10	6. W	7,987.5	305	96.59	7.50	5.40	3.43	32.91
Fri 5/9/97 13:00	604.50	84	28.0	10.5	8.5	13.0	13.0	6.2	10	15.0	5	10	8.25	8,083.9	320	86.57	7.50	5.16	3.43	32.97
Sat 5/10/97 7:30	623.00	78	26.0	10.0	9.0	13.0	13.0	6.2	11	15.0	5	10	6.00	8,193.4	315	96.45	7.50	4.81	3.43	32.9
Sat 5/11/97 14:00	629.50	71	26.0	10.0	9.0	13.0	13.0	6.0	11	15.0	5	10	6. W	8,208.8	310	86.54	7.50	4.81	3.43	32.97
Sun 5/11/97 7:30	647. W	70	26.0	6.5	9.0	13.0	13.0	6.0	11	15.0	5	10	6. W	61216.5	315	96.46	7.50	4.17	3.43	32.97
Sun 5/11/97 13:30	653.00	79	26.0	6.0	8.0	13.0	13.0	6.0	10	14.0	5	10	6.00	8,270.3	310	95.54	7.50	3.93	3.43	32.97
Mon 5/12/97 7:30	671.00	80	26.0	9.0	8.0	13.0	13.0	6.2	10	14.0	5	10	6.25	8,431.0	310	96.67	7.25	4.42	3.43	32.81
Mon 5/12/97 13:30	677.00	83	24.0	9.5	a.5	13.0	13.0	8.4	9	13.0	5	10	6.25	8,491.4	325	86.51	7.50	4.67	3.43	32.97
Tue 5/13/97 7:30	685.00	80	27.0	10.0	8.0	13.0	13.0	8.6	11	15.0	5	10	6.00	8,675.1	320	96.43	6.00	4.8	3.43	32.97
Tue 5/13/97 13:30	701.00	62	25.0	10.5	9.0	13.0	13.0	6.2	10	14.0	5	10	6.00	8,735.8	310	96.54	7.50	5.16	3.43	32.91
Wed 5/14/97 6:00	719.50	63	26.0	9.0	7.5	13.0	13.0	8.4	11	15.0	5	10	6.W	8,841.2	305	96.59	7.75	4.42	3.43	32.97
Wed 5/14/97 13:15	724.75	84	26.0	9.5	8.5	13.0	13.0	6.4	9	14.0	5	10	6.00	8,895.0	330	96.32	7.50	4.67	3.43	32.97
Thu 5/15/97 7:30	743.00	83	28.0	9.0	6.0	13.0	13.0	6.6	11	15.0	5	10	6. W	9,016.5	315	96.46	7.75	4.42	3.43	32.97
Thu 5/15/97 15:00	750.50	66	24.0	9.5	6.5	13.0	13.0	6.6	9	14.0	5	10	6.00	9,091.1	330	96.32	7.50	4.67	3.43	32.97
Fri 5/16/97 8:00	767.50	82	26.0	9.0	7.5	13.0	13.0	6.4	11	16.0	5	10	8.00	9,148.1	330	96.32	7.50	4.42	3.43	32.97
Fri 5/16/97 13:00	772.50	83	24.0	9.5	8.5	13.0	13.0	8.0	10	15.0	5	10	6.00	9,194.2	330	96.32	7.50	4.67	3.43	32.97
Sat 5/17/97 8:00	791.50	80	25.0	9.0	9.6	13.0	13.0	8.0	11	16.0	5	10	6.00	9,384.9	315	96.46	7.50	4.42	3.43	32.97
Sat 5/17/97 12:30	796.00	83	25.0	9.0	10.0	13.0	13.0	9.0	10	15.0	5	10	6.00	9,425.6	320	96.43	7.50	4.42	3.43	32.93
Sun 5/18/97 8:00	815.50	81	24.0	11.0	10.0	13.0	13.0	8.0	11	16.0	5	10	6.00	9,624.9	310	96.54	7.50	5.40	3.43	32.97
Sun 5/18/97 12:30	820.00	82	25.0	9.0	10.0	13.0	13.0	8.0	10	15.0	5	10	6.00	9,663.8	315	86.46	7.50	4.42	3.43	32.97
Mon 5/19/97 7:30	839.00	84	24.0	10.0	9.5	13.0	13.0	7.2	11	17.0	5	10	6.00	9,734.0	290	96.75	7.25	4.91	3.43	32.97
Mon 5/19/97 13:00	844.50	86	23.0	11.0	10.5	13.0	13.0	7.6	10	16.0	5	10	6.00	9,790.0	335	95.27	7.25	5.40	3.43	32.91
Tue 5/20/97 7:30	863.00	82	24.0	12.0	11.0	12.0	12.0	7.8	12	17.0	5	10	6.00	9,978.1	260	96.66	7.75	5.69	3.17	30.4

APP-12

TABLE-2
OPERATING DATA
ZEEWEED - PHASE I

Date & Time	Cumulative Operating Time [hrs]	Temperature [°F]	Sprayer Pump Pressure [psi]	Vacuum Before Backpulsing [in Hg]	Vacuum After Backpulsing [in Hg]	Permeate Rate Before Backpulsing [lpm]	Permeate Rate After Backpulsing [lpm]	Backpulsing Pressure [psig]	Backpulsing Cartridge Pressure Inlet [psig]	Backpulsing Cartridge Pressure Outlet [psig]	Backpulsing Frequency [min]	Backpulsing Duration [sec]	Permeate Rate to Drain [lpm]	Permeate Totalizer [gal]	Bleed Rate [lpd]	Recovery %	Air Flow [scfm]	MP [psi]	Permeate Rate Before Backpulsing [gpm]	Flux [gpd/ft ²]
Tue 5/20/97 13:00	868.50	83	24.0	12.5	11.5	12.0	12.0	7.6	11	17.0	5	10	5.00	10,032.1	320	95.43	7.75	6.14	3.17	30.43
Wed 5/21/97 7:30	887.00	52	24.0	13.5	12.5	12.0	12.0	5.4	11	17.0	5	10	5.00	10,217.8	310	95.54	7.25	6.53	3.17	30.43
Wed 5/21/97 14:00	593.50	56	23.0	13.5	12.5	13.0	13.0	7.5	11	17.0	5	10	6.00	10,282.9	325	95.37	7.50	5.53	3.43	32.97
Thu 5/22/97 7:30	911.00	53	24.0	12.0	11.0	13.0	13.0	5.2	12	15.0	5	10	5.00	10,368.9	305	95.59	7.75	5.59	3.43	32.97
Thu 5/22/97 13:00	915.50	55	23.0	13.0	12.0	13.0	13.0	7.4	11	17.0	5	10	5.00	10,424.3	325	95.37	7.50	5.39	3.43	32.97
Fri 5/23/97 8:00	935.50	51	25.0	13.0	12.0	12.5	12.5	7.5	12	15.0	5	10	6.00	10,554.3	310	95.54	7.75	5.39	3.30	31.70
Fri 5/23/97 14:30	942.00	54	25.0	13.0	12.0	13.0	13.0	7.5	12	15.0	5	10	5.00	10,643.2	310	95.54	7.50	5.39	3.43	32.97
Sat 5/24/97 8:00	959.50	52	25.0	13.0	12.0	13.0	13.0	7.5	12	15.0	5	10	5.00	10,698.7	310	95.54	7.50	5.39	3.43	32.97
Sat 5/24/97 13:00	954.50	55	25.0	13.0	12.0	12.5	13.0	7.5	12	15.0	5	10	5.00	10,739.9	325	95.37	7.50	5.39	3.30	31.70
Sun 5/25/97 8:00	953.50	52	25.0	13.0	12.0	13.0	13.0	7.4	12	15.0	5	10	6.00	10,893.2	315	95.48	7.50	5.39	3.43	32.97
Sun 5/25/97 13:00	958.50	55	25.0	13.0	12.0	13.0	13.0	7.5	12	15.0	5	10	6.00	10,920.6	320	95.43	7.50	5.39	3.43	32.97
Mon 5/26/97 8:00	1,007.50	52	25.0	13.0	12.0	13.0	13.0	7.4	12	15.0	5	10	5.00	11,081.7	315	96.48	7.50	5.39	3.43	32.97
Mon 5/26/97 13:30	1,013.00	55	24.0	13.0	12.0	13.0	13.0	7.5	10	24.0	5	10	5.00	11,109.1	315	95.48	7.50	5.39	3.43	32.97
Tue 5/27/97 7:30	1,031.00	57	25.0	13.0	12.5	12.0	12.0	7.6	12	15.0	5	10	5.00	11,246.5	310	95.54	7.50	5.39	3.17	30.43
Tue 5/27/97 13:00	1,036.50	59	23.0	13.5	12.5	12.0	12.0	7.5	11	17.0	5	10	5.00	11,302.0	325	95.37	7.25	6.53	3.17	30.43
Wed 5/28/97 5:00	1,055.50	53	24.0	13.0	12.5	12.5	12.5	7.8	12	19.0	5	10	5.00	11,381.0	315	95.45	7.75	5.39	3.30	31.70
Wed 5/28/97 14:00	1,061.50	67	24.0	14.0	13.0	12.5	12.5	5.0	11	17.0	5	10	5.00	11,437.3	325	95.43	7.25	6.55	3.30	31.70
Thu 5/29/97 7:30	1,079.60	56	25.0	13.0	12.5	12.5	12.5	5.5	12	15.0	5	10	6.00	11,455.7	320	96.43	7.50	5.39	3.30	31.70
Thu 5/29/97 13:00	1,084.50	57	23.5	14.0	12.5	12.5	12.5	7.6	11	17.0	5	10	5.00	11,540.6	325	95.37	7.25	6.88	3.30	31.70
Fri 5/30/97 7:30	1,103.00	85	25.0	13.5	13.0	13.0	13.0	5.2	11	15.0	5	10	6.00	11,555.2	320	95.43	7.50	5.53	3.43	32.97
Fri 5/30/97 13:00	1,108.50	57	24.0	14.0	13.5	13.0	13.0	5.0	11	17.0	5	10	5.00	11,720.2	325	95.37	7.25	5.55	3.43	32.97
Sat 5/31/97 5:00	1,127.50	64	25.0	14.0	13.0	13.0	13.0	5.2	12	15.0	5	10	5.00	11,829.0	320	95.43	7.25	5.55	3.43	32.97
Sat 5/31/97 13:00	1,132.50	67	24.0	14.0	13.5	13.0	13.0	5.1	11	17.0	5	10	6.00	11,881.5	315	95.45	7.25	6.55	3.43	32.97
Sun 6/1/97 8:00	1,151.50	61	25.0	14.0	13.0	13.0	13.0	7.5	11	15.0	5	10	5.00	11,973.2	320	95.43	7.25	5.55	3.43	32.97
Sun 6/1/97 13:00	1,156.50	66	25.0	14.0	13.0	13.0	13.0	5.0	11	17.0	5	10	5.00	12,024.8	320	95.43	7.50	5.55	3.43	32.97
Mon 6/2/97 7:30	1,175.00	64	25.0	14.0	13.5	13	13	5.4	13	19	5	10	5.00	12101.2	310	85.54	7.75	5.55	3.43	32.97
Mon 6/2/97 13:00	1,180.50	56	23.0	14.5	14.0	13	13	7	11	15	5	10	5.00	12155.1	325	85.37	7.50	7.12	3.43	32.97
Tue 6/3/97 7:30	1,199.00	52	25.0	15.5	15.0	13	13	7.5	12	15	5	10	5. w	12337.4	305	95.59	7.75	7.51	3.43	32.97
Tue 6/3/97 14:00	1,205.50	66	24.0	15.0	14.5	14	14	7.5	11	18	5	10		12403.2	330	95.32	7.50	7.37	3.70	35.51
Wed 6/4/97 7:30	1,223.00	91	25.0	16.6	15.5	14	14	6.4	12	19	5	10	6.00	12561.1	320	96.43	9. W	5.10	3.70	35.51
Wed 6/4/97 13:00	1,228.50	88	23.0	17.0	15.0	13	13	8	11	15	5	10	6.00	12616.7	335	95.27	7.50	5.35	3.43	32.97
Thu 6/5/97 7:30	1,247.00	53	25.0	16.0	15.0	13.5	13.5	9.4	13	19	5	10	6.00	12713.9	315	96.48	6.25	7.56	3.57	34.24
Thu 6/5/97 13:00	1,252.50	89	23.0	17.0	16.0	13.5	13.5	7.5	11	18	5	10	6.00	12755.4	320	95.43	7.50	5.35	3.57	34.24
Fri 6/6/97 7:30	1,271.00	63	24.0	17.5	15.5	13	13	6.2	12	20	5	10	6.00	12927.7	320	96.43	5.00	6.50	3.43	32.97
Fri 6/6/97 13:00	1,276.50	89	24.0	17.0	16.0	14	14	7.8	12	19	5	10	5.00	12970.3	325	95.55	7.25	6.35	3.70	35.51
Sat 6/7/97 5:00	1,295.50	52	24.0	16.5	16.0	13	13	7.5	12	15	5	10	5.00	13052.7	320	95.74	7.50	8.10	3.43	32.97
Sat 6/7/97 13:00	1,300.50	89	24.0	17.0	16.0	13	13	5.1	12	19	5	10	5.00	13105.4	325	95.56	7.75	6.35	3.43	32.97

APP-13

**TABLE B-2
OPERATING DATA
ZEEWEED - PHASE I**

Date & Time	Cumulative Operating Time [hrs]	Temperature [°F]	Sprayer Pump Pressure [psig]	Vacuum Before Backpuls [in Hg]	Vacuum After Backpuls [in Hg]	Permeate Rate Before Backpuls [lpm]	Permeate Rate After Backpuls [lpm]	Backpuls Pressure [psig]	Backpuls Cartridge Pressure Inlet [psig]	Backpuls Cartridge Pressure Outlet [psig]	Backpuls Frequency [min]	Backpuls Duration [sec]	Permeate Rate to Drain [lpm]	Permeate Totalizer [gal]	Bleed Rate [lpd]	Recovery %	Air Flow [scfm]	TMP [psig]	Permeate Rate Before Backpuls [lpm]	Flux [l/m ² /hr]
Sun 6/8/97 8:0	1,319.50	83	24.0	16.0	16.0	13	13	6	12	16	5	10	5.00	13164.1	320	95.74	7.50	7.66	3.43	32.9
Sun 6/8/97 13:0	1,324.50	87	25.0	16.0	16.0	13.5	13.5	8.2	12	16	5	10	5.00	13201.8	315	95.81	7.50	7.66	3.57	34.2
Mon 6/9/97 7:3	1,343.00 W	88	25.0	15.0	14.5	14	14	7.9	13	20	5	10	5.00	13267.1	300	96.00	8.00	7.37	3.70	35.5
Mon 6/9/97 13:3	1,348.00	89	24.0	16.0	15.0	14	14	6	12	18	5	10	4.00 W	13315.7	325	94.66	7.75	7.66	3.70	35.5
Tue 6/10/97 7:3	1,367.00	84	26.0	15.5	14.5	14.5	14.5	5.1	13	20	5	10	4.00	13391.6	325	94.66	7.75	7.61	3.63	36.7
Tue 6/10/97 13:3	1,373.00	91	24.0	16.0	15.0	14	14	7.6	12	17	5	10	4.00	13426.6	320	94.74	6.00 W	7.66	3.70	35.5
Wed 6/11/97 7:3	1,391.00	85	24.0	16.0	15.0	14	14	6	13	20	5	10	4.00	13564.9	320	94.74	7.75	7.66	3.70	35.5
Wed 6/11/97 13:3	1,397.00	93	24.0	16.0	15.0	14	14	7.9	12	18	5	10	4.00 W	13601.9	325	94.66	8.00	7.66	3.70	35.5
Thu 6/12/97 7:3	1,415.00	84	24.0	15.0	15.0	14	14	6	13	18	5	10	4.00 W	13656.2	320	94.74	7.75	7.37	3.70	35.5
Thu 6/12/97 13:0	1,420.50																			
Fri 6/13/97 7:3	1,439.00	83	24.0	15.0	15.0	12	12	7.9	12	20	6	10	4.00	13716.3	320	94.74	7.75	7.37	3.17	30.4
Fri 6/13/97 13:3	1,445.00	92	25.0	15.0	15.0	12	12	8	12	20	5	10	4.00	13734.7	315	94.51	7.75	7.37	3.17	30.4
Sat 6/14/97 7:3	1,463.00	89	25.0	15.0	15.0	12	12	8	12	20	5	10	4.00	13756.6	320	94.74	7.75	7.37	3.17	30.4
Sat 6/14/97 13:3	1,469.00	93	26.0	16.0	15.0	13	13	7.9	11	19	5	10	4.00 W	13606.7	320	94.74	7.50	7.56	3.43	32.9
Sun 6/15/97 7:3	1,467.00 W	83	25.0	16.0	16.0	12	12	7.6	12	20	5	10	4.00	13657.8	320	94.74	7.50	7.66	3.17	30.4
Sun 6/15/97 13:3	1,493.00	81	25.0	16.0	15.0	10	10	6	12	20	5	10	4.00	13669.8	320	94.74	7.50	7.65	2.64	25.31

Flux = Filtrate flow/membrane area

Recovery - amount of feed water converted to filtrate (product water)

Recovery = amount of water produced / (amount of water produced + bleed rate)

Recovery = Permeate Rate to Drain / (Permeate Rate to Drain + Bleed Rate)

Backwash Vol = sweep vol + Filtrate exhaust

Membrane Area based on Outer diam = 150 ft²

TABLE 1-3
OPERATING DATA
ZEEWEED PHASE II

Date & Time	Cumulative Operating Time (hrs)	Temperature [°F]	Sprayer Pump Pressure [psi]	Vacuum Before Backpouse [in Hg]	Vacuum After Backpouse [in Hg]	Permeate Rate Before Backpouse [gpm]	Permeate Rate After Backpouse [gpm]	Backpouse Pressure [psig]	Backpouse Cartridge Pressure Inlet [psig]	Backpouse Cartridge Pressure Outlet [psig]	Backpouse Frequency [rpm]	Backpouse Duration [sec]	Permeate Rate to Drain [gpm]	Permeate Totalizer [gal]	Sludge Waste Vol [gal]	Avg. Daily Recovery (%)	Air Flow [scfm]	TMP [psi]	Permeate Rate Before Backpouse [gpm]	Flux [gpd/ft²]	Bioreactor MLSS [mg/l]	Faecal CBOD (mg/L)	WWTP Influent CBOD (mg/L)	Hydraulic Retention Time	Solids Retention Time (d)	Sludge Production (lbs/d)
Thu 6/19/97 7:30	0.00	81	12.0	3.0	3.0	6.0	6.0	5.0	12	15	10	10	4.0	141,848	8.8		8.50	1.47	1.69	15.22				2.9		
Thu 6/19/97 13:30	6.00	93	20.0	3.0	3.0	6.0	6.0	5.0	10	15	10	20	4.0	142,018	0	99.92	8.50	1.47	2.11	20.29				2.9		
Fri 6/20/97 7:30	24.00	82	20.0	3.0	3.0	6.0	6.0	5.0	10	15	10	20	4.0	143,344	8.8		8.50	1.47	2.11	20.29	14,100	251		2.9	21	1.03
Fri 6/20/97 13:30	30.00	92	20.0	3.0	3.0	6.0	6.0	5.0	10	15	10	20	4.0	143,719	0	99.92	8.50	1.47	2.11	20.29				2.9		
Sat 6/21/97 7:30	48.00	82	20.0	3.0	3.0	6.0	6.0	5.0	10	15	10	20	4.0	144,904	8.8		8.50	1.47	2.11	20.29				2.9	21	
Sat 6/21/97 13:30	54.00	94	18.0	3.0	3.0	6.0	6.0	5.0	11	15	10	20	4.0	145,322	0	99.92	8.50	1.47	2.11	20.29				2.9		
Sun 6/22/97 7:30	72.00	85	17.0	3.0	3.0	6.0	6.0	6.0	11	15	10	20	4.0	146,664	8.8		8.00	1.47	2.11	20.29				2.9	21	
Sun 6/22/97 13:30	78.00	93	18.0	3.0	3.0	6.0	6.0	6.0	10	15	10	20	4.0	147,084	0	99.92	8.00	1.47	2.11	20.29				2.9		
Mon 6/23/97 7:30	96.00	80	17.0	4.0	4.0	6.0	6.0	6.0	11	15	10	20	4.0	148,304	8.8		8.00	1.98	2.11	20.29	13,040	670	145	2.9	21	0.96
Mon 6/23/97 13:30	102.00	84	16.0	3.0	3.0	6.0	6.0	7.0	11	14	10	20	4.0	148,703	0	99.92	8.50	1.47	2.11	20.29				2.9		
Tue 6/24/97 7:30	120.00	81	17.0	3.0	3.0	6.0	6.0	7.0	11	15	10	20	4.0	149,568	8.8		8.00	1.47	2.11	20.29				2.9	21	
Tue 6/24/97 13:30	126.00	89	18.0	3.0	3.0	6.0	6.0	7.0	11	15	10	20	4.0		0	99.92	8.00	1.47	2.11	20.29				2.9		
Wed 6/25/97 13:30	150.00	78	18.0	3.0	3.0	6.0	6.0	6.0	11	15	10	20	4.0	151,136	8.8		8.00	1.47	2.11	20.29	14,500	208	220	2.9	21	1.06
Wed 6/25/97 13:30	150.00	89	17.0	3.0	3.0	6.0	6.0	6.0	10	15	10	20	4.0	151,539	0	99.92	8.00	1.47	2.11	20.29				2.9		
Thu 6/26/97 7:30	166.00	79	17.0	3.0	3.0	6.0	6.0	6.0	11	14	10	20	4.0	152,688	7		8.00	1.47	2.11	20.29				2.9		26
Thu 6/26/97 13:30	174.00	92	17.0	3.0	3.0	6.0	6.0	6.0	10	15	10	20	4.0	153,085	0	99.94	7.00	1.47	2.11	20.29				2.9		
Fri 6/27/97 7:30	192.00	83	15.0	3.0	3.0	6.0	6.0	6.0	10	15	10	20	4.0	154,202	7		7.00	1.47	2.11	20.29	17,260	175	138	2.9	26	1.08
Fri 6/27/97 13:30	198.00	91	15.0	3.0	3.0	6.0	6.0	6.0	10	15	10	20	4.0	154,604	0	99.94	7.00	1.47	2.11	20.29				2.9		
Sat 6/28/97 7:30	216.00	86	15.0	3.0	3.0	6.0	6.0	6.0	10	15	10	20	4.0	155,695	7		7.00	1.47	2.11	20.29				2.9		26
Sat 6/28/97 13:30	222.00	91	14.0	3.0	3.0	6.0	6.0	6.0	10	15	10	20	4.0	155,947	0	99.94	7.00	1.47	2.11	20.29				2.9		
Sun 6/29/97 7:30	240.00	83	15.0	3.0	3.0	6.0	6.0	7.0	10	15	10	20	4.0	155,695	7		7.00	1.47	2.11	20.29				2.9		26
Sun 6/29/97 13:30	248.00	91	10.0	4.0	4.0	6.0	6.0	7.0	10	17	10	20	4.0	156,330		99.94	7.00	1.98	2.11	20.29				2.9		
Mon 6/30/97 8:00	264.50	82	1.0	4.5	4.0	6.0	6.0	7.4	10	11	20	10	4.0	157,442	8		7.25	2.21	2.11	20.29	15,660	182	152	2.9	23	1.06
Mon 6/30/97 14:00	270.50	93	0.0	5.0	3.5	6.0	6.0	7.0	10	13	20	10	3.5	157,779	0	99.93	7.00	2.48	2.11	20.29				3.3		
Tue 7/1/97 7:00	287.50	83	0.0	4.5	4.5	6.0	6.0	7.8	12	14	20	10	3.5	158,925	11		8.00	2.21	2.11	20.29				3.3	17	
Tue 7/1/97 13:00	293.50	93	11.0	4.5	4.0	6.0	6.0	7.4	10	13	20	10	4.0	159,333	0	99.90	7.50	2.21	2.11	20.29				2.9		
Wed 7/2/97 7:00	311.50	84	22.0	5.0	4.5	6.0	6.0	7.8	12	14	20	10	4.0	160,493	8		7.75	2.46	2.11	20.29	17,300	293	197	2.9	23	1.15
Wed 7/2/97 13:00	317.50	93	15.0	4.5	4.0	6.0	6.0	7.4	10	13	20	10	3.5	160,666	0	99.93	10.00	2.21	2.11	20.29				3.3		
Thu 7/3/97 7:00	335.50	85	18.0	4.5	4.0	6.0	6.0	7.9	12	15	20	10	3.5	161,936	10		10.25	2.21	2.11	20.29				3.3		19
Thu 7/3/97 13:00	341.50	94	15.0	4.5	4.0	6.0	6.0	7.8	11	13	20	10	3.5	162,290	0	99.90	10.00	2.21	2.11	20.29				3.3		
Fri 7/4/97 7:00	359.50	84	14.0	5.0	5.0	6.0	6.0	8.4	12	15	20	10	3.5	163,350	10		10.25	2.46	2.11	20.29	15,700	319	210	3.3	19	1.31
Fri 7/4/97 13:00	365.50	94	13.0	5.0	4.5	6.0	6.0	8.0	11	13	20	10	3.5	163,719	0	99.90	10.00	2.46	2.11	20.29				3.3		
Sat 7/5/97 7:10	383.67	82	13.0	5.0	5.0	6.0	6.0	8.0	11	15	20	10	3.5	164,727	10		10.00	2.46	2.11	20.29				3.3		19
Sat 7/5/97 13:30	390.00	92	11.0	5.0	5.0	6.0	6.0	8.0	11	14	20	10	3.5	165,059	0	99.90	10.00	2.46	2.11	20.29				3.3		
Sun 7/6/97 7:30	408.00	83	13.0	6.0	5.0	6.0	6.0	8.0	12	15	20	10	3.5	165,974	10		10.00	2.85	2.11	20.29				3.3		
Sun 7/6/97 13:30	414.00	94	11.0	6.0	6.0	6.0	6.0	6.0	11	14	20	10	3.5	166,178	0	99.90	10.00	2.46	2.11	20.29				3.3		
Mon 7/7/97 7:00	431.50	85	2.0	6.0	6.0	6.0	6.0	9.8	13	16	20	10	2.0	168,761	0		8.75	2.95	2.38	22.83				5.8		
Mon 7/7/97 13:00	437.50	90	10.0	5.5	5.0	6.0	6.0	7.8	12	16	20	10	2.0	167,059	10	99.83	10.00	2.70	2.38	22.83	16,040	542	184	5.8	19	1.34
Tue 7/8/97 7:00	455.50	83	5.0	6.0	6.0	6.0	6.0	8.2	13	17	20	10	2.5	167,978	15		10.00	2.95	2.38	22.83				4.7	12	
Tue 7/8/97 13:00	461.50	91	0.0	5.5	5.5	6.0	6.0	7.8	12	16	20	10	2.0	168,290	0	99.77	10.00	2.70	2.38	22.83				5.8		
Wed 7/9/97 7:00	479.50	81	0.0	7.0	6.5	10.0	10.0	8.2	13	18	20	10	2.0	169,185	0		10.25	3.44	2.84	25.36				5.8		
Wed 7/9/97 13:00	485.50	92	0.0	6.0	6.0	10.0	10.0	7.8	12	18	20	10	2.0	169,484	15	99.74	10.00	2.95	2.84	25.36	19,400	444	152	5.8	12	2.43
Thu 7/10/97 7:00	503.50	84	0.0	7.0	6.5	11.0	11.0	8.4	12	17	20	10	2.0	170,422	15		10.25	3.44	2.91	27.90				5.8	12	
Thu 7/10/97 13:00	509.50	92	0.0	6.5	6.5	11.0	11.0	8.4	12	18	20	10	3.0	170,703	0	99.79	10.00	3.19	2.91	27.90				3.9		
Fri 7/11/97 7:00	527.50	84	0.0	8.0	7.5	12.0	12.0	8.2	12	18	20	10	2.5	171,427	0		10.00	3.93	3.17	30.43				4.7		
Fri 7/11/97 13:00	533.50	94	0.0	7.0	6.5	6.0	6.0	8.4	11	18	20	10	3.0	171,748	15	99.81	10.00	3.44	2.11	20.29	18,800	412	158	3.9	12	2.36
Sat 7/12/97 7:00	551.50	83	0.0	8.0	7.5	6.0	6.0	8.0	11	15	20	10	3.0	172,841	15		10.00	3.93	2.11	20.29				3.9	12	
Sat 7/12/97 13:00	557.50	92	0.0	7.0	6.5	6.0	6.0	8.4	12	16	20	10	3.0	173,258	0	99.83	10.00	3.44	2.11	20.29				3.9		
Sun 7/13/97 7:00	575.50	82	0.0	8.0	6.5	6.0	6.0	8.2	11	15	20	10	3.0	174,417	15		10.00	4.42	2.11	20.29				3.9	12	
Sun 7/13/97 13:30	582.00	92	0.0	6.5	6.0	6.0	6.0	8.4	12	17	20	10	3.0	174,708		99.83	10.00	4.17	2.11	20.29				3.9		
Mon 7/14/97 7:00	599.50	83	0.0	9.5	9.0	6.0	6.0	7.8	13	18	20	10	3.5	175,910	0		10.00	4.87	2.11	20.29				3.3		
Mon 7/14/97 13:00	605.50	84	0.0	8.0	8.0	6.0	6.0	8.8	11	18	20	10	3.0	176,308	15	99.84	10.00	3.93	2.11	20.29	18250	162		3.9	12	2.03

APP-15

TABLE B-3
OPERATING DATA
ZEEWEED PHASE II

Date & Time	Cumulative Operating Time (hrs)	Temperature (°F)	Sprayer Pump Pressure (psi)	Vacuum Before Backpouse (in Hg)	Vacuum After Backpouse (in Hg)	Permeate Rate Before Backpouse (gpm)	Permeate Rate After Backpouse (gpm)	Backpouse Pressure (psig)	Backpouse Cartridge Pressure Inlet (psig)	Backpouse Cartridge Pressure Outlet (psig)	Backpouse Frequency (min)	Backpouse Duration (sec)	Permeate Rate to Drain (gpm)	Permeate Totalizer (gall)	Sludge Waste Vol (gall)	Avg. Daily Recovery (%)	Air Flow (scfm)	TMP (psi)	Permeate Rate Before Backpouse (gpm)	Flux (gpd/ft²)	Bioreactor MLSS (mg/l)	Feed CBOD (mg/L)	WWTP Influent CBOD (mg/L)	Hydraulic Retention Time	Solids Retention Time (d)	Sludge Production (lbs/d)
Tue 7/15/97 7:00	623.50	86	0.0	9.0	8.0	8.0	8.0	8.8	13	18	20	10	3.0	177,149	15	89.83	10.26	4.42	2.11	20.29						
Tue 7/15/97 13:00	629.50	83	0.0	8.0	8.0	8.0	8.0	8.2	12	16	20	10	3.0	177,641	0	89.83	10.00	3.93	2.11	20.29						
Wed 7/16/97 7:00	647.50	84	0.0	8.5	8.0	8.0	8.0	8.6	13	18	20	10	3.0	178,379	0	89.79	10.50	4.17	2.11	20.29						
Wed 7/16/97 13:00	653.50	94	0.0	8.0	8.0	8.0	8.0	8.2	12	17	20	10	3.0	178,743	18	89.79	10.00	3.93	2.11	20.29		17,100	181		10	2.57
Thu 7/17/97 7:00	671.50	84	0.0	8.5	8.0	8.0	8.0	8.8	13	18	20	10	3.0	179,398	18	89.79	10.25	4.17	2.11	20.29						
Thu 7/17/97 13:00	677.50	85	0.0	8.0	7.5	8.0	8.0	8.6	12	17	20	10	3.0	179,734	0	89.79	10.00	3.93	2.11	20.29						
Fri 7/18/97 7:00	695.50	83	0.0	9.0	8.0	8.0	8.0	8.8	13	18	20	10	3.0	180,374	0	89.79	10.25	4.42	2.11	20.29						
Fri 7/18/97 13:00	701.50	83	0.0	9.0	7.5	8.0	8.0	7.8	12	17	20	10	3.0	180,730	18	89.79	10.00	3.93	2.11	20.29		16,400	188		10	2.46
Sat 7/19/97 7:00	719.50	81	0.0	8.0	8.0	8.0	8.0	8.2	12	17	20	10	3.0	181,128	18	89.79	10.00	3.93	2.11	20.29						
Sat 7/19/97 13:00	725.50	92	0.0	8.0	8.0	8.0	8.0	8.4	12	16	20	10	3.0	181,224	0	89.79	10.00	3.93	2.11	20.29						
Sun 7/20/97 7:00	743.50	82	0.0	8.0	8.0	8.0	8.0	7.8	12	17	20	10	3.0	181,249	18	89.79	10.00	3.93	2.11	20.29						
Sun 7/20/97 13:00	749.50	91	0.0	8.0	7.5	8.0	8.0	8.2	12	16	20	10	3.0	181,423	0	89.79	10.00	3.93	2.11	20.29						
Mon 7/21/97 7:00	767.50	87	0.0	7.0	8.5	8.0	8.0	9.0	13	17	20	10	4.0	181,487	0	89.84	9.50	3.44	2.11	20.29						
Mon 7/21/97 13:00	773.50	94	0.0	7.5	8.5	8.0	8.0	7.0	12	17	20	10	4.0	181,912	18	89.84	10.00	3.68	2.11	20.29		13,750			10	2.06
Tue 7/22/97 7:00	791.50	88	0.0	8.0	7.5	8.0	8.0	8.9	13	18	20	10	4.0	183,204	14	89.88	10.25	3.93	2.11	20.29						
Tue 7/22/97 13:00	797.50	94	0.0	7.5	7.5	8.0	8.0	8.4	12	16	20	10	4.0	183,638	0	89.88	10.00	3.68	2.11	20.29						
Wed 7/23/97 7:00	815.50	85	0.0	8.5	8.0	8.0	8.0	8.8	13	18	20	10	4.0	184,371	0	89.88	10.00	4.17	2.11	20.29						
Wed 7/23/97 13:00	821.50	94	0.0	8.0	7.0	8.0	8.0	8.8	12	16	20	10	4.0	184,782	14	89.88	9.50	3.93	2.11	20.29		14,400			13	1.68
Thu 7/24/97 7:00	839.50	85	0.0	8.0	7.0	8.0	8.0	9.0	12	17	20	10	4.0	185,406	14	89.78	9.50	3.93	2.11	20.29						
Thu 7/24/97 13:00	845.50	93	0.0	8.0	7.0	8.0	8.0	8.8	12	16	20	10	4.0	185,470	0	89.88	10.00	3.93	2.11	20.29						
Fri 7/25/97 7:00	863.50	88	0.0	8.0	7.0	8.0	8.0	8.8	13	18	20	10	4.0	185,742	0	100.00	10.50	3.93	2.11	20.29						
Fri 7/25/97 13:00	869.50	85	0.0	7.6	8.5	8.0	8.0	8.4	12	18	20	10	3.5	186,116	14	89.87	10.00	3.68	2.11	20.29		14,440			13	1.89
Sat 7/26/97 7:00	887.50	89	0.0	8.5	8.0	8.0	8.0	8.4	13	18	20	10	4.0	186,622	0	89.87	10.25	3.19	2.11	20.29						
Sat 7/26/97 13:00	893.50	95	0.0	7.0	8.5	8.0	8.0	8.9	12	16	20	10	4.0	186,997	7	89.94	10.00	3.44	2.11	20.29						
Sun 7/27/97 7:00	911.50	89	0.0	7.0	8.5	8.3	8.0	8.8	13	18	20	10	1.0	187,515	14	89.82	10.50	3.44	2.18	20.92						
Sun 7/27/97 13:00	917.50	94	0.0	7.0	8.5	8.0	8.0	8.0	12	17	20	10	4.0	187,792	0	89.88	10.00	3.44	2.11	20.29						
Mon 7/28/97 7:00	935.50	88	0.0	8.5	8.0	10.0	10.0	8.9	14	19	20	10	4.0	188,237	14	89.88	10.25	4.17	2.64	25.38		15300			13	1.79
Mon 7/28/97 13:00	941.50	94	0.0	8.0	7.5	10.0	10.0	8.4	12	17	20	10	4.0	188,636	0	89.88	10.00	3.93	2.64	25.38						
Tue 7/29/97 7:00	959.50	88	0.0	8.5	8.0	12.0	12.0	8.6	14	19	20	10	4.0	189,288	18	89.84	10.50	4.17	3.17	30.43						
Tue 7/29/97 13:00	965.50	94	0.0	10.5	9.5	12.0	12.0	8.0	12	17	20	10	4.0	189,592	0	89.84	10.00	5.16	3.17	30.43						
Wed 7/30/97 7:00	983.50	88	0.0	10.0	9.5	11.0	11.0	8.8	13	19	20	10	4.0	190,059	16	89.88	10.25	4.91	2.91	27.90		15300			12	2.04
Wed 7/30/97 13:00	989.50	95	0.0	8.0	7.5	8.0	8.0	9.0	12	18	20	10	4.0	190,352	0	89.88	10.00	3.93	2.11	20.29						
Thu 7/31/97 7:00	1007.50	87	0.0	8.5	8.0	9.0	9.0	9.0	13	18	20	10	4.0	190,715	18	89.84	10.25	4.17	2.38	22.83						
Thu 7/31/97 13:00	1013.50	94	0.0	8.5	8.0	8.0	8.0	9.8	12	16	20	10	4.0	191,033	0	89.84	10.00	4.17	2.11	20.29						
Fri 8/1/97 7:00	1031.50	87	0.0	8.5	8.0	8.0	8.0	9.2	13	19	20	10	4.0	191,574	18	89.88	10.25	4.17	2.11	20.29		14700			12	1.96
Fri 8/1/97 13:00	1037.50	94	0.0	8.0	7.0	8.0	8.0	7.8	13	18	20	10	2.0	191,938	0	89.88	10.00	3.93	2.11	20.29						
Sat 8/2/97 7:00	1055.50	87	0.0	8.0	7.0	8.0	8.0	8.6	13	17	20	10	4.0	193,076	14	89.88		3.93	2.11	20.29						
Sat 8/2/97 13:00	1061.50	91	0.0	8.0	7.0	8.0	8.0	8.6	12	17	20	10	4.0	193,441	0	89.88		3.93	2.11	20.29						
Sun 8/3/97 7:00	1078.50	88	0.0	7.0	6.5	8.0	8.0	9.1	13	18	20	10	4.0	194,178	18	89.88		3.44	2.11	20.29						
Sun 8/3/97 13:00	1085.50	98	0.0	7.0	6.5	8.0	8.0	9.4	12	17	20	10	4.0	194,398	0	89.88		3.44	2.11	20.29						
Mon 8/4/97 7:00	1103.50	88	0.0	7.5	7.0	8.0	8.0	9.2	13	18	20	10	4.0	194,587	18	89.88	10.25	3.68	2.11	20.29		14150			12	1.89
Mon 8/4/97 13:00	1109.50	98	0.0	8.0	7.0	8.0	8.0	8.8	12	18	20	10	4.0	194,850	0	89.88	10.00	3.93	2.11	20.29						
Tue 8/5/97 7:00	1127.50	87	0.0	8.0	7.5	8.0	8.0	8.9	13	18	20	1.0	195,802	16	89.88	10.25	3.93	2.11	20.29							
Tue 8/5/97 13:00	1133.50	94	0.0	8.0	7.0	8.0	8.0	7.2	13	18	20	10	2.0	196,171	0	89.86	10.00	3.93	2.11	20.29						
Wed 8/6/97 7:00	1151.50	87	0.0	8.5	8.0	8.0	8.0	7.8	14	19	20	2.6	197,148	14	89.85	10.00	4.17	2.11	20.29		12300			13	1.44	
Wed 8/6/97 13:00	1157.50	98	0.0	8.0	7.5	8.0	8.0	7.4	12	17	20	2.5	197,457	0	89.81	10.00	3.93	2.11	20.29							
Thu 8/7/97 7:00	1175.50	88	0.0	8.0	8.5	8.0	8.0	8.0	14	19	20	2.5	198,330	10	89.86	10.25	4.42	2.11	20.29							
Thu 8/7/97 13:00	1181.50	95	0.0	8.0	7.5	8.0	8.0	7.4	12	18	20	2.6	198,628	0	89.86	10.00	3.93	2.11	20.29							
Fri 8/8/97 7:00	1199.50	88	0.0	9.0	8.5	8.0	8.0	8.0	14	20	10	2.5	199,510	10	89.88	10.25	4.42	2.11	20.29		12850			18	1.10	
Fri 8/8/97 13:00	1205.50	95	0.0	8.0	7.5	8.0	8.0	7.8	13	18	20	2.5	199,809	0	89.86	10.00	3.93	2.11	20.29							
Sat 8/9/97 7:00	1223.50	85	0.0	8.5	8.0	8.0	8.0	8.0	14	20	10	2.5	200,678	10	89.86	10.25	4.17	2.11	20.29							
Sat 8/9/97 13:00	1229.50	98	0.0	8.5	8.0	8.0	8.0	7.8	13	18	20	2.5	200,975	0	89.86	10.00	4.17	2.11	20.29							

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TABLE B-3
OPERATING DATA
ZEEWEED - PHASE II

Date & Time	Cumulative Operating Time (hrs)	Temperature (°F)	Sprayer Pump Pressure (psi)	Vacuum Before Backpouse (in Hg)	Vacuum After Backpouse (in Hg)	Permeate Rate Before Backpouse (lpm)	Permeate Rate After Backpouse (lpm)	Backpouse Pressure (psi)	Backpouse Cartridge Pressure Inlet (psig)	Backpouse Cartridge Pressure Outlet (psig)	Backpouse Frequency (Hz)	Backpouse Duration (sec)	Permeate Rate to Drain (lpm)	Permeate Totalizer (gal)	Sludge Waste Vol (gal)	Avg. Daily Recovery (%)	Air Flow (scfm)	TMP (psi)	Permeate Rate Before Backpouse (gpm)	Filtr (gpd/ft²)	Bioreactor MLSS (mg/l)	Feed CBOB (mg/L)	WWTP Influent CBOB (mg/L)	Hydraulic Retention Time	Solids Retention Time (d)	Sludge Production (lbs/d)
Sun 8/10/97 7:00	1247.50	85	0.0	8.0	8.5	8.0	8.0	7.8	14	20	10	20	2.5	201,846	10	89.88	10.25	4.42	2.11	20.29	12850			4.7	19	107
Sun 8/10/97 13:00	1253.50	85	0.0	8.5	8.0	8.0	8.0	7.8	13	19	10	20	2.5	202,142	0	89.88	10.00	4.17	2.11	20.29				4.7		
Mon 8/11/97 7:00	1271.50	87	0.0	9.0	8.5	8.0	8.0	8.0	14	20	10	20	2.5	203,021	11	89.85	10.25	4.42	2.11	20.29	14400			4.7	17	132
Mon 8/11/97 13:00	1277.50	95	0.0	9.0	8.0	8.0	8.0	7.4	13	19	10	20	2.6	203,316	0	89.85	10.00	4.42	2.11	20.29				4.7		
Tue 8/12/97 7:00	1295.50	87	0.0	9.0	8.5	8.0	8.0	7.8	14	20	10	20	2.5	204,188	10	89.86	10.25	4.42	2.11	20.29				4.7	19	
Tue 8/12/97 13:00	1301.50	85	0.0	8.5	8.0	8.0	8.0	7.4	13	19	10	20	2.5	204,483	0	89.96	10.00	4.17	2.11	20.29				4.7		
Wed 8/13/97 7:00	1319.50	85	0.0	9.0	8.0	8.0	8.0	7.9	14	20	10	20	2.5	205,358	11	89.85	10.00	4.67	2.11	20.29	13700			4.7	17	126
Wed 8/13/97 13:00	1325.50	94	0.0	9.0	9.0	8.0	8.0	7.2	13	19	10	20	2.5	205,642	0	89.85	10.00	4.67	2.11	20.29				4.7		
Thu 8/14/97 7:00	1343.50	84	0.0	10.0	9.5	8.0	8.0	7.4	15	21	10	20	2.5	206,529	10	89.86	10.00	4.91	2.11	20.29				4.7	19	
Thu 8/14/97 13:00	1349.50	95	0.0	9.0	8.0	8.0	8.0	7.7	13	19	10	20	2.5	206,810	0	89.86	10.00	4.67	2.11	20.29				4.7		
Fri 8/15/97 7:00	1367.50	85	0.0	10.5	9.5	8.0	8.0	7.8	14	21	10	20	2.5	207,690	10	89.86	10.25	5.16	2.11	20.29	13100			4.7	19	109
Fri 8/15/97 13:00	1373.50	88	0.0	9.5	8.0	8.0	8.0	7.2	13	19	10	20	2.5	207,971	0	89.88	10.00	4.67	2.11	20.29				4.7		

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**TABLE B-4
WATER QUALITY DATA
MEMCOR - PHASES I AND II**

Date	Feed Water									Memcor Filtrate																Memcor Backwash																	
	TDS [mg/l]	Conductivity [uS/cm]	pH	Turbidity [NTU]	TSS [mg/l]	TOC [mg/l]	Color [color units]	UVA	Total Coliform [CFU/100ml]	Fecal Coliform [CFU/100ml]	HPC [CFU/ml]	Run Time	Conductivity A.M. [uS/cm]	Conductivity P.M. [uS/cm]	Conductivity AVG [uS/cm]	pH	Turbidity A.M. [NTU]	Turbidity P.M. [NTU]	Turbidity AVG [NTU]	TSS [mg/l]	SDI	TOC [mg/l]	Color [color units]	UVA	TDS [mg/l]	BOD ₅ [mg/l]	NH ₃ -N [mg/l]	N-NO ₂ -NO ₃ [mg/l]	TKN [mg/l]	P-Total Phosphorus [mg/l]	Total Coliform [CFU/100ml]	Fecal Coliform [CFU/100ml]	HPC [CFU/ml]	Conductivity [uS/cm]	pH	Turbidity [NTU]	TDS [mg/l]	TSS [mg/l]					
Sun 27-07				(2)								2448.7	1520	1530	1525	7.06	(2)																										
Mon 28-07				(2)	5			16	10	19,900		2472.2	1420	1440	1430	7.20	(2)			0.2	0.8																						
Tue 29-07				(2)								2495.2	1530	1510	1520	7.04	(2)					1.07	7.6	15				0.04	0.7	1.1	0.6	ND	ND	5,600									
Wed 30-07				(2)								2518.5	1560	1520	1540	7.02	(2)					1.07																					
Thu 31-07				(2)								2541.8	1540	1580	1560	7.08	(2)					1.2																					
Fri 1-08				(2)								2564.9	1550	1710	1630	7.04	(2)					2.47																					
Sat 2-08				(2)								2586.2	1560		780	6.96	(2)																										
Sun 3-08				(2)								2609.3	1540	1560	1550	7.00	(2)																										
Mon 4-08				(2)	2							2632.8	1500	1500	1500	7.07	(2)			0.17	2.47	6.4	5	0.124		1.08	0.02	3.9	1.0	0.8													
Tue 5-08				(2)								2655.9	1520	1500	1510	7.00	(2)					0.87																					
Wed 6-08				(2)								2679.3	1500	1670	1585	6.98	(2)					1.8		0.137																			
Thu 7-08				1.9								2702.4	1530	1550	1540	6.99	0.04	0.18	0.11		2.07																						
Fri 8-08				2.17								2725.5	1530	1710	1620	7.06	0.12	0.02	0.07		2																						
Sat 9-08				1.56								2748.4	1710	1910	1810	7.00	0.06	0.11	0.09																								
Sun 10-08				1.43								2771.9	1500	1740	1620	7.05	0.2	0.29	0.25																								
Mon 11-08				1.88	1.5			ND	59	7,000		2795.1	1420	1490	1455	6.97	0.08	-0.03	0.03	0.4	1.73	7.6	5	0.11		0.61	0.03	2.8	2.3	1.77	ND	ND	1,500										
Tue 12-08				1.89								2818.3	1470	1660	1565	7.08	0.04	0.02	0.03		1.87																						
Wed 13-08				3.75								2841.6	1450	1530	1490	7.1	0.03	0.07	0.05		1.73			0.135																			
Thu 14-08				2.19								2864.7	1490	1610	1550	7.2	0.06	0.01	0.04		1.67																						
Fri 15-08				2.43									1510		755	7.1	0.05		0.03																								

Notes:
 (1) - Unit Down for Cleaning
 (2) - Turbidimeter not working properly
 NS - Not Sampled
 ND - Not Detected

**TABLE B-5
WATER QUALITY DATA
ZEEWEED - PHASE I**

Date	Feed Water										Zeeweed Permeate										Zeeweed Concentrate																		
	TDS [mg/l]	Conductivity [uS/cm]	pH	Turbidity [NTU]	TSS [mg/l]	TOC [mg/l]	Color [color units]	UVA	Total Coliform [CFU/100ml]	Fecal Coliform [CFU/100ml]	HPC [CFU/ml]	Run Time [hr]	TDS [mg/l]	Conductivity A.M. [uS/cm]	Conductivity P.M. [uS/cm]	Conductivity AVG [uS/cm]	pH	Turbidity A.M. [NTU]	Turbidity P.M. [NTU]	Turbidity AVG [NTU]	TSS [mg/l]	SDI [CFU/ml]	TOC [mg/l]	Color [color units]	UVA	Total Coliform [CFU/100ml]	Fecal Coliform [CFU/100ml]	HPC [CFU/ml]	TDS [mg/l]	Conductivity [uS/cm]	pH	Turbidity [NTU]	TSS [mg/l]	Total Coliform [CFU/100ml]	Fecal Coliform [CFU/100ml]	HPC [CFU/ml]			
Fri 30-05		2000	7.00	1.35								1108.5	2140	2030	2085	8.05	0.04	0.04	0.04																				
Sat 31-05		1830	7.00	1.80								1132.5	1880	1810	1845	8.00	0.15	0.06	0.11			3.60																	
Sun 1-06		1820	7.08	26.00								1156.5	1880	1860	1870	8.30	0.62	0.14	0.38																				
Mon 2-06		1780	7.02	1.00								1180.5	1870	2020	1945	7.97	0.06	0.05	0.06																				
Tue 3-06		1750	7.00	1.20	2.88							1205.5	1760	2180	1970	8.01	0.04	0.04	0.04			2.80																	
Wed 4-06		1940	6.91	1.40								1228.5	2000	1990	1995	7.99	0.09	0.12	0.11			2.60																	
Thu 5-06		1640	6.93	1.34				0.115				1252.5	1730	1840	1785	7.84	0.10	0.11	0.11			4.80																	
Fri 6-06		1700	6.87	1.74								1276.5	1710	1740	1725	7.99	0.06	0.10	0.08			7.20		6.7	10	0.117													
Sat 7-06		1600	6.98	1.60								1300.5	1610	1600	1605	8.00	0.16	0.05	0.11																				
Sun 8-06		1700	7.02	1.90								1324.5	1720	1740	1730	8.04	0.12	0.10	0.11																				
Mon 9-06		1520	6.93	1.10								1349.0	1550	1700	1625	8.08	0.07	0.08	0.08																				
Tue 10-06	984	1570	7.16	1.20	0.8							1373.0	1620	1820	1720	8.09	0.07	0.05	0.06			7.10																	
Wed 11-06		1640	7.00	1.94								1397.0	1680	2000	1840	8.13	0.17	0.33	0.25			0																	
Thu 12-06		1580	7.00	1.54								1420.5	1730	N/A	1730	7.74	0.34	N/A	0.34			8.10																	
Fri 13-06		1630	7.11	1.22								1445.0	1660	1720	1690	8.02	0.32	0.10	0.21			5.67																	
Sat 14-06		1600	7.17	3.40								1469.0	1620	1600	1610	8.24	0.18	0.10	0.14																				
Sun 15-06		1620	7.10	2.12								1493.0	1640	1630	1635	8.13	0.22	0.14	0.18																				

Notes:
NS - Not Sampled

Appendix C. Laboratory Reports

Source Water Data



CH2MHILL

CH2M HILL
2300 NW Walnut Blvd.
Corvallis, OR
97330-3538
Mailing address:
P.O. Box 428
Corvallis, OR
97339-0428
Tel 541.752.4271
Fax 541.752.0276

June 30.1997

City of McAllen

138067.A0.ZZ

RE: Analytical Data for City of McAllen
CVO Laboratory Reference No. 5440 and 5590

Jim Geisbush/PHX

On June 3.1997. the CH2M HILL Corvallis Applied sciences Laboratory received one sample with a request for analysis of selected parameters.

The analytical results and associated quality control data are enclosed Any unusual difficulties encountered during the analysis of your samples are discussed in the case narrative.

Under CH2M HILL policy. your samples will be stored for 30 days after reporting. If you have nor given us prior instructions for disposal. we will contact you if any samples require disposal as hazardous waste.

The CH2M HILL Applied Sciences Laboratory appreciates your business and looks forward co serving your analytical needs again. If you should have any questions concerning the data. or if you need additional information. please call Ms. Kathy McKinley at (541) 758-0235. extension 3 120.

Sincerely,

Kelly Ensor
Senior Administrative Assistant

Enclosures

Applied Sciences Laboratory 2300 NW Walnut Blvd., Corvallis, OR 97330-3538
Corvallis Office P. O. Box 428, Corvallis, OR 97339-0428

541 752-4271
Fax No. 541 752-0276

CLIENT SAMPLE CROSS-REFERENCE

CH2M KILL Applied Science Laboratory Reference No. 5440 and 5590

CVO Sample ID	Client Sample ID	Date Collected	Time Collected
%001	Lake2	06/02/1997	11:45
559001	Lake2 3D	6/21/97	12:16

**CASE NARRATIVE
DBPs**

Lab Reference No.: 5590

Client/Project: City of McAllen

L. Holding Times:
All acceptance criteria were.

II. Analysis:

A. _____
All acceptance criteria were met.

B. Blanks:
All acceptance criteria were met.

C. Duplicate Sample(s):
All acceptance criteria were met.

D. Spike Sample(s):
All acceptance criteria were met except for trichloroacetic acid which had a spike recovery of 64%.

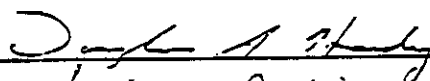
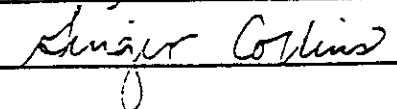
E. Surrogate Recoveries
All acceptance criteria were met.

F. Lab Control Sample(s):
All acceptance criteria were met.

G. Other:
None

III. Documentation Exceptions:
None

IV. I certify that this data package is in compliance with the terms and conditions agreed to by the client and CH2M HILL, both technically and for completeness, except for the conditions detailed above. Release of the data contained in this hardcopy data package has been authorized by the Laboratory Manager or designee, as verified by the following signature.

Prepared by: 
Reviewed by: 

CASE NARRATIVE
FORMATION POTENTIAL

Lab Reference No.: 5440

Client/Project: City of McAllen

- I. Holding Time:
Formation potential was set up 16 days after sample collection.
- II. pH / Cl residual analysis:
- A. Calibration:
All acceptance criteria were met.
- B. Blanks:
All acceptance criteria were met.
- C. Other:
The added precursor blank had a recovery of 139%.
- IV. Documentation Exceptions:
None
- V. I certify that this data package is in compliance with the terms and conditions agreed to by the client and CH2M HILL, both technically and for completeness, except for the conditions detailed above. Release of the data contained in this hardcopy data package has been authorized by the Laboratory Manager or his designee, as verified by the following signature.

Prepared by:

Donald A. Hardy

Reviewed by:

Denise Collins

CASE NARRATIVE
GENERAL CHEMISTRY

Lab Reference No.: 5440

Client/Project: City of McAllen

- I. Holding Time:
All acceptance criteria were met.
- II. Digestion Exceptions:
None
- III. Analysis:
- A. Calibration:
All acceptance criteria were met.
- B. Blanks:
All acceptance criteria were met.
- C. Matrix Spike Sample(s):
All acceptance criteria were met.
- D. Duplicate Sample(s):
All acceptance criteria were met.
- E. Lab Control Sample(s):
All acceptance criteria were met.
- F. Other:
Not applicable.
- IV. Documentation Exceptions:
None.

V. I certify that this data package is in compliance with the terms and conditions agreed to by the client and CH2M HILL, both technically and for completeness, except for the conditions detailed above. Release of the data contained in this hardcopy data package has been authorized by the Laboratory Manager or his designee, as verified by the following signature.

Prepared by: Helen Van Nieu

Reviewed by: Laura Estame

CASE NARRATIVE
METALS

Lab Reference No.: 5440

Client/Project: City of McAllen

- I. Holding Time:
All acceptance criteria were met.
- II. Digestion Exceptions:
None
- III. Analysis:
- A. Calibration:
All acceptance criteria were met.
- B. Blanks:
All acceptance criteria were met.
- C. ICP Interference Check Sample:
All acceptance criteria were met.
- D. Spike Sample(s):
All acceptance criteria were met.
- E. Duplicate Sample(s):
All acceptance criteria were met.
- F. Laboratory Control Sample(s):
All acceptance criteria were met except Silicon which had a recovery of 131%.
- G. ICP Serial Dilution:
Not Required.
- H. Other:
None
- IV. Documentation Exceptions:
None
- V. I certify that this data package is in compliance with the terms and conditions agreed m by the client and CH2M HILL, both technically and for completeness, except for the conditions detailed above. Release of the data contained in this hardcopy data package has been authorized by the Laboratory Manager or his designee, as verified by the following signature.

Prepared by: 

Reviewed by: 

Corvallis Applied Sciences Laboratory

Client Information

Project Name: Cii of McAllen Pilot Study
 Project Manager: Patrick Asogwa
 Sampled by: M. Salazar
 Client Sample ID: Lake2
 Sampling Date: 6/2/97
 Sampling time: sea Chain of Custody
 Type: Grab
 Matrix: Water
 Basis: As received

Lab Information

Dam Rec'd: 6/3/97
 Lab ID: 544001
 Report Revision No.: 0
 Reported By: HVN and KDJ
 Reviewed By: *LAS*

Analyte	Reporting Limit	Sample Result	Qualifier	Units	Method	Date Analyzed
Chemistry						
Alkalinity		1060		mg/L	EPA 310.1	6/11/97
Bicarbonate		1060		mg/L	EPA 310.1	6/11/97
Carbonate	1.0	1.0	U	mg/L	EPA 310.1	6/11/97
Bromide	0.03	0.54		mg/L	EPA 300	6/20/97
Chloride	2.50	201		mg/L	EPA 300	6/5/97
Color (ALPHA) Apparent	5	10		color units	EPA1 102	6/4/97
color w-254	0.009	0.092		abs/cm	SM 5910	6/4/97
Fluoride-Free	0.10	0.99		mg/L	EPA 300	6/4/97
N-Nile	0.10	0.10	U	mg/L	EPA300	6/4/97
P-oral Phosphorus	0.05	0.05	U	mg/L	EPA 365.1	6/9/97
Total Dissolved Solids	1	772		mg/L	EPA 160.1	6/9/97
Sulfate	250	262		mg/L	EPA 300	6/5/97
TOC	0.50	3.9		mg/L	EPA 415.1/2	6/9/97
Metals						
Aluminum, ICP	42.1	248		µg/L	EPA 200.7	6/16/97
Barium, ICP	0.53	124		µg/L	EPA 200.7	6/16/97
Calcium, I C P	49.7	77.700		µg/L	EPA 200.7	6/16/97
Iron, ICP	17.8	171		µg/L	EPA 200.7	6/16/97
Magnesium, ICP	29.2	27.900		µg/L	EPA 200.7	6/16/97
Manganese, ICP	0.8	17.8		µg/L	EPA 200.7	6/16/97
Potassium, ICP	275	9,580		µg/L	EPA 200.7	6/16/97
Silicon, ICP	110	6.300		µg/L	EPA 200.7	6/17/97
Sodium, ICP	135	140,000		µg/L	EPA 200.7	6/16/97
Strontium, ICP	9.4	2,400		µg/L	EPA 200.7	6/17/97

U=Not detected at specified reporting limits

Corvallis Applied Sciences Laboratory

Project Information	Lab Information
Project Name: City of McAllen Pilot Study	Date Rec'd: 6/3/97
Project Manager: Patrick Asogwa	Lab ID: 544001
Sampled By: M. Salazar	Analysis Method: SM 5710.D
Client Sample ID: Lake2	Report Revision No.: 0
Sampling Date: 6/2/97	Reported By: OAH
Sampling Time: 11:35	Reviewed By: <i>gmc</i>
Type: Grab	
Matrix: Water	
Basis: As Received	

HAA/THM Formation Potential Test Conditions

Set-up Date/Time	Target Contact Time	Initial pH	Contact pH	Contact Temperature (°C)	Chlorine Dosage (mg/L)
6/18/97 16:08	3 days	7.6	7.6	25	6.50

Chlorine Demand Test Results

Take-off Date/Time	Contact Time	Measured pH	Measured Temperature ccl	Chlorine Residual (mg/L)
6/21/97 12:16	68:08	7.8	25	0.30

U=Not detected at specified reporting limits

Corvallis Applied Sciences Laboratory

Client Information

Project Name: City of McAllen Pilot Study
 Project Manager: Patrick Asogwa
 Sampled By: O. Hardy
 Client Sample ID: Lake2 30
 Sampling Date: 6/21/97
 Sampling Time: 1216
 Type: Grab
 Matrix: Water
 Basis: As Received

Lab Information

Date Rec'd: 6/23/97
 Lab ID: 559001
 Report Revision No.: 0
 Reported By: OAH
 Reviewed By: *gmc*
 Units: µg/L

Analyte	CAS #	Reporting Limit	Sample Result	Qualifier	Date Analyzed
<i>Haloacetic Acids - SM 6251.B</i>					
Chloroacetic acid	79-11-8	0.5	3.3		6/24/97
Bromoacetic acid	A-06-3	0.5	53		6/24/97
Dichloroacetic acid	79-43-6	0.5	152		6/24/97
Trichloroacetic acid	76-03-9	0.5	8.9		6/24/97
Bromochloroacetic acid	5589-96-3	a.5	20.1		6/24/97
Dibromoacetic acid	631-64-t	0.5	18.6		6/24/97
2,3-Dibromopropanoic acid	600-05-5		115%	SS	
<i>Trihalomethanes - EPA 502.2</i>					
Chloroform	67-66-3	0.5	35.3		6/23/97
Bromodichloromethane	75-27-4	0.5	63.7		6/23/97
Dibromochloromethane	124-48-1	a.5	81.3		6/23/97
Bromoform	75-25-2	0.5	34.3		6/23/97
1,2-Dichloroethane-d4	17068-07-0		94%	SS	

SS=Surrogate standard

U=Not detected at specified reporting limits

CH2MHILL Analytical Services
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AND AGREEMENT TO PERFORM SERVICES

1 LMG 2667 Feklene Drive
 Montgomery, AL 36116-1822
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1 LRD 6090 Caterpillar Road
 Redding, CA 96003-1412
 (916) 244-6227 FAX (916) 244-4108

1 LKW Carviro Analytical Laboratories, Inc.
 50 Bathurst, Unit 12, Waterloo, Ontario, Canada N2V 2C5
 (519) 747-2575 FAX (519) 747-3806

1 LCV 2300 NW Walnut Boulevard
 Corvallis, OR 97330 3838
 (541) 752-4271 FAX (541) 752-0276

COC #

Project # 138067 AD.22		Purchase Order #		Requested Analytical Method #										THIS AREA FOR LAB USE ONLY																																																																														
Project Name McAllen Pilot Study				TOTAL # OF CONTAINERS	<table border="1"> <tr> <td>Lab #</td> <td>Page</td> <td>of</td> </tr> <tr> <td>559001</td> <td>1</td> <td>1</td> </tr> <tr> <td>Lab PM</td> <td colspan="2">Custody Review</td> </tr> <tr> <td>Log In</td> <td colspan="2">LIMS Verification</td> </tr> <tr> <td>pH</td> <td colspan="2">Custody Seals Y N</td> </tr> <tr> <td></td> <td>Ice</td> <td>V N</td> </tr> <tr> <td>IC Level</td> <td>1</td> <td>2</td> <td>3</td> <td>Other</td> </tr> <tr> <td colspan="3">Cooler Temperature</td> <td rowspan="2">Lab ID</td> </tr> <tr> <td colspan="3">Alternate Description</td> </tr> </table>										Lab #	Page	of	559001	1	1	Lab PM	Custody Review		Log In	LIMS Verification		pH	Custody Seals Y N			Ice	V N	IC Level	1	2	3	Other	Cooler Temperature			Lab ID	Alternate Description			Lab #																																															
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Requested Completion Date: ASAP		Site ID Lake #2		<table border="1"> <tr> <td colspan="2">Sample Disposal:</td> <td colspan="17">Preservative</td> </tr> <tr> <td>Dispose</td> <td>Return</td> <td colspan="17"></td> </tr> <tr> <td><input type="checkbox"/></td> <td><input type="checkbox"/></td> <td colspan="17"></td> </tr> </table>													Sample Disposal:		Preservative																	Dispose	Return																		<input type="checkbox"/>	<input type="checkbox"/>																																				
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Special Instructions:																																																																																												

APP-28

Contact: **Ginger**

June 27, 1997

City of McAllen

138067.A0.ZZ

RE: **Analytical** Dam for City of **McAllen**
CVO **Laboratory Reference** No. 5440 and 5590

Jim Geisbush/PHX

On June 3, 1997, the **CH2M HILL Corvallis Applied Sciences** Laboratory received one sample with a request for analysis of selected parameters.

The **analytical results** and associated **quality control data** are enclosed. Any unusual **difficulties** encountered during the **analysis** of your **samples** are discussed in the case narrative.

Under **CH2M HILL** policy, your samples will be stored for 30 days after **reporting**. If you have not given us prior **instructions** for disposal, we **will contact** you if **any** samples require **disposal** as hazardous waste.

The **CH2M HILL Applied Sciences Laboratory** appreciates your **business** and looks forward to sewing your analytical needs **again**. If you should have any questions concerning the **data**, or if you need additional **information**, please call Ms. Kathy **McKinley** at (541) **758-0235**, extension 3 120.

Sincerely,



Kelly Ensor
Senior Administrative Assistant

Enclosures

Applied Sciences
Laboratory
Corvallis Office

2300 NW Walnut Blvd., Corvallis, OR 97330-3538
P. O. Box 428, Corvallis, OR 97339-0428

541 752-4271
Fax No. 541 752-0276

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1 LMO 2687 Fairlane Drive
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1 IIR 6090 Caterpillar Road
 Redding, CA 96003-1412
 (916) 244-6227 FAX (916) 244-4109

1 ILKW Canvira Analytical Laboratories, Inc.
 60 Bathurst, Unit 12, Waterloo, Ontario, Canada N2V 2C5
 (519) 747-2676 FAX (519) 747-3808

1 IUCO 2300 NW Walnut Boulevard
 Corvallis, OR 97330-3634
 (541) 752-4271 FAX (541) 752-0276

COC # _____

Project # 138067.A7.22		Purchase Order #		TOTAL # OF CONTAINERS										Requested Analytical Method #						THIS AREA FOR LAB USE ONLY		
Project Name McAllen Pilot Study														Metals TOC Organics Inorganics General Chemical Analysis (Residue) General Chemical Analysis (2L Residue)						Lab # 5440-1		Page
Company Name McAllen Public Utilities				Preservative HNO3 H2SO4 NONE HNO3 NONE HNO3						Lab PM		Custody Review										
Project Manager or Contact & Phone # Patrick Asogwa (916) 611-4151		Report Copy to: Jim Geisbush								Log In		LIMS Verification										
Requested Completion Date: ASAP		Site ID Lake #2		Sample Disposal: Dispose <input checked="" type="checkbox"/> Return <input type="checkbox"/>		pH		Custody Seals Y N		Ice Y N												
Sampling		Type		Matrix		CLIENT SAMPLE ID (8 CHARACTERS)				LAB QC		QC Level 1 2 3 Other										
Date Time		COM GRAB		WATER SOIL AIR								Cooler Temperature										
												Alternate Description										
6-2-97 11:45A		✓		✓		LAK2						} 1 Order UV-254										
6-2-97 11:30A		✓		✓		LAK2																
6-2-97 11:35		✓		✓		LAK2																
6-2-97 11:36		✓		✓		LAK2																
6-2-97 11:40		✓		✓		LAK2																
6-2-97 11:46		✓		✓		LAK2																
Relinquished By		Empty Bottles		Date/Time		Received By		Empty Bottles		Date/Time												
Sampled By and Title Mark Sch Martin Salazar		(Please sign and print name)		Date/Time 6-2-97 12:00		Relinquished By Mark Sch Martin Salazar		(Please sign and print name)		Date/Time 6-2-97 12:00												
Received By Vari M... ..		(Please sign and print name)		Date/Time 6-2-97		Relinquished By		(Please sign and print name)		Date/Time												
Received By		(Please sign and print name)		Date/Time		Shipped Via UPS Fed-Ex Other		Shipping #														
Special Instructions:												contact: Ginger										

APP-30

CLIENT SAMPLE CROSS-REFERENCE

CH2M HILL Applied Science Laboratory Reference No. 5440 and 5590

CVO Sample ID	Client Sample ID	Date Collected	Time Collected
544001	Lake2	6/2/97	11:45
559001	Lake2 3D	6/21/97	12:16

**CASE NARRATIVE
DBPs**

Lab Reference No.: 5590

Client/Project: City of McAllen

I. Holding Times:
All acceptance criteria were met.

II. Analysis:

A. **Calibration:**
All acceptance criteria were met.

B. **Blanks:**
All acceptance criteria were met.

C. **Duplicate Sample(s):**
All acceptance criteria were met.

D. **Spike Sample(s):**
All acceptance criteria were met except for trichloroacetic acid which had a spike recovery of 64%.

E. **Surrogate Recoveries:**
All acceptance criteria were met.

F. **Lab Control Sample(s):**
All acceptance criteria were met.

G. **Other:**
None

III. Documentation Exceptions:
None

IV. I certify that this data package is in compliance with the terms and conditions agreed to by the client and CH2M HILL, both technically and for completeness, except for the conditions detailed above. Release of the data contained in this hardcopy data package has been authorized by the Laboratory Manager or designee, as verified by the following signature.

Prepared by: _____

Reviewed by: _____

CASE NARRATIVE
FORMATION POTENTIAL.

Lab Reference No.: 5440

Client/Project: City of McAllen

L **Holding Time:**
Formation potential was **set up** 16 days **after** sample **collection**.

II **pH / Cl residual analysis:**

A. **Calibration:**
All acceptance criteria **were met**.

B. **Blanks:**
All acceptance criteria **were met**

C. **Other:**
The added precursor blank had a recovery of 139%.

IV. **Documentation Exceptions:**
None

V. I **certify** that this **data** package is in **compliance with the terms** and conditions agreed **to** by **the client** and **CH2M HILL**, both **technically** and for **completeness**, **except** for the conditions derailed above. Release of **the data contained** in **this** hardcopy **data** package has been **authorized** by **the Laboratory Manager** or his **designee**, as verified by **the** following signature.

Prepared by: _____

Reviewed by: _____

**CASE NARRATIVE
GENERAL CHEMISTRY**

Lab Reference No.: **5440**

Client/Project: City of McAllen

- I. Holding Time:
All acceptance criteria were met.

- II. Digestion Exceptions:
None

- III. Analysis:
 - A. Calibration:
All acceptance criteria were met.

 - B. Blanks:
All acceptance criteria were met.

 - C. Matrix Spike Sample(s):
All acceptance criteria were met.

 - D. Duplicate Sample(s):
All acceptance criteria were met.

 - E. Lab Control Sample(s):
All acceptance criteria were met.

 - F. Other:
Not applicable.

- IV. Documentation Exceptions:
None.

- V. I certify **that** this data package is in **compliance** with the **terms** and conditions agreed to by the client and **CH2M HILL**, both **technically** and for **completeness**, except for the **conditions detailed** above. Release of the data **contained in this** hardcopy data package **has** been authorized by the **Laboratory** Manager or his designee, **as** verified by **the** following signature.

Prepared by: _____

Reviewed by: _____

**CASE NARRATIVE
METALS**

Lab Reference No.: 5440

Client/Project: City of McAllen

- I. Holding Time:
All acceptance criteria were met.
- II. Digestion Exceptions:
None
- III. Analysis:
- A. Calibration:
All acceptance criteria were met.
 - B. Blanks:
All acceptance criteria were met.
 - C. ICP Interference Check Sample:
All acceptance criteria were met.
 - D. Spike Sample(s):
All acceptance criteria were met.
 - E. Duplicate Sample(s):
All acceptance criteria were met.
 - F. Laboratory Control Sample(s):
All acceptance criteria were met except Silicon which had a recovery of 131%.
 - G. ICP Serial Dilution:
Not Required.
 - H. Other:
None
- IV. Documentation Exceptions:
None
- V. I certify that **this** data package is in **compliance with the terms** and conditions **agreed** to by the **client and CH2M HILL**, both technically and **for completeness, except for the** conditions **detailed** above. **Release** of the data **contained in this hardcopy** dam package **has been authorized** by the **Laboratory Manager** or his **designee, as** verified by **the** following **signature**.

Prepared by: _____

Reviewed by: _____

Corvallis Applied Sciences Laboratory

Client Information

Project Name: City of McAllen Pilot Study
 Project Manager: Patek Asogwa
 Sampled By: M. Salazar
 Client Sample ID: Lake2
 Sampling Date: 6/2/97
 Sampling I-II: See chain of Custody
 Type: Grab
 Matrix: water
 Basis: As received

Lab Info

Date Rec'd: 6/3/97
 Lab ID: S44001
 Report Revision No.: 0
 Reported By: HVN and KOJ
 Reviewed By:

Analyte	Reporting Limit	Sample Result	Qualifier	Units	Method	Date Analyzed
Chemistry						
Alkalinity		1060		mg/L	EPA 310.1	6/11/97
Bicarbonate		1060		mg/L	EPA 310.1	6/11/97
Carbonate	1.0	1.0	U	mg/L	EPA 310.1	6/11/97
Bromide	0.03	0.54		mg/L	EPA 300	6/20/97
Chloride	260	201		mg/L	E P A 3 0 0	6/5/97
Color (ALPHA) Apparent	5	10		color units	EPA110.2	6/4/97
Color w-254	0.009	0.092		abs/cm	SM 5910	6/4/97
Fluoride-Free	0.10	0.99		mg/L	EPA 300	6/4/97
N-Nitrate	0.70	0.10	U	mg/L	EPA300	6/4/97
P-Total Phosphorus	0.05	0.05	U	mg/L	EPA 366.1	6/9/97
Total Dissolved Solids	1	772		mg/L	EPA 160.1	6/9/97
Sulfate	2.50	262		mg/L	EPA 300	6/5/97
TOC	0.60	3.9		mg/L	EPA 415.1/2	6/9/97
Metals						
Aluminum, ICP	421	246		µg/L	EPA 200.7	6/16/97
Barium, ICP	0.53	124		µg/L	EPA 200.7	6/16/97
Calcium, ICP	49.1	77,700		µg/L	EPA 200.7	6/16/97
Iron, ICP	17.6	171		µg/L	EPA 200.7	6/16/97
Magnesium, ICP	262	27,900		µg/L	EPA 200.7	6/16/97
Manganese, ICP	0.6	17.6		µg/L	EPA 200.7	6/16/97
Potassium, ICP	276	9,580		µg/L	EPA 200.7	6/16/97
Silicon, ICP	110	6,300		µg/L	EPA 200.7	6/17/97
Sodium, ICP	136	140,000		µg/L	EPA 200.7	6/16/97
Strontium, ICP	9.4	2,400		µg/L	EPA 200.7	6/17/97

U=Not detected at specified reporting limits

Applied Sciences Laboratory
Corvallis Office

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P.O. Box 428, Corvallis, OR 97339-0428

(541) 752-4271
Fax No. (541) 752-0276

Corvallis Applied Sciences Laboratory

<u>Client Information</u>	<u>Lab Information</u>
Project Name: City of McAllen Pilot Study	Date Rec'd: 6/3/97
Project Manager: Patrick Asogwa	Lab ID: 544001
Sampled By: M. Salazar	Analysis Method: SM 5710.D
Client Sample ID: Lake2	Report Revision No.: 0
Sampling Date: 6/2/97	Reported By: DAH
Sampling Time: 11:35	Reviewed By:
Type: Grab	
Matrix: Water	
Basis: As Received	

HAA/THM Formation Potential Test Conditions

Set-up Date/Time	Target Contact Time	Initial pH	Contact pH	Contact Temperature (°C)	Chlorine Dosage (mg/L)
6/18/97 16:08	3 days	7.6	7.6	25	6.50

Chlorine Demand Test Results

Take-off Date/Time	Contact Time	Measured pH	Measured Temperature (°C)	Chlorine Residual (mg/L)
6/21/97 12:16	68:08	7.8	25	0.30

U=Not detected at specified reporting limits

Corvallis Applied Sciences Laboratory

Client	Lab Information
Project Name: City of McAllen Pilot Study	Date Rec'd: 6/23/97
Project Manager: Patrick Asogwa	Lab ID: 559001
Sampled By: D. Hardy	Report Revision No.: 0
Client Sample ID: Lake2 3D	Reported By: DAH
Sampling Date: 6/21/97	Reviewed By:
Sampling I-ma: 1216	Units: µg/L
Type: Grab	
Matrix: Water	
Basis: As Received	

Analyte	CAS #	Reporting Limit	Sample Result	Qualifier	Date Analyzed
<i>Haloacetic Acids - SM 6251.B</i>					
Chloroacetic acid	79-11-8	0.5	32		6/24/97
Bromoacetic acid	79-08-3	0.5	5.3		6/24/97
Dichloroacetic acid	79-43-6	0.5	152		6/24/97
Trichloroacetic acid	76-03-9	0.5	8.9		6/24/97
Bromochloroacetic acid	5589-96-3	0.6	20.1		6/24/97
Dibromoacetic acid	631-64-1	0.6	18.6		6/24/97
2,3-Dibromopropanoic acid	600-05-5		11.5%	SS	
<i>Trihalomethanes - EPA 502.2</i>					
Chloroform	67-66-3	0.5	36.3		6/23/97
Bromodichloromethane	75274	0.5	63.7		6/23/97
Dibromochloromethane	124-w-1	0.5	81.3		6/23/97
Bromoform	75-25-2	0.5	34.3		6/23/97
1,2-Dichloroethane-d4	17068-07-0		94%	SS	

SS=Surrogate standard
 U=Not detected at specified reporting limits

Corvallis Applied Sciences Laboratory

Client Information

Project Name: City of McAllen
 Project Manager: Jim Geisbush/PHX
 Sampled By: R. Villareal
 Client Sample ID: Feedwater
 Sampling Date: 5/19/97
 Sampling Time: 10:40
 Type: Grab
 Matrix: Water
 Basis: As Received

Lab Information

Date Rec'd: 5/20/97
 Lab ID: 535701
 Analysis Method: SM 5710.D
 Report Revision No.: 0
 Reported By: DAH
 Reviewed By:

HAA/THM Formation Potential Test Conditions

Set-up Date/Time	Target Contact Time	Initial pH	Contact pH	Contact Temperature (°C)	Chlorine Dosage (mg/L)
6/2/97 15:04	72:00	7.3	7.8	23	10.00

Chlorine D-d Test Results

Take-off Date/Time	Contact Time	Measured pH	Measured Temperature (°C)	Chlorine Residual (mg/L)
6/5/97 9:38	66:34	7.6	23	1.12

U=Not detected at specified reporting limits

Corvallis Applied Sciences Laboratory

Project Name: City of McAllen	Lab [REDACTED]
Project Manager: Jim Geisbush/PHX	Date Rec'd: 5/20/97
Sampled By: R. Villareal	Lab ID: 535702
Client Sample ID: Memcor Filtrate	Analysis Method: SM 5710.D
Sampling Date: 5/19/97	Report Revision No.: 0
Sampling Time: 10:40	Reported By: DAH
Type: Grab	Reviewed By:
Matrix: Water	
Basis: As Received	

HAA/THM Formation Potential Test Conditions

Set-up Date/Time	Target Contact Time	Initial pH	Contact pH	Contact Temperature (°C)	Chlorine Dosage (mg/L)
6/2/97 15:11	72:00	7.3	7.8	23	10.00

Chlorine D - d Test Results

Take-off Date/Time	Contact Time	Measured pH	Measured Temperature (°C)	Chlorine Residual (mg/L)
6/5/97 14:40	71:29	7.7	23	1.72

U=Not detected at specified reporting limits

Corvallis Applied Sciences Laboratory

Client Information

Project Name: City of McAllen
 Project Manager: Jim Geisbush/PHX
 Sampled By: R. Villareal
 Client Sample ID: Zaeweed Permeate
 Sampling Date: 5/19/97
 Sampling Time: 10:40
 Type: Grab
 Matrix: Water
 Basis: As Received

Lab Information

Date Rec'd: 5/20/97
 Lab ID: 535703
 Analysis Method: SM 5710.D
 Report Revision No.: 0
 Reported By: DAH
 Reviewed By:

HAA/THM Formation Potential Test Conditions

Set-up Date/Time	Target Contact Time	Initial pH	Contact pH	Contact Temperature (°C)	Chlorine Dosage (mg/L)
6/2/97 15:19	72:00	8.0	7.8	23	10.00

Chlorine Demand Test Results

Take-off Date/Time	Contact Time	Measured pH	Measured Temperature (°C)	Chlorine Residual (mg/L)
6/5/97 14:47	71:28	7.6	23	0.44

U=Not detected at specified reporting limits

Corvallis Applied Sciences Laboratory

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Client Information

Project Name: City of McAllen
 Project Manager: Jim Geisbush/PHX
 Sampled By: D. Hardy
 Client Sample ID: FEEDWATER 3D
 Sampling Date: 6/5/97
 Sampling Time: 9:38
 Type: Grab
 Matrix: Water
 Basis: As Received

Lab Information

Date Rec'd: 6/5/97
 Lab ID: 546701
 Report Revision No.: 1
 Reported By: DAH
 Reviewed By:
 Units: µg/L

Analyte	CAS #	Reporting Limit	Sample Result	Qualifier	Date Analyzed
<i>Haloacetic Acids - SM 6251.B</i>					
Chloroacetic acid	79-11-8	0.5	7.9		6/24/97
Bromoacetic acid	79-08-3	0.5	8.7		6/24/97
Dichloroacetic acid	79-43-6	0.5	28.4		6/24/97
Trichloroacetic acid	76-03-9	0.5	15.8		6/24/97
Bromochloroacetic acid	5589-96-3	0.5	34.4		6/24/97
Dibromoacetic acid	631-64-1	0.5	26.3		6/24/97
2,3-Dibromopropanoic acid	600-05-5		134%	SS	
<i>Trihalomethanes - EPA 502.2</i>					
Chloroform	67-66-3	0.5	45.2		6/9/97
Bromodichloromethane	75-27-4	0.5	89.8		6/9/97
Dibromochloromethane	124-48-1	0.5	130	E	6/9/97
Bromoform	75-25-2	0.5	67.7		6/9/97
1,2-Dichloroethane-d4	17068-07-0		90%	SS	

E=Exceeded instrument calibration range
 SS=Surrogate standard
 U=Not detected at specified reporting limits

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Corvallis Applied Sciences Laboratory

Client Information

Project Name: City of McAllen
 Project Manager: Jim Geisbush/PHX
 Sampled By: D. Hardy
 Client Sample ID: FEEDWATER 30
 Sampling Date: 6/5/97
 Sampling Time: 9:38
 Type: Grab
 Matrix: water
 Basis: As Received

Lab Information

Date Rec'd: 6/5/97
 Lab ID: 546701
 Report Revision No.: 0
 Reported By: DAH
 Reviewed By:
 Units: µg/L

Analyte	CAS #	Reporting Limit	Sample Result	Qualifier	Date Analyzed
<i>Haloacetic Acids - SM 6251.B</i>					
Chloroacetic acid	79-11-8	0.5	5.5		6/10/97
Bromoacetic acid	79-08-3	0.5	26		6/10/97
Dichloroacetic acid	79-43-6	0.5	29.1		6/10/97
Trichloroacetic acid	76-03-9	0.5	13.9		6/10/97
Bromochloroacetic acid	5589-96-3	0.5	39.6		6/10/97
Dibromoacetic acid	631-64-1	0.5	30.5		6/10/97
2,3-Dibromopropanoic acid	600-05-5		194%	SS	
<i>Trihalomethanes - EPA 502.2</i>					
Chloroform	67-66-3	0.5	46.2		6/9/97
Bromodichloromethane	75-27-4	0.5	69.6		6/9/97
Dibromochloromethane	124-48-1	0.5	130	E	6/9/97
Bromoform	75-25-2	0.5	67.7		6/9/97
1,2-Dichloroethane-d4	17068-07-0		90%	SS	

E=Exceeded instrument calibration range
 SS=Surrogate standard
 U=Not detected at specified reporting limits

Corvallis Applied Sciences Laboratory

Client Information

Project Name: City of McAllen
 Project Manager: Jim Geisbush/PHX
 Sampled By: D. Hardy
 Client Sample ID: MEMCOR 3D
 Sampling Date: 6/5/97
 Sampling Time: 14:40
 Type: Grab
 Matrix: Water
 Basis: As Received

Lab Information

Date Rec'd: 6/5/97
 Lab ID: 546702
 Report Revision No.: 1
 Reported By: DAH
 Reviewed By:
 Units: µg/L

Analyte	CAS #	Reporting Limit	Sample Result	Qualifier	Date Analyzed
<i>Haloacetic Acids - SM 6251.B</i>					
Chloroacetic acid	79-11-8	0.6	6.6		6/24/97
Bromoacetic acid	79-08-3	0.5	10.7		6/24/97
Dichloroacetic acid	7943-6	0.6	36.3		6/24/97
Trichloroacetic acid	76-03-9	0.6	13.3		6/24/97
Bromochloroacetic acid	5589-96-3	0.6	41.8		6/24/97
Dibromoacetic acid	631-64-1	0.6	34.3		6/24/97
2,3-Dibromopropanoic acid	600-05-5		122%	66	
<i>Trihalomethanes - EPA 502.2</i>					
Chloroform	67-66-3	0.6	46.3		6/9/97
Bromodichloromethane	75-27-4	0.5	89.3		6/9/97
Dibromochloromethane	12446-1	0.5	124	E	6/9/97
Bromoform	75-25-2	0.6	64.6		6/9/97
1,2-Dichloroethane-d4	17068-07-0		93%	SS	

E=Exceeded instrument calibration range
 SS=Surrogate standard
 U=Not detected at specified reporting limits

Corvallis Applied Sciences Laboratory

Client Information

Project Name: City of McAllen
 Project Manager: Jim Geisbush/PHX
 Sampled By: D. Hardy
 Client Sample ID: MEMCOR 3D
 Sampling Date: 6/5/97
 Sampling Time: 14:40
 Type: Grab
 Matrix: Water
 Basis: As Received

Lab Information

Date Rec'd: 6/5/97
 Lab ID: 546702
 Report Revision No.: 0
 Reported By: DAH
 Reviewed By:
 Units: µg/L

Analyte	CAS #	Reporting Limit	Sample Result	Qualifier	Date Analyzed
<i>Haloacetic Acids - SM 6251.B</i>					
Chloroacetic acid	79-11-8	0.5	6.4		6/10/97
Bromoacetic acid	79-08-3	0.5	9.4		6/10/97
Dichloroacetic acid	79-43-6	OS	30.3		6/10/97
Trichloroacetic acid	76-03-9	OS	a2		6/10/97
Bromochloroacetic acid	5589-96-3	0.5	41.4		6/10/97
Dibromoacetic acid	631-64-1	0.5	34.9		6/10/97
2,3-Dibromopropanoic acid	600-05-5		107%	SS	
<i>Trihalomethanes - EPA 502.2</i>					
Chloroform	67-66-3	OS	46.3		6/9/97
Bromodichloromethane	75-27-4	OS	69.3		6/9/97
Dibromochloromethane	724-48-1	0.5	124	E	6/9/97
Bromoform	75-25-2	OS	64.8		6/9/97
1,2-Dichloroethane-d4	17068-07-0		93%	SS	

E=Exceeded instrument calibration range
 SS=Surrogate standard
 U=Not detected at specified reporting limits

Corvallis Applied Sciences Laboratory

Client Information

Lab Information

Project Name: City of McAllen
 Project Manager: Jim Geisbush/PHX
 Sampled By: D. Hardy
 Client Sample ID: ZEEWEED 30
 Sampling Date: 6/5/97
 Sampling Time: 14:47
 Type: Grab
 Matrix: Water
 Basis: As Received

Date Rec'd: 6/5/97
 Lab ID: 546703
 Report Revision No.: 1
 Reported By: DAH
 Reviewed By:
 Units: µg/L

Analyte	CAS #	Reporting Limit	Sample Result	Qualifier	Date Analyzed
<i>Haloacetic Acids - SM 6251.B</i>					
Chloroacetic acid	79-11-8	0.5	9.3		6/24/97
Bromoacetic acid	79-08-3	0.3	12.2		6/24/97
Dichloroacetic acid	79-43-6	0.9	243		6/24/97
Trichloroacetic acid	76-03-9	0.5	16.4		6/24/97
Br. a c i d	5589-96-3	0.9	34.1		6/24/97
Dibromoacetic acid	631-64-1	0.5	293		6/24/97
2,3-Dibromopropanoic acid	600-05-5		104%	SS	
<i>Trihalomethanes - EPA 502.2</i>					
Chloroform	67-66-3	0.5	38.9		6/9/97
Bromodichloromethane	75-27-4	0.5	17.4		6/9/97
Dibromochloromethane	12443-1	0.5	113	E	6/9/97
Bromoform	75-25-2	0.5	W.1		6/9/97
1,2-Dichloroethane-d4	17003-07-0		99%	SS	

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Corvallis Applied Sciences Laboratory

Client Information

Project Name: City of McAllen
 Project Manager: Jim Geisbush/PHX
 Sampled By: D. Hardy
 Client Sample ID: ZEEWEED 3D
 Sampling Date: 6/5/97
 Sampling Time: 14:47
 Type: Grab
 Matrix: water
 Basis: As Received

Lab Info

Date Rec'd: 6/5/97
 Lab ID: 546703
 Report Revision No.: 0
 Reported By: DAH
 Reviewed By:
 Units: µg/L

Analyte	CAS #	Reporting Limit	Sample Result	Qualifier	Date Analyzed
<i>Haloacetic Acids - SM 6251.B</i>					
Chloroacetic acid	79-11-8	0.5	7.4		6/10/97
Bromoacetic acid	79-08-3	0.5	13.8		6/10/97
Dichloroacetic acid	7943%	0.5	25.8		6/10/97
Trichloroacetic acid	76.03%	0.5	124		6/10/97
Bromochloroacetic acid	5589-96-3	0.5	36.4		6/10/97
Dibromoacetic acid	631-64-1	0.5	31.2		6/10/97
2,3-Dibromopropanoic acid	600-05-5		104%	ss	
<i>Trihalomethanes - EPA 502.2</i>					
Chloroform	67-66-3	0.5	38.9		6/9/97
Bromodichloromethane	75-27-4	0.6	77.4		6/9/97
Dibromochloromethane	124-48-1	0.5	113	E	6/9/97
Bromoform	75-25-2	0.5	60.1		6/9/97
1,2-Dichloroethane-d4	17068-07-0		9.5%	SS	

E=Exceeded instrument calibration range
 SS=Surrogate standard
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CH2M HILL
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Corvallis, OR
97330-3538
Mailing address:
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97339-0428
Tel 541.752.4271
Fax 541.752.0276

July 23, 1997

City of McAllen

138067.A0.ZZ

RE: Analytical Data for City of **McAllen**
CVO Laboratory Reference No. 5700

Jii Geisbush/PHX

On July 8, 1997, the **CH2M HILL Corvallis Applied** Sciences Laboratory received **three** samples **with** a request for analysis of selected parameters.

The **analytical results** and associated **quality control** data are enclosed. Any unusual **difficulties encountered** during the analysis of your samples are discussed in **the** case narrative.

Under **CH2M HILL** policy, your samples **will** be stored for 30 days after reporting. If you have not given us prior **instructions** for disposal, we will contact you if any **samples require** disposal as hazardous **waste**.

The **CH2M HILL Applied Sciences Laboratory** **appreciates** your **business** and looks forward to **servicing your** analytical needs again. If you should have any questions concerning the data, or if **you** need additional **information**, please **call** Ms. Kathy McKinley at (541) **758-0235**, extension 3120.

Since&

Kelly Ensor
Senior Administrative Assistant

Enclosures

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Corvallis Office

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P. O. Box 428, Corvallis, OR 97339-0428

541 752-4271
Fax No. 541 752-0276

CLIENT SAMPLE CROSS-REFERENCE

CH2M HILL Applied Science Laboratory Reference No. 5700

CVO Sample ID	Client Sample ID	Date Collected	Time Collected
570001	Zeeweed Feedwater	07/07/1997	
570002	Zeeweed Permeate	07/07/1997	
570003	Memcor Filtrate	07/07/1997	

CASE NARRATIVE
GENERAL CHEMISTRY

Lab Reference No.: 5700

Client/Project: City of McAllen

- I. Holding Time:
Au acceptance criteria were met.
- II. Digestion Exceptions:
None
- III. Analysis:
- A. Calibration:
An acceptance criteria were met.
- B. Blanks:
All acceptance criteria were met except for Total Phosphorus which had a blank result of 0.06 mg/L.
- C. Matrix Spike Sample(s):
All acceptance criteria were met.
- D. Duplicate Sample(s):
All acceptance criteria were met.
- E. Lab Control Sample(s):
Lab control for Total Phosphorus did not meet acceptance criteria. All other lab control acceptance criteria were met.
- F. Other:
Not applicable.
- N. Documentation Exceptions:
None:
- V. I certify that this data package is in compliance with the terms and conditions agreed to by the client and CH2M HILL, both technically and for completeness, except for the conditions detailed above. Release of the data contained in this hardcopy data package has been authorized by the Laboratory Manager or his designee, as verified by the following signature.

Prepared by: Helen Van Nieu

Reviewed by: Amal ins

Corvallis Applied Sciences Laboratory

Client Information

Project Name: Cii of McAllen Pilot Study
 Project Manager: Rosie Villarreal
 Sampled By: R. Villarreal
 Client Sample ID: Zeeweed Feedwater
 Sampling Date: 07/07/97
 Sampling time:: Not provided
 Type: Grab
 Matrix: water
 Basis:: As received

Lab Information

Date Rec'd: 07/08/97
 Lab ID: 570001
 Report Revision No.: 0
 Reported By: HVN
 Reviewed By: *gme*

Analyte	Reporting Limit	Sample Result	Qualifier	Units	Method	Date Analyzed
Chemistry						
N-NO3/NO2	0.01	0.02		mg/L	EPA 353.2	7/8/97
TKN	2	70.9		mg/L	EPA 351.4	7/14/97
P-Total Phosporus	0.25	3.58		mg/L	EPA 365.1	7/18/97

U=Not detected at specified reporting limits

Corvallis Applied Sciences Laboratory

<u>Client Information</u>	<u>Lab Information</u>
Project Name: City of McAllen Pilot Study	Date Rec'd: 07/08/97
Project Manager: Rosie Villarreal	Lab ID: 570002
Sampled By: R. Villarreal	Report Revision No.: 0
Client Sample ID: Zeeweed Permeate	Reported By: HVN
Sampling Date: 07/07/97	Reviewed By: <i>gmc</i>
Sampling Time: Not provided	
Type: Grab	
Matrix: Water	
Basis: As received	

<u>Anal e</u>	<u>Reporting Limit</u>	<u>Sample Result</u>	<u>Qualifier</u>	<u>Units</u>	<u>Method</u>	<u>Date Analyzed</u>
Chemistry						
N-NO3/NO2	0.01	0.84		mg/L	EPA 3532	7/8/97
TK N	5	11.0		mg/L	EPA 351.4	7/14/97
P-Total Phosporus	0.50	212		mg/L	EPA 365.1	7/18/97
TOC	1.0	6.6		mg/L	EPA 415.1/2	7/11/97
Color (ALPHA) Apparent	5	22		mg/L	EPA 110.2	7/8/97

U=Not detected at specified reporting limits

Corvallis Applied Sciences Laboratory

Client Information

Project Name: City of McAllen Pibt Study
Project Manager: Rosie Villarreal
sampled By: R. Villarreal
Client Sample ID: Memcor Filtrate
Sampling Date: 07/07/97
Sampling Time: Not provided
Type: Grab
Matrix: Water
Basis: As received

Lab Information

Date Rec'd: 07/08/97
Lab ID: 570003
Report Revision No.: 0
Reported By: HVN
Reviewed By: *gmc*

Analyte	Reporting Limit	Sample Result	Qualifier	Units	Method	Date Analyzed
Chemistry						
TOC	1.0	5.3		mg/L	EPA 415.1/2	7/11/97
Color (ALPHA) Apparent	5	10		mg/L	EPA 110.2	7/8/97

U=Not detected at specified reporting limits

COC # _____

Project # 138067.40.22		Purchase Order #		TOTAL # OF CONTAINERS										Requested Analytical Method #						THIS AREA FOR LAB USE ONLY								
Project Name McAllen Public Pilot Study														TOC Color TKN, NO ₂ -N, NH ₃ -N, Phosphorus						Lab # 5700-1-13			Page 1	of 1	Custody Review		LIMS Verification	
Company Name McAllen Public Utilities				Project Manager or Contact & Phone # Rosie Villareal 956-631-8340			Report Copy to: Jim Geistbusch (Mexico)			Log In			QC Level 1 2 3 Other							Cooler Temperature		Alternate Description		Lab ID				
Requested Completion Date: ASAP		Site ID NWTP#2		Sample Disposal: Disposal <input checked="" type="checkbox"/> Return <input type="checkbox"/>												pH		QC Level 1 2 3 Other		Cooler Temperature		Alternate Description		Lab ID				
Sampling		Type	Matrix	CLIENT SAMPLE ID (9 CHARACTERS)										LAB QC														
Date	Time	COMP	GRAB	WATER	SOIL	AIR																						
7-7-97		✓	✓	✓	✓		Zee-weed Field water										1											
7-7-97		✓	✓	✓	✓		Zee-weed Permeate										1											
7-7-97		✓	✓	✓	✓		Zee-weed Permeate										2											
7-7-97		✓	✓	✓	✓		Zee-weed Permeate										1											
7-7-97		✓	✓	✓	✓		Memcor Filtrate										2											
7-7-97		✓	✓	✓	✓		Memcor Filtrate										1											
Relinquished By Rosie Villareal		Empty Bottles 8		Date/Time 11/19/97		Received By Enrique Perez		Empty Bottles 8		Date/Time 11/19/97 @ 9:27 a.m.																		
Sampled By and Title Enrique Perez		(Please sign and print name)		Date/Time 11/17/97		Relinquished By Enrique Perez		(Please sign and print name)		Date/Time 11/19/97 @ 9:44 a.m.																		
Received By Rosie Villareal		(Please sign and print name)		Date/Time 11/17/97		Relinquished By Rosie Villareal		(Please sign and print name)		Date/Time 11/19/97 @ 11:50 a.m.																		
Received By Jeri Matlock		(Please sign and print name)		Date/Time 7-8-97 1000		Shipped Via UPS		Other <input type="checkbox"/> Fed-Ex <input type="checkbox"/>		Shipping #																		
Special Instructions:												George																

APP-55



CH2M HILL
2300 NW Walnut Blvd.
Corvallis, OR
97330-3538
Mailing address:
P.O. Box 428
Corvallis, OR
97339-0428
Tel 541.752.4271
Fax 541.752.0276

July 17, 1997

City of McAllen

138067.A0.ZZ

RE: **Analytical Data for City of McAllen**
CVO **Laboratory** Reference No. 5664

Jim Geisbush/PHX

On July 1, 1997, the **CH2M HILL Corvallis** Applied Sciences Laboratory received three **samples with a request** for analysis of selected **parameters**.

The **analytical** results and associated quality **control** data are **enclosed**. Any **unusual difficulties** encountered **during** the analysis of your samples are discussed in the case **narrative**.

Under **CH2M HILL** policy, your samples **will** be stored for 30 days **after** reporting. If you have not given us prior **instructions** for **disposal**, we **will** contact you if any samples require disposal as hazardous waste.

The **CH2M HILL** Applied Sciences **Laboratory appreciates** your **business** and looks forward to saving **your** analytical needs again. If you should have any questions concerning the data, **or** if you need **additional information**, please **call** Ms. Kathy McKinley at (541) 758-0235, extension 3120.

Sincerely,

A handwritten signature in black ink, appearing to read "Kelly Ensor".

Kelly Ensor
Senior **Administrative** Assistant

Enclosures

Applied Sciences Laboratory, 2300 NW Walnut Blvd., Corvallis, OR 97330-3538
Corvallis Office P. O. Box 428, Corvallis, OR 97339-0428

541 752-4271
Fax No. 541 752-0276

CASE NARRATIVE
GENERAL CHEMISTRY

Lab Reference No.: 5664

Client/Project: City of McAllen

- L. Holding time:
All acceptance criteria were met
- II. Digestion Exceptions:
None
- III. Analysis:
- A. Calibration:
All acceptance criteria were met.
- B. Blanks:
AU acceptance criteria were met
- C. Matrix Spike Sample(s):
All acceptance criteria were met.
- D. Duplicate Sample(s):
All acceptance criteria were met.
- E. Lab Control Sample(s):
All acceptance criteria were met
- F. Other:
Not applicable.
- IV. Documentation Exceptions:
None.

- V. I certify that this data package is in compliance with the terms and conditions agreed to by the client and CH2M HILL, both technically and for completeness, except for the conditions detailed above. Release of the data contained in this hardcopy data package has been authorized by the Laboratory Manager or his designee, as verified by the following signature.

Prepared by:

Helen Van Nieu

Reviewed by:

Singer Collins

CLIENT SAMPLE **CROSS-REFERENCE**

CH2M HILL Applied Science Laboratory Reference No. 5664

CVO Sample ID	Client Sample ID	Date Collected	Time Collected
566401	Zeeweed Feedwater	06/30/1997	10:42
566402	Zeeweed Permeate	06/30/1997	10:42
566403	Memcor Filtrate	06/30/1997	10:42

Corvallis Applied Sciences Laboratory

Client Information

Project Name: Cii of McAllen Pilot Study
 Project Manager: Rosie Villarreal
 Sampled By: R. Villarreal
 Client Sample ID: Zeeweed Feedwater
 Sampling Date: 06/30/97
 Sampling Time: 10:42
 Type: Grab
 Matrix: water
 Basis: As received

Lab Information

Date Rec'd: 07/01/97
 Lab ID: 566401
 Report Revision No.: 0
 Reported By: HVN
 Reviewed By: *gmc*

Analyte	Reporting Limit	Sample Result	Qualifier	Units	Method	Date Analyzed
Chemistry						
N-NO3/NO2	0.01	0.05		mg/L	EPA 353.2	7/1/97
TKN	5.0	33.5		mg/L	EPA 351.4	7/14/97
P-Total Phosporus	0.5	4.21		mg/L	EPA 365.1	7/1/97
TOC	10.0	60.0		mg/L	EPA 415.1/2	7/11/97

U=Not detected at specified reporting limits

Corvallis Applied Sciences Laboratory

Client Information

Project Name: Cii of McAllen Pilot Study
 Project Manager: Rosie Villarreal
 sampled By: R. Villarreal
 Client Sample ID: Zeeweed Permeate
 Sampling Date: 06/30/97
 Sampling time: 10:42
 Type: Grab
 Matrix: Water
 Basis: As received

Lab Info

Date Rec'd: 07/01/97
 Lab ID: 566402
 Report Revision No.: 0
 Reported By: HVN
 Reviewed By: *gmc*

Analyte	Reporting Limit	Sample Result	Qualifier	Units	Method	Date Analyzed
Chemistry						
N-NO3/NO2	0.01	0.01		mg/L	EPA 353.2	7/1/97
TKN	20	20.0		mg/L	EPA 351.4	7/14/97
P-Total Phosporus	0.05	0.34		mg/L	EPA 365.1	7/1/97
TOC	1.0	7.0		mg/L	EPA 415.1/2	7/11/97
Color (ALPHA) Apparent	5	15		mg/L	EPA 110.2	7/1/97

U=Not detected at specified reporting limits

Corvallis Applied Sciences Laboratory

Client Information

Project Name: City of McAllen Pilot Study
 Project Manager: Rosie Villarreal
 Sampled By: R. Villarreal
 Client Sample ID: Memcor Filtrate
 Sampling Date: 06/30/97
 Sampling Time: 10:42
 Type: Grab
 Matrix: Water
 Basis: As received

Lab Information

Date Rec'd: 07/01/97
 Lab ID: 566403
 Report Revision No.: 0
 Reported By: HVN
 Reviewed By: *gmc*

Parameter	Reporting Limit	Sample Result	Qualifier	Units	Method	Date Analyzed
Chemistry						
N-NO3/NO2	0.10	271		mg/L	EPA 353.2	7/1/97
TU N	20	32		mg/L	EPA 351.4	7/14/97
P-Total Phosphorus	0.05	0.17		mg/L	EPA 366.1	7/1/97
T ^o C	1.0	6.1		mg/L	EPA 415.1/2	7/11/97
Color (ALPHA) Apparent	5	13		mg/L	EPA 110.2	7/1/97

U=Not detected at specified reporting limits



CH2M HILL
2300 NW Walnut Blvd
Corvallis, OR
97330-3538
Mailing address:
P.O. Box 428
Corvallis, OR
97339-0428
Tel 541.752.4271
Fax 541.752.0276

07/15/97

City of **McAllen**

Subject Acknowledgment of **sample** sot 5748.

Dear Jim Geisbush/PHX:

This letter is to acknowledge the receipt of your sample set on **7/15/97**. It has been assigned **laboratory** number 5748. Please refer to the laboratory **number** if you need to inquire about this sample **set**. I have attached a copy of the chain of custody form to provide additional **information**.

There were no problems noted with the receipt of your samples.

If you need **assistance**, please feel **free** to **call 541/758-0235** extension 3 117.

Sincerely,
CH2M HILL

Jerri Mattick

Attachment

CH2M HILL Analytical Services
CHAIN OF CUSTODY RECORD
AND AGREEMENT TO PERFORM SERVICES

LMO 2507 Fablane Drive
 Montgomery, AL 36116-1822
 (334) 271-1444 FAX (334) 271-3428

LRD 5090 Caterpillar Road
 Redding, CA 96003-1412
 (916) 244-5227 FAX (916) 244-4100

LKW Carviro Analytical Laboratories, Inc.
 50 Bathurst, Unit 12, Waterloo, Ontario, Canada N2V 2C5
 (519) 747-2675 FAX (519) 747-3806

CVD 2300 NW Walnut Boulevard
 Corvallis, OR 97330-3838
 (541) 752-4271 FAX (541) 752-0276

COC #

Project # 138067.AQ.EE		Purchase Order #		Requested Analytical Method #				THIS AREA FOR LAB USE ONLY							
Project Name McAllen Pilot Study				TOTAL # OF CONTAINERS	TOC TKN, NO ₂ -NO ₃ N, T-Phosphorus Color	H ₂ SO ₄	+1	H ₂ SO ₄	None	Preservative	Lab # 5748-123	Page 1	of 1		
Company Name McAllen Public Utilities											Lab PM	Custody Review			
Project Manager or Contact & Phone # Rosie Villareal											Log In	LIMS Verification			
Report Copy to: Jim Gerbush (Phone)											pH	Custody Seals Y N			
Requested Completion Date: ASAP											Site ID 11WTP #2	Sample Disposal: Dispose <input checked="" type="checkbox"/> Return <input type="checkbox"/>	Ice Y N		
Requested Completion Date: ASAP											Site ID 11WTP #2	Sample Disposal: Dispose <input checked="" type="checkbox"/> Return <input type="checkbox"/>	QC Level 1 2 3 Other		
Requested Completion Date: ASAP											Site ID 11WTP #2	Sample Disposal: Dispose <input checked="" type="checkbox"/> Return <input type="checkbox"/>	Cooler Temperature		
Requested Completion Date: ASAP											Site ID 11WTP #2	Sample Disposal: Dispose <input checked="" type="checkbox"/> Return <input type="checkbox"/>	Alternate Description		
Requested Completion Date: ASAP											Site ID 11WTP #2	Sample Disposal: Dispose <input checked="" type="checkbox"/> Return <input type="checkbox"/>	Lab #		
Sampling 7/1/07 9:45		Type COM	Matrix WATER								CLIENT SAMPLE ID (# CHARACTERS)	LAB QC			
Date	Time	GRAV	SOIL	AIR											
7/1/07	9:45	✓	✓		2	✓	✓					1			
7/1/07	"	✓	✓		1	✓	✓					2			
7/1/07	"	✓	✓		2	✓	✓					2			
7/1/07	"	✓	✓		1	✓	✓					2			
7/1/07	"	✓	✓		1	✓	✓					2			
7/1/07	"	✓	✓		2	✓	✓					3			
7/1/07	"	✓	✓		1	✓	✓					3			
7/1/07	"	✓	✓		1	✓	✓					3			

APP-64

Relinquished By Rosie Villareal	Empty Bottles 11	Date/Time 7/1/07 9:30	Received By Enrique Perez	Empty Bottles 11	Date/Time 7/1/07 @ 2:30 AM
Sampled By and Title Enrique Perez	(Please sign and print name)	Date/Time 7/1/07 9:30	Relinquished By Enrique Perez	(Please sign and print name)	Date/Time 7/1/07 @ 2:52 AM
Received By Rosie Villareal	(Please sign and print name)	Date/Time 7/1/07 9:30	Relinquished By Rosie Villareal	(Please sign and print name)	Date/Time 7/1/07 @ 11:30 AM
Received By Jennifer Drowbridge	(Please sign and print name)	Date/Time 7/15/07 10:00	Shipped Via UPS (Fed-Ex)	Other	Shipping #



CH2M HILL
2300 NW Walnut Blvd.
Corvallis, OR
97330-3538
Mailing address:
P.O. Box 428
Corvallis, OR
97339-0428
Tel 541.752.4271
Fax 541.752.0276

7/9/97

City of McAllen

Subject: Acknowledgment of sample set 5700.

Dear Jii Geisbush/PHX:

This letter is m **acknowledge** the **receipt** of your sample set on **7/8/97**. It has been assigned laboramry number 5700. Please refer m the **laboratory** number if you need m **inquire about** this sample set I have attached a copy of the chain of cusmdy form m provide additional information.

There were no problems noted with the receipt of **your** samples.

If you need **assistance**, please feel free m **call 541/758-0235 extension 3 117**.

Sincerely,
CH2M HILL

A handwritten signature in black ink that reads "Jerri Mattick".

Jerri Mattick

Attachment

CH2MHILL Analytical Services
CHAIN OF CUSTODY RECORD
AND AGREEMENT TO PERFORM SERVICES

LMG 2507 Fairlane Drive
 Montgomery, AL 36116-1822
 (334) 271-1444 FAX (334) 271-3428

LRD 5000 Caterpillar Road
 Redding, CA 96003-1412
 (916) 244-5227 FAX (916) 244-4109

LRW Canpro Analytical Laboratories, Inc.
 50 Bathurst, Unit 12, Waterloo, Ontario, Canada N2V 2C6
 (519) 747-2676 FAX (519) 747-3806

LRV
 Corvallis, OR 97330-3838
 (541) 752-4271 FAX (541) 752-0276

COC # _____

Project # 133067.HV.2-2		Purchase Order #		Requested Analytical Method #				THIS AREA FOR LAB USE ONLY				
Project Name McAllen Public Pilot Study				TOTAL # OF CONTAINERS	TOC COLOR TKN, NO ₂ -NO ₃ N, phosphorus				Lab # 570-193	Page 1	of 1	
Company Name McAllen Public Utilities									ab PM	Custody Review		
Project Manager or Contact & Phone # Rosie Villalobos									og In	LIMS Verification		
Report Copy to: Jim Geisbach (Mexico)									pH	Custody Seals Y N		
Requested Completion Date: 1/31/97		Site ID NWT #2		Sample Disposal: Disposal <input checked="" type="checkbox"/> Return <input type="checkbox"/>				Ice Y N				
Sampling		Type	Matrix	CLIENT SAMPLE ID (8 CHARACTERS)				LAB QC				
Date	Time	COMP	GRAB	WATER	SOIL	AIR						
7-7-97		✓	✓	✓			Zee-weed Field water	1				
7-7-97		✓	✓	✓			Zee-weed Permeate	1				
7-7-97		✓	✓	✓			Zee-weed Permeate	2	✓			
7-7-97		✓	✓	✓			Zee-weed Permeate	1		✓		
7-7-97		✓	✓	✓			Mimcor Filtrate	2	✓			
7-7-97		✓	✓	✓			Mimcor Filtrate	1		✓		
Relinquished By Rosie Villalobos				Empty Bottles 8				Date/Time 7/7/97 @ 9:27 a.m.				
Sampled By and Title Jim Geisbach				Date/Time 7/7/97 @ 9:44 a.m.				Relinquished By Jim Geisbach				
Received By Rosie Villalobos				Date/Time 7/7/97 @ 14:50 a.m.				Relinquished By Rosie Villalobos				
Received By Kim Mottick				Date/Time 7-8-97 10:00				Shipped Via UPS <input type="checkbox"/> Fed-Ex <input type="checkbox"/> Other _____				
Special Instructions: 6 imp												

APP-66

Structure and parameter description on Reverse Side

DISTRIBUTION: Initial Yellow 1B, PI Client Rev 11/7/97 LAB 340



CH2M HILL
2300 NW Walnut Blvd.
Corvallis, OR
97330-3538
Mailing address:
P.O. Box 428
Corvallis, OR
97339-0428
Tel 541.752.4271
Fax 541.752.0276

July 4, 1997

City of McAllen

138067.A0.ZZ

RE: Analytical **Data** for City of **McAllen**
CVO Laboratory Reference No. 5597

Jim Geisbush/PHX

On June 23, 1997, the **CH2M HILL Corvallis** Applied Sciences Laboratory received **three** samples with a request for analysis of selected **parameters**.

The analytical **results and** associated **quality control** data **are** enclosed. Any **unusual difficulties** encountered during **the** analysis of your samples are discussed in **the** case **narrative**.

Under **CH2M HILL** policy, your samples **will be** stored for 30 days **after** reporting. If you have not given us prior **instructions** for disposal, we **will contact** you if any samples **require** disposal as hazardous **waste**.

The **CH2M HILL** Applied Sciences Laboratory **appreciates** your business and looks forward to serving **your** analytical needs again. **If** you **should** have **any** questions **concerning the data**, or if you need **additional information**, please call Ms. Kathy McKinley at (541) **758-0235**, extension 3120.

Sincerely,

Kelly Ensor
Senior **Administrative** Assistant

Enclosures

Applied Sciences Laboratory : 2300 NW Walnut Blvd., Corvallis, OR 97330-3538
Corvallis Office P. O. Box 428, Corvallis, OR 97339-0428

541 752-4271
Fax No. 541 752-0276

CLIENT **SAMPLE** CROSS-REFERENCE

CH2M HILL Applied Science Laboratory Reference No. 5597

CVO Sample ID	client Sample ID	Date Collected	Time collected
559701	Zeeweed Feedwater	06/20/1997	8:23
559702	Zeeweed Permeate	06/20/1997	8:23
559703	Memcor Filtrate	06/20/1997	8:23

**CASE NARRATIVE
GENERAL CHEMISTRY**

Lab Reference No.: **5597**

Client/Project: City of McAllen

- I. Holding Time:
Holding time for color was exceeded when the sample was received. All other acceptance criteria were met
- II. Digestion Exceptions:
None
- III. Analysis:
- A. Calibration:
All acceptance criteria were met
- B. Blanks:
An acceptance criteria were met.
- C. Matrix Spike Sample(s):
Matrix spike for TKN was lost due to sample dilution. All other matrix spike acceptance criteria were met.
- D. Duplicate Sample(s):
All acceptance criteria were met
- E. Lab Control Sample(s):
All acceptance criteria were met except for TKN.
- F. Other:
Not applicable.
- N. Documentation Exceptions:
None.

V. I certify that this data package is in compliance with the terms and conditions agreed to by the client and CH2M HILL, both technically and for completeness, except for the conditions detailed above. Release of the data contained in this hardcopy data package has been authorized by the Laboratory Manager or his designee, as verified by the following signature.

Prepared by:

Heleen Van Nise

Reviewed by:

Shirley Collins

Corvallis Applied Sciences Laboratory

Client Information

Project Name: City of McAllen Pilot Study
 Project Manager: Rosie Villarreal
 Sampled By: R. Villarreal
 Client Sample ID: Zeeweed Feedwater
 sampling Date: 06/20/97
 Sampling Time: 8:23
 Type: Grab
 Matrix: Water
 Basis: As received

Lab Information

Date Rec'd: 06/23/97
 Lab ID: 559701
 Report Revision No.: 0
 Reported By: HVN
 Reviewed By: *gmc*

Analyte	Reporting Limit	Sample Result	Qualifier	Units	Method	Date Analyzed
Chemistry						
N-NO3/NO2	0.01	0.58		mg/L	EPA 3532	6/27/97
TKN	4	28.8		mg/L	EPA 351.4	6/30/97
P-Total Phosphorus	0.50	4.76		mg/L	EPA 365.1	7/1/97

U=Not detected at specified reporting limits

Corvallis Applied Sciences Laboratory

Client Information

Project Name: City of McAllen Pilot Study
 Project Manager: Rosie Villarreal
 Sampled By: R Villarreal
 Client Sample ID: Zeeweed Permeate
 Sampling Date: 06/20/97
 Sampling time: 823
 Type: Grab
 Matrix: water
 Race: As received

Lab Information

Date Rec'd: 06/23/97
 Lab ID: 559702
 Report Revision No.: 0
 Reported By: HVN
 Reviewed By: *gmc*

Analyte	Reporting Limit	Sample Result	Qualifier	Units	Method	Date Analyzed
Chemistry						
N-NO3/NO2	0.10	132		mg/L	EPA 3532	6/27/97
TKN	4	4	U	mg/L	EPA351.4	6/30/97
P-Total Phosporus	0.05	0.55		mg/L	EPA 365.1	7/1/97

U=Not detected at specified reporting limits

Corvallis Applied Sciences Laboratory

Client Information

Project Name: City of McAllen
Project Manager: Rosie Villarreal
Sampled By: R. Villarreal
Sampling Date: 6/20/97
Sampling Time: 823
Type: Grab
Matrix: water
Basis: As received

Lab Information

Laboratory ID: ICROR001
Date Rec'd: 6/23/97
Analytical Method: EPA 1102
Date Analyzed: 6/24/97
Report Revision No.: 0
Reported By: HVN
Reviewed By: *gmc*

Client Sample ID	Lab Sample ID	Reporting Limit	color (ALPHA) Apparent Result	Units
Memcor Filtrate	559703	5	20	Color Units

U=Not detected a specified detection III

Applied Sciences Laboratory
Corvallis Office

2300 NW Walnut Blvd., Corvallis, OR 97330-3538
P.O. Box 428, Corvallis, OR 97339-0428

(541) 752-4271
Fax No. (541) 752-0276

Corvallis Applied Sciences Laboratory

Client Information

Project Name: City of McAllen
 Project Manager: Rosie Villarreal
 Sampled By R Villarreal
 Sampling Date: 6/20/97
 Sampling Time: 8:23
 Type: Grab
 Matrix: Water
 Basis: As received

Lab Information

Laboratory ID: ICROR001
 Date Rec'd: 6/23/97
 Analytical Method: SM5310.D
 Date Analyzed: 6/25/97
 Report Revision No.: 0
 Reported By: G. Collins
 Reviewed By: *GW*
 units: mg/L

Client Sample ID	Lab Sample ID	pH	Reporting Limit	Replicate 1	TOC Water Replicate 2	Average	Percent RPD
Memcor Filtrate	659703	<2	0.60	6.6	6.8	6.8	0.0

U=Not detected at specified detection limits

CH2MHILL Analytical Services
CHAIN OF CUSTODY RECORD
AND AGREEMENT TO PERFORM SERVICES

11 LMB 2567 Fabiana Drive
 Montgomery, AL 36116-1622
 (334) 271-1444 FAX (334) 271-3428

11 LRD 5090 Caterpillar Road
 Redding, CA 96003-1412
 (916) 244-5227 FAX (916) 244-4109

11 LNW Carvivo Analytical Laboratories, Inc.
 50 Bathurst, Unit 12, Waterloo, Ontario, Canada N2V 2C5
 (519) 747-2575 FAX (519) 747-3806

11 CVO 2300 NW Walnut Boulevard
 Corvallis, OR 97330-3838
 (541) 752-4271 FAX (541) 752-0276

COC # _____

Project # 138267.A-22		Purchase Order #		Requested Analytical Method #										THIS AREA FOR LAB USE ONLY								
Project Name McAllen Pilot Study														TOTAL # OF CONTAINERS								
Company Name McAllen Public Utilities				TKN, T-Phosphorus NO ₂ -NO ₃ N TKN, T-Phosphorus NO ₂ -NO ₃ N TOC Color																		
Project Manager or Contact & Phone # Rosie Villalobos 210-631-9340		Report Copy to: Jim Gerbush (Phony)															Preservative					
Requested Completion Date: ASAP	Site ID NWTP#2	Sample Disposal: Dispose <input checked="" type="checkbox"/> Return <input type="checkbox"/>		Date Time																		
Type		Matrix															CLIENT SAMPLE ID (9 CHARACTERS)					
Sampling		LAB QC		1+1 H ₂ SO ₄ 1+1 H ₂ SO ₄ H ₂ SO ₄ None																		
Date	Time	COMP	GRAB														WATER	SOIL	AIR	1 1 2 1		
6/20/97	8:23						Zee-weed Feedwater Zee-weed Permeate Memcor Filtrate Memcor Filtrate															
6/20/97	9:23																					
6/20/97	10:23																					
6/20/97	11:23																					
Relinquished By Rosie Villalobos		Empty Bottles 5		Date/Time 6/20/97 @ 8:15am	Received By X Hector Escobar		Empty Bottles 5		Date/Time 6/20/97 @ 8:30am	Special Instructions: 1000 contact: GR JV												
Sampled By and Title X Hector Escobar		(Please sign and print name) Hector Escobar		Date/Time 6/20/97 @ 8:23am	Relinquished By X Hector Escobar		(Please sign and print name) Hector Escobar		Date/Time 6/20/97 @ 11:30am													
Received By Rosie Villalobos		(Please sign and print name) Rosie Villalobos		Date/Time 6/20/97 @ 8:23am	Relinquished By Rosie Villalobos		(Please sign and print name) Rosie Villalobos		Date/Time 6/20/97 @ 11:30am													
Received By Jim Gerbush		(Please sign and print name) Jim Gerbush		Date/Time 6/20/97 @ 10:00am	Shipped Via UPS <input checked="" type="checkbox"/> Fed-Ex <input type="checkbox"/> Other _____		Shipping #															

APP-74

MONTHLY BILLING SUMMARY



Applied Sciences Laboratory

Corvallis, Oregon
2300 NW Walnut Blvd, Corvallis, OR 97330-3538
P.O. Box 428, Corvallis, OR 97339-0428
541 752-4271
Fax 541 752-0276

Cii of McAllen

Project Manager: Jim Geisbush/PHX

Invoice Date 06/23/97
Invoice No. A97-1165

Page 1 of 1

Qty	Description	Trans. Date	Unit Cost	Subtotal
1	Color (ALPHA) Apparent	6/23/97	\$20.00	\$20.00
2	Nitrate/Nitrite	6/23/97	\$35.00	\$70.00
2	Total Phosphorus	6/23/97	\$25.00	\$50.00
2	Total Kjeldahl Nitrogen	6/23/97	\$35.00	\$70.00
1	Total Organic Carbon	6/23/97	\$40.00	\$40.00

(THIS IS NOT A BILL - DO NOT SUBMIT PAYMENT) TOTAL AMOUNT: \$250.00

Our records indicate that the above tests were requested during the current billing period. Please notify the laboratory listed above if there are any discrepancies.

- PROJECT COPY -



CH2M HILL
2300 NW Walnut Blvd
Corvallis, OR
97330-3538
Mailing address:
P.O. Box 428
Corvallis, OR
97339-0428
Tel 541.752.4271
Fax 541.752.0276

July 3, 1997

City of McAllen

138067.A0.ZZ

RE: Analytical Data for City of McAllen
CVO Laboratory Reference No. 5607

Jim Geisbush/PHX

On June 24, 1997, the CH2M HILL Corvallis Applied Sciences Laboratory received three samples with a request for analysis of selected parameters.

The analytical results and associated quality control data are enclosed. Any unusual difficulties encountered during the analysis of your samples are discussed in the case narrative.

Under CH2M HILL policy, your samples will be stored for 30 days after reporting. If you have not given us prior instructions for disposal, we will contact you if any samples require disposal as hazardous waste.

The CH2M HILL Applied Sciences Laboratory appreciates your business and looks forward to serving your analytical needs again. If you should have any questions concerning the data, or if you need additional information, please call Ms. Kathy McKinley at (541) 758-0235, extension 3120.

Sincerely,

A handwritten signature in black ink, appearing to read "Kelly Ensor".

Kelly Ensor
Senior Administrative Assistant

Enclosures

Applied Sciences Laboratory, 2300 NW Walnut Blvd., Corvallis, OR 97330-3538
Corvallis Office P. O. Box 428, Corvallis, OR 97339-0428

541 752-4271
Fax No. 541 752.0276

CLIENT SAMPLE CROSS-REFERENCE

CH2M HILL Applied Science Laboratory Reference No. 5607

CVO Sample ID	Client Sample ID	Date Collected	Time Collected
56070 1	Zeeweed Feedwater	06/23/1997	10:40
560702	Zeeweed Permeate	06/23/1 997	10:40
560703	Memcor Filtrate	06/23/1997	10:40

CASE NARRATIVE
GENERAL CHEMISTRY

Lab Reference No.: 5607

Client/Project: City of McAllen

- I. Holding Time:
All acceptance criteria were met.
- II. Digestion Exceptions:
None
- III. Analysis:
- A. Calibration:
All acceptance criteria were met.
- B. Blanks:
All acceptance criteria were met.
- C. Matrix Spike Sample(s):
Matrix spike for TKN was lost due to sample dilution. All other matrix spike acceptance criteria were met.
- D. Duplicate Sample(s):
All acceptance criteria were met.
- E. Lab Control Sample(s):
All acceptance criteria were met except for TKN.
- F. Other:
Not applicable.
- IV. Documentation Exceptions:
None.
- V. I certify that this data package is in compliance with the terms and conditions agreed to by the client and CH2M HILL, both technically and for completeness, except for the conditions detailed above. Release of the data contained in this hardcopy data package has been authorized by the Laboratory Manager or his designee, as verified by the following signature.

Prepared by:

Helen Van Nieu

Reviewed by:

Amaj Collins

Corvallis Applied Sciences Laboratory

Client [REDACTED]	Lab Info [REDACTED]
Project Name: Cii of McAllen Pilot Study	Date Rec'd: 06/24/97
Project Manager: Rosie Villarreal	Lab ID: 560701
sampled By: R. Villarreal	Report Revision No.: 0
Client Sample ID: Zeeweed Feedwater	Reported By: HVN
Sampling Date: 06/23/97	Reviewed By: <i>gmc</i>
Sampling Time: 10:40	
Type: Grab	
Matrix: Water	
Basis: As received	

Analyte	Reporting Limit	Sample Result	Qualifier	Units	Method	Date Analyzed
Chemistry						
N-NO3/NO2	0.10	2.94		mg/L	EPA 353.2	6/27/97
TKN	2	2	U	mg/L	EPA 351.4	6/30/97
P-Total Phosporus	0.05	0.12		mg/L	EPA 365.1	7/2/97
TOC	0.5	6.1		mg/L	EPA 415.1/2	6/25/97

U=Not detected at specified reporting limits

Applied Sciences Laboratory
Corvallis Office

2300 NW Walnut Blvd., Corvallis, OR 97330-3538
P.O. Box 428, Corvallis, OR 97339-0428

(541) 752-4271
Fax No. (541) 752-0276

Corvallis Applied Sciences Laboratory

Client Information

Project Name: City of McAllen Pilot Study
 Project Manager: Rosie Villarreal
 Sampled By: R. Villarreal
 Client sample ID: Zeeweed Permeate
 Sampling Date: 06/23/97
 Sampling Time: 10:40
 Type: Grab
 Matrix: Water
 Basis: As received

Lab Information

Date Rec'd: 06/23/97
 Lab ID: 560702
 Report Revision No.: 0
 Reported By: HVN
 Reviewed By: *gmc*

Analyte	Reporting limit	Sample Result	Qualifier	Units	Method	Date Analyzed
Chemistry						
N-NO3/NO2	0.01	1.01		mg/L	EPA 353.2	6/27/97
TKN	2	5.1		mg/L	EPA 351.4	6/30/97
P-Total Phosporus	0.05	0.35		mg/L	EPA 365.1	7/2/97
TOC	0.5	6.6		mg/L	EPA 415.1/2	6/25/97
Color (ALPHA) Apparent	5	10		mg/L	EPA 110.2	6/24/97

U=Not detected at specified reporting l i m i t s

Corvallis Applied Sciences Laboratory

Client Information

Project Name: Cii of McAllen Pilot Study
 Project Manager: Rosie Villarreal
 Sampled By: R. Villarreal
 Client Sample ID: Memcor Filtrate
 Sampling Date: 06/23/97
 Sampling time: 10:40
 Type: Grab
 Matrix: Water
 Basis: As received

Lab Information

Date Rec'd: 06/23/97
 Lab ID: !
 Report Revision No.: 0
 Reported By: I
 Reviewed By: g

Analyte	Reporting Limit	Sample Result	Qualifier	Units	Method	Date Analyzed
Chemistry						
N-NO3/NO2	0.01	0 . 4 1		mg/L	E P A 353.2	6/27/97
TKN	4	59.0		mg/L	EPA 351.4	6/30/97
P-Total Phosporus	0.50	3.89		mg/L	EPA 365.1	7/2/97
TOC	10.0	56.8		mg/L	EPA 415.112	6/27/97
Color (ALPHA) Apparent	5	20		mg/L	EPA 1102	6/24/97

U=Not detected at specified reporting limits

CH2MHILL Analytical Services
CHAIN OF CUSTODY RECORD
AND AGREEMENT TO PERFORM SERVICES

1 LMG 2667 Fablane Drive
 Montgomery, AL 36118-1822
 (334) 271-1444 FAX (334) 271-3428

1 LRD 6090 Caterpillar Road
 Redding, CA 96003-1412
 (916) 244-5227 FAX (916) 244-4108

1 LKW Carviro Analytical Laboratories, Inc.
 60 Bathurst, Unit 12, Waterloo, Ontario, Canada N2V 2C6
 (519) 747-2575 FAX (519) 747-3806

1 CVO 2300 NW Walnut Boulevard
 Corvallis, OR 97330 3638
 (541) 762-4271 FAX (541) 752-0276

COC # _____

Project # 133067.A2.20		Purchase Order #		Requested Analytical Method #										THIS AREA FOR LAB USE ONLY				
Project Name McAllen Pilot Study				TOTAL # OF CONTAINERS	TOC COLOR TKN, NO ₂ -NO ₃ N, T-Phosphorus										.ab # 5207-173	Page 1	of 1	
Company Name McAllen Public Utilities															.ab PM	Custody Review		
Project Manager or Contact & Phone # Rose Villareal 210-631-8340															Report Copy to: Jim Geisbush (Phoenix)	.log In	LIMS Verification	
Requested Completion Date: ASAP															Site ID NWTP #2	Sample Disposal: Dispose <input checked="" type="checkbox"/> Return <input type="checkbox"/>	.sh	Custody Seals Y N Ice Y N
Sampling		Type COMB	Matrix WATER	CLIENT SAMPLE ID (8 CHARACTERS)	LAB QC	Preservative										QC Level 1 2 3 Other		
Date	Time							H2SO4	None	H+	H2SO4				Cooler Temperature			
6/23/97	10:40			Zeeveed	Fde Water	2	✓											
6/23/97	10:40			Zeeveed	Fde Water	1												
6/23/97	10:40			Zeeveed	Permeate	2	✓											
6/23/97	10:40			Zeeveed	Permeate	1		✓										
6/23/97	10:40			Zeeveed	Permeate	1			✓									
6/23/97	10:40			Memoer	Filterate	2	✓											
6/23/97	10:40			Memoer	Filterate	1		✓										
6/23/97	10:40			Memoer	Filterate	1			✓									
Relinquished By Rose Villareal				Empty Bottles 11	Date/Time 6/23/97 10:28	Received By X Hector Escobar				Empty Bottles 11	Date/Time 6/23/97 @ 10:28 A.M.							
Sampled By X Hector Escobar				(Please sign and print name)	Date/Time 6/23/97 10:40	Relinquished By X Hector Escobar				(Please sign and print name)	Date/Time 6/23/97 @ 10:50 A.M.							
Received By Rose Villareal				(Please sign and print name)	Date/Time 6/23/97 10:50	Relinquished By Rose Villareal				(Please sign and print name)	Date/Time 6/23/97 @ 2:30 P.M.							
Received By Neri M... ..				(Please sign and print name)	Date/Time 6/23/97 10:50	Shipped Via Fed-Ex				Shipping #								
Special Int														Contact: Ginger				

APP-82



CH2M HILL
2300 NW Walnut Blvd.
Corvallis, OR
97330-3538
Mailing address:
P.O. Box 428
Corvallis, OR
97339-0428
Tel 541.752.4271
Fax 541.752.0276

Septenk5. 1997

City of McAllen

138067.A0.ZZ

RE: Analytical Data for City of **McAllen**
CVO Laboratory Reference No. 5607

Jii Lozier/PHX

On June 24, 1997, the **CH2M HILL Corvallis Applied Sciences Laboratory** received three samples with a request for analysis of selected **parameters**.

An **error** was found on your original report due to a log in mor. **The TOC bottles** for the **Zeeweed Feedwater** and **Memcor Filtrate** were labeled **incorrectly**. please replace your original **report** pages with the **attached** revised **results** for **Zeeweed Feedwater** and **Memcor Filtrate**.

The **CH2M HILL Applied Sciences Laboratory** **appreciates** your business and looks forward to **servng** your **analytical** needs again. **If** you should have any questions concerning **the data**, or if you need **additional information**, please call Ms. Kathy McKinley at (541) **758-0235, extension 3120**.

Sincerely,

A handwritten signature in black ink that reads "Ginger Collins".

Ginger Collins
Environmental Chemist

Enclosures

Corvallis Applied Sciences Laboratory

Client Information

Project Name: City of McAllen Pilot Study
 Project Manager: Rosie Villarreal
 Sampled By: R. Villarreal
 Client Sample ID: Zeeweed Feedwater
 Sampling Date: 06/23/97
 sampling Time: 10:40
 Type: Grab
 Matrix: Water
 Basis: As received

Lab Information

Date Rec'd: 06/24/97
 Lab ID: 560701
 Report Revision No.: 1
 Reported By: HVN
 Reviewed By: *gmc*

Analyte	Reporting Limit	Sample Result	Qualifier	Units	Method	Date Analyzed
Chemistry						
N-NO3/NO2	0.10	2.94		mg/L	EPA 353.2	6/27/97
TKN	2	2	u	mg/L	EPA 351.4	6/30/97
P-Total Phosporus	0.05	0.12		mg/L	EPA 365.1	7/2/97
TOC	10.0	56.6		mg/L	EPA 415.112	6/27/97

U=Not detected at specified reporting limits

Corvallis Applied Sciences Laboratory

Client Information

Project Name: City of McAllen Pilot Study
 Project Manager: Rosie Villarreal
 Sampled By: R. Villarreal
 Client Sample ID: M-r Filtrate
 Sampling Date: 06/23/97
 Sampling Time: 10:40
 Type: Grab
 Matrix: Water
 Basis: As received

Lab Information

Date Rec'd: 06/23/97
 Lab ID: 560703
 Report Revision No.: 1
 Reported By: HVN
 Reviewed By: *gmc*

Analyte	Reporting Limit	Sample Result	Qualifier	Units	Method	Date Analyzed
Chemistry						
N-NO3/NO2	0.01	0.41		mg/L	EPA 353.2	6/27/97
TKN	4	59.0		mg/L	EPA 351.4	6/30/97
P-Total Phosphorus	0.50	3.89		mg/L	EPA 365.1	7/2/97
TDC	0.5	6.1		mg/L	EPA 415.1/2	6/25/97
Color (ALPHA) Apparent	5	20		mg/L	EPA 110.2	6/24/97

U=Not detected at specified reporting limits

MONTHLY BILLING SUMMARY



Applied Sciences Laboratory
CH2MHILL Corvallis, Oregon

2300 NW Walnut Blvd, Corvallis, OR 97330-3538
 P.O. Box 428, Corvallis, OR 97339-0428
 541 752-4271
 Fax 541 752-0276

City of **McAllen**

Project Manager: Jim **Geisbush/PHX**

Invoice Date **06/24/97**
 Invoice No. **A97-1178**

Page 1 of 1

Customer Number 138067.A0.ZZ	CH2M Hill Rep. Ginger Collins	Billing Period 7/9/97	Reference No. 6607
----------------------------------------	-----------------------------------------	---------------------------------	-----------------------

Qty	Description	Trans. Date	Unit Cost	Subtotal
3	Color (ALPHA) Apparent	6/24/97	\$20.00	\$60.00
3	Nitrate/Nitrite	6/24/97	635.00	\$105.00
3	Total Phosphorus	6/24/97	\$25.00	\$75.00
3	Total Kjeldahl Nitrogen	6/24/97	\$35.00	\$1 (15.00)
3	Total Organic Carbon	6/24/97	\$40.00	\$120.00

(THIS IS NOT A BILL - DO NOT SUBMIT PAYMENT) TOTAL AMOUNT: **\$465.00**

Our records indicate **that** the above tests were requested during the current billing period. Please notify the laboratory listed above if there are any discrepancies.

== PROJECT COPY ==



CH2MHILL

CH2M HILL
2300 NW Walnut Blvd
Corvallis, OR
97330-3538
Mailing address:
P.O. Box 428
Corvallis, OR
97339-0428
Tel 541.752.4271
Fax 541.752.0276

7/2/97

City of McAllen

Subject **Acknowledgment** of sample set **5664**.

Dear Jim Geisbush/PHX:

This **letter** is m **acknowledge the** receipt of your sample **set** on 7/1/97. It has **been** assigned **laboratory number** 5664. Please **refer** to **the laboratory number** if you need m **inquire** about this sample set I have **attached** a copy of the chain of **custody** form m provide additional **information**.

There were no **problems** noted with the **receipt** of your **samples**.

If you need **assistance**, please feel free m call **541/758-0235** extension 3 117.

Sincerely,
CH2M HILL

Jerri Mattick

Attachment

— RECEIVED —
JUL 7 1997
CH2M HILL/PHOENIX

CH2MHILL Analytical Services
CHAIN OF CUSTODY RECORD
AND AGREEMENT TO PERFORM SERVICES

LMS 2507 Fabiane Drive
 Montgomery, AL 36116-1822
 (334) 271-1444 FAX (334) 271-3428

LRD 6090 Chapparral Road
 Redding, CA 96003-1412
 (916) 244-6227 FAX (916) 244-4109

LKW Canviro Analytical Laboratories, Inc.
 50 Bathurst, Unit 12, Waterloo, Ontario, Canada N2V 2C5
 (510) 747-2576 FAX (510) 747-3806

CVO 2300 HW Walnut Boulevard
 Corvallis, OR 97330-3638
 (541) 752-4271 FAX (541) 752-4276

COC #

Project # 138067.A2-22		Purchase Order #		Requested Analytical Method #										THIS AREA FOR LAB USE ONLY				
Project Name McAllen Pilot Study				TOTAL # OF CONTAINERS	TDC TKN, T-Phosphorus, NH3-N, NO3-N Color 2997										Lab # 5604-173	Page 11	of	
Company Name McAllen Public Utilities															Lab PM	Custody Review		
Project Manager or Contact & Phone # Rosie Villareal															Log In	LIMS Verification		
Report Copy to: Jim Geisbush (Phos.)															pH	Custody Seals Y N		
Requested Completion Date: ASAP		Site ID NWTP#2		Sample Disposal: Dispose <input checked="" type="checkbox"/> Return <input type="checkbox"/>		Preservative										QC Level 1 2 3 Other		
Date		Time		Type		Matrix		CLIENT SAMPLE ID (8 CHARACTERS)				LAB QC		Cooler Temperature				
														Alternate Description				
														Lab ID				
6/29/97		10:42		✓		✓		Zee-weed Feedwater				2		✓				
6/29/97		10:42		✓		✓		Zee-weed Feedwater				1		✓				
6/29/97		10:42		✓		✓		Zee-weed Permeate				2		✓				
6/29/97		10:42		✓		✓		Zee-weed Permeate				1		✓				
6/29/97		10:42		✓		✓		Zee-weed Permeate				1		✓				
6/29/97		10:42		✓		✓		Memcor Filtrate				2		✓				
6/29/97		10:42		✓		✓		Memcor Filtrate				1		✓				
6/29/97		10:42		✓		✓		Memcor Filtrate				1		✓				
Relinquished By Rosie Villareal		Empty Bottles 11		Date/Time 6/29/97 @ 10:42		Received By Enrique Perez		Empty Bottles		Date/Time 6/30/97 @ 10:15		Date/Time 6/30/97 @ 10:15						
Sampled By and Title Enrique Perez		(Please sign and print name)		Date/Time 6/29/97 @ 10:42		Relinquished By Enrique Perez		(Please sign and print name)		Date/Time 6/30/97 @ 10:46		Date/Time 6/30/97 @ 10:46						
Received By Rosie Villareal		(Please sign and print name)		Date/Time 6/29/97 @ 10:42		Relinquished By Rosie Villareal		(Please sign and print name)		Date/Time 6/30/97 @ 15:00		Date/Time 6/30/97 @ 15:00						
Received By Jim Geisbush		(Please sign and print name)		Date/Time 7/1/97 @ 11:00		Shipped Via UPS		Fed-Ex		Other		Shipping #						
Special instructions:												contact: C...er						

APP-88



CH2MHILL

CH2M HILL
2300 NW Walnut Blvd.
Corvallis, OR
97330-3538
Mailing address:
P.O. Box 428
Corvallis, OR
97339-0428
Tel 541.752.4271
Fax 541.752.0276

July 30, 1997

City of McAllen

138067.A0.ZZ

RE: Analytical Data for City of **McAllen**
CVO Laboratory Reference No. 5748

Jim Geisbush/PHX

On July 15, 1997, the **CH2M HILL Corvallis Applied Sciences Laboratory** received **three samples with a request** for analysis of **selected parameters**.

The **analytical results** and **associated quality control** data are **enclosed**. Any **unusual difficulties encountered** during the analysis of **your** samples are discussed in the case **narrative**.

Under **CH2M HILL** policy, your samples **will** be stored for 30 days after reporting. If you have not given **us** prior **instructions** for disposal, we **will contact** you if any samples require disposal as hazardous **waste**.

The **CH2M HILL Applied Sciences Laboratory** appreciates **your** business **and** looks forward to **servng your analytical** needs **again**. If you **should** have any questions **concerning** the data, or if you need additional information, **please call** Ms. Kathy **McKinley** at (541) 758-0235, **extension** 3120.

Sincerely,

Kelly Ensor
Senior Administrative Assistant

Enclosures

Applied Sciences Laboratory
Corvallis Office

2300 NW Walnut Blvd., Corvallis, OR 97330-3538
P. O. Box 428, Corvallis, OR 97339-0428

541 752-4271
Fax No. 541 752-0276

CLIENT SAMPLE CROSS-REFERENCE

CH2M HILL Applied Science Laboratory Reference No. 5748

CVO Sample ID	Client Sample ID	Date Collected	Time Collected
574801	Zeeweed Feedwater	07/14/1997	9:45
574802	Zeeweed Permeate	07/14/1997	9:45
574803	Memcor Filtrate	07/14/1997	9:45

CASE NARRATIVE
GENERAL CHEMISTRY

Lab Reference No.: 5748

Client/Project: City of McAllen

- I. Holding Time:
All acceptance criteria were met.
- II. Digestion Exceptions:
None
- III. Analysis:
- A. Calibration:
All acceptance criteria were met.
- B. Blanks:
Blank for Total Phosphate had 0.06 mg/L PO₄-P. Other acceptance criteria were met.
- C. Matrix Spike Sample(s):
All acceptance criteria were met.
- D. Duplicate Sample(s):
All acceptance criteria were met.
- E. Lab Control Sample(s):
Lab Control for Total Phosphate did not meet criteria. Other acceptance criteria were met.
- F. Other:
Not applicable.
- IV. Documentation Exceptions:
None.
- V. I certify that this data package is in compliance with the terms and conditions agreed to by the client and CH2M HILL, both technically and for completeness, except for the conditions detailed above. Release of the data contained in this hardcopy data package has been authorized by the Laboratory Manager or his designee, as verified by the following signature.

Prepared by: Helen Van Nieu

Reviewed by: Angela Collins

Corvallis Applied Sciences Laboratory

Client Information

Project Name: City of McAllen Pilot Shady
 Project Manager: Rosie Villarreal
 Sampled By: R. Villarreal
 Client Sample ID: Zeeweed Feedwater
 Sampling Date: 07/14/97
 Sampling Time: 9:45
 Type: Grab
 Matrix: Water
 Bask.: As received

Lab Information

Date Rec'd: 07/15/97
 Lab ID: 574801
 Report Revision No.: 0
 Reported By: HVN
 Reviewed By: *gmc*

Analyte	Reporting Limit	Sample Result	Qualifier	Units	Method	Date Analyzed
Chemistry						
N-NO3/NO2	0.10	0.10	U	mg/L	EPA 363.2	7/16/97
TKN	5.0	612		mg/L	EPA 361.4	7/17/97
P-Total Phosporus	0.25	1.67		mg/L	EPA 366.1	7/18/97
TOC	10.0	46.5		mg/L	EPA 415.1/2	7/24/97

U=Not detected at specified reporting limits

Corvallis Applied Sciences Laboratory

Client

Project Name: **City of McAllen Pilot Study**
 Project Manager: **Rosie Villarreal**
 Sampled By: **R. Villarreal**
 Client Sample ID: **Zeeweed Permeate**
 Sampling Date: **07/14/97**
 Sampling time: **9:45**
 Type: **Grab**
 Matrix: **Water**
 Basis: **As received**

Lab Information

Date Rec'd: **07/15/97**
 Lab ID: **574802**
 Report Revision No.: **0**
 Reported By: **HVN**
 Reviewed By: *gme*

1

Analyte	Reporting Limit	Sample Result	Qualifier	Units	Method	Date Analyzed
Chemistry						
N-NO3/NO2	0.10	0.10	U	mg/L	EPA 353.2	7/16/97
TKN	1.0	12.5		mg/L	EPA 351.4	7/17/97
P-Total Phosphorus	0.05	0.05	U	mg/L	EPA 365.1	7/18/97
TOC	1.0	9.7		mg/L	EPA 415.1/2	7/24/97
Color (ALPHA) Apparent	5	10		mg/L	EPA 110.2	7/15/97

U=Not detected at specified reporting limits

Corvallis Applied Sciences Laboratory

Lab Information

Project Name: Cii of McAllen Pilot Study
Project Manager: Rosie Villarreal
Sampled By: R. Villarreal
Client Sample ID: Memcor Filtrate
Sampling Date: 07/14/97
Sampling Time: 9:45
Type: Grab
Matrix: water
Basis: As received

Date R&d: 07/15/97
Lab ID: 674603
Report Revision No.: 0
Reported By: HVN
Reviewed By: *gmc*

Analyte	Reporting Limit	Sample Result	Qualifier	Units	Method	Date Analyzed
Chemistry						
N-NO3/NO2	0.10	3.46		mg/L	EPA 363.2	7/16/97
TKN	1.0	1.9		mg/L	EPA 351.4	7/17/97
P-Total Phosphorus	0.05	0.05	U	mg/L	EPA 366.1	7/18/97
TOC	1.0	6.7		mg/L	EPA 415.1/2	7/24/97
Color (ALPHA) Apparent	5	5	U	mg/L	EPA 110.2	7/15/97

U=Not detected at specified reporting limits

Applied Sciences Laboratory
Corvallis Office

2300 NW Walnut Blvd., Corvallis, OR 97330-3538
P.O. Box 428, Corvallis, OR 97339-0428

(541) 752-4271
Fax No. (541) 752-0276

CH2MHILL Analytical Services
CHAIN OF CUSTODY RECORD
AND AGREEMENT TO PERFORM SERVICES

1 LMD 2587 Fairlane Drive
 Montgomery, AL 36116-1822
 (334) 271-1444 FAX (334) 271-3428

1 LRD 5090 Caterpillar Road
 Redding, CA 96003-1412
 (916) 244-5227 FAX (916) 244-4109

1 LKW Canviro Analytical Laboratories, Inc.
 60 Bathurst, Unit 12, Waterloo, Ontario, Canada N2V 2C5
 (519) 747-2575 FAX (519) 747-3806

1 CVO 2300 NW Walnut Boulevard
 Corvallis, OR 97330 3638
 (541) 752-4271 FAX (541) 752-0276

GOC #

Project # 138067.AQ.ZZ		Purchase Order #		Requested Analytical Method #										THIS AREA FOR LAB USE ONLY				
Project Name McAllen Pilot Study				TOTAL # OF CONTAINERS	TKN, NO ₃ -N, T-Phosphorus Color H ₂ SO ₄ H ₂ SO ₄ None										Lab # 5748-173	Page 1	of 1	
Company Name McAllen Public Utilities															Lab PM	Custody Review		
Project Manager or Contact & Phone # Rosie Villareal 956-631-9340															Report Copy to: Jim Geishush (Phone)	Log In	LIMS Verification	
Requested Completion Date: ASAP		Site ID LWTP #2													Sample Disposal: Dispose <input checked="" type="checkbox"/> Return <input type="checkbox"/>	pH	Custody Seals Y N Ice Y N	
Sampling 1997 7 a.m.		Type PRECIP GRAV WATER SOIL AIR	Matrix	CLIENT SAMPLE ID (9 CHARACTERS)	LAB QC	Preservative						QC Level 1 2 3 Other						
Date	Time											Cooler Temperature						
												Alternate Description		Lab ID				
7/14/97	9:45	✓	✓	2 re used Feed water	2	✓									1			
7/14	"	✓	✓	2 re used Feed water	1	✓	✓								2			
7/14	"	✓	✓	2 re used Permeate	2	✓									2			
7/14	"	✓	✓	2 re used Permeate	1	✓									2			
7/14	"	✓	✓	2 re used Permeate	1	✓									2			
7/14	"	✓	✓	Memor. Filtrate	2	✓									3			
7/14	"	✓	✓	Memor. Filtrate	1	✓									3			
7/14	"	✓	✓	Memor. Filtrate	1	✓									3			
Relinquished By Rosie Villareal		Emply Bottles 11		Date/Time 7/14/97 4:30	Received By Enrique Perez		Emply Bottles 11		Date/Time 7/14/97 @ 9:30 AM									
Sampled By and Title Enrique Perez		(Please sign and print name)		Date/Time 7/14/97	Relinquished By Enrique Perez		(Please sign and print name)		Date/Time 7/14/97 @ 9:52 AM									
Received By Rosie Villareal		Rosie Villareal		Date/Time 7/14/97 5:57	Relinquished By Rosie Villareal		Rosie Villareal		Date/Time 7/14/97 @ 11:30 am									
Received By Jennifer Drowbridge		(Please sign and print name)		Date/Time 7/15/97 1:00	Shipped Via UPS (Fed-Ex) Other		Shipping #											
Special Instructions:																		

APP-95

contact: Engrer



CH2MHILL

CH2M HILL
2300 NW Walnut Blvd.
Corvallis, OR
97330-3538
Mailing address:
P.O. Box 428
Corvallis, OR
97339-0428
Tel 541.752.4271
Fax 541.752.0276

08/05/97

City of McAllen Pilot Study

Subject: Acknowledgment of sample set 5875.

Dear Jim Lozier/PHX:

This letter is to **acknowledge** the receipt of your sample set on 8/5/97. It has been assigned laboratory number 5875. **Please refer** to the **laboratory number** if you need to **inquire** about this sample set. I have attached a copy of the chain of **custody** form to provide **additional information**.

There **were** no problem noted **with the** receipt of your samples

If you need **assistance**, please **feel free** to call 541/758-0235 extension 3117.

Sincerely,
CH2M HILL

Jerri Mattick

Attachment

RECEIVED
AUG 08 1997
CH2M HILL/PHX

CH2MHILL Analytical Services
CHAIN OF CUSTODY RECORD
AND AGREEMENT TO PERFORM SERVICES

LMS 2567 Fabiane Drive
 Montgomery, AL 36118-1022
 (334) 271-1444 FAX (334) 271-3420

LAD 6090 Callipillar Road
 Picking, GA 30133-1412
 (816) 244-5227 FAX (816) 244-4109

LNW Carviro Analytical Laboratories, Inc.
 50 Bathurst, Unit 12, Waterloo, Ontario, Canada N2V 2C8
 (510) 747-2575 FAX (510) 747-3906

CVO 2300 NW Walnut Boulevard
 Corvallis, OR 97330-3638
 (541) 752-4271 FAX (541) 752-0278

COC #

Project # 138 Oct 7, 97 Purchase Order # 19

Project Name McAllen Pilot Study

Company Name McAllen Public Utilities

Project Manager or Contact & Phone # Rosie Villanar Report Copy to: Tom Grisham (Phoenix)

Requested Completion Date: ASAP Site ID: WWT #2 Sample Disposal: Dispose Return

Requested Analytical Method #					
TOC	TKN, T-Phosphorus	Colo	Nitrite Nitrogen	Nitrate Nitrogen	
None	None	None	None	None	
Preservative					
H2SO4	H2SO4				

THIS AREA FOR LAB USE ONLY

Lab # 5875-173 Page 1 of 1

Lab PM _____ Custody Review _____

Log in _____ LIMS Verification _____

pH _____ Custody Seals Y N _____
 Ice Y N _____

QC Level 1 2 3 Other _____

Cooler Temperature _____

Alternate Description _____ Lab ID _____

Date	Time	Sampling	Type				Matrix	CLIENT SAMPLE ID (8 CHARACTERS)	LAB QC
			COM P	GRAB	WATER	SOIL			
8/1			✓	✓			2ce weed Feed water	2	
8/1			✓	✓			2ce weed Feed water	1	
8/1			✓	✓			2ce weed Permeate	2	
8/1			✓	✓			2ce weed Permeate	1	
8/1			✓	✓			2ce weed Permeate	1	
8/1			✓	✓			Mercon Filtrate	2	
8/1			✓	✓			Mercon Filtrate	1	
8/1			✓	✓			Mercon Filtrate	1	

Date	Time	Sampling	Type	Matrix	CLIENT SAMPLE ID	LAB QC	Requested Analytical Method #										
							TOC	TKN, T-Phosphorus	Colo	Nitrite Nitrogen	Nitrate Nitrogen						
8/1			✓	✓	2ce weed Feed water	2	✓	✓									
8/1			✓	✓	2ce weed Feed water	1	✓	✓									
8/1			✓	✓	2ce weed Permeate	2	✓	✓									
8/1			✓	✓	2ce weed Permeate	1	✓	✓									
8/1			✓	✓	2ce weed Permeate	1	✓	✓	✓	✓							
8/1			✓	✓	Mercon Filtrate	2	✓	✓									
8/1			✓	✓	Mercon Filtrate	1	✓	✓									
8/1			✓	✓	Mercon Filtrate	1	✓	✓									

QC Level 1 2 3 Other _____

Cooler Temperature _____

Alternate Description _____ Lab ID _____

Relinquished By Rosie Villanar Empty Bottles 11 Date/Time 8/4/97 2:55 AM

Sampled By and Title Rosie Villanar Date/Time 8/4/97 2:55 AM

Received By Rosie Villanar Date/Time 8/4/97 2:55 AM

Received By Rosie Villanar Empty Bottles 11 Date/Time 8/4/97 2:55 AM

Relinquished By Rosie Villanar Date/Time 8/4/97 2:55 AM

Received By Rosie Villanar Date/Time 8/4/97 2:55 AM

Shipped Via APR Fed-Ex Shipping # _____

Date/Time 8/4/97 2:55 AM

Date/Time 8/4/97 8:20 AM

Date/Time 8/4/97 3:00 PM

Special Instructions: Please Return 2 City of McAllen Ice Packs. Hoping they're on their way to you w/ last weeks cooler.

APP-97



CH2MHILL

— RECEIVED —

AUG 11 1997

CH2M HILL
2300 NW Walnut Blvd.
Corvallis, OR
97330-3538
Mailing address:
P.O. Box 428
Corvallis, OR
97339-0428
Tel 541.752.4271
Fax 541.752.0276

8/5/97

City of McAllen pilot Study

subject Acknowledgment of sample set 5872.

Dear Iii Lozier/PHX:

This letter is to acknowledge the receipt of your sample set on 8/4/97. It has been assigned laboratory number 5872. Please refer to the laboratory number if you need to inquire about this sample set. I have attached a copy of the chain of custody form to provide additional information.

There were no problems noted with the receipt of your samples.

If you need assistance, please feel free to call 541/758-0235 extension 3117.

Sincerely,
CH2M HILL

Jerri Mattick

Attachment

CH2MHILL Analytical Services
CHAIN OF CUSTODY RECORD
AND AGREEMENT TO PERFORM SERVICES

LMD 2567 Fairlane Drive
 Montgomery, AL 36116-1622
 (334) 271-1444 FAX (334) 271-3428

LRD 5090 Caterpillar Road
 Redding, CA 96003-1412
 (916) 244-5227 FAX (916) 244-4109

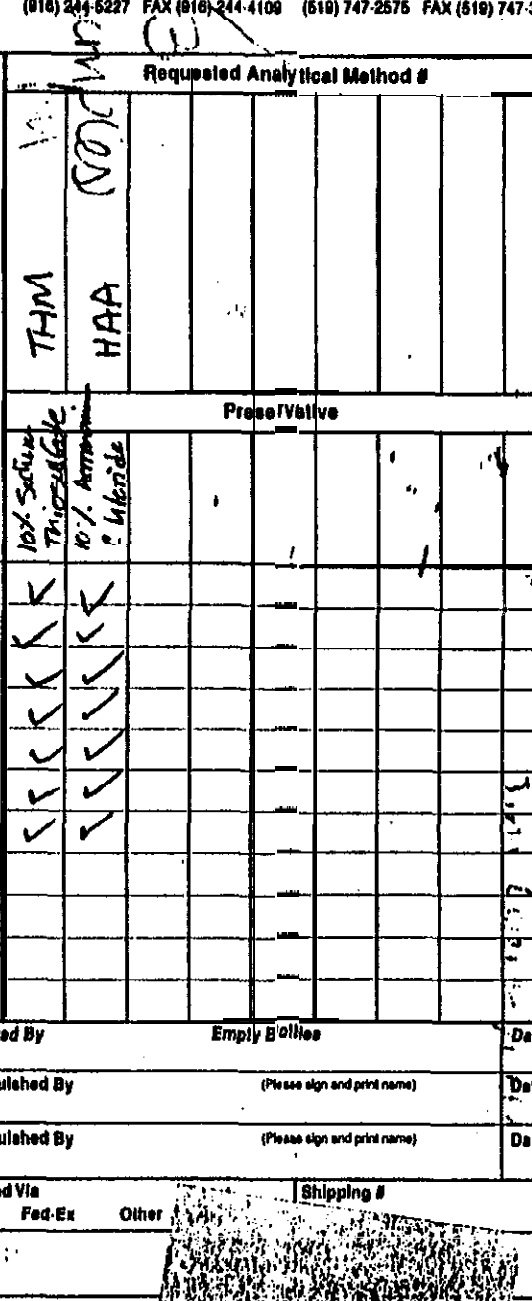
LNW Canviro Analytical Laboratories, Inc
 60 Balthurst, Unit 12, Waterloo, Ontario, Canada N2V 2C5
 (519) 747-2575 FAX (519) 747-3805

CVD 2300 NW Walnut Boulevard
 Corvallis, OR 97330-3638
 (541) 752-4271 FAX (541) 752-0278

COC #

Project # 138067.Aφ.22		Purchase Order #		Requested Analytical Method #				THIS AREA FOR LAS "SE ONLY"			
Project Name McAllen Pilot Study				TOTAL # OF CONTAINERS	THM	HAA	Preservative	Lab # 5872-1-23	Page 1	of 1	
Company Name McAllen Public Utilities								Lab PM	Custody Review		
Project Manager or Contact & Phone # Rosie Villareai		Report Copy to: Jim Geiskush						Log In	LIMS Verification		
Requested Completion Date: ASAP		Site ID WWTP #2						pH		Custody Seals Y N Ice Y N	
Sample Disposal: Dispos <input checked="" type="checkbox"/> Return <input type="checkbox"/>						QC Level 1 2 3 Other		Cooler Temperature			
Sampling		Type	Matrix	CLIENT SAMPLE ID (9 CHARACTERS)				LAB QC		Alternate Description	
Date	Time	COM PEP	GRA B	WET BE	SOIL	AIR					Lab ID
7/28	15:25	✓	✓				FP BLANK 7/28				
7/28	15:34	✓	✓				AP BLANK 7/28				
7/28	15:17	✓	✓				Zee weed form. 3D				
8/1	16:05	✓	✓				Memory Feed 3D				
7/28	15:11	✓	✓				Memory Filter 3D				
8/1	15:40	✓	✓				FP BLANK 8/1				
8/1	15:45	✓	✓				AP BLANK 8/1				
Relinquished By		Empty Bottles		Date/Time		Received By		Empty Bottles		Date/Time	
Sampled By and Title Kris D Snapp		(Please sign and print name)		Date/Time 8/1 1600		Relinquished By		(Please sign and print name)		Date/Time	
Received By Kris D Snapp		(Please sign and print name)		Date/Time 8/4 1510		Relinquished By		(Please sign and print name)		Date/Time	
Received By		(Please sign and print name)		Date/Time		Shipped Via UPS Fed-Ex Other		Shipping #			
Special instructions: Lab Contact : Ginger											

APP-99





CH2MHILL
2300 NW Walnut Blvd.
Corvallis, OR
97330-3538
Mailing address:
P.O. Box 428
Corvallis, OR
97339-0428
Tel 541.752.4271
Fax 541.752.0276

CH2M HILL
2300 NW Walnut Blvd.
Corvallis, OR
97330-3538
Mailing address:
P.O. Box 428
Corvallis, OR
97339-0428
Tel 541.752.4271
Fax 541.752.0276

08/13/97

City of McAllen

Subject: Acknowledgment of sample set 5916.

Dear Jim Lozier/PHX:

This letter is to acknowledge me receipt of your sample set on 8/12/97. It has been assigned laboratory number 5916. Please refer to the laboratory number if you need to inquire about this sample set. I have attached a copy of the chain of custody form to provide additional information.

There were no problems noted with the receipt of your samples.

If you need assistance, please feel free to call 541/758-0235 extension 3117.

Sincerely,
CH2M HILL

A handwritten signature in black ink that reads "Jerri Mattick".

Jerri Mattick

Attachment

CH2MHILL Analytical Services
CHAIN OF CUSTODY RECORD
AND AGREEMENT TO PERFORM SERVICES

LMB 2567 Fairlane Drive
 Montgomery, AL 36116-1622
 (334) 271-1444 FAX (334) 271-3428

LRD 5090 Calaveritas Road
 Redding, CA 96003-1412
 (916) 244-5227 FAX (916) 244-4109

LKW Canvix Analytical Laboratories, Inc.
 50 Bathurst, Unit 12, Waterloo, Ontario, Canada N2V 2C5
 (519) 747-2675 FAX (519) 747-3808

LCV 2300 NW Walnut Boulevard
 Corvallis, OR 97330-3838
 (541) 752-4271 FAX (541) 752-0278

COC #

Project # 138067-AP-22		Purchase Order #		TOTAL CONTAINERS						Requested Analytical Method #				THIS AREA FOR LAB USE ONLY				
Project Name McAllen Pilot Study										Company Name McAllen Public Utilities				TDC TKN, T-phosphorus, NH4-N, NO2-N, NO3-N		Color TKN, ST-phosphorus, NH4-N		Nitrite Nitrogen
Project Manager or Contact & Phone # Rosie Villanueva 954-631-9340				Report Copy to: Jim Geisbush (Prop. M)				Preservative		None None None			Lab PM			Custody Review		
Requested Completion Date: ASAP		Site ID W07PM2		Sample Disposal: Dispose <input checked="" type="checkbox"/> Return <input type="checkbox"/>		Log In							LIMS Verification			pH		
Sampling		Type		Matrix		CLIENT SAMPLE ID (8 CHARACTERS)				LAB QC		QC Level 1 2 3 Other			Cooler Temperature			
Date	Time	C	G	W	S	A							Alternate Description			Lab ID		
8/11/97	11:08		✓	✓			2 Leeward Feedwater				2							
8/11/97	11:08		✓	✓			2 Leeward Feedwater				1							
8/11/97	11:08		✓	✓			2 Leeward Permeate				2							
8/11/97	11:08		✓	✓			2 Leeward Permeate				1							
8/11/97	11:08		✓	✓			2 Leeward Permeate				1							
8/11/97	11:08		✓	✓			Merrimack Filtrate				2							
8/11/97	11:08		✓	✓			Merrimack Filtrate				1							
8/11/97	11:08		✓	✓			Merrimack Filtrate				1							
Relinquished By Rosie Villanueva		Empty Bottles 11		Date/Time 8/11/97 11:02		Received By X Enrique Perez		Empty Bottles 11		Date/Time 8/11/97 @ 11:02 a.m.		Special Instructions Please Return to Ice - Pucks			Contact: Finger			
Sampled By and Title X Enrique Perez		(Please sign and print name) Enrique Perez		Date/Time 8/11/97 11:08		Relinquished By X Enrique Perez		(Please sign and print name) Enrique Perez		Date/Time 8/11/97 @ 11:05 a.m.								
Received By Rosie Villanueva		(Please sign and print name) Rosie Villanueva		Date/Time 8/11/97 11:08		Relinquished By Rosie Villanueva		(Please sign and print name) Rosie Villanueva		Date/Time 8/11/97 @ 12:30 p.m.								
Received By Jim Geisbush		(Please sign and print name) Jim Geisbush		Date/Time 8/11/97		Shipped Via UPS Fed-Ex		Shipping #										

APP-101

Instructions and Agreement Provisions on Reverse Side

DISTRIBUTION: Original - LAB, Yellow - LAB, Pink - Client
 REV 1/97 LAB FORM 340



CH2MHILL

CH2M HILL
2300 NW Walnut Blvd.
Corvallis, OR
97330-3538
Mailing address:
P.O. Box 428
Corvallis, OR
97339-0428
Tel 541.752.4271
Fax 541.752.0276

August 15, 1997

City of McAllen Pilot Study

138067.A8.ZZ

**RE: Analytical Data for City of McAllen Pilot Study
CVO Laboratory Reference No. 5787 & 5872**

Jim Lozier/PHX

On July 22, and August 4, 1997, the CH2M HILL Corvallis Applied Sciences Laboratory received seven samples with a request for analysis of selected parameters.

The analytical results and associated quality control data are enclosed. Any unusual difficulties encountered during the analysis of your samples are discussed in the case narrative.

Under CH2M HILL policy, your samples will be stored for 30 days after reporting. If you have not given us prior instructions for disposal, we will contact you if any samples require disposal as hazardous waste.

The CH2M HILL Applied Sciences Laboratory appreciates your business and look forward to serving your analytical needs again. If you should have any questions concerning the data, or if you need additional information, please call Ms. Kathy McKinley at (541) 758-0235, extension 3120.

Sincerely,

**Kelly Ensor
Senior Administrative Assistant**

Enclosures

*Applied Sciences Laboratory
Corvallis Office*

*2300 NW Walnut Blvd., Corvallis, OR 97330-3538
P. O. Box 428, Corvallis, OR 97339-0428*

*541 752-4271
Fax No. 541 752-0276*

CLIENT SAMPLE CROSS-REFERENCE ..

CH2M HILL Applied Science Laboratory Reference No. 5787 & 5872

CVO Sample ID	Client Sample ID	Date Collected	Time Collected
578701	Zeeweed Feedwater	7/21/97	11:15
578702	Zeeweed Permeate	7/21/97	11:15
578703	Memcor Feedwater	7/21/97	11:15
578704	Memcor Filtrate	7/21/97	11:15
587201	Zeeweed Perm 3D	7/28/97	15:17
587202	Memcor Feed 3D	8/01/97	16:05
587203	Memcor Filtrate 3D	7/28/97	15:11

CASE NARRATIVE
DBPs/ORGANICS

Lab Reference No.: 5872

Client/Project: City of McAllen Pilot Study

- I. Holding Times:
All acceptance criteria were met.
- II. Analysis:
- A. Calibration:
All acceptance criteria were met.
- B. Blanks:
All acceptance criteria were met.
- C. Duplicate Sample(s):
All acceptance criteria were met.
- D. Spike Sample(s):
Dichloroacetic acid recovery (132%) exceeded acceptance criteria. All other acceptance criteria were met.
- E. Surrogate Recoveries:
All acceptance criteria were met.
- F. Lab Control Sample(s):
All acceptance criteria were met.
- G. Other:
Internal standard recoveries for samples 587202 & -03, 175% and 179% respectively, did not meet acceptance criteria.
- III. Documentation Exceptions:
None

IV. I certify that this data package is in compliance with the terms and conditions agreed to by the client and CH2M HILL, both technically and for completeness, except for the conditions detailed above. Release of the data contained in this hardcopy data package has been authorized by the Laboratory Manager or designee, as verified by the following signature.

Prepared by: Douglas A. Hardy 8/15/97
Reviewed by: Ginger Collins 8/15/97

**CASE NARRATIVE
GENERAL CHEMISTRY**

Lab Reference No.: 5787

Client/Project: City of McAllen Pilot Study

- I. Holding Time:
All acceptance criteria were met.
- II. Digestion Exceptions:
None
- III. Analysis:
 - A. Calibration:
All acceptance criteria were met.
 - B. Blanks:
All acceptance criteria were met.
 - c. Matrix Spike Sample(s):
All acceptance criteria were met.
 - D. Duplicate Sample(s):
All acceptance criteria were met.
 - E. Lab Control Sample(s):
All acceptance criteria were met.
 - F. Other:
Not applicable.
- IV. Documentation Exceptions:
None.
- V. I certify that this data package is in compliance with the terms and conditions agreed to by the client and CH2M HILL, both technically and for completeness, except for the conditions detailed above. Release of the data contained in this hardcopy data package has been authorized by the Laboratory Manager or his designee, as verified by the following signature.

Prepared by: Helen Van Nieu
Reviewed by: Luizy Collins

**CASE NARRATIVE
DBP/FORMATION POTENTIAL**

Lab Reference No.: 5787

Client/Project: City of McAllen Pilot Study

- I. Holding Time:
All holding times were met.

- II. pH / Cl residual analysis:
 - A. Calibration:
All acceptance criteria were met.

 - B. Blanks:
FP blank from 7/25/97 contained TTHM of 9.5 µg/L. AP blank from 7/25/97 recovered 129% TTHM. Acceptance criteria for FP and AP blanks from 7/29/97 were met.

 - C. Other:
None

- IV. Documentation Exceptions:
None

- V. I certify that this data package is in compliance with the terms and conditions agreed to by the client and CH2M HILL, both technically and for completeness, except for the conditions detailed above. Release of the data contained in this hardcopy data package has been authorized by the Laboratory Manager or his designee, as verified by the following signature.

Prepared by: *Douglas A. Hardy*
Reviewed by: *Traci D Snapp*

Corvallis Applied Sciences Laboratory

Client Information		Lab Information	
Project Name:	City of McAllen Pilot Study	Date Rec'd:	07/22/97
Project Manager:	Rosie Villarreal	Lab ID:	578701
sampled By:	Enrique Perez	Report Revision No.:	0
Client Sample ID:	Zeeweed Feedwater	Reported By:	HVN
Sampling Date:	07/21/97	Reviewed By:	<i>gmc</i>
Sampling Time:	11:15		
Type:	Grab		
Matrix:	Water		
Basis:	As received		

Analyte	Reporting Limit	Sample Result	Qualifier	Units	Method	Date Analyzed
Chemistry						
N-NO3/NO2	0.1	0.1	U	mg/L	EPA 253.2	7/25/97
TKN	- 5	101		mg/L	EPA 351.4	7/25/97
P-Total Phosphorous	0.5	13.5		mg/L	EPA 365.1	8/12/97
N-Ammonia	1.0	302		mg/L	SM4500-NH3-D	7/25/97

U=Not detected at specified reporting limits

Corvallis Applied Sciences Laboratory

Client Information

Project Name: City of McAllen Pilot Study
 Project Manager: Rosie Villarreal
 Sampled By: Enrique Perez
 Client Sample ID: Zeeweed Permeate
 Sampling Date: 07/21/97
 Sampling Time: 11:15
 Type: Grab
 Matrix: water
 Basis: As received

Lab Information

Date Rec'd: 07/22/97
 Lab ID: 578702
 Report Revision No.: 0
 Reported By: HVN
 Reviewed By: *gme*

Analyte	Reporting Limit	Sample Result	Qualifier	Units	Method	Date Analyzed
Chemistry						
N-NO3/NO2	0.1	16.1		mg/L	EPA 3532	7/25/97
TKN	1	8.7		mg/L	EPA 351.4	7/25/97
P-Total Phosphorous	0.05	3.1		mg/L	EPA 365.1	8/12/97
TDC	1.0	8.0		mg/L	EPA415112	7/24/97
Color (ALPHA) Apparent	5	20		mg/L	EPA 1102	7/23/97
N-Ammonia	0.1	5.4		mg/L	SM4500-NH3-D	7/25/97

U=Not detected at specified reporting limits

Applied Sciences Laboratory
 Corvallis Office

2300 NW Walnut Blvd., Corvallis, OR 97330-3538
 P.O. Box 428, Corvallis, OR 97339-0428

(541) 752-4271
 Fax No. (541) 752-0276

Corvallis Applied Sciences Laboratory

Client Information

Project Name: City of McAllen Pilot study
 Project Manager: Rosie Villarreal
 Sampled By: Enrique Perez
 Client Sample ID: Memcor Filtrate
 sampling Date: 07/21/97
 Sampling Time: 11:15
 Type: Grab
 Matrix: Water
 Bask: As received

Lab Information

Date R&d: 07/22/97
 Lab ID: 676704
 Report Revision No.: 0
 Reported By: HVN
 Reviewed By: *gmc*

Analyte	Reporting Limit	Sample Result	Qualifier	Unite	Method	Date Analyzed
Chemistry						
TOC	1.0	6.2		mg/L	EPA 415.1/2	7/24/97
Color (ALPHA) Apparent	5	5		mg/L	EPA1102	7/23/97

U=Not detected at specified reporting limits

Applied Sciences Laboratory
 Corvallis Office

2300 NW Walnut Blvd., Corvallis, OR 97330-3538
 P.O. Box 428, Corvallis, OR 97339-0428

(541) 752-4271
 Fax No. (541) 752-0276

Corvallis Applied Sciences Laboratory

Project Name: City of McAllen Project Manager: Rosie Villarreal sampled By: Enrique Perez Client Sample ID: Zeeweed Permeate Sampling Date: 7/21/97 Sampling time: 11:15 Type: Grab Matrix: Water Basis: As Received	Lab Info Date Rec'd: 7/22/97 Lab ID: 578702 Analysis Method: SM 5710.D Report Revision No.: 0 Reported By: DAH Reviewed By: <i>KDS</i>
----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------	-----------------------------------------------------------------------------------------------------------------------------------------------------------------

HAA/THM Formation Potential Test Conditions

Set-up Date/Time	Target Contact Time	Initial pH	Contact pH	Contact Temperature (°C)	Chlorine Dosage (mg/L)
7/25/97 15:46	72:00	7.6	7.9	23	10.00

Chlorine Demand Test Results

Take-off Date/Time	Contact Time	Measured pH	Measured Temperature (°C)	Chlorine Residual (mg/L)
7/28/97 15:17	71:31	7.0	23	2.18

U=Not detected at specified reporting limits

Applied Sciences Laboratory
Corvallis Office

2300 NW Walnut Blvd., Corvallis, OR 97330-3538
P.O. Box 428, Corvallis, OR 97339-0428

(541) 752-4271
Fax No. (541) 752-0276

Corvallis Applied Sciences Laboratory

Client Information

Project Name: City of McAllen
 Project Manager: Rosie Villarreal
 Sampled By: Enrique Perez
 Client Sample ID: Memcor Feedwater
 Sampling Date: 7/21/97
 Sampling Time: 11:15
 Type: Grab
 Matrix: Water
 Basis: As Received

Lab Information

Date Rec'd: 7/22/97
 Lab ID: 578703
 Analysis Method: SM 5710.D
 Report Revision No.: 0
 Reported By: DAH
 Reviewed By: KDS

HAA/THM Formation Potential Test Conditions

Set-up Date/Time	Target Contact Time	Initial pH	Contact pH	Contact Temperature (°C)	Chlorine Dosage (mg/L)
7/29/97 15:29	72:00	7.3	7.9	23	7.10

Chlorine Demand Test Results

Take-off Date/Time	Contact Time	Measured pH	Measured Temperature (°C)	Chlorine Residual (mg/L)
8/1/97 16:05	72:36	7.0	23	1.03

U=Not detected at specified reporting limits

Corvallis Applied Sciences Laboratory

Client Information Project Name: City of McAllen Project Manager: Rosie Villarreal Sampled By: Enrique Perez Client Sample ID: Memcor Filtrate Sampling Date: 7/21/97 Sampling Time: 11:15 Type: Grab Matrix: water Basis: As Received	Lab Information Date Rec'd: 7/22/97 Lab ID: 578704 Analysis Method: SM 5710.0 Report Revision No.: 0 Reported By: OAH Reviewed By: JCS
--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------	-----------------------------------------------------------------------------------------------------------------------------------------------------------------

HAA/THM Formation Potential Test Conditions

Set-up Date/Time	Target Contact Time	Initial pH	Contact pH	Contact Temperature (°C)	Chlorine Dosage (mg/L)
7/25/97 15:52	72:00	7.3	7.8	23	9.00

Chlorine Demand Test Results

Take-off Date/Time	Contact Time	Measured pH	Measured Temperature (°C)	Chlorine Residual (mg/L)
7/28/97 15:11	71:19	7.9	23	0.23

U=Not detected at specified reporting limits

Applied Sciences Laboratory
Corvallis Office

2300 NW Walnut Blvd., Corvallis, OR 97330-3538
P.O. Box 428, Corvallis, OR 97339-0428

(541) 752-4271
Fax No. (541) 752-0276

Corvallis Applied Sciences Laboratory

Client Information

Project Name: City of McAllen
 Project Manager: Rosie Villarreal
 Sampled By: Kristi Snapp
 Client Sample ID: Zeeweed Perm3D
 Sampling Date: 7/28/97
 Sampling Time: 15:17
 Type: Grab
 Matrix: water
 Basis: As Received

Lab Information

Date Rec'd: 8/4/97
 Lab ID: 587201
 Report Revision No.: 0
 Reported By: DAH
 Reviewed By: *gmc*
 Units: µg/L

Analyte	CAS #	Reporting Limit	Sample Result	Qualifier	Date Analyzed
<i>Haloacetic Acids - SM 6251.B</i>					
Chloroacetic acid	79-11-8	1.0	1.7		8/7/97
Bromoacetic acid	79-08-3	0.5	2.2		en197
Dichloroacetic acid	79-43-6	0.5	2.15		8/7/97
Trichloroacetic acid	76-03-9	OR	4.4		8/7/97
Bromochloroacetic acid	5589-96-3	0.5	1.35		8/7/97
Dibromoacetic acid	631-64-1	0.5	13.4		8/7/97
2,3-Dibromopropanoic acid	600-05-5		130%	SS	
<i>Trihalomethanes - EPA 502.2</i>					
Chloroform	67-66-3	0.5	4.2		8/11/97
Bromodichloromethane	75-27-4	0.5	6.5		8/11/97
Dibromochloromethane	124-43-1	0.5	5.8		8/11/97
Bromoform	75-25-2	0.5	5.4		8/11/97
1,2-Dichloroethane-d4	17068-07-0		66%	SS	

E=Exceeded instrument calibration range
 SS=Surrogate standard
 U=Not detected at specified reporting limits

Corvallis Applied Sciences Laboratory

Client Info

Project Name: City of McAllen
 Project Manager: Rosie Villarreal
 Sampled By: Kristi Snapp
 Client Sample ID: Memcor Feed3D
 Sampling Date: 8/1/97
 Sampling Time: 16:05
 Type: Grab
 Matrix: Water
 Basis: As Received

Lab Information

Date Rec'd: 8/4/97
 Lab ID: 587202
 Report Revision No.: 0
 Reported By: DAH
 Reviewed By: *gme*
 Units: µg/L

Analyte	CAS #	Reporting Limit	Sample Result	Qualifier	Date Analyzed
<i>Haloacetic Acids - SM 6251.B</i>					
Chloroacetic acid	7911-a	1.0	9.3		8/7/97
Bromoacetic acid	79-08-3	0.5	4.2		8/7/97
Dichloroacetic acid	79-43-6	0.5	35.3		8/7/97
Trichloroacetic acid	78-03-Q	0.5	35.2		8/7/97
Bromochloroacetic acid	5589-96-3	0.5	23.8		8/7/97
Dibromoacetic acid	631-64-1	0.5	11.6		8/7/97
2,3-Dibromopropanoic acid	600-05-5		113%	SS	
<i>Trihalomethanes - EPA 502.2</i>					
Chloroform	67-66-3	0.5	136	E	8/11/97
Bromodichloromethane	75-27-4	0.5	101		8/11/97
Dibromochloromethane	124-48-1	0.5	71.1		8/11/97
Bromoform	75-25-2	0.5	9.0		8/11/97
1,2-Dichloroethane-d4	17068-07-0		88%	SS	

E=Exceeded instrument calibration range
 SS=Surrogate standard
 U=Not detected at specified reporting limits

Applied Sciences Laboratory
 Corvallis Office

2300 NW Walnut Blvd., Corvallis, OR 97330-3538
 P.O. Box 428, Corvallis, OR 97339-0428

(541) 752-4271
 Fax No. (541) 752-0276

Corvallis Applied Sciences Laboratory

Client Information

Project Name: City of McAllen
 Project Manager: Rosie Villarreal
 Sampled By: Kristi Snapp
 Client Sample ID: Memcor Filtrate3D
 Sampling Date: 7/28/97
 Sampling time: 15:1t
 Type: Grab
 Matrix: Water
 Basis: As Received

Lab Information

Date Recd: 8/4/97
 Lab ID: 567203
 Report Revision No.: 0
 Reported By: DAH
 Reviewed By: *gme*
 Units: µg/L

Analyte	CAS #	Reporting Limit	Sample Result	Qualifier	Date Analyzed
Haloacetic Acids - SM 6251.B					
Chloroacetic acid	79-11-8	1.0	10.2		8/7/97
Bromoacetic acid	79-08-3	0.5	6.4		8/7/97
Dichloroacetic acid	79-43-6	0.5	39.1		8/7/97
Trichloroacetic acid	76-03-9	0.5	34.1		8/7/97
Bromochloroacetic acid	5589-96-3	0.5	26.0		8/7/97
Dibromoacetic acid	63164-1	0.5	12.5		8/7/97
2,3-Dibromopropanoic acid	600-05-5		119%	SS	
Trihalomethanes - EPA 502.2					
Chloroform	67-66-3	0.5	131	E	8/11/97
Bromodichloromethane	75-27-4	0.5	965		8/11/97
Dibromochloromethane	124-49-1	0.5	72.3		8/11/97
Bromoform	75-25-z	0.5	105		8/11/97
1,2-Dichloroethane-d4	17068-07-0		96%	SS	

E=Exceeded instrument calibration range
 SS=Surrogate standard
 U=Not detected at specified reporting limits

CH2MHILL Analytical Services
CHAIN OF CUSTODY RECORD
AND AGREEMENT TO PERFORM SERVICES

LMG 2667 Fairlane Drive
 Montgomery, AL 36118-1822
 (334) 271-1444 FAX (334) 271-3428

LRQ 5000 Caterpillar Road
 Redding, CA 96003-1412
 (916) 244-8227 FAX (916) 244-4100

LKW Canvix Analytical Laboratories, Inc.
 50 Bathurst, Unit 12, Waterloo, Ontario, Canada N2V 2C5
 (510) 747-9575 FAX (510) 747-3808

LCV 2300 NW Walnut Boulevard
 Corvallis, OR 97330-3636
 (541) 762-4271 FAX (541) 762-0278

COC #

Project # 138067.A0.22		Purchase Order #		Requested Analytical Method #						THIS AREA FOR LAB USE ONLY				
Project Name McAllen Pilot Study				TOTAL # OF CONTAINERS	THM	10% Sodium Thiosulfate	10% Ammonium Chloride	H ₂ O	Preservative	Lab # 5872-1-73	Page 1	of 1		
Company Name McAllen Public Utilities										Lab PM	Custody Review			
Project Manager or Contact & Phone # Rosie Villareal										Report Copy to: Jim Geiskush	Log In	LIMS Verification		
Requested Completion Date: ASAP		Site ID WWTP #2								Sample Disposal: Dispose <input checked="" type="checkbox"/> Return <input type="checkbox"/>		pn	Custody Seals Y N Ice Y I	
Sampling		Type	Matrix	CLIENT SAMPLE ID (9 CHARACTERS)		LAB QC		QC Level 1 2 3 Other						
Date	Time	COMP	GRAV	WATER	SOIL	AIR		Cooler Temperature						
7/20	16:25	V	V				FR BLANK 7/20							
7/20	15:30	V	V				AP BLANK 7/20							
7/20	15:17	V	V				Zee Weed Form. 3D							
8/1	16:05	V	V				Memory Feed 3D							
7/20	15:11	V	V				Memory Filter 20							
8/1	15:40	V	V				FP BLANK 8/1							
8/1	15:45	V	V				AP BLANK 8/1							
Relinquished By Empty Bottles				Date/Time	Relinquished By Empty Bottles				Date/Time					
Sampled By and Title Kristi Snapp				Date/Time 8/1 1600	Relinquished By (Please sign and print name)				Date/Time					
Received By Kristi Snapp				Date/Time 8/4 1220	Relinquished By (Please sign and print name)				Date/Time					
Received By (Please sign and print name)				Date/Time	Shipped Via UPS Fed-Ex Other _____			Shipping #						
Special Instructions: Lab Contact: Ginder														

APP-116

CH2M HILL Analytical Services
CHAIN OF CUSTODY RECORD
AND AGREEMENT TO PERFORM SERVICES

LMC 2567 Fairlane Drive
 Montgomery, AL 36116-1822
 (334) 271-1444 FAX (334) 271-3426

LRD 6090 California Road
 Redding, CA 96003-1412
 (916) 244-5227 FAX (916) 244-4109

LKW Carrizo Analytical Laboratories, Inc.
 60 Bathurst, Unit 12, Waterloo, Ontario, Canada N2V 2C5
 (519) 747-2575 FAX (519) 747-3806

LCV 2300 NW Walnut Boulevard
 Corvallis, OR 97330-3636
 (541) 752-4271 FAX (541) 752-0276

COC #

Project # 138007.A0.22		Purchase Order #		Requested Analytical Method #						THIS AREA FOR LAB USE ONLY																		
Project Name McAllen Pilot Study										TOTAL # OF CONTAINERS	TOC	Color	TKN, Phosphorus, NO ₂ -N, NH ₃ -N	THMP, HAA5P							Lab # 5787174	Page 1	of 1					
Company Name McAllen Public Utilities																					Lab PM	Custody Review						
Project Manager or Contact & Phone # Rosie Villanera 956-631-8340					Report Copy to: Jim Geisbush																Log In	LIMS Verification						
Requested Completion Date: ASAP		Site ID WWTP#2		Sample Disposal: Discard <input checked="" type="checkbox"/> Return <input type="checkbox"/>																	pH	Custody Seals Y N Ice Y N						
Sampling A.M.	Date	Time	Type PEO D B R W A T E R	Matrix S O I L A I R	CLIENT SAMPLE ID (9 CHARACTERS)																LAB QC	H ₂ SO ₄	None	H ₂ SO ₄	None	Preservative	QC Level 1 2 3 Other	Cooler Temperature
	7/21/97	11:15	✓	✓	Zee weed	Fed water	R		1														✓					
	7/21/97	"	✓	✓	Zee weed	Permeate			2												✓							
	7/21/97	"	✓	✓	Zee weed	Permeate			1													✓						
	7/21/97	"	✓	✓	Zee weed	Permeate			1														✓					
	7/21/97	"	✓	✓	Memcor	Fed water			1			✓																
	7/21/97	"	✓	✓	Memcor	Filtrate			2	✓																		
	7/21/97	"	✓	✓	Memcor	Filtrate			1		✓																	
	7/21/97	"	✓	✓	Memcor	Filtrate			1			✓																
Relinquished By - Rosie Villanera			Empty Bottles 11		Date/Time 7/21/97 11:00		Received By Enrique Perez			Empty Bottles 11		Date/Time 7-21-97 11:00 AM																
Sampled By and Title Enrique Perez			(Please sign and print name)		Date/Time A.M. 7/21/97 11:15		Relinquished By Enrique Perez			(Please sign and print name)		Date/Time 7-21-97 11:25 AM																
Received By Rosie Villanera			(Please sign and print name)		Date/Time A.M. 7/21/97 11:15		Relinquished By Rosie Villanera			(Please sign and print name)		Date/Time 7/21/97 @ 3:00 p.m.																
Received By Norm Matlak			(Please sign and print name)		Date/Time 7-22-97 10:50		Shipped Via UPS Fed-Ex Other _____			Shipping #																		
Special Instructions:													Ginger															

APP-117

MONTHLY BILLING SUMMARY



Applied Sciences Laboratory
CH2MHILL Corvallis, Oregon
 2300 NW Walnut Blvd, Corvallis, OR 97330-3538
 P.O. Box 428, Corvallis, OR 97339-0428
 541 752-4271
 Fax 541 752-0276

City of McAllen Pilot study
 Project Manager: Jim Lozier/PHX

Invoice Date 07/22/97
 Invoice No. A97-1364

Page 1 of 1

Customer Number	CH2M Hill Rep.	Billing Period	Reference No.
138067.A8.ZZ	Ginger Collins	8/27/97	5787

Qty	Description	Trans. Date	Unit Cost	Subtotal
2	Color(ALPHA) Apparent	7/22/97	\$20.00	\$40.00
2	Ammonia	7/22/97	\$20.00	\$40.00
2	Nitrate/Nitrite	7/22/97	\$35.00	\$70.00
2	Total Phosphorus	7/22/97	\$25.00	\$50.00
3	Trihalomethane & Haloacetic Acids Formation Potential (THM/HAAFP)	7/22/97	8135.00	\$405.00
2	Total Kjeldahl Nitrogen	7/22/97	\$35.00	\$70.00
2	Total Organic Carbon	7/22/97	\$40.00	\$80.00

(THIS IS NOT A BILL - DO NOT SUBMIT PAYMENT)

Total Amount Billed: **\$755.00**

Our records indicate that the above tests were requested during the current billing period. Please notify the laboratory listed above if there are any discrepancies.

- PROJECT COPY -

projinv.rdl rev 7-10-97

MONTHLY BILLING SUMMARY



CH2MHILL

Applied Sciences Laboratory

Corvallis, Oregon
2300 NW Walnut Blvd, Corvallis, OR 97330-3538
P.O. Box 428, Corvallis, OR 97339-0428
541 752-4271
Fax 541 752-0276

Cli of **McAllen** Pilot Study
Project Manager: Jim Lozier/PHX

Invoice Date 08/04/97
Invoice No. A97-1446

Page 1 Of 1

Customer Number 138067.A8.ZZ	CH2M Hill Rep. Ginger Collins	Billing Period 8/27/97	Reference No. 5872
----------------------------------------	-----------------------------------------	----------------------------------	------------------------------

Qty	Description	Trans. Date	Unit Cost	Subtotal
3	Haloacetic Acids	8/4/97	\$225.00	\$675.00
3	Trihalomethanes by Purge & Trap	8/4/97	\$75.00	\$225.00

(THIS IS NOT A BILL - DO NOT SUBMIT PAYMENT)

Total Amount Billed: \$900.00

Our records indicate that the above tests were requested during the current billing period. Please notify the laboratory listed above if there are any discrepancies.

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projinv.rtf rev 7-10-97



CH2MHILL

CH2M HILL
2300 NW Walnut Blvd.
Corvallis, OR
97330-3538
Mailing address:
P.O. Box 428
Corvallis, OR
97339-0428
Tel 541.752.4271
Fax 541.752.0276

August 18, 1997

City of McAllen

138067.A0.ZZ

RE: **Analytical Dam for City of McAllen**
CVO Laboratory Reference No. 5846

Jim Geisbush/PHX

On **July 30, 1997**, the **CH2M HILL Corvallis Applied Sciences Laboratory** received **three** samples with a request for analysis of **selected parameters**.

The analytical results and associated quality control data are enclosed. Any **unusual difficulties encountered during the analysis** of your samples are **discussed** in the case narrative.

Under **CH2M HILL** policy, **your samples** will be stored for 30 days after **reporting**. If you **have not** given us prior **instructions** for disposal, we **will contact you** if any **samples** require disposal as **hazardous waste**.

The **CH2M HILL Applied Sciences Laboratory** appreciates your business and looks forward to **servicing** your analytical needs **again**. If you **should have** any **questions concerning the data**, or if you need additional information, **please call** Ms. Kathy **McKinley** at **(541) 758-0235**, extension 3120.

Sincerely,

Kelly Ensor
Senior Administrative Assistant

Enclosures

Applied Sciences Laboratory
Corvallis Office

2300 NW Walnut Blvd., Corvallis, OR 97330-3538
P. O. Box 428, Corvallis, OR 97339-0428

541 752-4271
Fax No. 541 752-0276

CLIENT SAMPLE CROSS-REFERENCE

CH2M HILL Applied Science Laboratory Reference No. 5846

cvo	Sample ID	Client Sample ID	Date Collected	Time Collected
	584601	Zeeweed Feedwater	07/29/1997	
	584602	Zeeweed Permeate	07/29/1997	
	584603	Memcor Filtrate	07/29/1997	

CASE NARRATIVE
GENERAL CHEMISTRY

Lab Reference No.: 5846

Client/Project: City of McAllen

- I. Holding Time:
All acceptance criteria were met.
- II. Digestion Exceptions:
Digested standard for TKN had 66% recovery. Subsequent analysis produced 88% recovery. Acceptance criteria for other analyses were met.
- III. Analysis
- A. Calibration:
All acceptance criteria were met.
- B. Blanks:
All acceptance criteria were met.
- C. Matrix Spike Sample(s):
All acceptance criteria were met.
- D. Duplicate Sample(s):
All acceptance criteria were met.
- E. Lab Control Sample(s):
Lab Control recovery for TKN was 72%. Subsequent analysis recovery was 100%. Criteria for all other analyses were met.
- F. Other:
Not applicable.
- IV. Documentation Exceptions:
None.
- V. I certify that this data package is in compliance with the terms and conditions agreed to by the client and CH2M HILL, both technically and for completeness, except for the conditions detailed above. Release of the data contained in this hardcopy data package has been authorized by the Laboratory Manager or his designee, as verified by the following signature.

Prepared by: Helen Van Nieuwen

Reviewed by: Debra Collins

Corvallis Applied Sciences Laboratory

Client: [REDACTED]	Lab Int: [REDACTED]
Project Name: Cii of McAllen Pilot Study	Date Rec'd: 07/30/97
Project Manager: Rosie Villarreal	Lab ID: 584601
sampled By: R. Villarreal	Report Revision No.: 0
Client Sample ID: Zeeweed Feedwater	Reported By: HVN
Sampling Date: 07/29/97	Reviewed By: <i>gmc</i>
Sampling Time: Not indicated	
Type: Grab	
Matrix: water	
Basis: As received	

Analyte	Reporting Limit	Sample Result	Qualifier	Units	Method	Date Analyzed
Chemistry						
N-NO3/NO2	0.1	0.1	U	mg/L	EPA 353.2	8/15/97
TKN	1.0	1.09		mg/L	EPA 351.4	7/31/97
P-Total Phosphorus	25	29.1		mg/L	EPA 365.1	8/12/97
TOC	10.0	45.4		mg/L	EPA 415.1/2	8/11/97

U=Not detected at specified reporting limits

Applied Sciences Laboratory
Corvallis Office

2300 NW Walnut Blvd., Corvallis, OR 97330-3538
P.O. Box 428, Corvallis, OR 97339-0428

(541) 752-4271
Fax No. (541) 752-0276

Corvallis Applied Sciences Laboratory

<u>Client Information</u>	<u>Lab Information</u>
Project Name: City of McAllen Pilot Study	Date R&d: 07/30/97
Project Manager: Rosie Villarreal	Lab ID: 584602
Sampled By: R. Villarreal	Report Revision No.: 0
Client Sample ID: Zeeweed Permeate	Reported By: HVN
Sampling Date: 07/29/97	Reviewed By: <i>gmc</i>
Sampling Time: Not indicated	
Type: Grab	
Matrix: water	
Basis: As received	

Analyte	Reporting Limit	Sample Result	Qualifier	Units	Method	Date Analyzed
Chemistry						
N-NO3/NO2	0.1	6.4		mg/L	EPA 353.2	8/15/97
TKN	1.0	29		mg/L	EPA 351.4	7/31/97
P-Total Phosphorus	0.05	1.3		mg/L	EPA 365.1	8/12/97
Too	1.0	9.3		mg/L	EPA 415.1/2	8/7/97
Color (ALPHA) Apparent	5	25		mg/L	EPA 110.2	7/31/97

U=Not detected at specified reporting limits

Applied Sciences Laboratory
Corvallis Office

2300 NW Walnut Blvd., Corvallis, OR 97330-3538
P.O. Box 428, Corvallis, OR 97339-0428

(541) 752-4271
Fax No. (541) 752-0276

Corvallis Applied Sciences Laboratory

Project Name: Cii of McAllen Pilot Study		Lab Information	
Project Manager: Rosie Villarreal		Date Rec'd: 07/30/97	
Sampled By: R. Villarreal		Lab ID: 584603	
Client Sample ID: Memcor Filtrate		Report Revision No.: 0	
Sampling Date: 07/29/97		Reported By: HVN	
Sampling Time: Not indicated		Reviewed By: <i>gmc</i>	
Type: Grab			
Matrix: Water			
Basis: As received			

Analyte	Reporting Limit	Sample Result	Qualifier	Units	Method	Date Analyzed
Chemistry						
N-NO3/NO2	0.1	0.7		mg/L	EPA 3.532	8/15/97
TKN	1.0	1.1		mg/L	EPA 361.4	7/31/97
P-Total phosphorus	0.05	0.6		mg/L	EPA 366.1	8/12/97
TOC	1.0	7.6		mg/L	EPA 415.1/2	8/7/97
Color (ALPHA) Apparent	5	15		mg/L	EPA 1102	7/31/97

U=Not detected at specified reporting limits

MONTHLY BILLING SUMMARY



CH2MHILL

Applied Sciences Laboratory

Corvallis, Oregon

2300 NW Walnut Blvd, Corvallis, OR 97330-3538

P.O. Box 428, Corvallis, OR 97339-0428

541 752-4271

Fax 541 752-0276

City of McAllen Pilot Study

Project Manager: Jim Lozier/PHX

Invoice Date 07/30/97

Invoice No. A97-1422

Page 1 Of 1

Customer Number 138067.A8.ZZ		CH2M Hill Rep. Ginger Collins	Billing Period 8/27/97	Reference No. 58461
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Qty	Description	Trans. Date	Unit Cost	Subtotal
2	Color (ALPHA) Apparent	7/30/97	\$20.00	\$40.00
3	Ammonia	7/30/97	\$20.00	\$60.00
3	Nitrate/Nitrite	7/30/97	\$35.00	\$105.00
3	Total Phosphorus	7/30/97	\$25.00	\$75.00
3	Total Kjeldahl Nitrogen	7/30/97	\$35.00	\$105.00
3	Total Organic Carbon	7/30/97	\$40.00	\$120.00

(THIS IS NOT A BILL-DO NOT SUBMIT PAYMENT)

Total Amount Billed: **\$505.00**

Our records indicate that the above tests were requested during the current billing period. Please notify the laboratory listed above if there are any discrepancies.

- PROJECT COPY -

projrev.rdl rev 7-10-97



CH2MHILL

CH2M HILL
2300 NW Walnut Blvd
Corvallis, OR
97330-3538
Mailing address:
P.O. Box 428
Corvallis, OR
97339-0428
Tel 541.752.4271
Fax 541.752.0276

August 21, 1997

City of McAllen pilot Study

138067.A8.ZZ

RE: Analytical Data for City of McAllen pilot Study
CVO Laboratory Reference No. 5875

Jim Lozier/PHX

On August 5, 1997, the CH2M HILL Corvallis Applied Sciences Laboratory received three samples with a request for analysis of selected parameters.

The analytical results and associated quality control data are enclosed. Any unusual difficulties encountered during the analysis of your samples are discussed in the case narrative.

Under CH2M HILL policy, your samples will be stored for 30 days after reporting. If you have not given us prior instructions for disposal, we will contact you if any samples require disposal as hazardous waste.

The CH2M HILL Applied Sciences Laboratory appreciates your business and looks forward to serving your analytical needs again. If you should have any questions concerning the data, or if you need additional information, please call Ms. Kathy McKinley at (541) 758-0235, extension 3120.

Sincerely,

Kelly Ensor
Senior Administrative Assistant

Enclosures

Applied Sciences Laboratory
Corvallis Office

2300 NW Walnut Blvd., Corvallis, OR 97330-3538
P. O. Box 428, Corvallis, OR 97339-0428

541 752-4271
Fax No. 541 752-0276

CLIENT SAMPLE CROSS-REFERENCE

CH2M HILL Applied Science Laboratory Reference No. 5875

CVO Sample ID	Client Sample ID	Date Collected	Time Collected
587501	Zeeweed Feedwater	08/04/1997	
587502	Zeeweed Permeate	08/04/1997	
587503	Memcor Filtrate	08/04/1997	

CASE NARRATIVE
GENERAL CHEMISTRY

Lab Reference No.: 5875

Client/Project: City of McAllen Pilot Study

- I. Holding time:
All acceptance criteria were met.
- II. Digestion Exceptions:
None
- III. Analysis
- A. libration:
All acceptance criteria were met.
- B. Blanks:
All acceptance criteria were met.
- C. Matrix Spike Sample(s):
All acceptance criteria were met.
- D. Duplicate Sample(s):
All acceptance criteria were met.
- E. Lab Control Sample(s):
All acceptance criteria were met.
- F. Other:
Not applicable.
- IV. Documentation Exceptions: -
- None.

V. I certify that this data package is in compliance with the terms and conditions agreed to by the client and CH2M HILL, both technically and for completeness, except for the conditions detailed above. Release of the data contained in this hardcopy data package has been authorized by the Laboratory Manager or his designee, as verified by the following signature.

Prepared by: Angie Collins for Helen Van Nieu

Reviewed by: Aura Stone Jensen

Corvallis Applied Sciences Laboratory

Client Information

Lab Info

Project Name: City of McAllen Pilot Study
 Project Manager: Rosie Villarreal
 Sampled By: R. Villarreal
 Client Sample ID: Zeeweed Feedwater
 sampling Date: 08/04/97
 Sampling time: Not indicated
 Type: Grab
 Matrix: water
 Basis: As received

Date Rec'd: 08/05/97
 Lab ID: 587501
 Report Revision No.: 0
 Reported By: HVN
 Reviewed By: *Lala*

Analyte	Reporting Limit	Sample Result	Qualifier	Units	Method	Date Analyzed
Chemistry						
N-NO3/NO2	0.1	0.1	U	mg/L	EPA 353.2	8/15/97
				mg/L	EPA 351.4	8/7/97
N-Ammonia	10.0	22.9		mg/L	SM4500-NH3-D	8/7/97
P-Total Phosphorus	0.25	4.8		mg/L	EPA 355.1	8/12/97
TOG	10.0	55.4		mg/L	EPA 415.1/2	8/8/97

U=Not detected at specified reporting limits

Corvallis Applied Sciences Laboratory

Client Information

Project Name: **City of McAllen Pilot Study**
 Project Manager: **Rosie Villarreal**
 Sampled By: **R. Villarreal**
 Client Sample ID: **Zeeweed Permeate**
 Sampling Date: **08/04/97**
 Sampling Time: **Not indicated**
 Type: **Grab**
 Matrix: **water**
 Basis: **As received**

Lab Information

Date Rec'd: **08/05/97**
 Lab ID: **587502**
 Report Revision No.: **0**
 Reported By: **HVN**
 Reviewed By: *[Signature]*

Analyte	Reporting Limit	Sample Result	Qualifier	Units	Method	Date Analyzed
Chemistry						
TKN	1.0	1.3		mg/L	EPA 351.4	8/7/97
N-Ammonia	0.10	0.67		mg/L	SM4500-NH3-D	8/7/97
P-Total Phosphorus	0.5	3.4		mg/L	EPA 365.1	8/12/97
TOC	1.0	7.6		mg/L	EPA 415.1/2	8/8/97
Color (ALPHA) Apparent	5	20		mg/L	EPA110.2	8/5/97
N-Nitrate	0.1	17.4		mg/L	EPA300	8/6/97
N-Nitrite	0.1	1.7		mg/L	EPA300	8/6/97

U=Not detected at specified reporting limits

Applied Sciences Laboratory
 Corvallis Office

2300 NW Walnut Blvd., Corvallis, OR 97330-3538
 P.O. Box 428, Corvallis, OR 97339-0428

(541) 752-4271
 Fax No. (541) 752-0276

Corvallis Applied Sciences Laboratory

<u>Information</u>	<u>Lab Information</u>
Project Name: City of McAllen Pilot Study	Date Rec'd: 08/05/97
Project Manager: Rosie Villarreal	Lab ID: 587503
Sampled By: R. Villarreal	Report Revision No.: 0
Client Sample ID: M-r Filtrate	Reported By: HVN
Sampling Date: 08/04/97	Reviewed By: <i>Lala</i>
Sampling Time: Not indicated	
Type: Grab	
Matrix: water	
Basis: As received	

Analyte	Reporting Limit	Sample Result	Qualifier	Units	Method	Date Analyzed
Chemistry						
N-NO3/NO2	0.1	3.9		mg/L	EPA 353.2	8/15/97
TU N	1.0	1.0		mg/L	EPA 351.4	8/7/97
N-Ammonia	0.10	0.10	U	mg/L	SM4500-NH3-D	8/7/97
P-Total Phosphorus	0.05	0.80		mg/L	EPA 365.1	8/12/97
TDC	1.0	6.4		mg/L	EPA 415.1/2	8/8/97
Color (ALPHA) Apparent	5	5	U	mg/L	EPA 1102	8/5/97

U=Not detected at specified reporting limits

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Corvallis Office

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P.O. Box 428, Corvallis, OR 97339-0428

(541) 752-4271
Fax No. (541) 752-0276

CH2MHILL Analytical Services
CHAIN OF CUSTODY RECORD
AND AGREEMENT TO PERFORM SERVICES

LMO 2567 Falciano Drive
 Montgomery, AL 36118-1822
 (334) 271-1444 FAX (334) 271-3428

LRO 6090 Caterpillar Road
 Redding, CA 96003-1419
 (916) 244-6227 FAX (916) 244-4109

LKW Canviro Analytical Laboratories, Inc.
 50 Bethurst, Unit 12, Waterloo, Ontario, Canada N2V 2C5
 (519) 747-2575 FAX (519) 747-3808

CVO 2300 NW Walnut Boulevard
 Corvallis, OR 97330-3638
 (541) 752-4271 FAX (541) 752-0278

COC #

Project # 138067AD.72		Purchase Order # 18-206		Requested Analytical Method #						THIS AREA FOR LAB USE ONLY																								
Project Name McAllen Pilot Study				TOTAL # OF CONTAINERS	<table border="1"> <tr> <td>TOC</td> <td>TKN, T-Phosphorus</td> <td>Color</td> <td>Nitrite Nitrogen</td> <td>Nitrate Nitrogen</td> <td>NO₂/NO₃</td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>H₂SO₄</td> <td>H₂SO₄</td> <td>None</td> <td>None</td> <td>None</td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> </table>						TOC	TKN, T-Phosphorus	Color	Nitrite Nitrogen	Nitrate Nitrogen	NO ₂ /NO ₃					H ₂ SO ₄	H ₂ SO ₄	None	None	None						Lab # 5879-133	Page 1	of 1	
TOC	TKN, T-Phosphorus	Color	Nitrite Nitrogen								Nitrate Nitrogen	NO ₂ /NO ₃																						
H ₂ SO ₄	H ₂ SO ₄	None	None								None																							
Company Name McAllen Public Utilities											Lab PM	Custody Review																						
Project Manager or Contact & Phone # Rosic Villareal 956-631-8340				Report Copy to: Jim Geisbush (Phoenix)	Log In	LIMS Verification																												
Requested Completion Date: ASAP		Site ID WWT P#2		Sample Disposal: Dispose <input checked="" type="checkbox"/> Return <input type="checkbox"/>		pH		Custody Seals Y N		Ice Y N																								
Sampling		Type	Matrix	CLIENT SAMPLE ID (9 CHARACTERS)						LAB QC		QC Level 1 2 3 Other																						
Date	Time	COMB	DEBR	WATER	SOIL	AIR							Cooler Temperature																					
													Alternate Description		Lab ID																			
8/4?							2	✓																										
							2		✓																									
							2	✓																										
							1		✓																									
							1			✓	✓	✓																						
							2	✓																										
							1			✓																								
							1				✓																							
							1					✓																						
Relinquished By Rosic Villareal				Empty Bottles 11		Date/Time 8/4/97 7:55		Relinquished By Errique Pater				Empty Bottles 11		Date/Time 8-4-97 7:55 AM																				
Sampled By and Title Errique Pater				(Please sign and print name)		Date/Time 8-4-97 8:00 AM		Relinquished By Errique Pater				(Please sign and print name)		Date/Time 8-4-97 8:20 AM																				
Received By Rosic Villareal				(Please sign and print name)		Date/Time 8/4/97 9:20		Relinquished By Rosic Villareal				(Please sign and print name)		Date/Time 8-4-97 3:00 PM																				
Received By J. Overbridge				(Please sign and print name)		Date/Time 8/5/97 10:20		Shipped Via <input checked="" type="checkbox"/> Fed-Ex <input type="checkbox"/> Other				Shipping #																						
Special Instructions: Please Return 2 City of McAllen Ice Packs														Hoping they're on their way to you w/ fact books etc.																				

Instructions and Agreement Provided on Reverse Side

APP-134

MONTHLY BILLING SUMMARY



Applied Sciences Laboratory
 Corvallis, Oregon
 2300 NW Walnut Blvd, Corvallis, OR 97330-3538
 P.O. Box 428, Corvallis, OR 97339-0428
 541 752-4271
 Fax 541 752-0276

City of **McAllen** Pilot Study
 Project Manager Jim **Lozier/PHX**

Invoice Date **08/05/97**
 Invoice No. **A97-1451**

Page 1 of 1

Customer Number 138067.A8.ZZ	CH2M Hill Rep. Ginger Collins	Billing Period 8/27/97	Reference No. 5875
----------------------------------------	-----------------------------------------	----------------------------------	------------------------------

Qty	Description	Trans. Date	Unit Cost	Subtotal
2	Color (ALPHA) Apparent	8/5/97	\$20.00	\$40.00
3	Ammonia	8/5/97	\$20.00	\$60.00
2	Nitrate/Nitrite	8/5/97	\$35.00	\$70.00
1	Nitrate	8/5/97	\$30.00	\$30.00
1	Nitrite	8/5/97	\$20.00	\$20.00
3	Total Phosphorus	8/5/97	\$25.00	\$75.00
3	Total Kjeldahl Nitrogen	8/5/97	\$35.00	\$105.00
3	Total Organic Carbon	8/5/97	\$40.00	\$120.00

(THIS IS NOT A BILL - DO NOT SUBMIT PAYMENT)

Total Amount Billed: **\$520.00**

Our records indicate that the above tests were requested during the current billing period. Please notify the laboratory listed above if there are any discrepancies.

⇒ PROJECT COPY ⇒

projinv.rdl rev 7-10-97

MONTHLY BILLING SUMMARY

LARA

a CH2MHILL Applied Sciences **Laboratory**
 Corvallis, Oregon
 2300 NW Walnut Blvd, Corvallis, OR 97330-3538
 P.O. Box 428, Corvallis, OR 97339-0428
 541 752-4271
 Fax 541 752-0276

City of **McAllen**
 Project Manager: Jim **Lozier/PHX**

Invoice Date **08/12/97**
 Invoice No. **A97-1492**

Page **1** Of **1**

Customer Number 138067.A0.ZZ		CH2M Hill Rep. Ginger Collins	Billing Period 9/10/97	Reference No. 5916
----------------------------------------	--	-----------------------------------------	----------------------------------	------------------------------

Qty	Description	Trans. Date	Unit Cost	Subtotal
2	Color (ALPHA) Apparent	8/12/97	\$20.00	\$40.00
3	Ammonia	8/12/97	\$20.00	\$60.00
2	Nitrate/Nitrite	8/12/97	\$35.00	\$70.00
1	Nitrate	8/12/97	\$30.00	\$30.00
1	Nitrite	8/12/97	\$20.00	\$20.00
3	Total Phosphorus	8/12/97	\$25.00	\$75.00
3	Total Kjeldahl Nitrogen	8/12/97	\$35.00	\$105.00
3	Total Organic Carbon	8/12/97	\$40.00	\$120.00

(THIS IS NOT A BILL -DO NOT SUBMIT PAYMENT)

Total Amount Billed: **\$520.00**

Our records indicate that the above tests were requested during the current billing **period**. Please notify the **laboratory** listed above if there are any **discrepancies**.

== PROJECT COPY ==

projbill.rdb rev 7-10-97



CH2MHILL

CH2M HILL
2300 NW Walnut Blvd.
Corvallis, OR
97330-3538
Mailing address:
P.O. Box 428
Corvallis, OR
97339-0428
Tel 541.752.4271
Fax 541.752.0276

August 29, 1991

City of McAllen

138067.A0.ZZ

RE: Analytical Data for City of McAllen
CVO Laboratory Reference No. 5916

Jim Lozier/PHX

On August 12, 1997, the CH2M HILL Corvallis Applied Sciences Laboratory received three samples with a request for analysis of selected parameters.

The analytical results and associated quality control data are enclosed. Any unusual difficulties encountered during the analysis of your samples are discussed in the case narrative.

Under CH2M HILL policy, your samples will be stored for 30 days after reporting. If you have not given us prior instructions for disposal, we will contact you if any samples require disposal as hazardous waste.

The CH2M HILL Applied Sciences Laboratory appreciates your business and looks forward to serving your analytical needs again. If you should have any questions concerning the data, or if you need additional information, please call Ms. Kathy McKinley at (541) 758-0235, extension 3120.

Sincerely,

Kelly Ensor
Senior Administrative Assistant

Enclosures

Applied Sciences Laboratory
Corvallis Office

2300 NW Walnut Blvd., Corvallis, OR 97330-3538
P. O. Box 428, Corvallis, OR 97339-0428

541 752-4271
Fax No. 541 752-0276

CLIENT SAMPLE CROSS-REFERENCE

CH2M HILL Applied Science Laboratory Reference No. 5916

CVO Sample ID	Client Sample ID	Date Collected	Time Collected
591601	Zeeweed Feedwater	08/11/1997	11:08
591602	Zeeweed Permeate	08/11/1997	11:08
591603	Memcor Filtrate	08/11/1997	11:08

CASE NARRATIVE
GENERAL CHEMISTRY

Lab Reference No.: 5916

Client/Project: City of McAllen

- I. Holding Time:
All acceptance criteria were met.
- II. Digestion Exceptions:
None
- III. Analysis:
 - A. Calibration:
All acceptance criteria were met.
 - B. Blanks:
All acceptance criteria were met.
 - c. Matrix Spike Sample(s):
Matrix spike not available for TOC and NO₃/NO₂. All other acceptance criteria were met.
 - D. Duplicate Sample(s):
All acceptance criteria were met.
 - E. Lab Control Sample(s):
All acceptance criteria were met.
 - F. Other:
Not applicable.
- IV. Documentation Exceptions:
None.
- V. I certify that this data package is in compliance with the terms and conditions agreed to by the client and CH2M HILL, both technically and for completeness, except for the conditions detailed above. Release of the data contained in this hardcopy data package has been authorized by the Laboratory Manager or his designee, as verified by the following signature.

Prepared by: Helen Van Nise

Reviewed by: Janice Collins

0

Corvallis Applied Sciences Laboratory

Client: [REDACTED]	Lab: [REDACTED]
Project Name: Cii of McAllen Pilot Study	Date Rec'd: 08/12/97
Project Manager Rosie Villarreal	Lab ID: 591601
sampled By: R. Villarreal	Report Revision No.: 0
Client Sample ID: Zeeweed Feedwater	Reported By: HVN
Sampling Date: 08/11/97	Reviewed By: <i>gmc</i>
Sampling Time: 11:08	
Type: Grab	
Matrix: Water	
Basis: As received	

Analyte	Reporting Limit	Sample Result	Qualifier	Units	Method	Date Analyzed
Chemistry						
N-NO3/NO2	0.1	0.1	U	mg/L	EPA 353.2	8/15/97
N-Ammonia	0.4	14.6		mg/L	SM4500-NH3-D	8/19/97
TKN	5	46.1		mg/L	EPA 351.4	8/19/97
P-Total Phosporus	5.0	41.0		mg/L	EPA 365.1	8/27/97
TOC	10.0	43.4		mg/L	EPA 415.1/2	8/22/97

U=Not detected at specified reporting limits

Applied Sciences Laboratory
Corvallis Office

2300 NW Walnut Blvd., Corvallis, OR 97330-3538
P.O. Box 428, Corvallis, OR 97339-0428

(541) 752-4271
Fax No. (541) 752-0276

Corvallis Applied Sciences Laboratory

Client [REDACTED]

Lab [REDACTED]

1

Pmjuw Name: City of McAllen Pilot Study Date Rec'd: 08/12/97
 Project Manager: Rosie Villarreal Lab ID: 591602
 Sampled By: R. Villarreal Report Revision No.: 0
 Client Sample ID: Zeeweed Permeate Reported By: HVN
 Sampling Date: 08/11/97 Reviewed By: *gmc*
 Sampling time: 11:08
 Type: Grab
 Matrix: water
 Basis: As received

Analyte	Reporting Limit	Sample Result	Qualifier	Units	Method	Date Analyzed
Chemistry				mg/L		
N-Nitrate	0.1	15.8		mg/L	EPA 300	8/12/97
N-Nitrite	0.1	0.1	U		EPA 300	8/12/97
N-Ammonia	0.1	0.6		mg/L	SM4500-NH3-D	8/19/97
TKN	1	1	U	mg/L	EPA 351.4	8/19/97
P-Total Phosphorus	0.5	7.0		mg/L	EPA 385.1	8/27/97
TOC	1.0	7.5		mg/L	EPA 415.1/2	8/22/97
Color (ALPHA) Apparent	5	20		mg/L	EPA 110.2	8/13/97

U=Not detected at specified reporting Limits

Corvallis Applied Sciences Laboratory

Information

Project Name: City of McAllen Pilot Study
 Project Manager: Rosie Villarreal
 Sampled By: R. Villarreal
 Client Sample ID: Memcor Filtrate
 Sampling Date: owl 1/97
 Sampling Time: 11:08
 Type: Grab
 Matrix: Water
 Basis: As received

Lab Information

Date Rec'd: 08/12/97
 Lab ID: 941603
 Report Revision No.: 0
 Reported By: HVN
 Reviewed By: *gmc*

Analyte	Reporting Limit	Sample Result	Qualifier	Units	Method	Date Analyzed
Chemistry						
N-NO3/NO2	0.1	2.8		mg/L	EPA 353.2	8/15/97
N-Ammonia	0.1	0.1		mg/L	SM4500-NH3-D	8/19/97
TKN	1	2.3		mg/L	EPA 351.4	8/19/97
P-Total Phosphorus	0.05	1.77		mg/L	EPA 365.1	8/27/97
TOC	1.0	7.6		mg/L	EPA 415.1/2	8/22/97
Color (ALPHA) Apparent	5	5		mg/L	EPA 110.2	8/13/97

U=Not detected et specified reporting limits

Applied Sciences Laboratory
 Corvallis Office

2300 NW Walnut Blvd., Corvallis, OR 97330-3538
 P.O. Box 428, Corvallis, OR 97339-0428

(541) 752-4271
 Fax No. (541) 752-0276

CH2MHILL Analytical Services
CHAIN OF CUSTODY RECORD
AND AGREEMENT TO PERFORM SERVICES

[] LMG 2587 Fairlane Drive
 Montgomery, AL 36116-1622
 (334) 271-1444 FAX (334) 271-3428

[] LRD 5090 Caterpillar Road
 Redding, CA 96003-1412
 (916) 244-5227 FAX (916) 244-4109

[] LKW Cervino Analytical Laboratories, Inc.
 60 Bathurst, Unit 12, Waterloo, Ontario, Canada N2V 2C5
 (519) 747-2575 FAX (519) 747-3808

[] LCV0 2300 NW Walnut Boulevard
 Corvallis, OR 97330-3638
 (541) 752-4271 FAX (541) 752-0278

COC # _____

Project # 138067-APP-22		Purchase Order #		TOTAL CONTAINERS										Requested Analytical Method #						THIS AREA FOR LAB USE ONLY		
Project Name Meallen Pilot Study														TOC TKW, T-Phosphorus, NH ₃ -N, NO ₂ -N, N ₂ -N Color TKW 5T-Phosphorus, NH ₃ -N Nitrite Nitrogen Nitrate Nitrogen						Lab # 5916-173	Page 1	of 1
Company Name Meallen Public Utilities				Preserve H ₂ SO ₄ HI H ₂ SO ₄ None HI H ₂ SO ₄ None None						Lab PM	Custody Review											
Project Manager or Contact & Phone # Rosie Villareal		Report Copy to: Jim Geisbush (Phone)								Log In LIMS Verification						Log In	LIMS Verification					
Requested Completion Date: ASAP		Site ID WWTP#2		pH Custody Seals Y N Ice Y N												QC Level 1 2 3 Other						
Sample Disposal: Dispose <input checked="" type="checkbox"/> Return <input type="checkbox"/>		Cooler Temperature Alternate Description Lab ID								Cooler Temperature												
Sampling								CLIENT SAMPLE ID (8 CHARACTERS)		LAB QC		Date Time Type Matrix WATER SOIL AIR						Alternate Description			Lab ID	
Date		Time		LAB QC		H ₂ SO ₄ HI H ₂ SO ₄ None HI H ₂ SO ₄ None None												Alternate Description			Lab ID	
8/11/97 11:08		2. Zeeweed Feedwater		2								} -1						Alternate Description			Lab ID	
8/11/97 11:08		2. Zeeweed Feedwater		1		} -2												Alternate Description			Lab ID	
8/11/97 11:08		2. Zeeweed Permeate		2								} -3						Alternate Description			Lab ID	
8/11/97 11:08		2. Zeeweed Permeate		1		} -3												Alternate Description			Lab ID	
8/11/97 11:08		2. Zeeweed Permeate		1								} -3						Alternate Description			Lab ID	
8/11/97 11:08		Memcoz Filtrate		2		} -3												Alternate Description			Lab ID	
8/11/97 11:08		Memcoz Filtrate		1								} -3						Alternate Description			Lab ID	
8/11/97 11:08		Memcoz Filtrate		1		} -3												Alternate Description			Lab ID	
Relinquished By Rosie Villareal		Empty Bottles 11		Date/Time 8/11/97 11:02								Received By X Enrique Perez		Empty Bottles 11		Date/Time 8/11/97 @ 11:02 a.m.		Alternate Description			Lab ID	
Sampled By and Title X Enrique Perez		(Please sign and print name) Enrique Perez		Date/Time 8/11/97 11:02		Relinquished By X Enrique Perez		(Please sign and print name) Enrique Perez		Date/Time 8/11/97 @ 11:25 a.m.		Alternate Description			Lab ID							
Received By Rosie Villareal		(Please sign and print name) Rosie Villareal		Date/Time 8/11/97 11:25		Relinquished By Rosie Villareal		(Please sign and print name) Rosie Villareal		Date/Time 8/11/97 @ 12:30 p.m.		Alternate Description			Lab ID							
Received By Vern M. Hule		(Please sign and print name) Vern M. Hule		Date/Time 8-11-97		Shipped Via UPS Fed-Ex		Other		Shipping #		Alternate Description			Lab ID							
Special Instructor Jim Geisbush		Reference to TIC 0130		Date/Time		Shipped Via		Other		Shipping #		Alternate Description			Lab ID							

Instructions and Agreement Provisions on Reverse Side

DISTRIBUTION: Original - LAB Yellow - LAD Pink - Client

APP-143

Contact: Ginsler

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CH2M HILL
2300 NW Walnut Blvd.
Corvallis, OR
97330-3538
Mailing address:
P.O. Box 428
Corvallis, OR
97339-0428
Tel 541.752.4271
Fax 541.752.0276

June 25, 1997

City of McAllen

138067.A0.ZZ

RE: **Analytical Data** for City of **McAllen**
CVO Laboratory Reference No. 5357 and 5467

Jim Geisbush/PHX

On May 20, 1997, the **CH2M HILL Corvallis** Applied Sciences Laboratory received **three samples with a request** for analysis of selected **parameters**. From these samples 3 more were created for **THM's and HAA's**.

The **analytical results** and **associated quality** control data are enclosed. Any **unusual difficulties encountered** during the analysis of **your samples** are discussed in the **case** narrative.

Under **CH2M HILL** policy, your samples **will be** stored for 30 days after reporting. If you **have** not given us prior **instructions** for disposal, we will contact **you** if any samples **require** disposal as **hazardous** waste.

The **CH2M HILL** Applied Sciences laboratory **appreciates** your business and looks forward to serving your **analytical** needs again. If you **should have** any questions **concerning the data**, or if you need additional **information**, please **call** Ms. Kathy McKinley at (541) **758-0235, extension 3120**.

Sincerely,

Kelly Ensor
Senior Administrative Assistant

Enclosures

Applied Sciences Laboratory, 2300 NW Walnut Blvd., Corvallis, OR 97330-3538
Corvallis Office P. O. Box 428, Corvallis, OR 97339-0428

541 752-4271
Fax No. 541 752-0276

CLIENT SAMPLE CROSS-REFERENCE

CH2M HILL Applied Science Laboratory Reference No. **5357**

cvo Sample ID	Client Sample JD	Date Collected	Time Collected
535701	Feedwater	05/19/1997	10:40
535702	Memcor Filtrate	05/19/1997	10:40
535703	Zeeweed Permeate	05/19/1997	10:40

CLIENT SAMPLE CROSS-REFERENCE

CH2M HILL Applied Science Laboratory Reference No. 5467

<i>cvo</i>	<i>Sample ID</i>	Client Sample ID	Date Collected	Time Collected
	54670 1	FEEDWATER 3D	06/05/1997	9:38
	546702	MEMCOR 3D	06/05/1997	14:40
	546703	ZEEWEED 3D	06/05/1997	14:47

**CASE NARRATIVE
FORMATION POTENTIAL**

Lab Reference No.: 5357

Client/Project: City of McAllen

L Holding Time:
Holding time for this analysis is 24 hours. Holding time was exceeded upon arrival.

IL pH / Cl residual analysis:

A. Calibration:
All acceptance criteria were met.

B. Blanks:
All acceptance criteria were met.

C. Other:
None

IV. Documentation Exceptions:
None

V. I certify that this data package is in compliance with the terms and conditions agreed to by the client and CH2M HILL, both technically and for completeness, except for the conditions detailed above. Release of the data contained in this hardcopy data package has been authorized by the Laboratory Manager or his designee, as verified by the following signature.

Prepared by: Douglas A. Handy

Reviewed by: Munaw Collins

CASE NARRATIVE
GENERAL CHEMISTRY

Lab Reference No.: 5357

Client/Project: City of McAllen

- I. Holding Time:
All acceptance criteria were met.
- II. Digestion Exceptions:
None
- III. Analysis:
- A. ibration:
An acceptance criteria were met.
- B. Blanks:
All acceptance criteria were met.
- C. Matrix Spike Sample(s):
All acceptance criteria were met.
- D. Duplicate Sample(s):
All acceptance criteria were met.
- E. Lab Control Sample(s):
All acceptance criteria were met.
- F. Other:
Not applicable.
- N. Documentation Exceptions:
None.
- V. I certify that this data package is in compliance with the terms and conditions agreed to by the client and CH2M HILL, both technically and for completeness, except for the conditions detailed above. Release of the data contained in this hardcopy data package has been authorized by the Laboratory Manager or his designee, as verified by the following signature.

Prepared by: *Anger Collins*

Reviewed by: *Helen Van Nise*

CASE NARRATIVE
DBPs

Lab Reference No.: 5467

Client/Project: City of McAllen

I. Holding Times:

HAA samples were extracted within holding times, but had high surrogate recoveries. HAA reextractions were performed 18 days after collection, holding time is 9 days.

II. Analysis:

A. Calibration:

All acceptance criteria were met.

B. Blanks:

All acceptance criteria were met.

C. Duplicate Sample(s):

All acceptance criteria were met for HAA analysis. Not applicable for THM analysis.

D. Spike Sample(s):

All acceptance criteria were met except for trichloroacetic acid which had a spike recovery of 64%.

E. Surrogate Recoveries:

All acceptance criteria were met except for 546701 which had a recovery of 134% due to a surrogate interference.

F. Lab Control Sample(s):

All acceptance criteria were met.

G. Other:

None

III. Documentation Exceptions:

None

IV. I certify that this data package is in compliance with the terms and conditions agreed to by the client and CH2M HILL, both technically and for completeness, except for the conditions detailed above. Release of the data contained in this hardcopy data package has been authorized by the Laboratory Manager or designee, as verified by the following signature.

Prepared by:

Joseph A. Hardy

Reviewed by:

Angus Collins

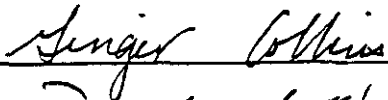
CASE NARRATIVE
DBPs

Lab Reference No.: 5467

Client/Project: City of McAllen

- I. Holding Times:
HAA samples were extracted within holding times, but had high surrogate recoveries. HAA extractions were performed 18 days after collection, holding time is 9 days.
- II. Analysis:
- A. Calibration:
All acceptance criteria were met
- B. Blanks:
All acceptance criteria were met
- C. Duplicate Sample(s):
All acceptance criteria were met.
- D. Spike Sample(s):
All acceptance criteria were met except for trichloroacetic acid (6/24/97) which had a spike recovery of 64%.
- E. Surrogate Recoveries:
All acceptance criteria were met for the 6/24/97 analysis except 546701 which had a recovery of 134%, due to a surrogate interference.
- F. Lab Control Sample(s):
All acceptance criteria were met.
- G. Other:
None
- III. Documentation Exceptions:
None

IV. I certify that this dam package is in compliance with the terms and conditions agreed to by the client and CH2M HILL, both technically and for completeness, except for the conditions detailed above. Release of the dam contained in this hardcopy dam package has been authorized by the Laboratory Manager or designee, as verified by the following signature.

Prepared by: 

Reviewed by: 

Corvallis Applied Sciences Laboratory

Client Information

Project Name: City of McAllen
 Project Manager: Frosie Villarreal
 Sampled By: E. Perez
 Sampling Date: 5/19/97
 Sampling I-ii: 10:40
 Type: Grab
 Matrix: Water
 Basis: As received

Lab Information

Laboratory ID: ICOR001
 Date Rec'd: 5/20/97
 Analytical Method: SM5310.D
 Date Analyzed: 5/28/97
 Report Revision No.: 0
 Reported By: G. Collins
 Reviewed By: *GW*
 Units: mg/L

Client Sample ID	Lab Sample ID	pH	Reporting Limit	Replicate 1	TOC Water Replicate 2	Average	Percent RPD
Feedwater	535701	<2	0.50	6.8	7.01	6.9	2.9

U=Not detected/at specified detection limits

Applied Sciences Laboratory
 Corvallis Office

2300 NW Walnut Blvd., Corvallis, OR 97330-3538
 P.O. Box 428, Corvallis, OR 97339-0428

(541) 752-4271
 Fax No. (541) 752-0276

Corvallis Applied Sciences **Laboratory**

Information	Lab Information
Project Name: Cii of McAllen	Laboratory ID: ICROR001
Project Manager: Rosie Villarreal	Date Recd: 5/20/97
Sampled By: E. Perez	Analytical Method: EPA 110.2
Sampling Date: 5/19/97	Date Analyzed: 5/21/97
Sampling Time: 10:40	Report Revision No.: 0
Type: Grab	Rewed By: H. Van Nice
Matrix: Water	Reviewed By: <i>gme</i>
Basis: As received	

Client Sample ID	Lab Sample ID	Reporting Limit	Color (ALPHA) Apparent Result	Units
Feedwater	535701	5	10	Cobr Units

U=Not detected at specified detection limits

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(541) 752-4271
Fax No. (541) 752-0276

Corvallis Applied Sciences Laboratory

Client Information

Project Name: city Of McAllen
 Project Manager: Jim Gaibush/PHX
 Sampled By: D. Hardy
 Client Sample ID: FEEDWATER 3D
 Sampling Date: 6/5/97
 Sampling Time: 9:38
 Type: Grab
 Matrix: water
 Basis: As Received

Lab Information

Date Rec'd: 6/5/97
 Lab ID: 546701
 Report Revision No.: 1
 Reported By: DAH
 Reviewed By: *gmc*
 Units: µg/L

Analyte	CAS #	Reporting Limit	Sample Result	Qualifier	Date Analyzed
<i>Haloacetic Acids - SM 6251.B</i>					
Chloroacetic add	79-11-E	0.5	7.9		6/24/97
Bromoacetic add	79-08-3	0.5	a.7		6/24/97
Dichloroacetic acid	79-43-6	0.5	28.4		6/24/97
Trichloroacetic acid	76-03-s	0.5	15.8		6/24/97
Bromochloroacetic acid	5589-96-3	0.5	34.4		6/24/97
Dibromoacetic acid	631-64-1	0.5	26.3		6/24/97
23-Dibromopropanoic acid	600-05-5		134%	SS	
<i>Trihalomethanes - EPA 502.2</i>					
Chloroform	67-66-3	0.5	462		6/9/97
Bromodichloromethane	75-27-i	0.5	89.8		6/9/97
Dibromochloromethane	12448-1	0.5	130	E	6/9/97
Bromoform	75-25-Z	0.5	67.7		6/9/97
1,2-Dichloroethane-d4	17068-07-a		90%	SS	

E=Exceeded instrument calibration range
 SS=Surrogate standard
 U=Not detected at specified reporting limits

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 Corvallis Office

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 P.O. Box 428, Corvallis, OR 97339-0428

(541) 752-4271
 Fax No. (541) 752-0276

Corvallis Applied Sciences Laboratory

Client Information

Project Name: City of McAllen
Project Manager: Jim Geisbush/PHX
Sampled By: O. Hardy
Client Sample ID: MEMCOR 3D
Sampling Date: 6/5/97
Sampling Time: 14:40
Type: Grab
Matrix: Water
Basis: As Received

Lab Information

Date Rec'd: 6/5/97
Lab ID: 546702
Report Revision No.: 1
Reported By: OAH
Reviewed By: *ame*
Units: µg/L

Analyte	CAS #	Reporting Limit	Sample Result	Qualifier	Date Analyzed
<i>Haloacetic Acids - SM 6251.B</i>					
Chloroacetic acid	79-11-8	0.5	6.6		6/24/97
Bromoacetic acid	79-08-3	0.5	10.7		6/24/97
Dichloroacetic acid	79-43-6	0.5	38.3		6/24/97
Trichloroacetic acid	76-03-9	0.5	13.3		6/24/97
Bromochloroacetic acid	5589-96-3	0.5	41.8		6/24/97
Dibromoacetic acid	631-64-1	0.5	34.3		6/24/97
2,3-Dibromopropanoic acid	600-05-5		122%	SS	
<i>Trihalomethanes - EPA 502.2</i>					
Chloroform	67-66-3	0.5	46.3		6/9/97
Bromodichloromethane	75-27-4	0.5	69.3		6/9/97
Dibromochloromethane	124-48-1	0.5	124	E	6/9/97
Bromoform	75-25-Z	0.5	64.8		6/9/97
1,2-Dichloroethane-d4	17068-07-0		93%	SS	

E=Exceeded instrument calibration range

SS=Surrogate standard

U=Not detected at specified reporting

limits

Corvallis Applied Sciences Laboratory

<p>Project Name: City Of McAllen Project Manager: Jim Geisbush/PHX sampled By: O. Hardy Client Sample 10: ZEEWEED 30 Sampling Oats: 6/5/97 Sampling Time: 14:47 Type: Grab Matrix: Water Basis: As Received</p>	<p>Lab Information Date Rec'd: 6/5/97 Lab ID: 546703 Report Revision No.: 1 Reported By: OAH Reviewed By: <i>gmc</i> Units: µg/L</p>
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Analyte	CAS #	Reporting Limit	Sample Result	Qualifier	Date Analyzed
<i>Haloacetic Acids - SM 6251.s</i>					
Chloroacetic acid	79-11-8	0.5	9.3		6/24/97
Bromoacetic acid	79-08-3	0.5	12.2		6/24/97
Dichloroacetic acid	79-43-6	0.5	24.3		6/24/97
Trichloroacetic acid	76-03-9	0.5	16.4		6/24/97
Bromochloroacetic acid	5589-96-3	0.5	34.1		6/24/97
Dibromoacetic acid	631-64-1	0.5	293		6/24/97
2,3-Dibromopropanoic acid	600-05-5		104%	SS	
<i>Trihalomethanes - EPA 502.2</i>					
Chloroform	67-66-3	0.5	36.9		6/9/97
Bromodichloromethane	75-27-4	0.5	n.4		6/9/97
Dibromochloromethane	12446-1	0.5	113	E	6/9/97
Bromoform	76-26-2	0.5	60.1		6/9/97
1,2-Dichloroethane-d4	17066-07-0		95%	SS	

E=Exceeded instrument calibration range
 \$S=Surrogate standard
 †=Not detected at specified reporting limits

CH2MHILL Analytical Services
CHAIN OF CUSTODY RECORD
AND AGREEMENT TO PERFORM SERVICES

LMQ 2607 Falcane Drive
 Montgomery, AL 36116-1822
 (334) 271-1444 FAX (334) 271-3428

LRD 6090 Caterpillar Road
 Redding, CA 96003-1412
 (916) 244-6227 FAX (916) 244-4108

ILKW Canviro Analytical Laboratories, Inc.
 60 Balfour, Unit 12, Waterloo, Ontario, Canada N2V 2C5
 (519) 747-2675 FAX (519) 747-3806

ICVD 2300 NW Walnut Boulevard
 Corvallis, OR 97330 3638
 (541) 752-4271 FAX (541) 752-0276

COC # _____

Project #		Purchase Order #		Requested Analytical Method #										THIS AREA FOR LAB USE ONLY				
13SC671A7-22				TCC COLOG-APPT THMP, HAAEP THMP, HAAEP THMP, HAAEP										Lab #	Page	of		
Project Name McAllen Pilot Study				TOTAL # OF CONTAINERS										5357-173	1	1		
Company Name McAllen Public Utilities														Lab PM	Custody Review			
Project Manager or Contact & Phone # Rose Villanueva 214-631-8310				Report Copy to: Jim Goshish (Alvarez)										Log In	LIMS Verification			
Requested Completion Date: ASAP		Site ID WWT#2		Sample Disposal: Dispose <input checked="" type="checkbox"/> Return <input type="checkbox"/>										pH	Custody Seals Y N Ice-blue <input checked="" type="checkbox"/> N			
Sampling	Date	Time	Type	Matrix	CLIENT SAMPLE ID (9 CHARACTERS)	LAB QC	Preservative					QC Level 1 2 3 Other			Cooler Temperature		Alternate Description	Lab ID
							H2SO4	None	None	None	None	1	2	3	Other	Temp		
	5/19/97	10:40	✓	✓	F E E D W A T E R	2	✓											} = 1 2 3
	5/19/97	10:40	✓	✓	F E E D W A T E R	1		✓										
	5/19/97	10:40	✓	✓	F E E D W A T E R	1				✓								
	5/19/97	10:40	✓	✓	MEMCOR Filtrate	1					✓							
	5/19/97	10:40	✓	✓	Zeeveld Farmate	1						✓						
Relinquished By Rose Villanueva			Empty Bottles 6			Date/Time 5/19/97 10:30		Received By Enrique Perez			Empty Bottles 6			Date/Time 5/19/97 @ 10:30 am				
Sampled By and Title Enrique Perez			(Please sign and print name)			Date/Time 5/19/97 10:30		Relinquished By Enrique Perez			(Please sign and print name)			Date/Time 5/19/97 @ 10:45				
Received By Rose Villanueva			(Please sign and print name)			Date/Time 5/19/97 11:30		Relinquished By Rose Villanueva			(Please sign and print name)			Date/Time 5/19/97 @ 11:30 am				
Received By Verni Alvarez			(Please sign and print name)			Date/Time 5/20/97 10:00		Shipped Via UPS <input checked="" type="checkbox"/> Fed Ex <input type="checkbox"/> Other _____			Shipping #							
Special Instructions:																		

contact: Ginger

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 (334) 271-1444 FAX (334) 271-3428

1180 5000 Caterpillar Road
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1111 NW Carviro Analytical Laboratories, Inc.
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 (619) 747-2575 FAX (619) 747-3806

✓ CVG 2300 NW Walnut Boulevard
 Corvallis, OR 97330 3838
 (541) 752 4271 FAX (541) 752 0276

COC #

Project # 130067.A0.22		Purchase Order #		Requested Analytical Method #										THIS AREA FOR LAB USE ONLY																																																															
Project Name City of McAllen - P.H.T Study				TOTAL # OF CONTAINERS	<table border="1"> <tr> <td>Lab #</td> <td>Page</td> <td>of</td> </tr> <tr> <td>5467-1-23</td> <td>1</td> <td>1</td> </tr> <tr> <td>Lab PM</td> <td colspan="2">Custody Review</td> </tr> <tr> <td>Log In</td> <td colspan="2">LIMS Verification</td> </tr> <tr> <td>ph</td> <td colspan="2">Custody Seals Y N</td> </tr> <tr> <td></td> <td colspan="2">Ice Y N</td> </tr> </table>										Lab #	Page	of	5467-1-23	1	1	Lab PM	Custody Review		Log In	LIMS Verification		ph	Custody Seals Y N			Ice Y N		<table border="1"> <tr> <td>QC Level</td> <td>①</td> <td>2</td> <td>2</td> <td>Other</td> <td>..</td> <td>...</td> </tr> <tr> <td colspan="7">Cooler Temperature</td> </tr> <tr> <td colspan="6">Alternate Description</td> <td>Lab ID</td> </tr> <tr> <td colspan="6"></td> <td>1</td> </tr> <tr> <td colspan="6"></td> <td>2</td> </tr> <tr> <td colspan="6"></td> <td>3</td> </tr> </table>			QC Level	①	2	2	Other	Cooler Temperature							Alternate Description						Lab ID							1							2							3
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Project Manager or Contact & Phone # Rusie V. Harwood		Request Completion Date: 6/9/97 6/11/97		Site ID 2471619		Sample Disposal: Dispose <input checked="" type="checkbox"/> Return <input type="checkbox"/>																																																																							
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6/5 15:00		X		X								FP BLANK																																																																	
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Sampled By and Title		(Please sign and print name)		Date/Time		Relinquished By		(Please sign and print name)		Date/Time																																																																			
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Received By		(Please sign and print name)		Date/Time		Shipped Via		Shipping #																																																																					
Special Instructions:																																																																													

APP-158

Corvallis Applied Sciences Laboratory

Client Information

Project Name: City of McAllen
 Project Manager: Jim Geisbush/PHX
 Sampled By: R. Villareal
 Client Sample ID: Feedwater
 Sampling Date: 5/19/97
 Sampling Time: 10:40
 Type: Grab
 Matrix: water
 Basis: As Received

Lab Information

Date Rec'd: 5/20/97
 Lab ID: 535701
 Analysis Method: SM 5710.D
 Report Revision No.: 0
 Reported By: DAH
 Reviewed By:

HAA/THM Formation Potential Test Conditions

Set-up Date/Time	Target Contact Time	Initial pH	contact pH	Contact Temperature (°C)	Chlorine Dosage (mg/L)
6/2/97 15:04	72:00	7.3	7.8	23	10.00

Chlorine Demand Test Results

Take-off Date/Time	Contact Time	Measured pH	Measured Temperature (°C)	Chlorine Residual (mg/L)
6/5/97 9:38	66:34	7.6	23	1.12

U=Not detected at specified reporting limits

This report has been expedited through our laboratory to meet your request. This data is classed *Preliminary* until you receive the hard copy report which has passed the ASL final review process.

Corvallis Applied Sciences Laboratory

Client Information

Project Name: City of McAllen
 Project Manager: Jim Geisbush/PHX
 Sampled By: R. Villareal
 Client Sample ID: Feedwater
 Sampling Date: 5/19/97
 Sampling Time: 10:40
 Type: Grab
 Matrix: Water
 Basis: As Received

Lab Information

Date Rec'd: 5/20/97
 Lab ID: 535701
 Analysis Method: SM 5710.D
 Report Revision No.: 0
 Reported By: DAH
 Reviewed By:

HAATHM Formation Potential Test Conditions

Set-up Date/Time	Target Contact Time	Initial pH	Contact pH	Contact Temperature (°C)	Chlorine Dosage (mg/L)
6/2/97 15:04	72:00	7.3	7.8	23	10.00

Chlorine Demand Test Results

Take-off Date/Time	Contact Time	Measured pH	Measured Temperature (°C)	Chlorine Residual (mg/L)
6/5/97 9:38	66:34	7.6	23	1.12

U=Not detected at specified reporting limits

This report has been expedited through our laboratory to meet your request. This data is classed *Preliminary* until you receive the hard copy report which has passed the ASL final review process.

Corvallis Applied Sciences Laboratory

File Info

Project Name: city of McAllen
 Project Manager: Jim Geisbush/PHX
 Sampled By: R. Villareal
 Client Sample ID: Memcor Filtrate
 Sampling Date: 5/19/97
 Sampling time: 10:40
 Type: Grab
 Matrix: water
 Basis: As Received

Lab Info

Date Rec'd: 5/20/97
 Lab ID: 535702
 Analysis Method: SM 5710.D
 Report Revision No.: 0
 Reported By: DAH
 Reviewed By:

HAA/THM Formation Potential Test Conditions

Set-up Date/Time	Target Contact Time	Initial pH	Contact pH	Contact Temperature (°C)	Chlorine Dosage (mg/L)
6/2/97 15:11	72:00	7.3	7.0	23	10.00

Chlorine Demand Test Results

Take-off Date/Time	Contact Time	Measured pH	Measured Temperature (°C)	Chlorine Residual (mg/L)
6/5/97 14:40	71:29	7.7	23	1.72

U=Not detected at specified reporting limits

This report has been expedited through our laboratory to meet your request. This data is classed *Preliminary* until you receive the hard copy report which has passed the ASL final review process.

Corvallis Applied Sciences Laboratory

Client Information

Project Name: City of McAllen
 Project Manager: Jim Geisbush/PHX
 Sampled By: R. Villareal
 Client Sample ID: Zaeweed Permeate
 Sampling Date: 5/19/97
 Sampling Time: 10:40
 Type: Grab
 Matrix: Water
 Basis: As Received

Lab Info

Date Rec'd: 5/20/97
 Lab ID: 535703
 Analysis Method: SM 5710.0
 Report Revision No.: 0
 Reported By: DAH
 Reviewed By:

HAA/THM Formation Potential Test Conditions

Set-up Date/Time	Target Contact Time	Initial pH	Contact pH	Contact Temperature (°C)	Chlorine Dosage (mg/L)
6/2/97 15:19	72:00	8.0	7.8	23	10.00

Chlorine Demand Test Results

Take-off Date/Time	Contact Time	Measured pH	Measured Temperature (°C)	Chlorine Residual (mg/L)
6/5/97 14:47	71:28	7.6	23	0.44

U=Not detected at specified reporting limits

This report has been expedited through our laboratory to meet your request. This data is classed *Preliminary* until you receive the hard copy report which has passed the ASL final review process.

Corvallis Applied Sciences Laboratory

Client Information

Project Name: city of McAllen
 Project Manager: Jim Geisbush/PHX
 Sampled By: D. Hardy
 Client Sample ID: FEEDWATER 3D
 Sampling Dam: 6/5/97
 sampling Time: 9:38
 Type: Grab
 Matrix: Water
 Basis: As Received

Lab Information

Date Rec'd: 6/5/97
 Lab ID: 546701
 Report Revision No.: 0
 Reported By: DAH
 Reviewed By:
 Units: µg/L

Analyte	CAS #	Reporting Limit	Sample Result	Qualifier	Date Analyzed
<i>Haloacetic Acids - SM 6251.B</i>					
Chloroacetic add	79-11-S	0.5	5 . 5		6/10/97
Bromoacetic acid	79-08-3	0.5	8.6		6/10/97
Dichloroacetic add	79-43-6	0.6	29.1		6/10/97
Trichloroacetic acid	76-03-9	0.5	13.9		6/10/97
Bromochloroacetic acid	5589-96-3	0.5	39.6		6/10/97
Dibromoacetic acid	631-64-1	0.5	30.5		6/10/97
2,3-Dibromopropanoic a c i d	600-05-5		194%	SS	
<i>Trihalomethanes - EPA 502.2</i>					
Chloroform	67-66-3	0.5	46.2		6/9/97
Bromodichloromethane	75-27-4	0.5	69.6		6/9/97
Dibromochloromethane	12442-1	0.5	130	E	6/9/97
Bromoform	75-25-2	0.5	67.7		6/9/97
1,2-Dichloroethane-d4	17068-07-0		90%	SS	

E=Exceeded instrument calibration range

SS=Surrogate standard

U=Not detected at specified reporting limits

This report has been expedited through our laboratory to meet your request. This data is classed *Preliminary* until you receive the hard copy report which has passed the ASL final review process.

Corvallis Applied Sciences Laboratory

Client Information

Project Name: City of McAllen
 Project Manager: Jim Geisbush/PHX
 Sampled By: D. Hardy
 Client Sample ID: MEMCOR 3D
 sampling Date: 6/5/97
 Sampling Time: 14:40
 Type: Grab
 Matrix: water
 Basis As Received

Lab Info

Date Rec'd: 6/5/97
 Lab ID: 546702
 Report Revision No.: 0
 Reported By: DAH
 Reviewed By:
 Units: µg/L

Analyte	CAS #	Reporting Limit	Sample Result	Qualifier	Date Analyzed
<i>Haloacetic Acids - SM 6251.B</i>					
Chloroacetic acid	Toll-6	0.5	6.4		6/10/97
Bromoacetic acid	79-08-3	0.5	9.4		6/10/97
Dichloroacetic acid	79-43-6	0.5	30.3		6/10/97
Trichloroacetic acid	76-03-9	0.5	6.2		6/10/97
Bromochloroacetic acid	5589-96-3	0.5	41.4	E	6/10/97
Dibromoacetic acid	631-64-1	0.5	34.9		6/10/97
2,3-Dibromopropanoic acid	600-05-5		107%	SS	
<i>Trihalomethanes - EPA 502.2</i>					
Chloroform	67-66-3	0.5	46.3		6/9/97
Bromodichloromethane	75-27-4	0.5	66.3		6/9/97
Dibromochloromethane	12446-1	0.5	124	E	6/9/97
Bromoform	75-25-2	0.5	64.6		6/9/97
1,1-Dichloroethane-d4	17068-07-0		63%	SS	

E=Exceeded instrument calibration range
 SS=Surrogate standard
 U=Not detected at specified reporting limits

This report has been expedited through our laboratory to meet your request. This data is classed *Preliminary* until you receive the hard copy report which has passed the ASL final review process.

Corvallis Applied Sciences Laboratory

Project Name: City of McAllen Project Manager: Jim Geisbush/PHX Sampled By: O. Hardy Client Sample ID: ZEEWEED 30 Sampling Date: 6/5/97 Sampling time: 14:47 Type: Grab Matrix: water Basis: As Received	Lab Info Dam Rec'd: 6/5/97 Lab ID: 546703 Report Revision No.: 0 Reported By: OAH Reviewed By: Units: µg/L
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Analyte	CAS #	Reporting Limit	Sample Result	Qualifier	Date Analyzed
<i>Haloacetic Acids - SM 6251.B</i>					
Chloroacetic acid	79-11-8	0.5	7 . 4		6/10/97
Bromoacetic acid	79-08-3	0.5	13.8		6/10/97
Dichloroacetic acid	7943-a	0.5	25.8		6/10/97
Trichloroacetic acid	76-03-9	0.5	124		6/10/97
Bromochloroacetic acid	5589-96-3	0.5	36.4		6/10/97
Dibromoacetic acid	631-w-l	0.5	31.2		6/10/97
2,3-Dibromopropanoic acid	600-05-5		104%	SS	
<i>Trihalomethanes - EPA 502.2</i>					
Chloroform	67-66-3	0.5	38.9		6/9/97
Bromodichloromethane	75-27-4	0.5	17.4		6/9/97
Dibromochloromethane	124-48-1	0.5	113	E	6/9/97
Bromoform	75-25-2	0.5	60.1		6/9/97
1,2-Dichloroethane-d4	17068-07-0		9 5 %	SS	

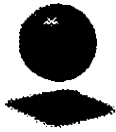
E=Exceeded instrument calibration range

SS=Surrogate standard

U=Not detected at specified reporting limit

This report has been expedited through our laboratory to meet your request. This data is classed **Preliminary** until you receive the hard copy report which has passed the ASL final review process.

MONTHLY BILLING SUMMARY



Applied Sciences Laboratory
Corvallis, Oregon
 2300 NW Walnut Blvd, Corvallis, OR 97330-3538
 P.O. Box 428, Corvallis, OR 97339-0428
 541 752-4271
 Fax 541 752-0276

City of **McAllen**
 Project Manager: Jim **Geisbush/PHX**

Invoice Date **06/06/97**
 Invoice No. **A97-1013**

Page 1 of 1

Customer Number 138067.A0.ZZ		CH2M Hill Rep. Doug Hardy	Billing Period 7/9/97	Reference No. 5467
Qty	Description	Trans. Date	Unit Cost	Subtotal
3	Haloacetic Acids	6/5/97	\$225.00	\$675.00
3	Trihalomethanes by Purge & Trap	6/5/97	\$75.00	\$225.00

(THIS IS NOT A BILL-DO NOT SUBMIT PAYMENT) TOTAL AMOUNT: **\$900.00**

Our records indicate that, the **above tests** were requested during the current billing period. **Please notify the laboratory listed** above if there are any **discrepancies**.

- PROJECT COPY -

MONTHLY BILLING SUMMARY



CH2MHILL

Applied Sciences Laboratory

Corvallis, Oregon

2300 NW Walnut Blvd, Corvallis, OR 97330-3538

P.O. Box 428, Corvallis, OR 97339-0428

541 752-4271

Fax 541 752-0276

City of **McAllen**

Project Manager: Jim **Geisbush/PHX**

Invoice Date **05/20/97**

Invoice No. **A97-0887**

Page 1 of 1

Customer Number 138067.A0.ZZ	CH2M Hill Rep. Ginger Collins	Billing Period 7/9/97	Reference No. 5357
----------------------------------------	----------------------------------	---------------------------------	------------------------------

Qty	Description	Trans. Date	Unit Cost	Subtotal
1	Color (ALPHA) Apparent	5/20/97	\$20.00	\$20.00
3	Trihalomethane 8 Haloacetic Acids Formation Potential (THM/HAAFP): pH, temperature, chlorine dose, and reaction time set at desired test conditions	5/20/97	\$135.00	\$405.00
1	Total Organic Carbon (EPA 415.1)	5/20/97	\$40.00	\$40.00

(THIS IS NOT A BILL -DO NOT SUBMIT PAYMENT)

TOTAL AMOUM: \$465.00

Our records indicate that the above tests were requested during the current billing period. Please notify the laboratory listed above if there are any discrepancies.

-- PROJECT COPY --

APP-167



CH2MHILL

- RECEIVED -

JUN 30 1997

CH2M HILL/PHOENIX

CH2M HILL
2300 NW Walnut Blvd.
Corvallis, OR
97330-3538
Mailing address:
P.O. Box 428
Corvallis, OR
97339-0428
Tel 541.752.4271
Fax 541.752.0276

6/25/97

City of McAllen

Subject: Acknowledgment of sample set 5607.

Dear Jim Geisbush/PHX:

This letter is to acknowledge the receipt of your sample set on 6/24/97. It has been assigned laboratory number 5607. Please refer to the laboratory number if you need to inquire about this sample set. I have attached a copy of the chain of custody form to provide additional information.

There were no problems noted with the receipt of your samples.

If you need assistance, please feel free to call 541/758-0235 extension 3117.

Sincerely,
CH2M HILL

Jerri Mattick

Attachment

CH2MHILL Analytical Services
CHAIN OF CUSTODY RECORD
AND AGREEMENT TO PERFORM SERVICES

LMB 2567 Fairlane Drive
 Montgomery, AL 36118-1622
 (334) 271-1444 FAX (334) 271-3428

LRD 5090 Gallop Road
 Redding, CA 96003-1412
 (916) 244-5227 FAX (916) 244-4109

LKW CanPro Analytical Laboratories, Inc.
 50 Bathurst, Unit 12, Waterloo, Ontario, Canada N2V 2C5
 (519) 747-2575 FAX (519) 747-3806

CVO 2300 NW Walnut Boulevard
 Corvallis, OR 97330-3838
 (541) 752-4271 FAX (541) 752-0276

COC # _____

Project # 133667-HZ-22		Purchase Order #		Requested Analytical Method #										THIS AREA FOR LAB USE ONLY						
Project Name McAllen Pilot Study				TOTAL # OF CONTAINERS - TDC - 100% - TKN, NO ₂ -NO ₃ N, - Phosphorus										Lab # 51001-173	Page 1	of 1				
Company Name McAllen Public Utilities														Lab PM	Custody Review					
Project Manager or Contact & Phone # Rose Villanar 210-631-8340		Report Copy to: Tim Gerstbush (Phoenix)		Preservative										Log In	LIMS Verification					
Requested Completion Date: ASAP		Site ID NWPH2		Sample Disposal: Dispose <input checked="" type="checkbox"/> Return <input type="checkbox"/>												QC Level 1 2 3 Other	Custody Seals Y N			
Sampling		Type	Matrix	CLIENT SAMPLE ID (8 CHARACTERS)		LAB QC												Cooler Temperature		
Date	Time	DEP	GRAB	BOB	AI													Alternate Description		Lab ID
6/23/97	10:40					Zeeveed	Feedwater	2												
6/23/97	10:40					Zeeveed	Feedwater	1												
6/23/97	10:40					Zeeveed	Permeate	2												
6/23/97	10:40					Zeeveed	Permeate	1												
6/23/97	10:40					Zeeveed	Permeate	1												
6/23/97	10:40					Memco	Filtrate	2												
6/23/97	10:40					Memco	Filtrate	1												
6/23/97	10:40					Memco	Filtrate	1												
Relinquished By Rose Villanar		Empty Bottles 11		Date/Time 6/23/97 10:23		Received By X Hector Escobar		Empty Bottles 11		Date/Time 6/23/97 @ 11:28 AM										
Sampled By and Title X Hector Escobar		(Please sign and print name)		Date/Time 6/23/97 10:23		Relinquished By X Hector Escobar		(Please sign and print name)		Date/Time 6/23/97 @ 11:28 AM										
Received By Rose Villanar		(Please sign and print name)		Date/Time 6/23/97 10:50		Relinquished By Rose Villanar		(Please sign and print name)		Date/Time 6/23/97 @ 2:30 PM										
Received By Jean Martinez		(Please sign and print name)		Date/Time 6/23/97 10:00		Shipped Via UPS Fed Ex Other		Shipping #												
Special Instructions: Jean Martinez 6/23/97 10:00													Contact: Ginger							

APP-169



CH2MHILL

CH2M HILL
2300 NW Walnut Blvd.
Corvallis, OR
97330-3538
Mailing address:
P.O. Box 428
Corvallis, OR
97339-0428
Tel 541.752.4271
Fax 541.752.6276

06/23/97

City of McAllen

Subject Acknowledgment of sample set 5557.

Dear Jim Geisbush/PEX:

This letter is to acknowledge the receipt of your sample set on 6/23/97. It has been assigned laboratory number 5597. Please refer to the laboratory number if you need to inquire about this sample set. I have attached a copy of the chain of custody form to provide additional information.

There were no problems noted with the receipt of your samples.

If you need assistance, please feel free to call 541/758-0235 extension 3117.

Sincerely,
CH2M HILL

Jerri Matrick

Attachment

CH2MHILL Analytical Services
CHAIN OF CUSTODY RECORD
AND AGREEMENT TO PERFORM SERVICES

LMS 2567 Fairland Drive
 Montgomery, AL 36116-1822
 (334) 271-1444 FAX (334) 271-3428

LRD 5080 Caterpillar Road
 Redding, CA 96003-1412
 (916) 244-6227 FAX (916) 244-4109

Calviro Analytical Laboratories, Inc.
 55 Hurst, Unit 12, Waterloo, Ontario, Canada N2V 2C5
 (519) 747-2575 FAX (519) 747-3808

I CVB 2300 NW Walnut Boulevard
 Corvallis, OR 97330-3638
 (541) 752-4271 FAX (541) 752-0276

COC # _____

Project # 15267.14-22		Purchase Order #		Requested Analytical Method #						THIS AREA FOR LAB USE ONLY												
Project Name Miller Pilot Study				TKN, Phosphorus NO ₂ , NO ₃ TKN, Phosphorus NH ₃ -N TDC Coliform						Lab # 5501-143	Page 1	of 1										
Company Name Miller Public Utilities										Lab PM	Custody Review											
Project Manager or Contact & Phone # Rose Villareal 210-631-8340		Report Copy to: Jim Gerbush (Proxy)		Preservative						Log In	LIMS Verification											
Requested Completion Date: ASAP		Site ID WWT#2		Sample Disposal: Dispose <input checked="" type="checkbox"/> Return <input type="checkbox"/>								pH	Custody Seals Y N Ice Y N									
Sampling		Type	Matrix	CLIENT SAMPLE ID (8 CHARACTERS)		LAB QC		QC Level 2 3 Other														
Date	Time	TEOC	DECS	WATER	AIR			Cooler Temperature														
6/20/97	8:23	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>			1	1	H ₂ SO ₄														
6/20/97	9:23	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>			1	1	H ₂ SO ₄														
6/20/97	8:23	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>			2	1	H ₂ SO ₄														
6/20/97	8:23	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>			1	1	None														
Relinquished By Rose Villareal		Empty Bottles 5		Date/Time 6/20/97 @ 8:15am		Received By X Hector Escobar		Empty Bottles 5		Date/Time 6/20/97 @ 8:15am												
Sampled By and Title X Hector Escobar		(Please sign and print name) Hector Escobar		Date/Time 6/20/97 @ 8:15am		Relinquished By X Hector Escobar		(Please sign and print name) Hector Escobar		Date/Time 6/20/97 @ 8:15am												
Received By Rose Villareal		(Please sign and print name) Rose Villareal		Date/Time 6/20/97 @ 11:30am		Relinquished By Rose Villareal		(Please sign and print name) Rose Villareal		Date/Time 6/20/97 @ 11:30am												
Received By Verni A. K... ..		(Please sign and print name)		Date/Time 6/23/97		Shipped Via UPS <input checked="" type="checkbox"/> Fed-Ex <input type="checkbox"/> Other _____		Shipping #														
Special Instructions: 1000												contact - (777)...										

TOTAL # OF CONTAINERS

APP-171



CH2MHILL

CH2M HILL
2300 NW Walnut Blvd.
Corvallis, OR
97330-3538
Mailing address:
P.O. Box 428
Corvallis, OR
97339-0428
Tel 541.752.4271
Fax 541.752.0276

June 10, 1997

City of McAllen

138067.A0.ZZ

RE: Analytical Data for City of McAllen
CVO Laboratory Reference No. 5468

Jim Geisbush/PHX

On June 6, 1997, the CH2M HILL, Corvallis Applied Sciences Laboratory received two samples with a request for analysis of selected parameters.

The analytical results and associated quality control data are enclosed. Any unusual difficulties encountered during the analysis of your samples are discussed in the case narrative.

Under CH2M HILL policy, your samples will be stored for 30 days after reporting. If you have not given us prior instructions for disposal, we will contact you if any samples require disposal as hazardous waste.

The CH2M HILL Applied Sciences Laboratory appreciates your business and looks forward to serving your analytical needs again. If you should have any questions concerning the data or if you need additional information, please call Ms. Kathy McKinley at (541) 758-0235, extension 3120.

Sincerely,

Kelly Ensor
Senior Administrative Assistant

Enclosures

Applied Sciences Laboratory,
Corvallis Office

2300 NW Walnut Blvd., Corvallis, OR 97330-3538
P. O. Box 428, Corvallis, OR 97339-0428

541 752-4271
Fax No. 541 752-0276

CLIENT SAMPLE CROSS-REFERENCE

CH2M HILL Applied Science Laboratory Reference No. 5468

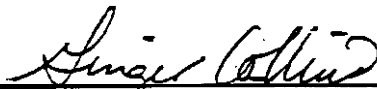
CVO Sample ID	Client Sample ID	Date Collected	Time Collected
546801	Memcor Filtrate	06/05/1997	9:30
546802	Zeeweed Permeate	06/05/1997	9:30

CASE NARRATIVE
GENERAL CHEMISTRY

Lab Reference No.: 5468

Client/Project: City of McAllen

- I. Holding time:
All acceptance criteria were met.
- II. Digestion Exceptions:
None
- III. Analysis:
 - A. Calibration:
All acceptance criteria were met.
 - B. Blanks:
All acceptance criteria were met.
 - C. Matrix Spike Sample(s):
All acceptance criteria were met.
 - D. Duplicate Sample(s):
All acceptance criteria were met.
 - E. Lab Control Sample(s):
The panel observed a 20 Color Unit standard as 15 Color Units. Other acceptance criteria were met.
 - F. Other:
Not applicable.
- N. Documentation Exceptions:
None.
- V. I certify that this data package is in compliance with the terms and conditions agreed to by the client and CH2M HILL, both technically and for completeness, except for the conditions detailed above. Release of the data contained in this hardcopy data package has been authorized by the Laboratory Manager or his designee, as verified by the following signature.

Prepared by: 

Reviewed by: 

Corvallis Applied Sciences Laboratory

Client Information

Project Name: City of McAllen
 Project Manager: Rosie Villarreal
 Sampled By: E. Perez
 Sampling Date: 6/5/97
 Sampling Time: 9:30
 Type: Grab
 Matrix: water
 Basis: As received

Lab Information

Laboratory IO: ICROR001
 Date Rec'd: 616197
 Analytical Method: SM5310.D
 Date Analyzed: 6/9/97
 Report Revision No.: 0
 Reported By: G. Collins
 Reviewed By: *[Signature]*
 Units: mg/L

Client Sample ID	Lab Sample ID	pH	Reporting Limit	Replicate 1	TOC Water Replicate 2	Average	Percent RPD
Memcor Filtrate	546801	<2	0.50	6.9	6.9	6.9	0.0
Zeeweed Permeate	546802	<2	0.50	6.8	6.7	6.7	1.5

U=Not detected at specified detection limits

Applied Sciences Laboratory
 Corvallis Office

2300 NW Walnut Blvd., Corvallis, OR 97330-3538
 P.O. Box 428, Corvallis, OR 97339-0428

(541) 752-4271
 Fax No. (541) 752-0276

Corvallis Applied Sciences Laboratory

Client

Project Name: City of McAllen
 Project Manager Rosie Villarreal
 Sampled By: E. Perez
 Sampling Date: 6/5/97
 Sampling time: 930
 Type: Grab
 Matrix: Water
 Basis: As received

Lab Information

Laboratory ID: ICOR001
 Date Rec'd: 6/6/97
 Analytical Method: EPA 110.2
 Date Analyzed: 6/6/97
 Report Revision No.: 0
 Reported By: H. Van Nice
 Reviewed By: *gmc*

Client	Sample ID	Lab Sample ID	Reporting Limit	Color (ALPHA) Apparent Result	Units
	Memcor Filtrate	546901	5	5	Color Units
	Zeeweed Permeate	546802	5	10	Color Units

U=Not detected at specified detection limits

Applied Sciences Laboratory
 Corvallis Office

2300 NW Walnut Blvd., Corvallis, OR 97330-3538
 P.O. Box 428, Corvallis, OR 97339-0428

(541) 752-4271
 Fax No. (541) 752-0276

CH2MHILL Analytical Services
CHAIN OF CUSTODY RECORD
AND AGREEMENT TO PERFORM SERVICES

1 LMG 2567 Fairlane Drive
 Montgomery, AL 36116-1822
 (334) 271-1444 FAX (334) 271-3428

1 LRD 5090 Caterpillar Road
 Redding, CA 96003-1412
 (916) 244-5227 FAX (916) 244-4109

1 LKW Canfro Analytical Laboratories, Inc.
 50 Bathurst, Unit 12, Waterloo, Ontario, Canada N2V 2C5
 (519) 747-2576 FAX (519) 747-3800

1 LCV 2300 NW Walnut Boulevard
 Corvallis, OR 97330 3838
 (541) 752 4271 FAX (541) 752 0276

COC # _____

Project # 138667 A-E-22		Purchase Order #		Requested Analytical Method #										THIS AREA FOR LAB USE ONLY																											
Project Name McAllen Pilot Study				TOTAL # OF CONTAINERS	<table border="1"> <tr><td>TCC</td><td>Color</td><td>TOC</td><td>Color</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr> <tr><td>H2SO4</td><td>None</td><td>H2SO4</td><td>None</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr> </table>										TCC	Color	TOC	Color									H2SO4	None	H2SO4	None									Lab # 5468-182	Page 1	of 1
TCC	Color	TOC	Color																																						
H2SO4	None	H2SO4	None																																						
Company Name McAllen Public Utilities															Lab PM	Custody Review																									
Project Manager or Contact & Phone # Rosie Villarreal 210-631-6340		Report Copy to: Jim Geistbush (Phoebe)													Log in	LIMS Verification																									
Requested Completion Date: ASAP		Site ID WWTP #2		Sample Disposal: Dispose <input checked="" type="checkbox"/> Return <input type="checkbox"/>		QC Level 1 2 3 Other	Custody Seals V N Ice V N																																		
Sampling		Type	Matrix	CLIENT SAMPLE ID (9 CHARACTERS)								LAB QC		Cooler Temperature																											
Date	Time	COMB	GRAB	WATER	SOIL	AIR											Alternate Description			Lab ID																					
6/5/97	09:30						Memcor Filterable								2					B-1																					
6/5/97	09:30						Memcor Filterable								1																										
6/5/97	09:30						Zerowed Permeable								2																										
6/5/97	09:30						Zerowed Permeable								1																										
Relinquished By Rosie Villarreal				Empty Bottles 6		Date/Time 6/5/97 09:15		Received By Enrique Perez				Empty Bottles 6		Date/Time 6/5/97 @ 09:15																											
Sampled By and Title Enrique Perez				Date/Time 6/5/97 09:30		Relinquished By Enrique Perez				Date/Time 6/5/97 @ 09:40																															
Received By Rosie Villarreal				Date/Time 6/5/97 09:40		Relinquished By Rosie Villarreal				Date/Time 6/5/97 @ 1:40 p.m.																															
Received By John Meitzner				Date/Time 6/6/97		Shipped Via UPS Fed-Ex				Shipping #																															
Special Instructions: 1000													Contact: Enrique																												

APP-177

MONTHLY BILLING SUMMARY



Applied Sciences Laboratory
CH2MHILL Corvallis, Oregon
 2300 NW Walnut Blvd. Corvallis, OR 97330-3538
 P.O. Box 428, Corvallis, OR 97339-0428
 541 752-4271
 Fax 541 752-0276

City of McAllen
 Project Manager: Jim Geisbush/PHX

Invoice Date 06/06/97
 Invoice No. A97-1017

Page 1 Of 1

Customer Number 138067.A0.ZZ		CH2M Hill Rep. Ginger Collins	Billing Period 6/11/97	Reference No. 5468
Qty	Description	Trans. Date	Unit Cost	Subtotal
2	Color (ALPHA) Apparent	6/6/97	\$20.00	\$40.00
2	Total Organic Carbon	6/6/97	\$40.00	\$80.00

(THIS IS NOT A BILL – DO NOT SUBMIT PAYMENT) TOTAL AMOUNT: \$120.00

Our records indicate that the above tests were requested during the current billing period. Please notify the laboratory listed above if there are any discrepancies.

-- PROJECT COPY --



CH2MHILL

CH2M HILL
2300 NW Walnut Blvd.
Corvallis, OR
97330-3538
Mailing address:
P.O. Box 428
Corvallis, OR
97339-0428
Tel 541.752.4271
Fax 541.752.0276

JUN 11 1997

6/6/97

City of McAllen

Subject Acknowledgment of sample set 5468.

Dear Jii Geisbush/PHX:

This letter is to acknowledge the receipt of your sample set 0" 6/6/97. It has been assigned laboratory number 5468. Please refer to the laboratory number if you need to inquire about this sample set. I have attached a copy of the chain of custody form to provide additional information.

There were no problems noted with the receipt of your samples.

If you need assistance, please feel free to call 541/758-0235 extension 3 117.

Sincerely,
CH2M HILL

Jerri Mattick

Attachment

CH2MHILL Analytical Services
CHAIN OF CUSTODY RECORD
AND AGREEMENT TO PERFORM SERVICES

LMB 2507 Fairlane Drive
 Montgomery, AL 36116-1022
 (334) 271-1444 FAX (334) 271-3428

LMO 6090 Gallopillar Road
 Redding, CA 96003-1412
 (916) 244-5227 FAX (916) 244-4109

LKW Canviro Analytical Laboratories, Inc.
 50 Balfour, Unit 12, Waterloo, Ontario, Canada N2V 2C5
 (519) 747-2575 FAX (519) 747-3806

LJCVO 2300 NW Walnut Boulevard
 Corvallis, OR 97330-3638
 (541) 752-4271 FAX (541) 752-0278

COC #

Project # 13867 AR. 21		Purchase Order #		Requested Analytical Method #										THIS AREA FOR LAB USE ONLY									
Project Name McCallen Pilot Study				TOTAL # OF CONTAINERS	TCC Color TOC Color H ₂ SO ₄ None H ₂ SO ₄ None										Lab # 5462 182	Page 1	of 1						
Company Name McCallen Public Utilities															Lab PM	Custody Review							
Project Manager or Contact & Phone # Kusie Villareal 210-631-8340		Report Copy to: Jim Geishbush (Morriv)													Log In	LIMS Verification							
Requested Completion Date: A-CAP		Site ID WWTP # 2													Sample Disposal: Dispose <input checked="" type="checkbox"/> Return <input type="checkbox"/>		pH	Custody Seals Y / I Ice Y / I					
Sampling		Type	Matrix	CLIENT SAMPLE ID (9 CHARACTERS)						LAB QC	Preservative			QC Level 1 2 3 Other									
Date	Time	PRECIPITATION	WATER	SOIL	AIR								Cooler Temperature										
6/15/97	08:30	✓	✓			Menacor Fillable						2	✓			Alternate Description		Lab ID					
6/15/97	08:30	✓	✓			Menacor Fillable						1	✓					-1					
6/15/97	09:30	✓	✓			Zerweck Permeate						2						-2					
6/15/97	09:30	✓	✓			Zerweck Permeate						1											
Relinquished By Kusie Villareal				Empty Bottles 6				Date/Time 6/15/97 08:30				Received By Lorraine Klee				Empty Bottles 6				Date/Time 6/15/97 09:40			
Sampled By and Title Lorraine Klee				(Please sign and print name)				Date/Time 6/15/97 08:30				Relinquished By Lorraine Klee				(Please sign and print name)				Date/Time 6/15/97 09:40			
Received By Kusie Villareal				(Please sign and print name)				Date/Time 6/15/97 09:40				Relinquished By Kusie Villareal				(Please sign and print name)				Date/Time 6/15/97 09:40			
Received By Jim Geishbush				(Please sign and print name)				Date/Time 6/16/97				Shipped Via UPS <input checked="" type="checkbox"/> Fed-Ex <input type="checkbox"/> Other				Shipping #							
Specie actions:																							

APP-180



CH2MHILL

CH2M HILL
2300 NW Walnut Blvd.
Corvallis, OR
97330-3538
Mailing address:
P.O. Box 428
Corvallis, OR
97339-0428
Tel 541.752.4271
Fax 541.752.0276

June 5, 1997

City of McAllen

138067.A0.ZZ

RE: Analytical Data for City of McAllen
CVO Laboratory Reference No. 5416

Jim Geisbush/PHX

On May 30, 1997, the **CH2M HILL Corvallis** Applied Sciences Laboratory received **one sample** with a request for analysis of **selected parameters**.

The **analytical** results and associated quality **control** data are enclosed. Any **unusual difficulties** encountered **during** the **analysis** of your samples are discussed in the case **narrative**.

Under **CH2M HILL** policy, your samples **will** be **stored** for 30 days **after** reporting. If you have not given us prior **instructions** for disposal we will contact you if any samples **require** disposal as hazardous waste.

The **CH2M HILL** Applied Sciences Laboratory **appreciates your** business and looks **forward** to **servicing** your **analytical** needs again. If you should have any questions **concerning** the **data**, or **if you need** additional **information**, please **call** Ms. **Kathy McKinley** at (541) **758-0235**, extension 3120.

Sincerely,

Kelly Ensor
Senior Administrative Assistant

Enclosures

Applied Sciences Laboratory 2300 NW Walnut Blvd., Corvallis, OR 97330-3538
Corvallis Office P. O. Box 428, Corvallis, OR 97339-0428

541 752-4271
Fax No. 541 752-0276

CLIENT SAMPLE CROSS-REFERENCE

CH2M HILL Applied Science Laboratory Reference No. 5416

CVO Sample ID	Client Sample ID	Date Collected	Time Collected
541601	Feedwater	05/29/1997	9:00

CASE NARRATIVE
GENERAL CHEMISTRY

Lab Reference No.: 5416

Client/Project: City of McAllen

L Holding Time:
All acceptance criteria were met.

a Digestion Exceptions:
None

III. Analysis:

A. Calibration:
All acceptance criteria were met.

B. Blanks:
All acceptance criteria were met.

C. Matrix Spike Sample(s):
Not applicable.

D. Duplicate Sample(s):
All acceptance criteria were met.

E. Lab Control Sample(s):
The panel observed a 20 color unit standard as 15 color Units. Other acceptance criteria were met.

F. Other:
Not applicable.

IV. Documentation Exceptions:
None.

V. I certify that this data package is in compliance with the terms and conditions agreed to by the client and CH2M HILL, both technically and for completeness, except for the conditions detailed above. Release of the data contained in this hardcopy data package has been authorized by the Laboratory Manager or his designee, as verified by the following signature.

Prepared by: *Ainger Collins* 6/5/97

Reviewed by: *Helen Van Nee* 6/5/97

Corvallis Applied Sciences Laboratory

Client Information

Project Name: City of McAllen
 Project Manager Rosie Villarreal
 sampled By: E. Perez
 sampling Date: 5/29/97
 Sampling time: 9:00
 Type: Grab
 Matrix: water
 Basis: As received

Lab Information

Laboratory ID: ICROR001
 Date Rec'd: 5/30/97
 Analytical Method: SMS310.D
 Date Analyzed: 6/2/97
 Report Revision No.: 0
 Reported By: G. Collins
 Reviewed By: *[Signature]*
 Units: mg/L

Client Sample ID	Lab Sample ID	pH	Reporting Limit	Replicate 1	TOC water Replicate 2	Average	Percent RPD
Feedwater	541601	<2	1.0	6.9	6.9	6.9	0.0

U=Not detected at specified detection limits

Applied Sciences Laboratory
Corvallis Office

2300 NW Walnut Blvd., Corvallis, OR 97330-3538
P.O. Box 428, Corvallis, OR 97339-0428

(541) 752-4271
Fax No. (541) 752-0276

Corvallis Applied Sciences Laboratory

Client Information

Project Name: City of McAllen
Project Manager: Rosie Villarreal
Sampled By: E. Perez
Sampling Date: 5/29/97
Sampling time: 9:00
Type: Grab
Matrix: Water
Basis: As received

Lab Information

Laboratory ID: ICRCR001
Date Rec'd: 5/30/97
Analytical Method: EPA 110.2
Date Analyzed: 5/30/97
Report Revision No.: 0
Reported By: H. Van Nice
Reviewed By: *gmc*

Client Sample ID	Lab Sample ID	Reporting Limit	Color (ALPHA) Apparent Result	Units
Feedwater	641601	5	5 U	Color Units

U=Not detected at specified detection limits

Applied Sciences Laboratory
Corvallis Office

2300 NW Walnut Blvd., Corvallis, OR 97330-3538
P.O. Box 428, Corvallis, OR 97339-0428

(541) 752-4271
Fax No. (541) 752-0276

CH2MHILL Analytical Services
CHAIN OF CUSTODY RECORD
AND AGREEMENT TO PERFORM SERVICES

LMO 2587 Fairlane Drive
 Montgomery, AL 36116-1622
 (334) 271-1444 FAX (334) 271-3428

LRD 5090 Caterpillar Road
 Redding, CA 96003-1412
 (916) 244-5227 FAX (916) 244-4109

LKW Canviro Analytical Laboratories, Inc.
 56 Balthurst, Unit 12, Waterloo, Ontario, Canada N2V 2C6
 (519) 747-2575 FAX (519) 747-3808

CVO 2300 NW Walnut Boulevard
 Corvallis, OR 97331
 (541) 752-4271 FAX (541) 752-4272

COC #

Project #		Purchase Order #		Requested Analytical Method #										THIS AREA FOR LAB USE																	
Project Name Pilot M Fallen XXXXXX Study		Company Name M Fallen Public Utilities		Project Manager or Contact & Phone # Rose Villarreal (210)-631-8340		Report Copy to: Jim Geishbush		TOTAL # OF CONTAINERS TOC Color										Lab # 5416-1	Page 1	of 1											
Requested Completion Date: ASAP		Site ID WWTP #2		Sample Disposal: Dispose <input checked="" type="checkbox"/> Return <input type="checkbox"/>														Lab PM	Custody Review												
Sampling		Type	Matrix	CLIENT SAMPLE ID (9 CHARACTERS)								LAB QC	Preservative										Log in	LIMS Verification							
Date	Time	CODE	ORDER	WATER	SOIL	AIR																				pH	Custody Seals Y <input checked="" type="checkbox"/> N				
5/29/97	09:00						F	E	E	D	W	A	T	E	R	2	H ₂ O ₄	None											QC Level <input checked="" type="checkbox"/> 1 2 3 Other	Cooler Temperature	
5/29/97	09:00						F	E	E	D	W	A	T	E	R	1													Alternate Description	Lab ID	
Relinquished By R		Empty Bottles 3		Date/Time 5/29/97 08:45		Received By Enrique Perez		Empty Bottles 3		Date/Time 5/29/97 08:45												Cooler Temperature									
Signed By and Title Enrique Perez		(Please sign and print name)		Date/Time 5/29/97 09:00		Relinquished By Enrique Perez		(Please sign and print name)		Date/Time 5/29/97 09:15												Cooler Temperature									
Received By R		(Please sign and print name)		Date/Time 5/29/97 09:40		Relinquished By Ramon Treviño		(Please sign and print name)		Date/Time 5/29/97 09:40												Cooler Temperature									
Received By Kathy McKinley		(Please sign and print name)		Date/Time 5/30/97		Shipped Via UPS Fed-Ex Other		Shipping #												Cooler Temperature											
Special Instructions: 1040												Shipping #		Cooler Temperature																	

contact: G. J. [Signature]

APP-186

MONTHLY BILLING SUMMARY



CH2MHILL

Applied Sciences Laboratory

Corvallis, Oregon

2300 NW Walnut Blvd. Corvallis, OR 97330-3538

P.O. Box 428, Corvallis, OR 97339-0428

541 752-4271

Fax 541 752-0276

City of McAllen

Project Manager: Jim Geisbush/PHX

Invoice Date 06/02/97

Invoice No. A97-0968

Page 1 of 1

Customer Number 138067.A0.ZZ		CH2M Hill Rep. Ginger Collins	Billing Period 6/1 1/97	Reference No. 5416
----------------------------------------	--	----------------------------------	-----------------------------------	------------------------------

Qty	Description	Trans. Date	Unit Cost	Subtotal
1	Color (ALPHA) Apparent	5/30/97	\$20.00	\$20.00
1	Total Organic Carbon	5/30/97	\$40.00	\$40.00

(THIS IS NOT A BILL - DO NOT SUBMIT PAYMENT)

TOTAL AMOUNT: \$60.00

Our records indicate that the above tests were requested during the current billing period. Please notify the laboratory listed above if there are any discrepancies.

- PROJECT COPY -

APP-187



CH2MHILL

CH2M HILL
2300 NW Walnut Blvd.
Corvallis, OR
97330-3538
Mailing address:
P.O. Box 428
Corvallis, OR
97339-0428
Tel 541.752.4271
Fax 541.752.0276

6/4/97

City of McAllen

Subject: Acknowledgment of sample set 5440.

Dear Jim Geisbush/PHX:

This letter is to acknowledge the receipt of your sample set on 6/3/97. It has been assigned laboratory number 5440. Please refer to the laboratory number if you need to inquire about this sample set. I have attached a copy of the chain of custody form to provide additional information.

There were no problems noted with the receipt of your samples.

If you need assistance, please feel free to call 541/758-0235 extension 3117.

Sincerely,
CH2M HILL

Jerri Mattrick

Attachment

CH2MHILL Analytical Services
CHAIN OF CUSTODY RECORD
AND AGREEMENT TO PERFORM SERVICES

LMO 2567 Fairlane Drive
 Montgomery, AL 36116-1622
 (334) 271-1444 FAX (334) 271-3428

LMO 6090 Caterpillar Road
 Redding, CA 96003-1412
 (916) 244-5227 FAX (916) 244-4109

INW Canviro Analytical Laboratories, Inc.
 56 Bathurst, Unit 12, Waterloo, Ontario, Canada N2V 2C5
 (519) 747-2575 FAX (519) 747-3808

GVO 2300 NW Walnut Boulevard
 Corvallis, OR 97330-3838
 (541) 752 4271 FAX (541) 752 0276

COC #

Project # 138067.A7.22		Purchase Order #		Requested Analytical Method #						THIS AREA FOR LAB USE ONLY											
Project Name McAllen Pilot Study		Company Name McAllen Public Utilities		Requested Analytical Method # Metals TOC Organics Inorganics General Chemical Analysis (Non-MS) General Chemical Analysis (2L Method)						Lab # 5440-1	Page 1	of 1									
Project Manager or Contact & Phone # Patrick Asogwa (916) 631-4131		Report Copy to: Jim Geisbush								Lab PM	Custody Review		Log In	LIMS Verification							
Requested Completion Date: ASAP		Site ID Lake #2		Sample Disposal: Dispose <input checked="" type="checkbox"/> Return <input type="checkbox"/>		Preservative						pH	Custody Seals Y N Ice Y N								
Sampling		Type		Matrix		CLIENT SAMPLE ID (8 CHARACTERS)						LAB QC		QC Level 1 2 3 Other							
Date	Time	COM	PRE	GRA	WATER	BOIL	AIR							Cooler Temperature							
6-2-97	11:15a							HA03	HA504	NONE	NONE	NONE	NONE								
6-2-97	11:30a																				
6-2-97	11:35																				
6-2-97	11:36																				
6-2-97	11:40																				
6-2-97	11:46																				
Relinquished By		Empty Bottles		Date/Time		Received By		Empty Bottles		Date/Time		Alternate Description		Lab ID							
Sampled By and Title Mark Sh Martin Salazar		(Please sign and print name)		Date/Time 6-2-97 12:00		Relinquished By Mark Salazar		(Please sign and print name)		Date/Time 6-2-97 12:00		Shipped Via		Shipping #							
Received By		(Please sign and print name)		Date/Time		Relinquished By		(Please sign and print name)		Date/Time		UPS Fed-Ex Other									
Received By		(Please sign and print name)		Date/Time		Shipped Via		UPS Fed-Ex Other		Shipping #		Special Instructions: contact George									

APP-189



CH2MHILL

CH2M HILL
2300 NW Walnut Blvd.
Corvallis, OR
97330-3538
Mailing address:
P.O. Box 428
Corvallis, OR
97339-0428
Tel 541.752.4271
Fax 541.752.0276

6/2/97
CITY OF McALLEN

6/2/97

City of McAllen

Subject: **Acknowledgment** of sample set 5416.

Dear Jim Geisbush/PHX:

This letter is m acknowledge the **receipt** of your sample set on **5/30/97**. It has been assigned **laboratory number 5416**. Please refer to the **laboratory number** if you need to inquire about this sample **set**. I **have attached** a copy of **the chain** of custody form m provide **additional information**.

There were no problems noted **with** the **receipt** of **your** samples.

If you need assistance, please feel free to call 541/758-0235 extension 3117.

Sincerely,
CH2M HILL

Jerri Mattrick

Attachment

CH2MHILL Analytical Services
CHAIN OF CUSTODY RECORD
AND AGREEMENT TO PERFORM SERVICES

LMS 2567 Fekrane Drive
 Montgomery, AL 36116-1622
 (334) 271-1444 FAX (334) 271-3428

LRD 5090 Galapillar Road
 Redding, CA 96003-1412
 (916) 244-5227 FAX (916) 244-4109

LKW Canviro Analytical Laboratories, Inc.
 60 Bathurst, Unit 12, Waterloo, Ontario, Canada N2V 2C5
 (519) 747-2575 FAX (519) 747-3808

CVO 2300 NW Walnut Boulevard
 Corvallis, OR 97330-3636
 (541) 752-4271 FAX (541) 752-0278

COC #

Project #		Purchase Order #		Requested Analytical Method #										THIS AREA FOR LAB USE ONLY														
Project Name Mcallen XXXXXX Pilot Study		Company Name Mcallen Public Utilities		Project Manager or Contact & Phone # P. de Villarreal (310) 631-8340		Report Copy to: Jim Geishbush		TOTAL # OF CONTAINERS TOC Color										Lab # 5416-1	Page 1	of 1								
Requested Completion Date: ASAP		Site ID WWTP #2		Sample Disposal: Dispose <input checked="" type="checkbox"/> Return <input type="checkbox"/>														Lab PM	Custody Review									
Sampling		Type COMB	Matrix WATER	CLIENT SAMPLE ID. (8 CHARACTERS)						LAB QC	Preservative										Log In	LIMS Verification						
Date	Time			F	E	E	D	W	A	T	E	R	2	H2SO4	None											pH	Custody Seals Y <input checked="" type="checkbox"/> N <input type="checkbox"/>	
5/29/17	08:00			F	E	E	D	W	A	T	E	R	1													QC Level 1 2 3 Other	Ice <input checked="" type="checkbox"/> N <input type="checkbox"/>	
5/29/17	08:00			F	E	E	D	W	A	T	E	R														Cooler Temperature		
													Alternate Description			Lab ID												
Relinquished By P. de Villarreal													Empty Bottles 3			Date/Time 5/29/17 08:45			Received By Enrique Perez			Empty Bottles 3			Date/Time 5/29/17 06:45			
Sampled By and Title Enrique Perez													Date/Time 5/29/17 09:25			Relinquished By Enrique Perez			Date/Time 5/29/17 09:15			Received By Enrique Perez			Date/Time 5/29/17 09:15			
Received By Kathy McKelvey													Date/Time 5/29/17 09:38			Relinquished By Kathy McKelvey			Date/Time 5/29/17 09:40			Received By Kathy McKelvey			Date/Time 5/29/17 09:40			
Received By Kathy McKelvey													Date/Time 5/30/17			Shipped Via UPS Fed-Ex Other			Shipping #									
Special Instructions: 1040																												



CH2MHILL

CH2M HILL
2300 NW Walnut Blvd
Corvallis, OR
97330-3538
Mailing address:
P.O. Box 428
Corvallis, OR
97339-0428
Tel 541.752.4271
Fax 541.752.0276

May 30, 1997

City of McAllen

138067.A0.ZZ

RE: **Analytical Dam for City of McAllen**
CVO **Laboratory** Reference No. 5383
Jim Geisbush/PHX

On May 23, 1997, the **CH2M HILL Corvallis Applied Sciences Laboratory** received two samples with a request for **analysis of selected parameters.**

The **analytical results and associated quality control data are** enclosed. Any **unusual difficulties encountered** during the **analysis of your samples** are discussed in the case **narrative.**

Under **CH2M HILL** policy, your **samples will be** scored for 30 days **after** reporting. If you have **not** given us prior **instructions** for disposal, we **will contact you** if any **samples** require disposal as hazardous **waste.**

The **CH2M HILL Applied Sciences Laboratory appreciates** your business and looks **forward to serving** your **analytical** needs again. If you should have any questions concerning **the data**, or if you need **additional information**, please call Ms. Kathy McKinley at (541) 758-0235, **extension 3120.**

Sincerely,

Kelly Ensor
Senior Administrative Assistant

Enclosures

Applied Sciences Laboratory
Corvallis Office

2300 NW Walnut Blvd., Corvallis, OR 97330-3538
P. O. Box 428, Corvallis, OR 97339-0428

541 752-4271
Fax No. 541 752-0276

CLIENT SAMPLE CROSS-REFERENCE

CH2M HILL Applied Science Laboratory Reference No. 5383

CVO Sample ID	Client Sample ID	Date Collected	Time Collected
538301	MEMCOR Filtrate	05/22/1997	8:45
538302	ZEEWEED Permeate	05/22/1997	8:45

CASE NARRATIVE
GENERAL CHEMISTRY

Lab Reference No.: 5383

Client/Project: City of McAllen

- L. Holding Time:
All acceptance criteria were met.
- II. Digestion Exceptions:
None
- III. Analysis:
- A. Calibration:
All acceptance criteria were met.
- B. Blanks:
All acceptance criteria were met.
- C. Matrix Spike Sample(s):
All acceptance criteria were met.
- D. Duplicate Sample(s):
All acceptance criteria were met.
- E. Lab Control Sample(s):
All acceptance criteria were met.
- F. Other:
Observation of a Lab Control made for Color Analysis produced a value of 10 color units for a standard of 20 color units.
- Iv. Documentation Exceptions:
None.
- V. I certify that this data package is in compliance with the terms and conditions agreed to by the client and CH2M HILL, both technically and for completeness, except for the conditions detailed above. Release of the data contained in this hardcopy data package has been authorized by the Laboratory Manager or his designee, as verified by the following signature.

Prepared by: *Linger Collins* 5-30-97

Reviewed by: *Helen Van Nieu* 5/30/97

Corvallis Applied Sciences Laboratory

Project Name: Cii of McAllen Project Manager: Rosie Villarreal Sampled By: E. Perez Sampling Date: Yw97 Sampling time: 8:45 Type: Grab Matrix: Water Basis: As received	Lab Information Laboratory ID: ICRO001 Date Rec'd: 5/23/97 Analytical Method: EPA 110.2 Date Analyzed: 5/23/97 Report Revision No.: 0 Reported By: H. Van Nice Reviewed By: <i>gmc</i>
------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------	---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------

Client Sample ID	Lab Sample ID	Reporting Limit	Color (ALPHA) Apparent Result	Units
Memcor Filtrate	538301	5	5 U	Color Units
Zeeweed Permeate	538302	5	5	Color Units

U=Not detected at specified detection limits

Applied Sciences Laboratory
Corvallis Office

2300 NW Walnut Blvd., Corvallis, OR 97330-3538
P.O. Box 428, Corvallis, OR 97339-0428

(541) 752-4271
Fax No. (541) 752-0276

CH2MHILL Analytical Services
CHAIN OF CUSTODY RECORD
AND AGREEMENT TO PERFORM SERVICES

11MO 2567 Fablane Drive
 Montgomery, AL 36116-1822
 (334) 271-1444 FAX (334) 271-3428

11RD 6090 Caterpillar Road
 Redding, CA 96003-1412
 (916) 244-5227 FAX (916) 244-4109

11RW Canvite Analytical Laboratories, Inc.
 50 Bathurst, Unit 12, Waterloo, Ontario, Canada N2V 2C5
 (519) 747-2676 FAX (519) 747-3808

11CV0 2300 NW Walnut Bn
 Corvallis, OR 97330-3638
 (541) 752-4271 FAX (541) 752-

COC # _____

Project # 138067, P.O. 22		Purchase Order #		Requested Analytical Method #						THIS AREA FOR LAB USE ONLY																											
Project Name McAllen Pilot Study				TOTAL # OF CONTAINERS	<table border="1" style="width:100%; height: 100%;"> <tr><td style="width: 20%;">TCC</td><td style="width: 20%;">Color</td><td style="width: 20%;">TCC</td><td style="width: 20%;">Color</td><td style="width: 20%;"></td><td style="width: 20%;"></td><td style="width: 20%;"></td><td style="width: 20%;"></td></tr> <tr><td colspan="8" style="text-align: center;">Preservative</td></tr> <tr><td style="width: 20%;">H₂S</td><td style="width: 20%;">None</td><td style="width: 20%;">H₂SO₄</td><td style="width: 20%;">None</td><td style="width: 20%;"></td><td style="width: 20%;"></td><td style="width: 20%;"></td><td style="width: 20%;"></td></tr> </table>						TCC	Color	TCC	Color					Preservative								H ₂ S	None	H ₂ SO ₄	None					Lab # 538301	Page 2	of
TCC	Color	TCC	Color																																		
Preservative																																					
H ₂ S	None	H ₂ SO ₄	None																																		
Company Name McAllen Public Utilities				Lab PM	Custody Review																																
Project Manager or Contact & Phone # Rosie Villareal 210-631-8340		Report Copy to: Jim Gaisbush (Mexico)		Log In	LIMS Verification																																
Requested Completion Date: ASAP		Site ID WUTP#2		Sample Disposal: Deposit <input checked="" type="checkbox"/> Return <input type="checkbox"/>		pH		Custody Seals Y N																													
						Ice		Y N																													
Sampling		Type GROUND WATER SOIL AIR	Matrix	CLIENT SAMPLE ID (8 CHARACTERS)				LAB QC		QC Level 1 2 3 Other																											
Date	Time									Cooler Temperature																											
5/22/97	8:45	✓	✓	MEMCOR Filtrate				2		Alternate Description																											
5/22/97	8:45	✓	✓	MEMCOR Filtrate				1		Lab ID																											
5/22/97	8:45	✓	✓	ZEEWED Permeate				2		}																											
5/22/97	8:45	✓	✓	ZEEWED Permeate				1		}																											
Relinquished By Rosie Villareal		Empty Bottles 6		Date/Time 5/22/97 8:55		Received By Enrique Perez		Empty Bottles 6		Date/Time 5/22/97 @ 8:30 am.																											
Sampled By and Title Enrique Perez		(Please sign and print name)		Date/Time 5/22/97 8:45		Relinquished By Enrique Perez		(Please sign and print name)		Date/Time 5/22/97 @ 9:00 am.																											
Received By Rosie Villareal		(Please sign and print name)		Date/Time 5/22/97 9:00		Relinquished By Rosie Villareal		(Please sign and print name)		Date/Time 5/22/97 @ 12:00 p.m.																											
Received By Shirley Collins		(Please sign and print name)		Date/Time 5/23/97		Shipped Via UPS Fed-Ex		Shipping #																													
Spec. Actions:										Marta A. Garcia																											

APP-196

Corvallis Applied Sciences Laboratory

Client Information

Project Name: City of McAllen
Project Manager: Rosie Villarreal
Sampled By: E. Perez
Sampling Date: 5/29/97
sampling Time: 9:00
Type Grab
Matrix: water
Basis: As received

Lab Information

Laboratory ID: ICRCR001
Date Rec'd: 5/30/97
Analytical Method: EPA 110.2
Date Analyzed: 5/30/97
Report Revision No.: 0
Reported By: H. Van Nice
Reviewed By:

Client Sample ID	Lab Sample ID	Reporting Limit	Color (ALPHA) Apparent Result	Units
Feedwater	541601	5	5 U	Color Units

U=Not detected at specified detection limits

Applied Sciences Laboratory
Corvallis Office

2300 NW Walnut Blvd., Corvallis, OR 97331-3538
P.O. Box 428, Corvallis, OR 97339-0428

(541) 752-4271
Fax No. (541) 752-0276

Corvallis Applied Sciences Laboratory

Client Information

Project Name: City of McAllen
 Project Manager: Rosie Villarreal
 Sampled By: E. Perez
 Sampling Date: 5/29/97
 Sampling time: 9:00
 Type: Grab
 Matrix: Water
 Basis: As received

Lab Information

Laboratory ID: ICOR001
 Date Rec'd: 5/30/97
 Analytical Method: SM5310.D
 Date Analyzed: 6/2/97
 Report Revision No.: 0
 Reported By: G. Collins
 Reviewed By:
 Units: mg/L

Client Sample ID	Lab Sample ID	pH	Reporting Limit	Replicate 1	TOC Water Replicate 2	Average	Percent RPD
Feedwater	641601	Q	1.0	6.9	6.9	6.9	Cl.0

U=Not detected at specified detection limits

Applied Sciences Laboratory
 Corvallis Office

2300 NW Walnut Blvd., Corvallis, OR 97330-3538
 P.O. Box 428, Corvallis, OR 97339-0428

(541) 752-4271
 Fax No. (541) 752-0276

MONTHLY BILLING SUMMARY



Applied Sciences Laboratory

Corvallis, Oregon
 2300 NW Walnut Blvd. Corvallis, OR 97330-3538
 P.O. Box 428, Corvallis, OR 97339-0428
 541 m-277
 Fax 541 752-0276

City Of McAllen

Project Manager: Jim Geisbush/PHX

Invoice Date 05/27/97
 Invoice No. A97-0910

Page 1 Of 1

Customer Number 138067.A0.ZZ	CHW Hill Rep. Ginger Collins	Billing Period 6/11/97	Reference No. 5383
Debit	Trans. Date	Amount	Total
2	Color (ALPHA) Apparent	5/23/97	320.00
2	Total Organic Carbon	5/23/97	\$40.00
			\$80.00

(THIS IS NOT A BILL - DO NOT SUBMIT PAYMENT) TOTAL AMOUNT: \$120.00

Our records indicate that the above tests were requested during the current billing period. Please notify the laboratory listed above if there are any discrepancies.

- PROJECT COPY -



CH2MHILL

CH2M HILL
2300 NW Walnut Blvd.
Corvallis, OR
97330-3538
Mailing address:
P.O. Box 428
Corvallis, OR
97339-0428
Tel 541.752.4271
Fax 541.752.0276

5/27/97

City of McAllen

Subject: Acknowledgment of sample set 5383.

Dear Jim Geisbush/PHX:

This letter is to acknowledge the receipt of your sample set on 5/23/97. It has been assigned laboratory number 5383. Please refer to the laboratory number if you need to inquire about this sample set. I have attached a copy of the chain of custody form to provide additional information.

There were no problems noted with the receipt of your samples.

If you need **assistance**, please feel **free to call 541/758-0235** extension 3117.

**Sincerely,
CH2M HILL**

Jerri Mattick

Attachment

CH2MHILL Analytical Services
CHAIN OF CUSTODY RECORD
AND AGREEMENT TO PERFORM SERVICES

LMS 2587 Fairlane Drive
 Montgomery, AL 36116-1822
 (334) 271-1444 FAX (334) 271-3428

LAD 8000 Capital Road
 Redding, CA 96003-1412
 (916) 244-8227 FAX (916) 244-4108

LKW Canviro Analytical Laboratories, Inc.
 50 Bathurst, Unit 12, Waterloo, Ontario, Canada N2V 2C8
 (519) 747-2575 FAX (519) 747-3808

CVO 2300 NW Walnut Boulevard
 Corvallis, OR 97330-3638
 (541) 752-4271 FAX (541) 752-0276

COC #

Project #		Purchase Order #		Requested Analytical Method #										THIS AREA FOR LAB USE ONLY														
Project Name McAllen Pilot Study				TOTAL # OF CONTAINERS	TOL	Color	TOL	Color									Lab # 538301	Page 2	of									
Company Name McAllen Public Utilities																	Lab PM	Custody Review										
Project Manager or Contact & Phone # Rosie Villareal 210-631-8340																	Log In	LIMS Verification										
Report Copy to: Jim Geisbush (Phone)																	pH	Custody Seals Y N										
Requested Completion Date: ASAP		Site ID WWTP#2			Sample Disposal: Dispose <input checked="" type="checkbox"/> Return <input type="checkbox"/>		Preservative													Ice	Y N							
Sampling		Type	Matrix		CLIENT SAMPLE ID (8 CHARACTERS)		LAB QC												QC Level 1 2 3 Other									
Date	Time	COMP	GRAB		WATER	SOIL	AIR			H2SO4	None	H2SO4	None											Cooler Temperature				
5/22/97	8:45							MEMCOR Filtrate	2	✓															Alternate Description			Lab ID
5/22/97	8:45							MEMCOR Filtrate	1		✓																	-1
5/22/97	8:45							2EE WEE D Permeate	2			✓																-2
5/22/97	8:45						2EE WEE D Permeate	1				✓																
Relinquished By Rosie Villareal				Empty Bottles 6				Date/Time 5/22/97 8:30		Received By Rosie Villareal				Empty Bottles 6				Date/Time 5/22/97 @ 8:30 am										
Sampled By and Title Rosie Villareal				(Please sign and print name)				Date/Time 5/22/97		Relinquished By Rosie Villareal				(Please sign and print name)				Date/Time 5/22/97 @										
Received By Rosie Villareal				(Please sign and print name)				Date/Time 5/22/97		Relinquished By Rosie Villareal				(Please sign and print name)				Date/Time 5/22/97 @ 12:00 p.m.										
Received By Shirley Collins				(Please sign and print name)				Date/Time 5/23/97		Shipped Via UPS Fed-Ex Other				Shipping #														
Special Instructions: Contact: Ginger																												

APP-201



CH2MHILL

CH2M HILL
2300 NW Walnut Blvd.
Corvallis, OR
97330-3538
Mailing address:
P.O. Box 428
Corvallis, OR
97339-0428
Tel 541.752.4271
Fax 541.752.0276

05/21/97

City of McAllen

Subject: Acknowledgment of sample set 5357.

Dear Jim Geisbush/PHX:

This letter is to **acknowledge** the **receipt** of **your** sample set on **5/20/97**. It has **been** assigned laboratory number **5357**. **Please refer to** the **laboratory number** if you need to **inquire** about this sample **set**. I have **attached** a copy of **the** chain of **custody** form to **provide** additional **information**.

There were no problems noted with the **receipt** of **your** samples.

If you need assistance, please **feel free** to call **541/758-0235** extension 3 117.

Sincerely,
CH2M HILL

Jerri Matnick

Attachment

CH2MHILL Analytical Services
CHAIN OF CUSTODY RECORD
AND AGREEMENT TO PERFORM SERVICES

LMO 2587 Fabiane Drive
 Montgomery, AL 38118-1822
 (334) 271-1444 FAX (334) 271-3428

LRD 6000 Calaveras Road
 Redding, CA 96003-1412
 (916) 244-5227 FAX (916) 244-4100

LKW Canviro Analytical Laboratories, Inc.
 50 Balfour, Unit 12, Waterloo, Ontario, Canada N2V 2C5
 (519) 747-2575 FAX (519) 747-3808

LCV 2300 NW Walnut Boulevard
 Corvallis, OR 97330-3838
 (541) 752-4271 FAX (541) 752-0278

COC #

Project # 13010711277		Purchase Order #		Requested Analytical Method #						THIS AREA FOR LAB USE ONLY		
Project Name M. Allen Pilot Study				TOTAL # OF CONTAINERS	TOC	Colog-Spht.	THMP, HAAEP	THMP, HAAEP	THMP, HAAEP	Lab # 5451-173	Page 1	of 1
Company Name M. Allen Public Utilities					Preservative					Lab PM	Custody Review	
Project Manager or Contact & Phone # Rosie Villarejo 210-631-8340					Report Copy to: J.M. Geishush (Phoenix)					Log In	LIMS Verification	
Requested Completion Date: ASAP		Site ID: WWTP#2			Sample Disposal: Dispose <input checked="" type="checkbox"/> Return <input type="checkbox"/>					pH	Custody Seals Y N Ice - blue <input checked="" type="checkbox"/> N	
Sampling		Type	Metric		CLIENT SAMPLE ID (9 CHARACTERS)	LAB QC				QC Level 1 2 3 Other	Cooler Temperature Cool	
Date	Time	COMP	GRAB	WATER	SOIL	AIR			Alternate Description		Lab ID	
5/19/97	10:20		✓					F E E D W A T E R				
5/19/97	10:40		✓					F E E D W A T E R				
5/19/97	10:40		✓					F E E D W A T E R				
5/19/97	10:40		✓					M E N S O R F I L T R A T E				
5/19/97	10:40		✓					Z e r o u s P a r a m e t e r s				
Empty Bottles 6 Maced				Date/Time 5/19/97 10:30	Received By Encarna Perez	Empty Bottles 6				Date/Time 5/19/97 @ 10:30 am		
(Please sign and print name)				Date/Time	Relinquished By	(Please sign and print name)				Date/Time		
Encarna Perez				5/19/97 10:30	Encarna Perez	Encarna Perez				5/19/97 @ 10:45		
(Please sign and print name)				Date/Time	Relinquished By	(Please sign and print name)				Date/Time		
Rosie Villarejo				5/19/97 11:30	Rosie Villarejo	Rosie Villarejo				5/19/97 @ 11:30 am		
(Please sign and print name)				Date/Time	Shipped Via	Shipping #						
				5/19/97 11:30	UPS Fed-Ex Other							

APP-203

contact: Encarna



CH2MHILL

CH2M HILL
2300 NW Walnut Blvd.
Corvallis, OR
97330-3538
Mailing address:
P.O. Box 428
Corvallis, OR
97339-0428
Tel 541.752.4271
Fax 541.752.0276

May 19, 1997

City of McAllen

138067.A0.ZZ

RE: Analytical Data for City of McAllen
CVO Laboratory Reference No. 5293

Jim Geisbush/PHX

On May 9, 1997, the CH2M HILL Corvallis Applied Sciences Laboratory received two samples with a request for analysis of selected parameters.

The analytical results and associated quality control data are enclosed. Any unusual difficulties encountered during the analysis of your samples are discussed in the case narrative.

Under CH2M HILL policy, your samples will be stored for 30 days after reporting. If you have not given us prior instructions for disposal, we will contact you if any samples require disposal as hazardous waste.

The CH2M HILL Applied Sciences Laboratory appreciates your business and looks forward to serving your analytical needs again. If you should have any questions concerning the data, or if you need additional information, please call Ms. Kathy McKinley at (541) 758-0235, extension 3120.

Sincerely,

Kelly Ensor
Senior Administrative Assistant

Enclosures

Applied Sciences Laboratory 2300 NW Walnut Blvd., Corvallis, OR 97330-3538
Corvallis Office P. O. Box 428, Corvallis, OR 97339-0428

541 752-4271
Fax No. 541 752-0276

CLIENT SAMPLE CROSS-REFERENCE

CH2M HILL Applied Science **Laboratory** Reference No. 5293

CVO Sample ID	Client Sample ID	Date collected	Time Collected
529301	Memcor Filtrate	05/08/1997	9:05
529302	Zeeweed Permeate	05/08/1997	9:05

**CASE NARRATIVE
GENERAL CHEMISTRY**

Lab Reference No.: 5293

Client/Project: City of McAllen

- I. Holding Time:
All acceptance criteria were met.
- II. Digestion Exceptions:
None
- III. Analysis:
 - A. Calibration:
All acceptance criteria were met.
 - B. Blanks:
All acceptance criteria were met.
 - C. Matrix Spike Sample(s):
All acceptance criteria were met.
 - D. Duplicate Sample(s):
All acceptance criteria were met.
 - E. Lab Control Sample(s):
All acceptance criteria were met.
 - F. Other:
Not applicable.
- IV. Documentation Exceptions:
None.
- V. I certify that this data package is in compliance with the terms and conditions agreed to by the client and CH2M HILL, both technically and for completeness, except for the conditions detailed above. Release of the data contained in this hardcopy data package has been authorized by the Laboratory Manager or his designee, as verified by the following signature.

Prepared by: Greg Collins 5/15/97
Reviewed by: Helen Van Tice

Corvallis Applied Sciences Laboratory

Client Information

Project Name: cil of McAllen
Project Manager: Joe Ibarra Jr.
Sampled By: E. Perez
Sampling Date: 5/8/97
Sampling -time: 9:05
Type: Grab
Matrix: Water
Basis: As received

Lab Information

Laboratory ID: ICROP001
Date Rec'd: 5/9/97
Analytical Method: EPA 110.2
Date Analyzed: 5/9/97
Report Revision No.: 0
Reported By: H. Van Nice
Reviewed By: *SHC*

Client Sample ID	Lab Sample ID	Reporting Limit	Color (ALPHA) Apparent Result	Units
Memcor Filtrate	529301		10	Color Units
Zeeweed Permeate	529302		15	Color Units

U=Not detected at specified detection limits

Corvallis Applied Sciences Laboratory

Client

Project Name: Cii of McAllen
 Project Manager: Joe Ibarra Jr.
 Sampled By: E. Perez
 Sampling Date: 5/8/97
 Sampling Time: 9:05
 Type: Grab
 Matrix: water
 Basis: As received

L a b -

Laboratory ID: ICROR001
 Date Rec'd: 5/9/97
 Analytical Method: SM5310.D
 Date Analyzed: 5/9/97
 Report Revision No.: 0
 Reported By: G. Collins
 Reviewed By: *SPH*
 Units: mg/L

Client Sample ID	Lab Sample ID	pH	Reporting Limit	Replicate 1	TOC Water Replicate 2	Average	Percent RPD
Memcor Filtrate	529301	<2	0.50	7.4	7.6	7.6	27
Zeeweed Permeate	529302	<2	0.50	7.5	7.5	7.5	10.0

U=Not detected at specified detection limits

Applied Sciences Laboratory
 Corvallis Office

2300 NW Walnut Blvd., Corvallis, OR 97330-3538
 P.O. Box 428, Corvallis, OR 97339-0428

(541) 7524271
 Fax No. (541) 752-0276

CH2M HILL Analytical Services
CHAIN OF CUSTODY RECORD
AND AGREEMENT TO PERFORM SERVICES

I LMS 2567 Faklane Drive
 Montgomery, AL 36116-1622
 (334) 271-1444 FAX (334) 271-3428

I LRD 5090 Caterpillar Road
 Redding, CA 96003-1412
 (916) 244-5227 FAX (916) 244-4100

I LRW Canvite Analytical Laboratories, Inc.
 50 Bathurst, Unit 12, Waterloo, Ontario, Canada N2V 2C5
 (519) 747-2575 FAX (519) 747-3806

I CVB 2300 NW Walker Boulevard
 Corvallis, OR 97330-3638
 (541) 752-4271 FAX (541) 752-0278

COC #

Project # 15061172		Purchase Order #		Requested Analytical Method #								THIS AREA FOR LAB USE ONLY													
Project Name McAllen Plant Study				TOTAL # OF CONTAINERS	<table border="1"> <tr> <td>TOC</td> <td>Color-apt</td> <td>TOC</td> <td>Color-apt</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> </table>								TOC	Color-apt	TOC	Color-apt							Lab # 5873 H2	Page 1	of 1
TOC	Color-apt	TOC	Color-apt																						
Company Name McAllen Public Utilities													Lab PM	Custody Review											
Project Manager or Contact & Phone # Joe Thomas		Report Copy to: Jim Gishurst (Murray)											Log In	LIMS Verification											
Requested Completion Date: ASAP		Site ID DUSTP #2										pH	Custody Seals Y I Ice Y I												
Sample Disposal: Dispose <input type="checkbox"/> Return <input type="checkbox"/>				Preservative								QC Level 1 2 3 Other													
Sampling		Type COM P GRA B WATER SOIL AIR	Matrix		CLIENT SAMPLE ID (8 CHARACTERS)				LAB QC		Cooler Temperature														
Date	Time A.M.										Alternate Description		Lab ID												
5/8/97	9:05	✓	✓		ME NCO R FILL WTR				✓				1												
5/8/97	9:05	✓	✓		ME NCO R FILL GAC				✓				1												
5/8/97	9:05	✓	✓		2 covered Permeate				✓				2												
5/8/97	9:05	✓	✓		2 covered Permeate				✓				2												
Relinquished By Rese Villanueva		Empty Bottles 6		Date/Time 5/8/97		Received By Rese Villanueva		Empty Bottles 6		Date/Time 5/8/97 8:45am															
Sampled By and Title Rese Villanueva		(Please sign and print name)		Date/Time 5/8/97		Relinquished By Rese Villanueva		(Please sign and print name)		Date/Time 5/8/97															
Received By Rese Villanueva		(Please sign and print name)		Date/Time 5/8/97		Relinquished By Rese Villanueva		(Please sign and print name)		Date/Time 5/8/97															
Received By Jim Mattick		(Please sign and print name)		Date/Time 5/8/97		Shipped Via UPS		Fed-Ex Other		Shipping #															
Special Instructions:																									

APP-209

Instructions and Agreement Details on Reverse Side

DISTRIBUTION: Original - LAB Yellow - LAB Pink - Cite

MONTHLY BILLING SUMMARY .



Applied Sciences Laboratory

CH2MHILL Corvallis, Oregon
2300 NW Walnut Blvd, Corvallis, OR 97330-3538
P.O. Box 428, Corvallis, OR 97339-0428
541 752-4271
Fax 541 752-0276

City of McAllen

Project Manager: Jim Geisbush/PHX

Invoice Date 05/12/97
Invoice No. A97-0833

Page 1 of 1

Qty	Description	Trans. Date	Unit Cost	Subtotal
2	Color (ALPHA) Apparent	5/9/97	\$20.00	5 4 0 . 0 0
2	Total Organic Carbon	5/9/97	\$40.00	850.00

(THIS IS NOT A BILL-DO NOT SUBMIT PAYMENT)

TOTAL AMOUNT:

\$120.00

Our records indicate that the above tests were requested during the current billing period. Please notify the laboratory listed above if there are any discrepancies.

- PROJECT COPY -



CH2MHILL

CH2M HILL
2300 NW Walnut Blvd.
Corvallis, OR
97330-3538
Mailing address:
P.O. Box 428
Corvallis, OR
97339-0428
Tel 541.752.4271
Fax 541.752.0276

May 13, 1997

City of McAllen

138067.A0.ZZ

RE: Analytical Data for City of **McAllen**
CVO **Laboratory** Reference No. 5244

Jim Geisbush/PHX

On May 2, 1997, the **CH2M HILL Corvallis** Applied Sciences Laboratory received three samples **with** a request for analysis of selected parameters.

The **analytical** results and associated quality control data are enclosed. Any **unusual difficulties encountered** during the analysis of **your samples** are discussed in **the case narrative**.

Under **CH2M HILL** policy, your samples **will** be stored for 30 days **after reporting**. If you have **not given us** prior **instructions** for disposal, we **will** contact you if any samples require disposal as **hazardous waste**.

The **CH2M HILL** Applied Sciences **Laboratory** appreciates your business and looks forward to serving your analytical needs again. **If you should** have any questions concerning the data, or if you **need** additional **information**, **please** call Ms. Kathy McKinley at (541) **758-**0235, extension 3120.

Sincerely,

Kelly Ensor
Senior **Administrative** Assistant

Enclosures

Applied Sciences Laboratory 2300 NW Walnut Blvd., Corvallis, OR 97330-3538
Corvallis Office P. O. Box 428, Corvallis, OR 97339-0428

541 752-4271
Fax No. 541 752-0276

CLIENT SAMPLE CROSS-REFERENCE

CH2M HILL Applied Science Laboratory Reference No. 5244

CVO Sample ID	Client Sample ID	Date Collected	Time Collected
524401	Feedwater	05/01/1997	
524402	Memcor Filtrate	05/01/1997	
52443	Zeeweed Permeate	05/01/1997	

CASE NARRATIVE
GENERAL CHEMISTRY

Lab Reference No.: 5244

Client/Project: City of McAllen

- I. Holding Time:
All acceptance criteria were met.
- II. Digestion Exceptions:
None
- III. Analysis:
- A. Calibration:
All acceptance criteria were met
- B. Blanks:
All acceptance criteria were met
- C. Matrix Spike Sample(s):
All acceptance criteria were met.
- D. Duplicate Sample(s):
All acceptance criteria were met.
- E. Lab Control Sample(s):
All acceptance criteria were met.
- F. Other:
Not applicable.
- IV. Documentation Exceptions:
None.
- V. I certify that this data package is in compliance with the terms and conditions agreed to by the client and CH2M HILL, both technically and for completeness, except for the conditions detailed above. Release of the data contained in this hardcopy data package has been authorized by the Laboratory Manager or his designee, as verified by the following signature.

Prepared by: Singer Collins DATE: 5-12-97

Reviewed by: Helen Van Nice DATE: 5/12/97

Corvallis Applied Sciences Laboratory

Client Information

Project Name: City of McAllen
 Project Manager: Joe Ibarra Jr.
 Sampled By: E. Perez
 Sampling Date: 5/1/97
 Sampling Time: Not provided
 Type: Gab
 Matrix: Water
 Basis: As received

Lab Info

Laboratory ID: ICROR001
 Date R&d: 5/2/97
 Analytical Method: EPA1102
 Date Analyzed: 5/2/97
 Report Revision No.: 0
 Reported By: H. Van Nice
 Reviewed By: *gmc*

Client	Sample ID	Lab Sample ID	Reporting Limit	Color (ALPHA) Apparent Result	Units
Feedwater		524401		23	Color Unik
Memcor Filtrate		524402		17	Color Units
Zeeweed Permeate	524403			10	Color Units

U=Not detected at specified detection limits

Applied Sciences Laboratory
Corvallis Office

2300 NW Walnut Blvd., Corvallis, OR 97330-3538
P.O. Box 428, Corvallis, OR 97339-0428

(541) 752-4271
Fax No. (541) 752-0276

Corvallis Applied Sciences Laboratory

Client Information

Project Name: Cii of McAllen
 Project Manager: Joe Ibarra Jr.
 Sampled By: E. Perez
 Sampling Date: 5/1/97
 Sampling Time: Not provided
 Type: Grab
 Matrix: Water
 Basis: As received

Lab

Laboratory ID: ICROR001
 Date Rec'd: 5/2/97
 Analytical Method: SMS310.D
 Date Analyzed: 5/9/97
 Report Revision No.: 0
 Reported By: S. Collins
 Reviewed By: *[Signature]*
 units: mg/L

Client Sample ID	lab	pH	Reporting	TOC Water			Percent
	Sample ID		Limit	Replicate1	Replicate2	Average	RPD
Feedwater	524401	<2	0.80	8.5	8.4	8.4	12
Memcor Filtrate	524402	<2	0.50	8.1	8.1	8.1	0.0
Zeeweed Permeate	524403	<2	0.50	8.0	8.1	8.1	1.2

U=Not detected at specified detection limits

CH2MHILL Analytical Services
CHAIN OF CUSTODY RECORD
AND AGREEMENT TO PERFORM SERVICES

LMO 2507 Fairlane Drive
 Montgomery, AL 36116-1622
 (334) 271-1444 FAX (334) 271-3428

LRB 6090 Caterpillar Road
 Redding, CA 96003-1412
 (916) 244-5227 FAX (916) 244-4109

LMW Carviro Analytical Laboratories, Inc.
 50 Balhwaal, Unit 12, Waterloo, Ontario, Canada N2V 2C5
 (519) 747-2575 FAX (519) 747-3806

LCV 2300 NW Walnut Boulevard
 Corvallis, OR 97330-3638
 (541) 752-4271 FAX (541) 752-0276

COC # _____

Project # 138067.HD.22		Purchase Order #		Requested Analytical Method #						THIS AREA FOR LAB USE ONLY			
Project Name McAllen Pilot Study				TOTAL # OF CONTAINERS	TOC	Color	TOC	Color	TOC	Color	Lab # 5244-173	Page 1	of 1
Company Name McAllen Public Utilities					TOC	Color	TOC	Color	TOC	Color	Lab PM	Custody Review	
Project Manager or Contact & Phone # Joe Ibarra, Jr.					TOC	Color	TOC	Color	TOC	Color	Log In	LIMS Verification	
Report Copy to: Jim Grisham (Phoenix)					TOC	Color	TOC	Color	TOC	Color	pH	Custody Seals Y N	
Requested Completion Date: A.A		Site ID P. WWTP # 2			TOC	Color	TOC	Color	TOC	Color	ICE Y N		
Sample Disposal: <input checked="" type="checkbox"/> Dispose <input type="checkbox"/> Return					Preservative						QC Level 1 2 3 Other		
Sampling		Type PECO GRAB WATER SOIL AIR	Matrix	CLIENT SAMPLE ID (8 CHARACTERS)	LAB QC	H ₂ SO ₄	None	H ₂ SO ₄	None	H ₂ SO ₄	None	Cooler Temperature	
Date	Time											Alternate Description	
5/1/97		✓		Feedwater		✓						2	
5/1/97		✓		Feedwater			✓					3	
5/1/97		✓		Memcor Filtrate			✓						
5/1/97		✓		Memcor Filtrate			✓						
5/1/97		✓		Zenosed Permeate				✓					
5/1/97		✓		Zenosed Permeate					✓				
Relinquished By R		Empty Bottles 9		Date/Time 5/1/97	Received By Enrique Perez		Empty Bottles 9		Date/Time 5/1/97 @				
Sampled By and Title Enrique Perez		(Please sign and print name)		Date/Time 5/1/97 9:45	Relinquished By Enrique Perez		(Please sign and print name)		Date/Time 5/1/97 10:00				
Received By Ramon Treviño		(Please sign and print name)		Date/Time 5/1/97 @	Relinquished By Ramon Treviño		(Please sign and print name)		Date/Time 5/1/97 @ 11:15 am				
Received By Ven. M. H. H. H.		(Please sign and print name)		Date/Time 5/1/97	Shipped Via UPS <input checked="" type="checkbox"/> Fed-Ex <input type="checkbox"/> Other _____		Shipping #						
Special Instr: 0930													

APP-216

MONTHLY BILLING SUMMARY



Applied Sciences Laboratory
 Cowallis, Oregon
 2300 NW Walnut Blvd. Corvallis, OR 97330-3538
 P.O. Box 428, Corvallis, OR 97339-0428
 541 752-4271
 Fax 541 752-0276

City of McAllen
 Project Manager: Jim Geisbush/PHX

Invoice Date 05/05/97
 Invoice No. A97-0791

Page 1 of 1

Customer Number 138067.A0.ZZ	CH2M Hill Rep. Ginger Collins	Billing Period 5/14/97	Reference No. 5244	
Qty	Description	Trans. Date	Unit Cost	Subtotal
3	Color (ALPHA) Apparent	5/2/97	\$20.001	\$60.00
3	Total Organic Carbon	5/2/97	\$40.00	\$120.00

(THIS IS NOT A BILL - DO NOT SUBMIT PAYMENT) TOTAL AMOUNT: 3160.00

Our records indicate that Me above tests were requested during the current billing period. Please notify the laboratory listed above if there are any discrepancies.

- PROJECT COPY -



CH2MHILL

CH2M HILL
2300 NW Walnut Blvd
Corvallis, OR
97330-3538
Mailing address:
P.O. Box 428
Corvallis, OR
97339-0428
Tel 541.752.4271
Fax 541.752.0276

05/13/97

City of McAllen

Subject Acknowledgment of sample set 5309.

Dear Jim Geisbush/PHX:

This letter is **to** acknowledge the receipt of **your sample** set on **5/13/97**. It has been assigned laboratory **number** 5309. Please refer to **the** laboratory **number** if you **need** to **inquire about this sample set**. **I have attached a copy of the chain of custody form** to provide additional **information**.

There were no problem noted with the **receipt** of **your** samples.

If you need **assistance**, please feel **free** to call **541/758-0235** extension 3 117.

Sincerely,
CH2M HILL

Jerri Matlack

Attachment



CH2MHILL

CH2M HILL
2300 NW Walnut Blvd
Corvallis, OR
97330-3538
Mailing address:
P.O. Box 428
Corvallis, OR
97339-0428
Tel 541.752.4271
Fax 541.752.0275

05/12/97

City of McAllen

Subject Acknowledgment of sample set 5293.

Dear Jim Geisbush/PHX:

This letter is to acknowledge the receipt of your sample set on 5/9/97. It has been assigned laboratory number 5293. Please refer to the laboratory number if you need inquire about this sample set. I have attached a copy of the chain of custody form to provide additional information.

There were no problems noted with the receipt of your samples.

If you need assistance, please feel free to call 541/758-0235 extension 3117.

Sincerely,
CH2M HILL

Jerri Mattick

Attachment

CH2MHILL Analytical Services
CHAIN OF CUSTODY RECORD
AND AGREEMENT TO PERFORM SERVICES

LMG 2567 Fairlane Drive
 Montgomery, AL 36118-1822
 (334) 271-1444 FAX (334) 271-3428

LRD 5000 Caterpillar Road
 Redding, CA 96003-1412
 (816) 244-6227 FAX (816) 244-4109

LKW Canviro Analytical Laboratories, Inc.
 50 Balhurst, Unit 12, Waterloo, Ontario, Canada N2V 2C5
 (519) 747-2575 FAX (519) 747-3806

CVO 2300 NW Walnut Boulevard
 Corvallis, OR 97330-3838
 (541) 752-4271 FAX (541) 752-0276

COC # _____

Project # 138067-H-2		Purchase Order #		Requested Analytical Method #				THIS AREA FOR LAB USE ONLY								
Project Name McAllen Pilot Study				TOTAL # OF CONTAINERS	TOC		C/Plac- -appt		TOC		Color-appt		Lab # 5293182	Page 1	of 1	
Company Name McAllen Public Utilities					TOC		Color-appt						Custody Review			
Project Manager or Contact & Phone # Joe Ibarra Jr.					TOC		Color-appt						LIMS Verification			
Report Copy to: Jim Geisbush (Phoenix)					Color-appt		TOC						Custody Seals Y N			
Requested Completion Date: ASAP					Preservative		H ₂ SO ₄		None		H ₂ SO ₄		None		Ice Y N	
Site ID WWT#2		Sample Disposal: <input checked="" type="checkbox"/> Dispose <input type="checkbox"/> Return						QC Level 1 2 3 Other				Cooler Temperature				
Sampling		Type	Matrix	CLIENT SAMPLE ID (9 CHARACTERS)				LAB QC				Alternate Description			Lab ID	
Date	Time	COM P	GRA B	WATER	SOIL	AIR										
5/8/97	9:05	✓	✓	✓			MEMCOR FILTERITE								1	
5/8/97	9:05	✓	✓	✓			MEMCOR Filtrate								1	
5/8/97	9:05	✓	✓	✓			Zee-weed Permeate								2	
5/8/97	9:05	✓	✓	✓			Zee-weed Permeate								1	
Relinquished By Rosie Villanueva		Empty Bottles 6		Date/Time 5/8/97 8:45		Received By Enrique Perez		Empty Bottles 6		Date/Time 5/8/97 8:45am						
Sampled By and Title Enrique Perez		(Please sign and print name)		Date/Time 5/8/97 9:05		Relinquished By Enrique Perez		(Please sign and print name)		Date/Time 5/8/97 9:05 AM						
Received By Rosie Villanueva		(Please sign and print name)		Date/Time 5/8/97 9:05		Relinquished By Rosie Villanueva		(Please sign and print name)		Date/Time 5/8/97 10:00am						
Received By Venji Mattick		(Please sign and print name)		Date/Time 5/8/97 10:05		Shipped Via UPS		Shipping #								
Special Instructions:														Contract: Enrique		

Special Feedwater Analysis
for
Mentec Cleaning Solution
Optimization

May 7, 1997

City of McAllen

138067.A0.ZZ

RE: Analytical Data for City of McAllen
CVO Laboratory Reference No. 5261
Jim Geisbush/PHX

On May 6, 1997, the CH2M HILL Corvallis Applied Sciences Laboratory received one sample with a request for analysis of selected parameters.

The analytical results and associated quality control data are enclosed. Any unusual difficulties encountered during the analysis of your samples are discussed in the case narrative.

Under CH2M HILL policy, your samples will be stored for 30 days after reporting. If you have not given us prior instructions for disposal, we will contact you if any samples require disposal as hazardous waste.

The CH2M HILL Applied Sciences Laboratory appreciates your business and looks forward to serving your analytical needs again. If you should have any questions concerning the data, or if you need additional information, please call Ms. Kathy McKinley at (541) 758-0235, extension 3120.

sincerely,

Kelly Ensor
Senior Administrative Assistant

Enclosures

Applied Sciences Laboratory
Corvallis Office

2300 NW Walnut Blvd., Corvallis, OR 97330-3538
P. O. Box 428, Corvallis, OR 97339-0428

541 752-4271
Fax No. 541 752-0276

CLIENT SAMPLE CROSS-REFERENCE

CH2M HILL Applied Science Laboratory Reference No. 5261

CVO Sample ID	Client Sample ID	Date Collected	Time Collected
526101	FEEDWATER	05/05/1997	8:20

**CASE NARRATIVE
GENERAL CHEMISTRY**

Lab Reference No.: 5261

Client/Project: City of McAllen

- I. Holding Time:
Holding time for pH was exceeded when sample was received in the lab.

- II. Digestion Exceptions:
None

- III. Analysis:
 - A. Calibration:
All acceptance criteria were met

 - B. Blanks:
All acceptance criteria were met.

 - C. Matrix Spike Sample(s):
Not applicable for Alkalinity. Reagent were not available for spiking Silica.

 - D. Duplicate Sample(s):
All acceptance criteria were met.

 - E. Lab Control Sample(s):
All acceptance criteria were met.

 - F. Other:
Not applicable.

- IV. Documentation Exceptions:
None.

- V. I certify that this data package is in compliance with the terms and conditions agreed to by the client and CH2M HILL, both technically and for completeness, except for the conditions detailed above. Release of the data contained in this hardcopy data package has been authorized by the Laboratory Manager or his designee, as verified by the following signature.

Prepared by: _____

Reviewed by: _____

CASE NARRATIVE
METALS

Lab Reference No.: 5261

Client/Project: City of McAllen

- I. Holding Time:
Au acceptance criteria were met
- II. Digestion Exceptions:
None
- III. Analysis:
- A. Calibration:
All acceptance criteria were met
- B. Blanks:
All acceptance criteria were met.
- C. ICP Interference Check Sample:
Au acceptance criteria were met.
- D. Spike Sample(s):
All acceptance criteria were met.
- E. Duplicate Sample(s):
Duplicate criteria (+/- 20 RPD) were not met for Iron (92.9 RPD). As reported, tile sample contained 37.3 µg/L Fe, while the sample duplicate contained 102 µg/L Fe..
- F. Laboratory Control Sample(s):
All acceptance criteria were met.
- G. ICP Serial Dilution:
Not Required.
- H. Other:
None
- IV. Documentation Exceptions:
None
- V. I certify that this data package is in compliance with the terms and conditions agreed to by the client and CH2M HILL, both technically and for completeness, except for the conditions detailed above. Release of the data contained in this hardcopy data package has been authorized by the Laboratory Manager or his designee, as verified by the following signature.

Prepared by: _____

Reviewed by: _____



CH2M HILL
2300 NW Walnut Blvd.
Corvallis, OR
97330-3538
Mailing address:
P.O. Box 428
Corvallis, OR
97339-0428
Tel 541.752.4271
Fax 541.752.0276

May 7, 1997

City of McAllen

138067.A0.ZZ

RE: Analytical Data for City of McAllen
CVO Laboratory Reference No. 5261
Jii Geisbush/PHX

On May 6, 1997, the **CH2M HILL Corvallis** Applied Sciences Laboratory **received** one **sample** with a **request** for analysis of selected **parameters**.

The analytical **results** and associated quality control data **are** enclosed. Any unusual **difficulties** encountered **during** the analysis of **your** samples **are discussed** in the case **narrative**.

Under **CH2M HILL** policy, your samples will **be** stored for 30 days after **reporting**. If you have not given **us** prior **instructions** for disposal we will contact you if any samples require disposal as hazardous waste.

The **CH2M HILL** Applied Sciences Laboratory appreciates your business and looks forward to serving **your** analytical needs again. If you should have any **questions** concerning **the** data, or if you need additional information, please **call** Ms. Kathy **McKinley** at (541) **758-0235**, extension 3120.

Sincerely,

Kelly Ensor
Senior **Administrative Assistant**

Enclosures

Applied Sciences Laboratory 2300 NW Walnut Blvd., Corvallis, OR 97330-3538
Corvallis Office P. O. Box 428, Corvallis, OR 97339-0428

541 752-4271
Fax No. 541 752-0276

CLIENT SAMPLE CROSS-REFERENCE

CH2M HILL Applied Science Laboratory Reference No. 5261

CVO Sample ID	Client Sample ID	Date Collected	Time Collected
526101	FEEDWATER	05/05/1997	8:20

CASE NARRATIVE
GENERAL CHEMISTRY

Lab Reference No.: 5261

Client/Project: City of McAllen

- I. Holding Time:
Holding time for pH was exceeded when sample was received in the Lab.
- II. Digestion Exceptions:
None
- III. Analysis:
- A. Calibration:
All acceptance criteria were met.
- B. Blanks:
All acceptance criteria were met.
- C. Matrix Spike Sample(s):
Not applicable for Alkalinity. Reagents were not available for spiking Silica.
- D. Duplicate Sample(s):
All acceptance criteria were met.
- E. Lab Control Sample(s):
All acceptance criteria were met.
- F. Other:
Not applicable.
- IV. Documentation Exceptions:
None.
- V. I certify that this data package is in compliance with the terms and conditions agreed to by the client and CH2M HILL, both technically and for completeness, except for the conditions detailed above. Release of the data contained in this hardcopy data package has been authorized by the Laboratory Manager or his designee, as verified by the following signature.

Prepared by: Selen Van Nieu

Reviewed by: Laura Stone

CASE NARRATIVE
METALS

Lab Reference No.: 5261

Client/Project: City of McAllen

- I. Holding time:
All acceptance criteria were met.
- II. Digestion Exceptions:
None
- III. Analysis:
- A. Calibration:
All acceptance criteria were met.
- B. Blanks:
An acceptance criteria were met.
- C. ICP Interference Check Sample:
An acceptance criteria were met.
- D. Spike Sample(s):
All acceptance criteria were met.
- E. Duplicate Sample(s):
Duplicate criteria (+/- 20 RPD) were not met for Iron (929 RPD). As reported, the sample contained 37.3 µg/L Fe, while the sample duplicate contained 102 µg/L Fe.
- F. Laboratory Control Sample(s):
All acceptance criteria were met.
- G. ICP Serial Dilution:
Not Required
- H. Other:
None
- N. Documentation Exceptions:
None
- V. I certify that this data package is in compliance with the terms and conditions agreed to by the client and CH2M HILL, both technically and for completeness, except for the conditions detailed above. Release of the data contained in this hardcopy data package has been authorized by the Laboratory Manager or his designee, as verified by the following signature.

Prepared by: Kim Jackson

Reviewed by: Laura Stone

Corvallis Applied Sciences Laboratory

Client Information

Project Name: McAllen Pilot Study
 Project Manager: Jim Lozier/PHX
 Sampled By: R. Villareal
 Client Sample ID: Feedwater
 Sampling Date: 5/5/97
 Sampling time: 8:20
 Type: Grab
 Matrix: water
 Basis: As Received

Lab Information

Date Rec'd: 5/6/97
 Lab ID: 526101
 Report Revision No.: 0
 Reported By: G. Collins
 Reviewed By: *U. Stone*

Analyte	Reporting Limit	Sample Result	Qualifier	Units	Method	Date Analyzed
Chemistry						
Alkalinity	0.5	130		mg/L	EPA 310.1	5/6/97
pH		7.1		mg/L	SM 2340.B	5/6/97
Reactive Silica	0.4	20.0		mg/L	SM4500Si-D	5/6/97
Metals						
Aluminum, ICP	42.1	42.1	U	µg/L	EPA 200.7	5/6/97
Calcium, ICP	49.1	111.000		µg/L	EPA 200.7	5/6/97
Iron, ICP	17.6	37.3		µg/L	EPA 200.7	5/6/97

U=Not detected at specified reporting limits

CH2MHILL Analytical Services
CHAIN OF CUSTODY RECORD
AND AGREEMENT TO PERFORM SERVICES

LMG 2587 Fairlane Drive
 Montgomery, AL 36116-1822
 (334) 271-1444 FAX (334) 271-3428

LRD 6090 Caterpillar Road
 Redding, CA 96003-1412
 (816) 244-6227 FAX (816) 244-4109

LKW Camko Analytical Laboratories, Inc.
 80 Bathurst, Unit 12, Waterloo, Ontario, Canada N2V 2C6
 (518) 747-2676 FAX (518) 747-3806

FVO 2300 NW Walnut Boulevard
 Corvallis, OR 97330-3638
 (541) 752-4271 FAX (541) 752-0276

COC #

Project # 1380614E:22		Purchase Order #		Requested Analytical Method #				THIS AREA FOR LAB USE ONLY							
Project Name McAllen Pilot Study				TOTAL # OF CONTAINERS	General Chemical Analytes METALS				Lab # 5361-1	Page 1	of 1				
Company Name McAllen Public Utilities									Lab PM			Custody Review			
Project Manager or Contact & Phone # Joe Zurra, Jr.		Report Copy to: Jim Geisbush (Annex)							Log In			LIMS Verification			
Requested Completion Date: ASAP		Site ID WWTP # 2							Sample Disposal: Dispose <input checked="" type="checkbox"/> Return <input type="checkbox"/>			pH		Custody Seals Y N Ice Y N	
Sampling		Type COM P	Matrix GRA B WATER SOIL AIR						CLIENT SAMPLE ID (8 CHARACTERS)				LAB QC		
Date	Time												QC Level 1 2 3 Other		
5/5/97	8:20a	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>						F E E D W A T E R				Cooler Temperature		
5/5/97	8:20am	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>						F E E D W A T E R				Alternate Description		
													Lab ID		
													@ do same as can be done w/ a sampling VIKI		
Relinquished By Rose Villanaral		Empty Bottles 2		Date/Time 5/5/97 8:23		Received By Susana Perez		Empty Bottles 2		Date/Time 5/5/97 @ 8:13am					
Sampled By and Title Susana Perez		(Please sign and print name)		Date/Time 5/5/97 8:23		Relinquished By Susana Perez		(Please sign and print name)		Date/Time 5/5/97 @ 8:23 AM					
Received By Rose Villanaral		(Please sign and print name)		Date/Time 5/5/97 8:23		Relinquished By Rose Villanaral		(Please sign and print name)		Date/Time 5/5/97 @ 4:30am					
Received By Jim Geisbush		(Please sign and print name)		Date/Time 5/6/97		Shipped Via UPS <input checked="" type="checkbox"/> Fed-Ex <input type="checkbox"/> Other _____		Shipping #							
Special Instructions: ICR															

contact: Helen

APP-231

MONTHLY BILLING SUMMARY



CH2MHILL

Applied Sciences Laboratory

Corvallis, Oregon

2300 NW Walnut Blvd, Corvallis, OR 97330-3538

P.O. Box 428, Corvallis, OR 97339-0428

541 752-4271

Fax 541 752-0276

City of McAllen

Project Manager: Jim Geisbush/PHX

Page 1 of 1

<i>Customer Number</i> 138067.A0.ZZ		CH2M Hill Rep. Helen VanNice	Billing Period 5/14/97	Reference No. 6261
-----------------------------------------------	--	-----------------------------------------------	----------------------------------	-----------------------

Qty	Description	Trans. Date	Unit Cost	Subtotal
1	Aluminum by ICP.	5/6/97	\$10.00	\$10.00
1	Alkalinity	5/6/97	\$20.00	\$20.00
1	Calcium by ICP.	5/6/97	\$10.00	\$10.00
1	Iron by ICP.	5/6/97	\$10.00	\$10.00
1	Silica-Reactive	5/6/97	\$25.00	\$25.00
1	pH	5/6/97	\$10.00	\$10.00

(THIS IS NOT A BILL-DO NOT SUBMIT PAYMENT) TOTAL AMOUNT: **\$85.00**

Our records indicate that the **above tests** were requested during the current billing **period**. Please **notify** the **laboratory listed** above if there are any **discrepancies**.

-- PROJECT COPY --



CH2MHILL

CH2M HILL
2300 NW Walnut Blvd.
Corvallis, OR
97330-3538
Mailing address:
P.O. Box 428
Corvallis, OR
97339-0428
Tel 541.752.4271
Fax 541.752.0276

5/7/97

City of McAllen

Subject: Acknowledgment of sample set 5261.

Dear Jim Geisbush/PHX:

This **letter** is m **acknowledge the** receipt of your sample **set** on **5/6/97**. It has been assigned laboramry number 5261. Please refer m **the** laboramry number if you **need** m inquire about this sample **set**. I have attached a copy of **the** chain of custody form m provide additional **information**.

There were no problems noted with the **receipt** of your samples.

If you **need assistance**, please **feel** free m **call 541/758-0235 extension 3 117**.

Sincerely,
CH2M HILL

Jerri Mattick

Attachment



CH2MHILL

CH2M HILL
2300 NW Walnut Blvd.
Corvallis, OR
97330-3538
Mailing address:
P.O. Box 428
Corvallis, OR
97339-0428
Tel 541.752.4271
Fax 541.752.0276

05/05/97

City of McAllen

Subject Acknowledgment of sample set 5244.

Dear Jim Geisbush/PHX:

This letter is to acknowledge the receipt of your sample set on 5/2/97. It has been assigned laboratory number 5244. Please refer in the laboratory number if you need to inquire about this sample set. I have attached a copy of the chain of custody form to provide additional information.

There were no problems noted with the receipt of your samples.

If you need assistance, please feel free to call 541/758-0235 extension 3117.

Sincerely,
CH2M HILL

Jerri Mattick

Attachment

CH2MHILL Analytical Services
CHAIN OF CUSTODY RECORD
AND AGREEMENT TO PERFORM SERVICES

LMB 2887 Fairlane Drive
 Montgomery, AL 36118-1622
 (334) 271-1444 FAX (334) 271-3428

LRD 5060 Caterpillar Road
 Redding, CA 96003-1412
 (916) 244-5227 FAX (916) 244-4109

LKW Carviro Analytical Laboratories, Inc.
 50 Bathurst, Unit 12, Waterloo, Ontario, Canada N2V 2C5
 (519) 747-2575 FAX (519) 747-3806

CV0 2300 NW Walnut Boulevard
 Corvallis, OR 97330-3638
 (541) 752-4271 FAX (541) 752-0276

COC # _____

Project # 138067.HD.22		Purchase Order #		Requested Analytical Method # 1						THIS AREA FOR LAB USE ONLY			
Project Name McAllen Pilot Study		Company Name McAllen Public Utilities		TOTAL # OF CONTAINERS TOC COLOR TOC COLOR TOC COLOR H ₂ SO ₄ None H ₂ SO ₄ None H ₂ SO ₄ None						Lab # 5244-172	Page 1	of 1	
Project Manager or Contact & Phone # Jose Ibarra Jr		Report Copy to: Jim Gelstush (Phoenix)								Lab PM	Custody Review		Log In
Requested Completion Date: A.S.A.P.		Site ID WWTP # 2		Sample Disposit: Dispose <input checked="" type="checkbox"/> Return <input type="checkbox"/>		pH		Custody Seals Y N Ice Y N					
Sampling		Type PROG GRAB	Matrix WATER SOIL AIR	CLIENT SAMPLE ID (9 CHARACTERS)		LAB QC		QC Level 1 2 3 Other					
Date	Time							Cooler Temperature					
5/1/97		✓	✓	Feedwater		2	✓	Alternate Description		Lab ID			
5/1/97		✓	✓	Feedwater		1							
5/1/97		✓	✓	Memcor Filtrate		2							
5/1/97		✓	✓	Memcor Filtrate		1							
5/1/97		✓	✓	Zenosed Permeate		2							
5/1/97		✓	✓	Zenosed Permeate		1							
Relinquished By R		Empty Bottles 9		Date/Time 5/1/97	Received By Enrique Perez		Empty Bottles 9		Date/Time 5/1/97 @				
Sampled By and Title Enrique Perez		Date/Time 5/1/97 9:45		Relinquished By Enrique Perez		Date/Time 5/1/97 10:00							
Received By Ramon Trevino		Date/Time 5/1/97 10:00		Relinquished By Ramon Trevino		Date/Time 5/1/97 10:15 am							
Received By Jan McHale		Date/Time 5/1/97		Shipped Via UPS <input checked="" type="checkbox"/> Fed-Ex <input type="checkbox"/> Other _____		Shipping #							
Special Instructions: 043													

APP-236



CH2MHILL

CH2M HILL
2300 NW Walnut Blvd.
Corvallis, OR
97330-3538
Mailing address:
P.O. Box 428
Corvallis, OR
97339-0428
Tel 541.752.4271
Fax 541.752.0276

April 30, 1997

City of McAllen

138067.A0.ZZ

RE: Analytical Data for **City of McAllen**
CVO **Laboratory** Reference No. 5213

Jii **Geisbush/PHX**

On April 25, 1997, the **CH2M HILL Corvallis Applied Sciences** Laboratory received two samples **with** a request for analysis of **selected parameters**.

The analytical results and **associated quality control data** are enclosed. Any **unusual difficulties** encountered **during the** analysis of your samples are discussed in the case **narrative**.

under **CH2M HILL** policy, **your** samples **will** be stored for 30 days after **reporting**. If you have **not** given **us** prior **instructions** for disposal, we will **contact** you if my samples require disposal as **hazardous** waste.

The **CH2M HILL Applied Sciences Laboratory** **appreciates your** business and looks forward to serving **your analytical needs** again. If you should have any questions **concerning** the **data**, or if you need additional **information**, please call Ms. **Kathy McKinley** at (541) 752-0235, **extension** 3120.

Sincerely,

Kelly **Ensor**
Senior **Administrative** Assistant

Enclosures

Applied Sciences Laboratory, . . . 2300 NW Walnut Blvd., Corvallis, OR 97330-3538
Corvallis Office P. O. Box 428, Corvallis, OR 97339-0428

541 752-4271
Fax No. 541 752-0276

CLIENT SAMPLE CROSS-REFERENCE

CH2M HILL Applied Science Laboratory Reference No. 5213

CVO Sample ID	Client Sample ID	Date Collected	Time Collected
521301	Memcor Filtrate	04/24/1997	
521302	Zeeweed Permeate	04/24/1997	

CASE NARRATIVE
GENERAL CHEMISTRY

Lab Reference No.: 5213

Client/Project: City of McAllen

- I. Holding Time:
All acceptance criteria were met.
- II. Digestion Exceptions:
None
- m. Analysis:
- A. Calibration:
All acceptance criteria were met.
- B. Blanks:
All acceptance criteria were met.
- C. Matrix Spike Sample(s):
All acceptance criteria were met.
- D. Duplicate Sample(s):
All acceptance criteria were met.
- E. Lab Control Sample(s):
All acceptance criteria were met.
- E. Other:
Not applicable.
- IV. Documentation Exceptions:
None.

V. I certify that this data package is in compliance with the terms and conditions agreed to by the client and CH2M HILL, both technically and for completeness, except for the conditions detailed above. Release of the data contained in this hardcopy data package has been authorized by the Laboratory Manager or his designee, as verified by the following signature.

Prepared by: *Dwight Collins* DATE: 4-29-97

Reviewed by: *Helene van Nieu* DATE: 4/29/97

Corvallis Applied Sciences Laboratory

Client Information

Project Name: City of McAllen
 Project Manager: Joel Barra Jr.
 Sampled By: E. Perez
 Sampling Date: 4/24/97
 Sampling time: Nat provided
 Type: Grab
 Matrix: Water
 Basis: As received

Lab Information

Laboratory ID: ICRO001
 Date Rec'd: 4/25/97
 Analytical Method: SM5310.D
 Date Analyzed: 4/28/97
 Report Revision No.: 0
 Reported By: G. Collins
 Reviewed By: *[Signature]*
 Units: mg/L

Client Sample ID	Lab Sample ID	pH	Reporting Limit	Replicate 1	TOC Water Replicate 2	Average	Percent RPD
Memcor Filtrate	521301	<2	0.50	7.6	7.6	7.6	0.0
Zeeweed Permeate	521302	<2	0.50	7.4	7.4	7.4	0.0

U=Not detected at specified detection limits

Applied Sciences Laboratory
 Corvallis Office

2300 NW Walnut Blvd., Corvallis, OR 97330-3538
 P.O. Box 428, Corvallis, OR 97339-0428

(541) 752-4271
 Fax No. (541) 752-0276

Corvallis Applied Sciences Laboratory

Client Information

Project Name: City of McAllen
 Project Manager: Joe Ibarra Jr.
 sampled By: E. Perez
 Sampling Date: 4/24/97
 Sampling Time: Not provided
 Type: Grab
 Matrix: water
 Basis: As received

Lab Information

Laboratory ID: ICROF001
 Date R&d: 4/25/97
 Analytical Method: EPA 1'10.2
 Date Analyzed: 4/25/97
 Report Revision No.: 0
 Reported By: H. Van Nice
 Reviewed By: *gmc*

Client Sample ID	Lab Sample ID	Reporting Limit	Color (ALPHA) Apparent Result	Units
Memcor Filtrate	521301		5	Color Units
Zaeweed Permeate	521302		7	Color Unik

U=Not detected at specified detection limits

CRMH

APPLIED SCIENCES LABORATORY

CHAIN OF CUSTODY RECORD AND AGREEMENT TO PERFORM SERVICES

CH2M Hill Project #		Purchase Order #		LAB TEST CODER										SHADED AREA - FOR LAB USE ONLY			
Project Name McAllen Pilot Study		Company Name/CH2M HILL Office McAllen Public Utilities		ANALYSES REQUESTED TOC (H ₂ SO ₄) Color - ppt TOC (H ₂ SO ₄) Color - ppt										Lab 1 # 5-213-12		Lab 2 #	
Project Manager & Phone # Mr. Jose Ibarra, Jr.		Report Copy to: Jim Gersbush												Requested Completion Date: A.S.A.P.		Sampling Requirements SDWA NPDES RCRA OTHER	
Type		Matrix		CLIENT SAMPLE ID (9 CHARACTERS)										Project #			
COM P		GRA B															
Date		Time															
4/24/97																	
4/24/97				Memcor Altrate										2			
4/24/97																	
4/24/97				ME M C O R Filtrate										1			
4/24/97																	
4/24/97				2 per used Permeate										2			
4/24/97																	
4/24/97				Zee weed Permeate										1			
4/24/97																	
Sampled By & Title Susan Perry Enrique Perez		Date/Time 4-24-97 9:00		Relinquished By Susan Perry Enrique Perez		Date/Time 4-24-97 11:00		COO Pkt		ICE		Temp					
Received By Rosie Villanad		Date/Time 4/24/97 9:10		Relinquished By Rosie Villanad		Date/Time 4/24/97 11:00		Add Res		PH							
Received By Jean M. Hestrick		Date/Time 4-25-97 13:00		Relinquished By		Date/Time											
Received By		Date/Time		Shipped Via UPS BUS FedEx Hand Other		Shipping #											
Work Authorized By		Remarks		Contact: Ginge													

APP-242

Instructions and Agreement Provisions on Reverse Side

DISTRIBUTION: Original - LAB, Yellow - L., Pink - Client
REV 3/97 ENRM 340

MONTHLY BILLING SUMMARY



CH2MHILL Applied Sciences Laboratory
 Corvallis, Oregon
 2300 NW Walnut Blvd, Corvallis, OR 97330-3538
 P.O. Box 428, Corvallis, OR 97339-0428
 541 752-4271
 Fax 541 752-0276

city of McAllen

Project Manager: Jim Geisbush/PHX

Invoice Date 04/25/97
 invoice No. A97-0764

Page 1 of 1

Customer Number 138067.A0.ZZ		CH2M Hill Rep. Helen VanNice	Billing Period 5/14/97	Reference No. 5213
Qty	Description	Trans. Date	Unit Cost	Subtotal
2	Color (ALPHA) Apparent	4/25/97	320.00	\$40.00
2	Total Organic Cart-on	4/25/97	940.00	\$80.00

(THIS IS NOT A BILL -DO NOT SUBMIT PAYMENT) TOTAL AMOUNT: \$120.00

Our records indicate that the above tests were requested during the current billing period. Please notify the laboratory listed above if there are any discrepancies.

- PROJECT COPY -

MONTHLY BILLING SUMMARY



Applied Sciences Laboratory

Corvallis, Oregon
2300 NW Walnut Blvd, Corvallis, OR 97330-3538
P.O. Box 428, Corvallis, OR 97339-0428
541 752-4271
Fax 541 752-0276

City of McAllen
Project Manager: Jim Geisbush/PHX

Invoice Date 04/21/97
Invoice No. A97-0710

Page 1 of 1

Customer Number 138067.A0.ZZ		CH2M Hill Rep. Ginger Collins	Billing Period 5/14/97	Reference No. 5182
---------------------------------	--	----------------------------------	---------------------------	-----------------------

Qty	Description	Trans. Date	Unit Cost	Subtotal
3	Color (ALPHA) Apparent	4/18/97	\$20.00	\$60.00
3	Total Organic Carbon	4/18/97	\$40.00	\$120.00

(THIS IS NOT A BILL - DO NOT SUBMIT PAYMENT) TOTAL AMOUNT: \$180.00

Our records indicate that the above tests were requested during the current billing period. Please notify the laboratory listed above if there are any discrepancies.

-- PROJECT COPY --



CH2MHILL

CH2M HILL
2300 NW Walnut Blvd.
Corvallis, OR
97330-3538
Mailing address:
P.O. Box 428
Corvallis, OR
97339-0428
Tel 541.752.4271
Fax 541.752.0276

April 30, 1997

City of McAllen

138067.A0.ZZ

RE: **Analytical Data** for City of McAllen
CVO Laboratory Reference No. 5182

Iii **Geisbush/PHX**

On April 18, 1997, the CH2M HILL Corvallis Applied Sciences Laboratory received **three samples** with a request for analysis of **selected parameters**.

The **analytical results** and associated **quality control data** **are** enclosed. Any **unusual difficulties encountered** during the analysis of your samples are discussed in **the case narrative**.

Under CH2M HILL policy; your samples **will** be stored for 30 days after reporting. If you have **not** given us prior **instructions** for disposal, we **will** contact you if any **samples require disposal as hazardous waste**.

The CH2M HILL Applied Sciences Laboratory appreciates your business and looks forward to serving **your analytical needs again**. If you should have any questions **concerning the data**, or if you **need additional** information, **please** call Ms. Kathy **McKinley** at (541) **758-0235**, extension 3120.

Sincerely,

Kelly Ensor
Senior Administrative Assistant

Enclosures

Applied Sciences Laboratory :: 2300 NW Walnut Blvd., Corvallis, OR 97330-3538
Corvallis Office P. O. Box 428, Corvallis, OR 97339-0428

541 752-4271
Fax No. 541 752-0276

CLIENTSAMPLE CROSS-REFERENCE .

CH2M HILL Applied Science Laboratory Reference No. 5182

cvo Sample ID	Client Sample ID	Date Collected	Time Collected
518201	Feed Water	04/17/1997	11:00
518202	Memcor Filtrate	04/17/1997	11:00
518203	Zeeweed Permeate	04/17/1997	11:00

CASE NARRATIVE
GENERAL CHEMISTRY

Lab Reference No.: 5182

Client/Project: City of McAllen

- I. Holding Time:
All acceptance criteria were met.
- II. Digestion Exceptions:
None
- III. Analysis:
 - A. Calibration:
All acceptance criteria were met.
 - B. Blanks:
All acceptance criteria were met.
 - C. Matrix Spike Sample(s):
All acceptance criteria were met.
 - D. Duplicate Sample(s):
All acceptance criteria were met.
 - E. Lab Control Sample(s):
All acceptance criteria were met.
 - F. Other:
Not applicable.
- IV. Documentation Exceptions:
None.
- V. I certify that this data package is in compliance with the terms and conditions agreed to by the client and CH2M HILL, both technically and for completeness, except for the conditions detailed above. Release of the data contained in this hardcopy data package has been authorized by the Laboratory Manager or his designee, as verified by the following signature.

Prepared by: Angela Collins DATE: 4-29-97
Reviewed by: Telen Van Nieu DATE: 4/29/97

Corvallis Applied Sciences Laboratory

Client Information

Project Name: Cii of McAllen
 Project Manager Joe Ibarra Jr.
 Sampled By: R. Villanal
 Sampling Date: 4/17/97
 Sampling time: 11:00
 Type: Grab
 Matrix: water
 Basis: As received

Lab Information

Laboratory ID: ICOR001
 Date Rec'd: 4/18/97
 Analytical Method: SM5310.D
 Date Analyzed: 4/28/97
 Report Revision No.: 0
 Reported By: G. Collins
 Reviewed By: *HW*
 units: mg/L

Client	Sample ID	Lab Sample ID	pH	Reporting Limit	Replicate 1	TOC Water Replicate 2	Average	Percent RPD
Feed water		518201	<2	0.50	8.1	8.3	8.2	2.4
Memcor Filtrate		518202	<2	0.50	7.8	7.8	7.8	0.0
Zeeweed Permeate		518203	<2	0.50	7.7	7.6	7.7	1.3

U=Not detected at specified detection Pmik

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 P.O. Box 428, Corvallis, OR 97339-0428

(541) 752-4271
 Fax No. (541) 752-0276

Corvallis Applied Sciences Laboratory

Client Information

Project Name: City of McAllen
 Project Manager: Joe Ibarra Jr.
 sampled By: R. Villanal
 Sampling Date: 4/17/97
 Sampling Time: 11 :00
 Type: Grab
 Matrix: water
 Basis: As received

L [REDACTED]
 Laboratory ID: ICOR001
 Date Rec'd: 4/18/97
 Analytical Method: EPA 110.3
 Date Analyzed: 4/18/97
 Report Revision No.: 0
 Reported By: H. Van Nice
 Reviewed By: *gme*

Client	Sample ID	Lab Sample ID	Reporting Limit	Color (ALPHA) Apparent Result	Units
Feed water		518201		25	color Unik
Memcor Filtrate		518202		0	Color Units
Zeeweed Permeate		513203		0	Color Unik

U=Not detected at specified detection limits

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LMW Carvivo Analytical Laboratories, Inc.
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 (519) 747-2575 FAX (519) 747-3806

CVO 2300 NW Walnut Boulevard
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COC # _____

Project # 1350 (6/1/97) 22		Purchase Order #		TOTAL # OF CONTAINERS						Requested Analytical Method #						THIS AREA FOR LAB USE ONLY							
Project Name McAllen Pilot Study										Lab # 582173						Page 1 of 1							
Company Name McAllen Public Utilities				Lab PM						Custody Review													
Project Manager or Contact & Phone # Joe Ibarra Jr. Jim Geishush (Phoenix)				Log In						LIMS Verification													
Requested Completion Date: N.S.A.P.		Site ID WWRP H2		Sample Disposal: Disposal <input checked="" type="checkbox"/> Return <input type="checkbox"/>		pH						Custody Seals Y N Ice Y N											
Type		Matrix		Preservative						QC Level 1 2 3 Other													
PEOC		GRAVE		WATER		SOIL		AIR		H2SO4		None		H2SO4		None		Cooler Temperature					
Date		Time		CLIENT SAMPLE ID (9 CHARACTERS)						LAB QC		Alternate Description						Lab ID					
4/17/97		11:00		F.e.k.t water						2		✓						1					
4/17/97		11:00		Food water						1		✓						1					
4/17/97		11:00		Memcor Filtrate						2		✓						2					
4/17/97		11:00		Memcor Filtrate						1		✓						1					
4/17/97		11:00		Zeeweed Permeate						2		✓						2					
4/17/97		11:00		Zeeweed Permeate						1		✓						1					
Relinquished By Roevillanad				Empty Bottles 139				Date/Time 4/17/97				Received By Roevillanad				Empty Bottles 9				Date/Time 4/17/97 10:30 AM			
Sampled By and Title Roevillanad				(Please sign and print name)				Date/Time 4/17/97				Relinquished By Roevillanad				(Please sign and print name)				Date/Time 4-12-97 11:15 AM			
Received By Roevillanad				(Please sign and print name)				Date/Time 4/17/97 11:00				Relinquished By Roevillanad				(Please sign and print name)				Date/Time 4/17/97 11:00			
Received By Van, A...				(Please sign and print name)				Date/Time 4-15-97 10:21				Shipped Via UPS				Shipping #				Other			
Special Instructions:																Contact: Gil							

APP-250



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97339-0428
Tel 541.752.4271
Fax 541.752.0276

04/21/97

APR 24 1997

City of McAllen

Subject: Acknowledgment of sample set 5182

Dear Jim Geisbush/PHX:

This **letter** is to acknowledge the receipt of your sample set on **4/18/97**. It has been **assigned** laboratory number 5182. Please **refer to** the laboratory **number if** you need to inquire **about** this sample **set**. I have attached a copy of the chain of custody **form** to provide additional **information**.

There **were** no problems noted **with** the receipt of **your** samples.

If you need **assistance**, please, feel **free** to call **541/758-0235** extension 3 117.

Sincerely,
CH2M HILL

Jerri Mattick

Attachment

April 30, 1997

City of **McAllen**

138067.A0.ZZ

RE: Analytical Data for City of **McAllen**
CVO **Laboratory** Reference No. 5182

Jim **Geisbush/PHX**

On April 18, 1997, the **CH2M HILL Corvallis Applied Sciences Laboratory** received three samples with a request for analysis of selected **parameters**.

The analytical results and associated quality **control** data are enclosed. Any unusual **difficulties** encountered during the analysis of your **samples are** discussed in the case narrative.

Under **CH2M HILL** policy, your samples will be stored for 30 days after reporting. If you have not given us prior instructions for disposal, we will contact you if any samples **require** disposal as hazardous waste.

The **CH2M HILL Applied Sciences Laboratory** appreciates your business and looks forward to serving your **analytical** needs again. If you should have **any** questions concerning the data, or if you need additional information, please **call** Ms. Kathy McKinley at (541) 7584235, extension 3 120.

Sincerely,



Kelly Ensor
Senior Administrative Assistant

Enclosures

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Corvallis Office

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P. O. Box 428, Corvallis, OR 97339-0428

541 752-4271
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CLIENT SAMPLE CROSS-REFERENCE

CH2M HILL Applied Science Laboratory Reference No. 5182

cvo Sample ID	Client Sample ID	Date collected	Time Collected
5182.01	Feed Water	04/17/1997	11:00
518202	Memcor Filtrate	04/17/1997	11:00
5 18203	Zeeweed Permeate	04/17/1997	11:00

**CASE NARRATIVE
GENERAL CHEMISTRY**

Lab Reference No.: 5182

Client/Project: City of McAllen

- I. Holding Time:
All acceptance criteria were met.
- II. Digestion Exceptions:
None
- III. Analysis:
- A. Calibration:
All acceptance criteria were met.
 - B. Blanks:
All acceptance criteria were met.
 - c. Matrix Spike Sample(s):
An acceptance criteria were met.
 - D. Duplicate Sample(s):
All acceptance criteria were met.
 - E. Lab Control Sample(s):
All acceptance criteria were met.
 - F. Other:
Not applicable.
- IV. Documentation Exceptions:
None.
- V. I certify that this data package is in compliance with the terms and conditions agreed to by the client and CH2M HILL, both technically and for completeness, except for the conditions detailed above. Release of the data contained in this hardcopy data package has been authorized by the Laboratory Manager or his designee, as verified by the following signature.

Prepared by: _____ DATE: _____

Reviewed by: _____ DATE: _____

Corvallis Applied Sciences Laboratory

Client Information

Project Name: City of McAllen
 Project Manager: Joe Ibarra Jr.
 Sampled By: R. Villanal
 sampling Date: 4/17/97
 Sampling Time: 11:00
 Type: Grab
 Matrix: Water
 Basis: As received

Lab Information

Laboratory ID: ICROR001
 Date Rec'd: 4/18/97
 Analytical Method: EPA 1'10.2
 Date Analyzed: 4/18/97
 Report Revision No.: 0
 Reported By: H. Van Nice
 Reviewed By

Client	Sample ID	Lab Sample ID	Reporting limit	color (ALPHA) Apparent Result	Units
Feed water		518201		2.5	Color Units
Memcor Filtrate		518202		0	Color Units
Zeeweed Permeate		518203		0	Color Units

U=Not detected at specified detection limits

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Fax 541.752.0276

4/28/97

City of McAllen

Subject: Acknowledgment of sample set 5213.

Dear Jii Geisbush/PHX:

This letter is to acknowledge the receipt of your sample set on 4/25/97. It has been assigned laboratory number 5213. Please refer to the laboratory number if you need to inquire about this sample set. I have attached a copy of the chain of custody form to provide additional information.

There were no problems noted with the receipt of your samples.

If you need assistance, please feel free to call 541/758-0235 extension 3117.

Sincerely,
CH2M HILL

Jerri Mattick

Attachment

CH2M Hill Project #		Purchase Order #		LAB TEST CODES				SHADED AREA - FOR LAB USE ONLY	
Project Name		Report Copy to:		ANALYSES REQUESTED				Lab 1 #	Lab 2 #
Company Name/CH2M Hill Office		Sample Disposal:						Quote #	Kit Request #
Project Manager & Phone #		Requested Completion Date:		# OF CONTAINERS				Project	
Mr. Jose Ibarra, Jr.		A.S.I.A.P.							
Sampling Requirements		Sampling Requirements		TOC (H ₂ SO ₄) Color - appt F.O.C (H ₂ SO ₄) Color - appt					
SDWA NPDES RCRA OTHER		Dispose Return							
Type Matrix		CLIENT SAMPLE ID (9 CHARACTERS)							
COM GRAB WATER SOIL AIR									
Date	Time								
4/24/97		Membar Filtrate	2						
4/24/97		Mf m c o r Filtrate	1						
4/24/97		Zee weed Permeate	2						
4/24/97		Zee weed Permeate	1						
Sampled By & Title		Date/Time		Relinquished By		Date/Time			
Susan Leigh Enrique Perez		4-24-97 9:00		Susan Leigh Enrique Perez		4-24-97 11:30			
Received By		Date/Time		Relinquished By		Date/Time			
Rosie Villanar		4/24/97 9:10		Rosie Villanar		4/24/97 11:30			
Received By		Date/Time		Relinquished By		Date/Time			
Jim Geishush		4/25/97 1:30							
Received By		Date/Time		Shipped Via		Shipment #			
				IPS BUS (Fed-Ex) Hand Other					
Work Authorized By		Remarks		Contact: Guyer					

APP-258

April 30, 1997

City of McAllen

138067.A0.ZZ

RE: Analytical Data for City of **McAllen**
CVO **Laboratory Reference** No. 5213

Jim Geisbush/PHX

On April 25, 1997, the **CH2M HILL Corvallis** Applied Sciences Laboratory received **two** samples **with** a request for analysis of selected parameters.

The analytical results and **associated** quality control data are enclosed. Any **unusual** difficulties encountered during **the** analysis of your **samples are discussed** in the case narrative.

Under **CH2M HILL** policy, **your** samples **will** be stored for 30 days after **reporting**. If you have not given us prior **instructions** for disposal, we will contact you if any samples require disposal as hazardous waste.

The **CH2M HILL** Applied Sciences Laboratory appreciates your business and looks forward to serving **your** analytical needs **again**. If you should **have any questions concerning** the data, or **if** you need additional information, please call Ms. Kathy McKinley at (541) **758-0235**, extension 3120.

Sincerely,



Kelly Ensor
Senior Administrative Assistant

Enclosures

Applied Sciences
Laboratory
Corvallis Office

2300 NW Walnut Blvd., Corvallis, OR 97330-3538
P. O. Box 428, Corvallis, OR 97339-0428

541 752-4271
Fax No. 541 752-0276

CLIENT SAMPLE CROSS-REFERENCE

CH2M HILL Applied Science Laboratory Reference No. 5213

CVO Sample ID	Client Sample ID	Date Collected	Time Collected
521301	Memcor Filtrate	04/24/1997	
521302	Zeeweed Permeate	04/24/1997	

CASE NARRATIVE
G E N E R A L - Y

Lab Reference **No.: 5213**

Client/Project: City of McAllen

- I. Holding Time:
All acceptance criteria were met.

- II. Digestion Exceptions:
None

- III. Analysis:
 - A. Calibration:
All acceptance criteria were met.

 - B. Blanks:
All acceptance criteria were met.

 - C. Matrix Spike Sample(s):
All acceptance criteria were met.

 - D. Duplicate Sample(s):
All acceptance criteria were met.

 - E. Lab Control Sample(s):
All acceptance criteria were met.

 - F. Other:
Not applicable.

- IV. Documentation Exceptions:
None.

V. I certify that this data package is in compliance with the terms and conditions agreed to by the client and CH2M HILL, both technically and for completeness, except for the conditions detailed above. Release of the data contained in this hardcopy data package has been authorized by the Laboratory Manager or his designee, as verified by the following signature.

Prepared by: _____ DATE: _____

Reviewed by: _____ DATE: _____

Corvallis Applied Sciences Laboratory

7

Client Information

Project Name: Cii of McAllen
 Project Manager Joe Ibarra Jr.
 sampled By: E. Perez
 Sampling Date: 4/24/97
 Sampling time: Not provided
 Type: Grab
 Matrix: water
 Basis: As received

Lab Information

Laboratory ID: ICROR001
 Date Rec'd: 4/25/97
 Analytical Method: EPA 110.2
 Date Analyzed: 4/25/97
 Report Revision No.: 0
 Reported By: H. Van Nice
 Reviewed By:

Client Sample ID	Lab Sample ID	Reporting Limit	Color (ALPHA) Apparent Result	Units
Memcor Filtrate	521301		5	Color units
Zeeweed Permeate	521302		7	Color units

U=Not detected at specified detection limits

Applied Sciences Laboratory,
 Corvallis Office

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Appendix D. MF System
Cleaning Procedures

ZeeWeed Cleaning Procedures (Prior to Phase II Operations)

1. A water flux was **performed** membranes.
2. The **ZeeWeed** process tank was flushed **three** times **with** plant service water.
3. A clean water flux was performed on the membranes.
4. The process tank was emptied and the clean-in-place tank (**CIP**) was **filled** with a **200** ppm sodium hypochlorite (**NaOCl**) solution which was then backwashed through **the** membranes. This was repeated twice.
5. The **process** tank was filled with plant service water and a clean water flux was **performed** on the membranes.
6. Step 4 (empty tank cleaning with sodium hypochlorite) was repeated
7. A clean water flux was performed on the membranes.
8. The process tank was filled with plant **service** water and sodium hypochlorite to yield a **200** ppm solution, and the membranes were allowed to soak **overnight** with the sprayer pump on and the blower on at **8** SCFM.
9. The process tank was flushed with plant service water.
10. The process tank was filled **with** plant service water and a clean water flux was **performed** on the membranes.
11. A bubble test was performed on the system

ZeeWeed/ZenoGem System Cleaning and Decommissioning Procedures

1. A water flux was performed with the modules in standard operating conditions.
2. The process tank was emptied and the clean-in-place tank (UP) was **filled** with a 200 ppm sodium hypochlorite solution made from clean tap water and the membrane was back pulsed with the solution until the membranes were fully wetted outside the lumen. The solution was allowed to so* on the surface of the lumen for 20 minutes.
3. Step 2 was repeated.
4. A clean water flux was performed.
5. The sodium hypochlorite solution was carefully and completely washed out of the **CIP** tank with clean tap water.
6. A solution of MC-1 was added to the **CIP** tank to produce a **pH** of 2 and the membranes were backpulsed with the **solution** as **in Step 3**.
7. A clean water flux was performed.
- a. After the cleaning tests were done, a **Zenon** representative was contacted to discuss the cleaning results.
9. The membranes were preserved with a 60% by volume glycerin solution containing 05% by weight of sodium **metabisulfite** provided by **Zenon**. The solution was placed in the **CIP** tank and the membranes were backwashed with the solution until the membranes were fully wetted on the outside of the lumen.
10. The system was preserved with the 60% glycerin solution
11. The unit was **re-created** and shipped back to **Zenon**.

Memcor **MF** System **Final** Cleaning and Decommissioning Procedures

1. The membranes were cleaned using a 2% **citric acid solution**, followed by a 2% mixture of **Memclean EXA**. This is the same procedure as for all of the other cleanings **during** the study.
2. The system was operated for 5 minutes in the service mode using a 1% **Memclean EXA** solution.
3. The **system** was **completely** drained using the drain down cycle and the **strainer** was cleaned to remove loose **particles** and replaced.
4. the exterior of the unit was cleaned with a mild soapy **solution**.
5. The **MF** unit was place in the original **crate** for return to the manufacturer along with the Material Safety Data Sheet and the CMF **Return** Check **List**.
6. All **additioanl** equipment associated with the system was cleaned and packed in its **origanal crates** for shipment

Move the following to the appendix

This page intentionally left blank

REPORT DOCUMENTATION PAGE			Form Approved OMB No. 0704-0188	
Public reporting burden for this collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden to Washington Headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suit 1204, Arlington VA 22202-4302, and to the Office of Management and Budget, Paperwork Reduction Report (0704-0188), Washington DC 20503.				
1. AGENCY USE ONLY (Leave Blank)	2. REPORT DATE March 1998	3. REPORT TYPE AND DATES COVERED Final		
4. TITLE AND SUBTITLE Wastewater Reclamation Pilot Study, City of McAllen, Texas, WWTP No. 2			5. FUNDING NUMBERS	
6. AUTHOR(S) Jim C. Lozier				
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) CH2M Hill			8. PERFORMING ORGANIZATION REPORT NUMBER WTTP Report No. 26	
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES) Bureau of Reclamation Water Resources Research Laboratory Technical Service Center Denver, Colorado			10. SPONSORING/MONITORING AGENCY REPORT NUMBER	
11. SUPPLEMENTARY NOTES				
12a. DISTRIBUTION/AVAILABILITY STATEMENT			12b. DISTRIBUTION CODE	
<p>13. ABSTRACT (Maximum 200 words) The study evaluated the capability of the Memcor microfiltration (MF) membrane technology and the ZeeWeed MF membrane technology to treat wastewater for indirect potable reuse to supplement the City of McAllen's water supply. The ZeeWeed MF system was also evaluated in conjunction with the ZenoGem process. The ZenoGem process is designed to biologically treat screened, de-gritted sewage and microfilter the "secondary effluent."</p> <p>Both Memcor and ZeeWeed are applicable to the advanced treatment of City of McAllen wastewater for the purpose of indirect potable reuse.</p> <p>The Memcor MF process can efficiently treat secondary effluent from the McAllen South WWTP. ZeeWeed MF technology is competitive with Memcor MF technology in the production of RO feedwater from secondary effluent when non-economic factors are considered. ZeeWeed is a versatile water reuse technology that can microfilter secondary effluent and clarify activated sludge to qualities suitable for use as RO feedwater.</p> <p>ZenoGem can treat McAllen's raw wastewater to a quality comparable to the City's existing WWTP effluent more efficiently than the existing WWTP.</p> <p>It is anticipated that a ZenoGem/RO system would be less expensive to construct and operate than the combination of conventional secondary wastewater treatment, Memcor or ZeeWeed MF, and RO.</p>				
14. SUBJECT TERMS wastewater reclamation, McAllen, Texas, wastewater treatment plant No. 2, Memcor, microfiltration membrane technology, indirect potable reuse, ZeeWeed, reverse osmosis, sewage, Whittier Narrows Groundwater Replenishment Project, Orange County, California, Water District, Upper Occoquan Sewage Authority Water Reclamation Plant, Virginia, Potomac Estuary Experimental Water Treatment Plant, Washington, D.C., San Diego Total Resource Recovery Project, Fred Hervey Water Reclamation Plant, Tampa Water Resource Recovery Project, West Basin Water Recycling Program, Reedy Creek Improvement District, Advanced Water Reclamation Program, City of Scottsdale, Arizona, Water Campus Project, City of San Diego Water Repurification Project			15. NUMBER OF PAGES	
			16. PRICE CODE	
17. SECURITY CLASSIFICATION OF REPORT UL	18. SECURITY CLASSIFICATION OF THIS PAGE UL	19. SECURITY CLASSIFICATION OF ABSTRACT UL	20. LIMITATION OF ABSTRACT UL	

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SI Metric Conversions

English Unit	Multiply By	SI Metric unit
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gal	3.785	L
gal	0.003785	m ³
gpm	0.05309	L/s
gpd/ft ²	1.698	L/m ² /hour
in	2.54	cm
lb	454	g
psi	0.0703	kg/cm ²
psig	0.0689	bar