ORIGINAL

BEFORE THE FLORIDA PUBLIC SERVICE COMMISSION

DOCKET NO. 960545-WS

WATER QUALITY INVESTIGATION OF ALOHA UTILITIES, INC

PRE-FILED DIRECT TESTIMONY OF DAVID W. PORTER, P.E.

Q. Please state your name and professional address.

A. David W. Porter, P.E., C.O., Water/Wastewater System Consulting Engineer, 3197 Ryans Court, Green Cove Springs, Florida, 32043.

Q. What is the purpose of your testimony?

A. To update the Public Service Commission on the activities of Aloha Utilities, Inc. since its Order in March of 1997 wherein it found the quality of service of Aloha was providing to its customers was unsatisfactory, and to demonstrate to the Commission that in fact the service provided by Aloha is not only satisfactory, but of very high quality. Aloha has done everything that it can reasonably be expected to do in order to resolve the water quality concerns that have been raised by the customers of the Utility.

Q. At the behest of the Public Service Commission as outlined in that March 1997 Order, did you prepare a study on behalf of Aloha Utilities outlining the potential upgrades that the Utility could undertake to its water system in order to alleviate some of the concerns?

A. Yes. While the study itself stated that it was limited to hydrogen sulfide removal, we also continued to investigate and actually put in writing within the study, some of the other alternatives that we had considered in order to address the water quality concerns that the customers had raised in those hearings almost three years ago. That study is attached hereto as **Exhibit DWP-1**.

Q. What were your ultimate conclusions in that study?

A. We determined that Aloha could undertake substantial improvements to help in the reduction

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of hydrogen sulfide to very minute levels. We believe that reducing hydrogen sulfide to these extremely low levels will not only assist in addressing some of the concerns of the customers with odor and copper corrosion, but will also assist the Utility in conforming to expected environmental agency regulations which will begin to be phased in approximately three to six years from now. It should be noted that hydrogen sulfide, which was the primary focus of the upgrades investigated, is not present in excessive levels in Aloha's water. This naturally occurring constituent of the water is converted to sulfate at Aloha's water treatment facilities. The resulting levels of sulfate are nowhere near the maximum limits allowed by the environmental regulatory authorities, nor are they even as high as those in the Pasco County system as of the most recent data I have reviewed.

The attached engineering study which we performed, discusses plant improvements which would reduce hydrogen sulfide levels to extremely low levels far beyond anything needed to have high quality water under current regulations. It will however, likely have the effect of reducing any odor concerns of customers, as well as having an impact on copper corrosion. As noted in the report, these improvements will not be required by DEP and EPA regulations for approximately three to six more years; however, we have volunteered to undertake them immediately.

I should note that there are several additional factors that will affect color and odor concerns the customers have raised. Water quality can be negatively impacted by home water treatment units and hot water systems in the customers' home.

Home water treatment units change the water chemistry from what it was as provided by Aloha and can increase the corrosivity of the water by removing most if not all, the naturally occurring minerals. Hot water system components, such as the hot water heater, can be a home to sulfur reducing bacteria that convert sulfate to sulfide that reacts with copper piping to form copper sulfide. The number of these sulfur reducing bacteria can increase to high

numbers when the quantity of hot water used in the home is small relative to the size of the hot water system (hot water tank size and amount of water held in the hot water piping). The Utility should not be placed in a position of trying to treat water to specifications assuming utilization of a home treatment system or the water quality changes that take place in home hot water systems. Not only would such a task be impossible, but would have to recognize numerous different home treatment systems and hot water use patterns which can, and do, affect the quality of the water in customers' homes. This is why the USEPA and FDEP do not allow water samples to be collected from customers' home water systems for analysis and reporting to meet regulatory water system monitoring for all but lead and copper tap sampling.

The quality of the water as it is delivered to customers' homes by Aloha is of high quality and meets, and in most cases exceeds, all USEPA and FDEP standards. The corrosion control program implemented in 1996 has performed as expected and was deemed "optimized" by the FDEP in August of 1998. On June 28, 1999 the FDEP notified Aloha that its corrosion control system was operating so well that the system was eligible for reduced monitoring. There should have been a drop in the number of additional homes reporting copper corrosion related black water problems due to the success of the corrosion control program.

The following factors can negatively affect the quality of the water after it is supplied by Aloha to the customer in his/her home:

1. The use of home water treatment units to modify the water chemistry.
2. The length of time water resides in the hot water system and its temperature before its use.
3. The type of hot water tank components installed in the home (magnesium anodes used in the hot water tank to prevent corrosion of the hot water tank).

4. The grade and quality of the copper pipe used to pipe the customers' homes.

Q. What have you concluded from your research and study of water quality and Aloha Utilities since the 1996 hearings?

A. When all is said and done, several things become clear:

1. First, Aloha's water meets all applicable standards and has for many years.

2. Aloha has complied with the USEPA and FDEP Lead and Copper Rule and has implemented and optimized a FDEP approved corrosion control program. Aloha's corrosion control program was deemed optimized by the FDEP in August of 1998 and was deemed eligible for reduced monitoring status in June of 1999.

3. Water quality changes that take place in the customers' homes are the primary, if not the exclusive, cause of the corrosion of some customers' copper piping systems. This corrosion of the copper pipe generates a copper sulfide byproduct that is experienced as "black water" in some customers' home water systems. Home water treatment systems and hot water systems are the primary cause of the adverse water quality changes.

4. Two years ago, Aloha completed a study to determine what water system modifications could be made to address the complaints of water odor and color expressed by some of Aloha's customers. This study was completed at the request of the Commission. The study identified and evaluated several alternative scenarios for upgrading the Seven Springs Water System. One alternative, that of consolidating a number of small pumping and treatment systems into three regional state-of-the-art water production, storage and delivery facilities was recommended. This alternative would produce a water of very high quality. This alternative would also address upcoming (three to

six years) regulatory driven modifications that will need to be made to the facilities. Aloha has previously volunteered to immediately move forward with the design and construction of these facilities, however, the Commission has declined to order Aloha to do so. Aloha still stands ready and willing to accelerate the design and construction of these improvements as the Commission so desires and if the appropriate rate relief can be provided to cover their cost.

Q. Do you have any further testimony to provide at this time?

A. No. I do not.

ALOHA UTILITIES, INC.
Water Facilities Upgrade Study Report

Exhibit DWP-1

Water Facilities Upgrade Study Report

Volume I - Engineering Analysis

for

Seven Springs Water System
Pasco County, Florida

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Executive Summary

A. Report Purpose

During the disposition of a recent PSC case, associated with establishing wastewater rates necessary to fund the construction, operation and maintenance of a new wastewater reuse system for the Seven Springs Wastewater Treatment System, those customers who were experiencing water problems testified at that hearing. These few customer's homes were located in the southeast corner Seven Springs Water System (SSWS) service area. When the FPSC order was released concerning the above referenced reuse case, it contained a requirement that Aloha conduct a study and prepare a report that discussed the installation of hydrogen sulfide (H_2S) removal equipment at the existing Seven Springs Well/Treatment Facilities. The FPSC apparently based their requirement for such study on a hope that reducing the H_2S concentration will correct the water discoloration problems.

The utility has worked with their engineering consultants, the Florida Department of Environmental Protection (FDEP) staff, corrosion control chemical vendor's technical staff, the Florida Public Service Commission (FPSC) engineering staff, copper corrosion control experts at the University of Colorado at Boulder and others to determine what causes the formation of the discolored water and to find a means of preventing the continuance of this problem for the affected customers.

B. Factors Affecting Treatment Alternatives

The following factors must be considered in any modification of the SSWS:

The Seven Springs Water System service area is being developed at very high rates. By 2015 it is estimated that the demand for water will be approximately 75% greater than today. In fact, the current water system is nearing full utilization based on Southwest Florida Water Management District (SWFWMD) Water Use Permitted capacity of its existing wells, the water storage capacity of the existing water storage facilities and the layout of the existing distribution piping system. Therefore, providing capacity for future customers was a consideration.

The current water supply system consists of wells, chlorination facilities and hydropneumatic tanks. Severe space limitations exist at the majority of the present water well/treatment facility sites which would prevent the addition of treatment technologies beyond those presently utilized. No readily available property exists within a reasonable distance upon which additional facilities could be constructed. Each of the well sites is now surrounded by residential and commercial properties; any of the chemical treatment facility modifications studied as part of this report preparation, if constructed at the existing well sites, could pose a safety risk and/or quality of life reduction for the residential and commercial neighbors.

The level of sulfide in the raw water and sulfate in the finished water produced by the Seven Springs Water System is average for Florida utilities and currently meets USEPA and FDEP requirements. Aloha has implemented a corrosion control program, that has been approved by the FDEP, in an attempt to control copper piping corrosion.

As a result of the Safe Water Drinking Act Amendments of 1996, the USEPA and FDEP are currently studying a number of major technical issues of concern to the water treatment industry that will ultimately result in the promulgation of new water treatment regulations. However the study needed to prepare these regulations has not as yet been finalized, and in some cases, has not even begun. Future rules (such as those that require THM reductions) may, and most likely will, require water utilities to add very elaborate water treatment equipment to their existing treatment, storage and distribution facilities. Any modifications to the existing facilities or construction of new facilities must be carefully implemented so as not to cause compliance difficulties in the future. Also, any modifications made at this time must not interfere with the on-going USEPA and FDEP required corrosion control program.

A draft report describing a soon to be completed study, undertaken at the University of Colorado, concerning sulfide induced copper corrosion mechanisms indicates that, for any major benefit to be realized by removing hydrogen sulfide from water, the hydrogen sulfide concentration must be reduced to almost undetectable concentrations. This draft report also shows that copper tubing with existing copper sulfide precipitates will continue to experience elevated corrosion rates for extended periods of time, even though the source of sulfide is removed.[1]

C. Three Approaches Were Considered

Three general approaches to addressing the water discoloration and odor problems identified in the FPSC Order were considered:

The standard approach considered is the continuation of the corrosion control program presently in use. Aloha began the injection of a corrosion inhibitor into the finished water produced at each of its existing water well/treatment sites on April 1, 1996. The inhibitor minimizes the natural rate of copper plumbing corrosion experienced whenever water is passed through copper piping. It is believed that this inhibitor will reduce the natural rate of home plumbing copper corrosion to a level such that the water discoloration will cease to be a problem. The installation of the corrosion inhibitor storage and feed equipment was also required by the USEPA and FDEP as part of the Utility's Lead and Copper Rule compliance program. The additional capital and operation and maintenance costs associated with this approach have already been expended or planned and are substantially lower than those related to the other alternatives studied here (Volume II presents the costs associated with the existing corrosion control program).

The second approach consisted of two alternative means of retrofitting each of eight (8) existing water well/treatment facilities and constructing two similar new well/treatment facilities with the type of treatment alterations envisioned by the FPSC in its Order (Alternatives 1A-Tray Aeration and 1B-Packed Tower Aeration). **Alternatives 1A and 1B, as analyzed in this report, provide for water supply, treatment, storage and high service pumping capacity increases to meet the demand projected for the 1998 design year. However, substantial capacity increases, beyond those provided for in these alternatives, will be needed by the year 2000.**

Reverse Osmosis and Ion Exchange technologies were considered in this approach but they were rejected as providing no measurable benefit in reducing H_2S.

Estimated capital and operation and maintenance costs associated with these Alternatives are as follows:

Alternative 1A-Tray Aeration
Capital Cost: $9,780,805
O&M Cost: $3,406,866/year

Alternative 1B-Packed Tower Aeration
Capital Cost: $12,457,583
O&M Cost: $3,707,466/year

The third approach, known as Alternative 2, consisted of the development of three (3) central, packed tower aeration water treatment, storage and pumping facilities. Alternative 2 not only provides for H_2S reduction but also includes provisions to easily allow future process modifications that may be necessary to comply with future USEPA and FDEP rules. **Unlike alternatives 1A and 1B, this alternative also provides increased treatment, storage and high service pumping capacity suitable for use up to the 2015 design year and beyond.** The costs associated with this alternative include conversion of the existing water wells to raw water pumping stations, relocating two of the wells, constructing two new wells, constructing modifications to the existing storage and pumping facility, constructing two new water treatment, storage and pumping facilities and constructing a number of distribution system piping modifications.

Estimated capital and operation and maintenance costs associated with Alternative 2 are as follows:

Alternative 2-Centralized Water Facilities
Capital Cost: $9,485,692
O&M Cost: $2,891,490/year (at 1998 Flow Rates)

These costs are essentially equal to the costs of modifying the existing facilities (Alternative 1A using tray aeration), however, Alternative 2 provides much higher H_2S removal and greatly increased capacity in addition to merely upgrading treatment capabilities. The operating costs associated with this alternative are also significantly less than the other alternatives. This alternative provides for future growth of the system and greatly increased water storage capacity. The distribution system improvements will allow water to reach the end users much more quickly, which has the effect of improving water quality as well as increasing pressure supplied. The layout of proposed water treatment facilities will allow for the inclusion of additional water treatment process units if they are necessary to comply with future USEPA and FDEP rules.

D. Recommendations

Based on the data presented in this report and the comments listed on this page we recommend the following:

1. Due to the extremely high capital and O&M costs associated with Alternates 1A, 1B and 2 and the effect that these costs will have on water rates (estimated to be at least a four fold increase), we recommend that the Utility's existing program to control copper corrosion and discolored water from copper sulfide formation be continued. This is

especially true, given that no substantial benefit may be realized by those customers with in-home treatment systems where the majority of the water discoloration and odor problems have been observed. Recent testing indicates that the existing corrosion control program has been quite effective in reducing copper corrosion. Sharp declines in the number of discolored water complaints indicate that water discoloration is also diminishing. Additional fine-tuning of the dosage of the corrosion inhibitor is underway and further copper corrosion rate reductions are anticipated. Aloha's finished water is routinely tested for odor. The results of this testing has shown the finished water to exhibit odor values that are well within USEPA and FDEP standards. However, future system modifications that will be made to comply with future regulation changes will further improve finished water quality.

2. Should the Commission determine that the existing corrosion control program is not sufficient and that the regulatory and cost uncertainties of Alternative 2 are acceptable, we recommend that Aloha work with the Commission to obtain an immediate phased rate increase to implement Alternative 2. Alternative 2 has been chosen over Alternatives 1A and 1B because: it is less costly that either 1A or 1B in both capital and operating costs (substantially less than 1B); it provides for treatment, storage, pumping and distribution capacity needed through the year 2015, which 1A and 1B do not; it provides for relatively easy modification of the facilities to meet future regulatory requirements, which 1A and 1B do not; and it provides for substantially higher removal of H_2S than 1A.The first phase of the work: completing pilot testing, completing design work and obtaining the necessary permitting should begin as soon as the rates can be put into effect to pay for these activities. Additional phases of the work: construction, start-up and certification should begin as soon as the first phase of the work is complete and as soon as the rates can be put into effect to pay for these activities as well.

Section References

1. S. Jacobs and M. Edwards, "Sulfide–Induced Copper Corrosion," Unpublished Draft Paper, University of Colorado-Boulder, Civil Engineering Department, 1997

Section 1-Introduction

A. Study and Report Purpose

In January 1996, Aloha Utilities began receiving complaints of discolored water from a small group of customer's located in the Southeast corner of Aloha's service area. At that time, the discolored water complaints were thought to be associated with the dislodging of silt and calcium scale from the sides of the distribution system piping. This was a reasonable assumption given the fact that two new high capacity water supply facilities had come on-line to serve the area just a month or two before. These high capacity water facilities provided more water, at higher pressures, to the surrounding area. The greater water pressure and flow rate caused greater water velocities throughout the water distribution system. This higher velocities could have scoured the piping walls, causing old depositions of silty material and calcium scale to become dislodged. The new water supply facilities were also located in a direction opposite from the previous water supply; therefore, the water entering the distribution system would now flow in a direction opposite that which it had previously. This reverse direction flow of water through the existing distribution piping would also contribute to the dislodging of silt and calcium based scale from the distribution piping walls.

Aloha began an aggressive water main flushing program to remove any silt and scale that might have been present in the water mains. Aloha's crews met with each person that registered a discolored water complaint to explain how to flush their hot water tank and internal home piping to remove any silt or scale that may have entered their home. Aloha notified its customers of its increased flushing efforts by placing public notices in each of the local newspapers and by spreading the news verbally as their crews flushed in a given area.

By late February the number of discolored water complaints had not subsided substantially. Aloha was contacted by the FDEP and asked to meet with members of their staff to discuss the water discoloration complaints that the FDEP had received. Aloha staff and their engineers developed a 30 day special testing program to determine if the water discoloration posed any health risks and to determine, if possible, what the cause of the discoloration was. The special testing showed that Aloha's water met all USEPA and FDEP requirements and that no health risks could be identified. FDEP testing also identified the cause of the discoloration to be the formation of a copper sulfide precipitate. It was also shown that this water discoloration was found primarily in hot water systems; few cold water discoloration problems could be found. Also, the water discoloration was not found in the water prior to its entry into a home; in fact, the water collected from the distribution system was never found to contain any copper, sulfide or copper sulfide compound at all. The generation of the copper sulfide compound was taking place strictly in plumbing of the affected customer's homes. In addition, it was shown that a neighbor of an affected customer often did not experience the water discoloration problem. It was at this time that the FDEP and Aloha determined that the problem was not one with the water supply in general, but, rather, a problem generated under special conditions within some customers homes.

Aloha instructed its consulting engineer to further investigate the problem and to attempt to determine what caused one neighbor to experience water discoloration and for others on the same street not to be affected.

Aloha's staff and consulting engineer visited a number of the affected customer's homes. Also, a thorough records review was undertaken. Numerous discussions were conducted with FDEP staff, other water utility operators and engineers, research scientists, water treatment equipment and chemical vendors and water chemists in an attempt to isolate the conditions which were common to the effected customers and to find a solution to their problem.

Several conditions were generally found to be present in the affected customer's homes:

1. The customer was not a large user of hot water or the home included a rather large capacity hot water tank.
2. An in-home water treatment unit (water conditioner) was present.
3. The customer's home was rather large and there were back bathrooms that received little use.

Also at this same time, Aloha had been working on permitting USEPA/FDEP required corrosion control feed stations at each of its well sites. These feed stations were to be used to inject corrosion control chemicals into the finished water from each well site prior to its release into the distribution system. These corrosion control systems were being installed to assist the utility in complying with the Lead and Copper Rule. The corrosion control chemicals to be used included a component (polyphosphate) that would intentionally strip any scale and silt from the distribution and home piping walls. Silt, scale and dirt must be removed before the corrosion control component of the chemical (orthophosphate) can protect the copper home plumbing. Aloha, hoped that the injection of this chemical would also assist in correcting the water discoloration problems being experienced.

Based on the investigation work performed, a theory as to the cause of the water discoloration could be developed.

In order for copper sulfide compound to form, both of the components, copper and sulfide, must be present. When both of these chemicals are present, they will bond together to form copper sulfide. How much of this copper sulfide forms (and therefore the amount of discoloration that is experienced) is directly related to how much of each chemical is present and how hot the water is. The more copper and sulfide there is, the faster the reaction takes place. Also, the hotter the water the faster the reaction takes place. Therefore, hot water piping with high concentrations of copper and sulfide would produce the most copper sulfide (and experience the most severe water discoloration problems).

Neither of these chemicals are present in the finished water produced by the Seven Springs Water System (verified numerous times by both the Utility and the FDEP) and distributed to its customer's homes. Where then, do the building blocks of copper sulfide come from to allow its formation in the affected customer's homes?

The plumbing in most homes is comprised of copper tubing. As water passes through this tubing, copper is dissolved into the water. The rate at which the copper dissolves into the water is dependent on a number of factors. These factors included the type of copper utilized in the manufacturer of the tubing and the corrosiveness and temperature of the water passing through the tubing. In-home water treatment units are utilized to remove hardness and other minerals present in the water. When these minerals are removed, the water can become very corrosive causing copper to be released into the water at high rates. Also, this transfer of copper to the water proceeds much faster as the temperature increases (such as in the hot water piping).

Sulfide is a form of sulfur. Sulfur can exist in several forms in water. The form that the sulfur takes in water is dependent on the pH (the relative balance of acid and alkalinity) of the water. When the pH is low (acid), the sulfide form predominates (as hydrogen sulfide); when it is high other forms such as sulfate predominate (as calcium or magnesium sulfate, etc.). Aloha's well water does contain modest amounts of sulfide when it is pumped from the wells as raw water. However, the raw water is treated, by oxidation with chlorine, to change the sulfide form of sulfur found in the raw water to sulfate at the water plant. No measurable quantity of sulfide is released with the finished water discharged to the water distribution system. In addition, the sulfate levels discharged are very low (approximately 10 mg/L average for the system). The USEPA maximum concentration of sulfate permitted to be discharged into a domestic water system is 25 times higher at 250 mg/L.

Sulfate can be converted back to sulfide by sulfur reducing bacteria. These bacteria are commonly found in small numbers in most water. So long as their number remain small, the amount of sulfate that will be converted back to sulfide is also small. Since these bacteria prefer to live in very warm areas (where the temperature is over 120°F) the number of bacteria is not sufficient enough to create problems in cold moving water. However, if the water temperature is hot and/or the water is stagnant, such as in a large hot water tank that is not used frequently or in seldom used guest bathroom plumbing, the number of bacteria can be increased to very high numbers. Also, in-home water treatment units remove chlorine from the water as delivered by Aloha. This also allows the number of sulfur reducing bacterial to increase substantially. When large numbers of sulfate reducing bacteria are present, relatively large quantities of sulfate can be converted back to sulfide (providing the sulfide needed to create copper sulfide buildup).

As stated earlier, copper and sulfide must be present for copper sulfide to be formed. Also, like all chemical reactions, the higher the temperature of the media in which the reaction is taking place, the faster the reaction proceeds. The faster the reaction proceeds, the larger the amount of the compound that will be formed in the same given time. Therefore, it is not difficult to see why some homes experience the problem to a high level and others do not experience it at all or only slightly. Those home with water treatment units cause more copper to be dissolved into the water increasing the rate of the copper sulfide reaction. Homes with large hot water tanks with little hot water use increase the number of sulfide reducing bacterial to high levels, increasing the quantity of sulfate converted to sulfide. This increased sulfide concentration drives the reaction faster and thus causes the creation of more copper sulfide in the same time period. The worst situation should occur when a home owner has both an in-home water treatment unit and large hot water tank with little hot water use.

Our field observations and discussions with affected customers shows that this is true.

If our description of the mechanism of the formation of the copper sulfide is correct, the solution to the problem should be as simple as removing one of the chemicals that form the compound, copper or sulfide. Since neither of these chemicals are present in Aloha's finished water, they must be formed exclusively in the affected customer's home. This poses quite a dilemma for the Utility since the Utility has very little control over what happens to the water after it enters the customer's home, especially when the customer has an in-home treatment unit.

Since the in-home treatment units materially change the chemical character of the water, as long as a customer utilizes an in-home water treatment unit, Aloha will have a great deal of difficulty assisting the customer in correcting its water discoloration and odor problems. Therefore, any home owner that chooses to continue to utilize an in-home treatment unit must be held responsible for solving this specific water quality problem. To the extent Aloha is placed in the position of attempting to treat water to meet these customer's specific and isolated problems, all customers will have to pay a substantial added cost and the problem may still not be solved.

The removal of all sulfur compounds from the finished water is not normally practiced in the drinking water industry. The equipment and plant modifications required to do so is very costly as would be the cost to operate such a system. The comparative cost of injecting corrosion control chemicals into the finished water to control the copper levels is substantially less. This cost difference is especially important since the water discoloration problem only exists at a relatively small number of homes, making the solution implementation cost per affected home very high.

Because of the great cost associated with implementing alternative means of controlling copper corrosion and the effect that this cost would have on water rates, Aloha chose to initially rely upon the addition of corrosion control chemicals to minimize the discolored water problems. Information supplied by the manufacturer of the corrosion inhibitor chemical and other utilities utilizing the same product gave Aloha every indication that its corrosion control program would solve the discolored water problems.

The injection of corrosion control chemicals has now been practiced for approximately one year. The number of discolored water complaints has decreased to approximately one third of those being received just prior to the implementation of the corrosion control program. Additional in-home water testing is underway and the level of copper found in the homes has decreased substantially, however, additional fine tuning of the system must continue in order to reduce the levels further.

A draft report, prepared by a research team at the University of Colorado-Boulder, reporting on the results of their recently completed study into sulfide induced copper corrosion states that once copper sulfide is present in copper water piping, removal of the source of sulfide will not immediately reduce the rate of copper corrosion (and therefore the rate at which copper is dissolved into the water) and, in fact, so long as the previously deposited copper sulfide is still attached to the copper piping corrosion may never be eliminated.

The University of Colorado study findings are very important because they show that the removal of hydrogen sulfide alone may not correct the water corrosion problems.

On March 12, 1997, the Florida Public Service Commission (FPSC) issued its Order Number PSC-97-0280-FOF-WS pertaining to Dockets Number 950615-SU and 960545-WS. Section VI of the Order titled: Quality of Service Conclusion, states "The Utility shall evaluate the best available treatment technologies for removal of hydrogen sulfide. The Utility shall evaluate, as a minimum, the following types of treatment: tray aeration, packed tower aeration, ion exchange and reverse osmosis. This list is not meant to preclude Aloha from considering other treatments. For each treatment option which is analyzed the utility shall, at a minimum, calculate the expected hydrogen sulfide removal efficiency of the process, estimate the capital costs, estimate any additional annual operation and maintenance expenses, estimate the impact on customers' rates, and provide a schedule for installation of the treatment. Aloha shall also provide the capital costs and expected annual operation and maintenance expenses which have been incurred for the corrosion control program which it has already implemented. Aloha shall also indicate which treatment option it recommends. This report shall be filed with the Commission within three months of the issuance of this Order. Mr. Porter stated he could prepare an engineering report within two months, but we shall allow an extra month to provide for the requested financial information."

The Commission Ordered Aloha to perform this study and prepare this report in hopes that reducing the hydrogen sulfide (H_2S) concentration of the finished water produced would reduce water discoloration and odor reported by a relatively small number of Aloha customers during the rate case hearings related to these Dockets. However, as stated earlier in this report, there is serious doubt that simply removing hydrogen sulfide will produce any measurable reduction in the incidence of discolored water.

This report has been prepared to comply with the Commission Order.

B. Parameters of the Study

Based on the content of the FPSC Order, this study and report address the following three approaches:

1. Continuation with the existing corrosion control program while continuing to research additional technologies that may increase the effectiveness of the existing program.
2. The addition of treatment process units and appurtenant equipment required to reduce H_2S concentrations to the minimum amount technically feasible and to increase system capacity to meet 1998 design year projected demands. The treatment options reviewed included tray aeration, packed tower aeration, ion exchange and reverse osmosis technologies.
3. The consolidation of the present multiple well/treatment plant system into three regional water treatment plants with the addition of packed tower aeration units to remove hydrogen sulfide. This approach also included increasing system capacity to meet 1998 design year projected demands. In addition, this approach also included the provision of the treatment, storage, high service pumping and distribution system capacity needed to meet the projected 2015 design year

demands. An additional 1.75 mgd raw water supply will be required to meet the 2015 design year demands that has not been included here. This means of obtaining this additional raw water supply is not defined at this time.

C. Report Format

This report has been produced in two volumes. Volume I is concerned with the technical aspects of the study (including construction and O&M cost estimates), whereas Volume II deals solely with the financial/rate analysis of the various options.

Volume I is broken in ten sections and seven appendices. The various sections present a discussion of the topic found in the title for that section. The appendices present support data that was utilized in one or more sections of the report. These appendices are referenced, where appropriate, throughout the various sections. Volume II consists of one section and one appendix. The appendix contained in Volume II presents support data utilized therein.

Section 2-Description of Service Area

A. Service Area Boundaries

The Seven Springs Water System (SSWS) is owned and operated by Aloha Utilities, Inc. (AUI), a private company providing potable water service pursuant to a certificate of authorization granted by the State of Florida Public Service Commission. Aloha's service area is totally contained within Pasco County, Florida. AUI has been granted the exclusive right to provide water and wastewater service to all customers located within the service area boundaries.

The SSWS is located in an unincorporated area of Pasco County, southeast of the City of New Port Richey. The SSWS is more specifically located in Township 26 South, Range 16 East; Township 26 South, Range 17 East; and Township 25 South, Range 16 East. Figure 2-1 shows the SSWS service area on a USGS quadrangle map. The service area is predominantly single family residential, with some multi-family units, commercial areas and schools. As indicated on Figure 2-1, large portions of the service area are presently undeveloped, however, it is projected that by 2015 a substantial portion of the service area will be built-out.

B. Existing Demographics

Presently, there are 7,871 residential and 161 commercial accounts which make up the customer base of the SSWS. For the purposes of this report, commercial accounts and residential accounts are assumed to have equivalent demands. Therefore the SSWS serves 8,032 equivalent customers at this time.

Based on South West Florida Water Management District population projection methods, the average annual weighted service population for the SSWS is 20,399 persons based on the number of connections shown above.

C. Future Demographics

Table 2-1 shows past and future projected number of equivalent customers and the associated water demands (average daily, maximum daily and peak monthly) for the period 1990 through 2015. Appendix C presents the data utilized to develop this table.

This support data which was used in developing the projected number of equivalent customers and the water demands for the years beyond 1995 can be found in Appendices C through F.

Based on the projections, the SSWS water demands for the design years utilized in this study (1998 and 2015) are as shown in Table 2-2. Table 2-2 shows that over the next 18 years, the Seven Springs Water System water demand is projected to increase by over 75 percent.

Year	Equivalent Customers	Average Daily Flow		Maximum Daily Flow		Peak Hourly Flow	
		MGD	GPM	MGD	GPM	MGD	GPM
1990	6,232	1.61	1,118	2.74	1,901	5.64	3,913
1995	7,796	2.23	1,549	3.79	2,633	7.81	5,420
2000	9,762	2.88	2,000	4.90	3,400	10.08	7,000
2005	11,762	3.47	2,410	5.90	4,097	12.15	8,434
2010	13,423	3.96	2,750	6.73	4,675	13.86	9,625
2015	15,322	4.52	3,139	7.68	5,336	15.82	10,986

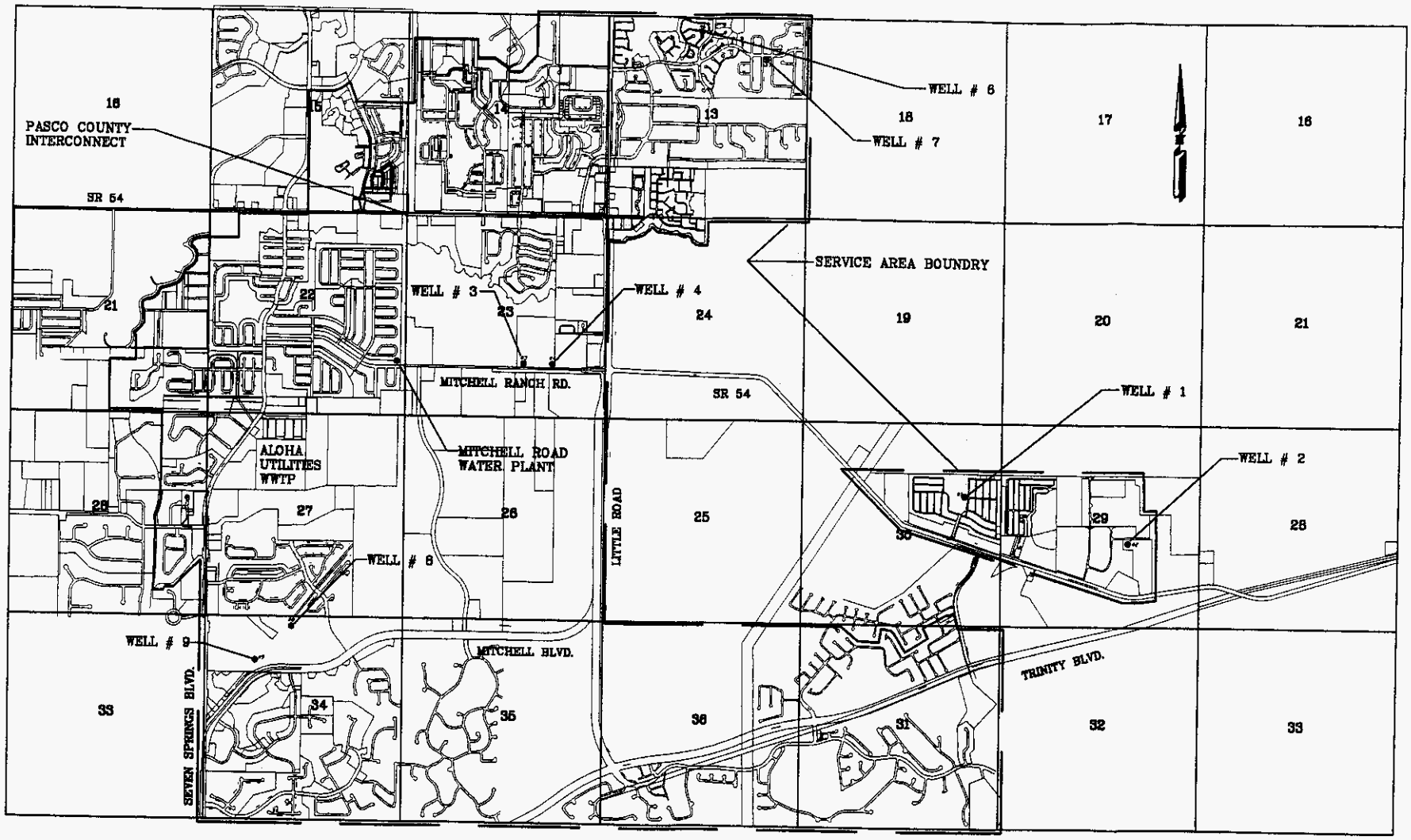
Historical and Projected Served Population and Water Demands

Table 2-1

Year	Average Daily Flow		Maximum Daily Flow		Peak Hourly Flow	
	MGD	GPM	MGD	GPM	MGD	GPM
1998	2.57	1,785	4.89	3,392	9.00	6,249
2015	4.52	3,139	7.68	5,336	15.82	10,986

Study Design Years 1998 and 2015 Water Demands

Table 2-2



Civil Engineering Associates Inc. 720 E. FLETCHER AVE. TAMPA FLORIDA	SEVEN SPRINGS WATER SYSTEM EXISTING WELLS & WATER PLANT	FIGURE 2-1

Section 3-Description of Existing Water System

A. Overview

The SSWS presently consists of eight (8) well/treatment facilities and one main water storage and pumping facility. Raw water is chlorinated and pumped to the distribution system. At each well site, ground water is pumped from a deep well, chlorinated and injected with corrosion inhibitor chemicals prior to its being discharged to the distribution system or sent to the main ground storage facility.

Wells No. 1 and 2 provide drinking water to the eastern portion of the service area, as indicated on Figure 2-1. Wells No. 3 and 4 pump treated water directly to the 0.5 million gallon ground storage tank at the Main Treatment Plant. Treated water from Wells No.1 and 2, that is not required to meet the water demand in the eastern portion of the service area, is also pumped to the ground storage tank at those times that it is available. The Main Treatment Plant is equipped with flow proportioned chlorination equipment to provide additional chlorination prior to the discharge of stored water to the distribution system. An emergency interconnect with the Pasco County water system is located on State Road 54, at the southeast corner of Section 15, as indicated on Figure 2-1. The emergency interconnect is controlled by a manually operated gate valve, and is only used when the SSWS is not capable of meeting the water system demands.

B. Well Number 1

Well No.1 is equipped with a Peerless vertical turbine pump rated at 1000 gallons per minute (gpm) at 242 feet of head. The pump is equipped with a right angle drive complete with an electric motor and back-up, fuel fired engine. A 10,000 gallon hydropneumatic tank, equipped with pressure switches, air compressor and controls has been provided. A polyphosphate/orthophosphate feed pump and chemical tank has been provided which injects corrosion control chemicals into the raw water prior to chlorination.

Chlorination is provided by Wallace and Tiernan wall mounted, manually operated, gas chlorinator with a capacity of 100 pounds per 24 hours of operation. A two cylinder chlorine scale measures and indicates the weight of the remaining chlorine in each cylinder. Each of the two chlorine cylinder mounted feed heads are equipped with a Wallace and Tiernan automatic switchover unit.

The chlorination room is constructed of concrete blocks, set on their sides, to provide open walls to allow for ventilation. A loss of chlorination alarm is also provided. During a power failure, a portable generator is used to provide power for lighting and the chlorination system.

C. Well Number 2

Well No.2 is equipped with a Peerless vertical turbine pump rated at 500 gpm at 242 feet of head. A

5,000 gallon hydropneumatic tank, equipped with pressure switches and an air compressor, controls pump operation. A polyphosphate/orthophosphate feed pump and chemical tank has been provided which injects corrosion control chemicals into the raw water prior to chlorination.

Chlorination is provided by a Wallace and Tiernan wall mounted, manually operated chlorinator with a capacity of 100 pounds per 24 hours of operation. A two cylinder chlorine scale measures and indicates the remaining weight of chlorine in each cylinder. Each of the two chlorine feed heads are equipped with a Wallace and Tiernan automatic switchover unit. A fan, located adjacent to the access door, ventilates the Chlorination Room. A loss of chlorination alarm is also provided.

D. Well Number 3

Well No.3 is equipped with a Peerless vertical turbine pump rated at 200 gpm at 176 feet of head. A 5,000 gallon hydropneumatic tank, equipped with pressure switches and an air compressor, controls pump operation. A polyphosphate/orthophosphate feed pump and chemical tank has been provided which injects corrosion control chemicals into the raw water prior to chlorination

Chlorination is provided by a Wallace and Tiernan wall mounted, manually operated chlorinator with a capacity of 100 pounds per 24 hours of operation. A two cylinder chlorine scale measures and indicates the remaining weight of chlorine in each cylinder. Each of the two chlorine feed heads are equipped with a Wallace and Tiernan automatic switchover unit. A fan, located adjacent to the access door, ventilates the Chlorination Room. A loss of chlorination alarm is also provided.

E. Well Number 4

Well No.4 is equipped with a Peerless vertical turbine pump rated at 200 gpm at 172 feet of head. A 5,000 gallon hydropneumatic tank, equipped with pressure switches and an air compressor, controls pump operation, A polyphosphate/orthophosphate feed pump and chemical tank has been provided which injects corrosion control chemicals into the raw water prior to chlorination

Chlorination is provided by a Wallace and Tiernan wall mounted, manually operated chlorinator with a capacity of 100 pounds per 24 hours of operation. A two cylinder chlorine scale measures and indicates the remaining weight of chlorine in each cylinder. Each of the two chlorine feed heads are equipped with a Wallace and Tiernan automatic switchover unit. A fan, located adjacent to the access door, ventilates the Chlorination Room. A loss of chlorination alarm is also provided.

F. Well Number 6

Well No.6 is equipped with a Peerless vertical turbine pump rated at 450 gpm at 200 feet of head. A 10,000 gallon hydropneumatic tank, equipped with pressure switches and an air compressor, controls pump operation. A polyphosphate/orthophosphate feed pump and chemical tank has been provided which injects corrosion control chemicals into the raw water prior to chlorination

Chlorination is provided by a Wallace and Tiernan wall mounted, manually operated chlorinator

with a capacity of 100 pounds per 24 hours of operation. A two cylinder chlorine scale measures and indicates the remaining weight of chlorine in each cylinder. Each of the two chlorine feed heads are equipped with a Wallace and Tiernan automatic switchover unit. A fan, located adjacent to the access door, ventilates the Chlorination Room. A loss of chlorination alarm is also provided.

G. Well Number 7

Well No.7 is equipped with a Peerless vertical turbine pump rated at 450 gpm at 200 feet of head. A 10,000 gallon hydropneumatic tank, equipped with pressure switches and an air compressor, control pump operation. A polyphosphate/orthophosphate feed pump and chemical tank has been provided which injects corrosion control chemicals into the raw water prior to chlorination

Chlorination is provided by a Wallace and Tiernan wall mounted, manually operated chlorinator with a capacity of 100 pounds per 24 hours of operation. A two cylinder chlorine scale measures and indicates the remaining weight of chlorine in each cylinder. Each of the two chlorine feed heads are equipped with a Wallace and Tiernan automatic switchover unit. A fan, located adjacent to the access door, ventilates the Chlorination Room. A loss of chlorination alarm is also provided.

H. Well Number 8

Well number 8 is equipped with a Peerless vertical turbine pump rated at 500 gpm at 240 feet of head. A 10,000 gallon hydropneumatic tank, equipped with pressure switches and an air compressor, control the operation of the well pump. A polyphosphate/orthophosphate feed pump and chemical tank has been provided which injects corrosion control chemicals into the raw water prior to chlorination

Chlorination is provided by a Wallace and Tiernan wall mounted, manually operated chlorinator with a capacity of 100 pounds per 24 hours of operation. A two cylinder chlorine scale measures and indicates the remaining weight of chlorine in each cylinder. Each of the two chlorine feed heads are equipped with a Wallace and Tiernan automatic switchover unit. A fan, located adjacent to the access door, ventilates the Chlorination Room. A loss of chlorination alarm is also provided.

I. Well Number 9

Well number 9 is equipped with a Peerless vertical turbine pump rated at 500 gpm at 240 feet of head. A 10,000 gallon hydropneumatic tank, equipped with pressure switches and an air compressor, control the operation of the well pump. A polyphosphate/orthophosphate feed pump and chemical tank has been provided which injects corrosion control chemicals into the raw water prior to chlorination

Chlorination is provided by a Wallace and Tiernan wall mounted, manually operated chlorinator with a capacity of 150 pounds per 24 hours of operation. A two cylinder chlorine scale measures and indicates the remaining weight of chlorine in each cylinder. Each of the two chlorine feed heads are equipped with a Wallace and Tiernan automatic switchover unit. A fan, located adjacent to the

access door, ventilates the Chlorination Room. A loss of chlorination alarm is also provided.

J. Main Storage and Pumping Facility

A 500,000 gallon ground storage tank receives treated water from Wells No. 1, 2, 3 and 4. A level sensing system in the ground storage tank closes the inlet valves when the tank is full. Closing the inlet valves cause the pressure in the water main connecting Wells No. 1, 2, 3, and 4 with the tank to increase. The resulting pressure increase is sensed by pressure switches at each well site, causing the well control system to stop the well pumps. The Main Treatment and Storage Facility contains the following pumping equipment:

- Two Peerless horizontal split case high service pumps rated at 1,000 gpm at 210 feet of head. Each pump is equipped with a hydroconstant speed drive which is used to vary the speed of the pump. Pump speed is automatically controlled by the pressure in the pump discharge header. The controls are set to maintain a pressure of approximately 52 pounds per square inch (psi).

- One constant speed Aurora horizontal split case high service pump rated at 1,000 gpm at 200 feet of head. The pump discharge rate is automatically varied by a pressure reducing valve on the pump discharge line. The pressure reducing valve is controlled by the pressure in the pump discharge header. The controls are set to maintain a pressure of approximately 52 psi, the same as the operating pressure set point for the Peerless pumps.

- One Peerless standby pump rated at 230 gpm at 231 feet of head. The standby pump will operate when the system pressure decreases to 20 psi, or when the power fails and the engine generator starts.

The number of high service pumps in operation is automatically controlled by the flow meter. Increasing water demand (flowrate) causes additional pumps to start. As indicated above, the pump discharge rate is automatically controlled by the pressure in the pump discharge header.

Chlorination equipment is provided to add chlorine to the water prior to its discharge to the distribution system. Two wall mounted, flow proportional Wallace and Tiernan chlorinators are located in the Chlorination Room. Each chlorinator has a capacity of 500 pounds per 24 hours of operation. Three sets of chlorine cylinders, with two 150 pound cylinders per set, supply chlorine gas to the chlorinators. Each chlorine tank feed head is equipped with a Wallace and Tiernan automatic switchover unit. Three Wallace and Tiernan two cylinder chlorine scales indicate the remaining weight of chlorine in each cylinder. A chlorine leak detector and loss of chlorine alarm are also provided. The Chlorine Room ventilation fan is located adjacent to the outside access door.

A standby generator is provided to automatically provide power should a power failure occur. The generator provides power for lighting, chlorination and the standby pump.

K. Pasco County Emergency Interconnect

The Pasco County emergency interconnect is located on State Road 54. The interconnect main is 6-inches in diameter and approximately 24 feet long, with a 6-inch flow meter. The Pasco County water main is 24 inches in diameter and has a static pressure of 80 psi.

L. Distribution System

The SSWS water distribution system was constructed by various entities over the past twenty five years. Large portions of the system was constructed by various land developers as part of their construction of a number of residential subdivisions. These individual subdivision water distribution systems are connected to the SSWS water system trunk mains. The majority of these trunk mains have been constructed by Aloha Utilities.

Often, the individual subdivision water piping systems, were constructed as if they were "stand-alone" water systems with little regard to the overall movement of water from one subdivision to another. This "stand-alone" water system design and construction mentality can create water quality problems due to extended aging of the water in dead-end piping sections.

Aloha Utilities has and continues to construct major water distribution system improvements in an attempt to correct dead-end piping system related operating problems.

M. Existing Corrosion Control Program

Aloha began the injection of a corrosion inhibitor into the finished water produced at each of its existing water well/treatment sites in March 1996. The inhibitor minimizes the natural rate of copper plumbing corrosion experienced whenever water is passed through copper piping. It was, and continues to be, the Utility's contention that this inhibitor will reduce the natural rate of home plumbing copper corrosion to a level such that the water discoloration will cease to be a problem. The installation of the corrosion inhibitor storage and feed equipment was also required by the USEPA and FDEP as part of the Utility's Lead and Copper Rule compliance program.

Recent copper analysis of water sampled from the taps of approximately 60 customers has shown a substantial reduction in copper concentration. This reduction in copper concentration is an indicator that the discolored water problem should also be improving. Additional fine-tuning of the corrosion control chemical feed rates will cause a further reduction in the copper concentration and the incidence of discolored water problems.

N. Operating Performance

The Utility periodically extracts samples of its finished water from various locations throughout its service area and analyses these samples for numerous parameters as prescribed by the USEPA and FDEP regulations. Table 3-1 presents a table comparing average water test result parameters, of which this report is concerned, for the Seven Springs Water System with the Maximum

Concentration Limits set forth for each parameter by the regulatory agencies. Also included are test parameter results for several other water facilities located in Florida. This table indicates that the finished water produced by the Seven Springs Water System not only meets the current Federal and State standards, but in many cases, far exceeds the requirements. The table also shows that SSWS finished water is at least of typical quality, and in some cases, higher quality as compared to other Florida communities.

In addition to the Utility's analysis of the finished water produced by the Seven Springs Water System, the FDEP routinely inspects the water supply, treatment, storage and distribution facilities to assess the overall condition of the facilities and to determine the Utility's overall level of compliance with the FDEP's rules and regulations. The FDEP has not issued any notices of violation to the Utility as a result of the FDEP's last two yearly inspections.

Parameter	MCL or Action Level	Seven Springs Water System	Pinellas County	Pasco County	City of Melbourne	Orlando Utilities Commission
Sulfate	250 mg/L	10 mg/L	10 mg/L	25 mg/L	43 mg/L	9.4 mg/L
Copper	1.3 mg/L	<0.01 mg/L	0.04 mg/L	0.02 mg/L	BDL	<0.05 mg/L
Lead	0.015 mg/L	<0.001 mg/L	BDL	0.001 mg/L	0.0010 mg/L	<0.002 mg/L

BDL = Below Detection Limit

Water Quality Comparison

Table 3-1

Section 4-Existing and Pending/Future Regulatory Agency Regulations

A. Overview of Water Industry Related Regulations

Drinking water facilities located in the United States are regulated by the United States Environmental Protection Agency (USEPA). USEPA develops and promulgates regulations based on the laws enacted by Congress.

USEPA delegates the operation of the water system regulatory program to the various states (with the exception of two states). In Florida, the Florida Department of Environmental Protection is delegated by the USEPA to administer and operate the water regulatory program.

Individual States either adopt the USEPA regulations outright by reference in their regulations, develop their own water system regulations based on the USEPA regulations or develop their regulations utilizing both options.

USEPA regulations stipulate that State regulations must be "at least as stringent" as the USEPA rules. The State regulations may be more stringent to reflect specific conditions that exist in the particular State that may not exist in other States.

The States may also delegate the administration and operation of the water system regulation program to other political sub-entities; such as counties, water management districts, etc.

In addition to USEPA water industry specific regulations, water system operators are regulated by a large number of other Federal Government Agencies that do not specifically regulate water system operations. Examples of these agencies include OSHA, DOA, DOT and many others. The regulation of the water supply industry by agencies other than the USEPA are beyond the scope of this report and these regulations are not presented and/or discussed. In addition, USEPA regulations not specifically associated with the regulation of the water industry (such as TOSCA, SARA, NEPA, NHPA, etc.) are likewise beyond the scope of this report and are not presented and/or discussed.

The South West Florida Water Management District (SWFWMD) regulates and controls the use of water resources in the Aloha Utilities service area. SWFWMD has issued Aloha Utilities, Inc. a water use permit allowing the withdrawal, at specific rates, of ground water via the Seven Springs Water System water supply wells. Rules and regulations regarding the withdrawal of ground water change frequently to reflect the varying nature and condition of the aquifer.

B. Present United States Environmental Protection Agency Regulations

The Safe Drinking Water Act, passed by Congress in 1974, is the primary U.S. law which regulates the drinking water industry. This act has been reauthorized a number of times. In addition, it has

been amended as necessary to address concerns not originally contained in the law. Major amendments were added in 1986, and more recently, in 1996 during the law's last reauthorization.

Presently, a substantial number of amendments are being considered for inclusion into the Act at a future date. The USEPA has been tasked with developing the proposed language for these amendments. As part of its efforts, the USEPA is studying many existing regulations to determine if more stringent standards for key contaminants should be implemented. In addition, USEPA is studying new contaminants, not previously regulated, to determine which may be regulated in the near future.

The primary regulatory tools developed by the USEPA to implement the Safe Drinking Water Act consist of two major bodies of regulations, the National Primary Drinking Water Regulations and the National Secondary Drinking Water Regulations. In addition to these bodies of regulations, the USEPA has also developed a number of special regulation requirements that address specific types of water contaminant problems. These special regulations include the Surface Water Treatment Rule, the Total Coliform Rule, the Lead and Copper Rule, the Disinfection By-products Rule, the Inorganic and Synthetic Organic Chemical Rule, Ground Water Disinfection Rule, Radionuclides Rule and the Revised Monitoring Requirements. The USEPA also has specialized rules regarding Public Notification for systems that do not comply with the rules.

USEPA's body of regulations are complex and, at times, very difficult to comprehend. Measures taken by a Utility to comply with one set of requirements may cause the Utility to become out-of-compliance with other requirements. In general, a great number of a Utility's resources are applied to maintaining compliance with USEPA rules and regulations.

A copy of the reauthorized USEPA SDWA, showing the 1996 amendments is provided in Appendix A.

C. Present FDEP Regulations

In Florida, FDEP has been delegated primary enforcement responsibility for the operation of the State's drinking water program by the USEPA.

FDEP has promulgated rules and regulations that, primarily, parallel the USEPA regulations. In fact, FDEP has adopted, by reference in the Florida regulations, USEPA rules in some circumstances (such as the Lead and Copper Rule).

FDEP rules are therefore, equally complex and, at times, difficult to comprehend. As in dealing with the USEPA rules, a great number of a Utility's resources are applied to maintaining compliance with FDEP rules and regulations.

A copy of the FDEP rules that most impact the operation of the Seven Springs Water System is provided in Appendix A.

D. Present SWFWMD Regulations

SWFWMD promulgates water withdrawal regulations and oversees the water withdrawal permitting program.

Currently, the Seven Springs Water System lies in a geographical area designated a Water Use Caution Area (WUCA) by the SWFWMD. A WUCA is an area with a highly utilized water source (aquifer) that is in danger of being overused. Water withdrawals in a WUCA are closely monitored and controlled.

In the Seven Springs area, the SWFWMD has issued a moratorium on new water withdrawals, effectively banning the construction of new water wells that will increase water withdrawals over those presently permitted. This is presently a problem for the Seven Springs Water System as it is growing and additional water withdrawals are now and will continue to be needed in the future.

Aloha Utilities, Inc. is presently searching for unused water wells controlled by others in hopes of obtaining those wells for its use. In addition, Aloha is investigating the utilization of water sources outside the WUCA and the use of alternate aquifer withdrawals (deep aquifer withdrawals).

D. USEPA, FDEP and SWFWMD Pending/Future Regulations

Major changes to the entire body of water industry regulations are anticipated due to the requirements of the 1996 Amendments to the Safe Drinking Water Act. At the time of the preparation of this report, both the USEPA and the FDEP are preparing to make major modifications to the water rules. SWFWMD, because of the water shortage in the Northern Tampa Bay Water Use Caution Area, will be closely monitoring the usage of water by all regulated water utilities located in the area, and will, if necessary, adopt additional water conservation rules to reduce the consumption of water in the area.

Disinfection By-Product (M/DBP) Cluster Regulations

The M/DBP Cluster regulations, when promulgated, will become the first Final National Primary Drinking Water Regulation to be put forth by USEPA in several years.

These regulations will require utilities to reduce the quantity of by-products (produced when water is disinfected using current technology, such as chlorination) released in the finished water.

There is great debate over the mechanism the USEPA is attempting to utilize to determine which parameters will be regulated in the future. Therefore, the USEPA has set-up a number of advisory groups to assist it in developing the background data needed to decide how to study which parameters should be regulated.

These studies have slowed down the regulation promulgation process greatly. It is estimated, by

industry leaders (such as the American Water Works Association), that these regulations will not be available in draft format (for review) until 1998. It is possible that the rules will not go into effect until late 1998 or 1999.

The likely schedule for promulgation of these rules pose quite a dilemma for utilities designing and constructing new water facilities between now and 1998 or 1999, as future, and as yet unknown, rule changes will need to be taken into account in the design of these facilities because the new facilities will most assuredly be required to comply with the regulations in the future. Flexibility in the design of the facilities must be considered carefully and process units selected, today, must also be evaluated for suitability for use in the future.

Groundwater Disinfection Regulations

Since 1992 USEPA has been attempting to develop a rule that will require the disinfection of groundwater to eliminate viruses and certain strains of bacteria in drinking water. Because of the difficulty of monitoring for viral contamination, and other technical issues, the rule has not as yet been promulgated.

The USEPA has not yet determined what microbial pathogens will be regulated. However, it is the opinion of many utility operators and water engineers that, at a minimum, water utilities may need to begin utilizing a stronger disinfecting agent that does not form trihalomethanes (such as ozone) to comply with the future rules.

The likely schedule for promulgation of these rules pose quite a dilemma for utilities designing and constructing new water treatment facilities as future, unknown, rule changes will need to be taken into account in the design of these facilities. Flexibility in the design of the facilities must be considered carefully and process units selected today must be evaluated as to their suitability for use in meeting future requirements.

Radon Regulations

The Safe Drinking Water Act Amendments of 1996 had a significant impact on the status of the then pending Radionuclides Regulation. The USEPA was previously considering establishing a radon limit as low as 200 pCi/L (a very low number) prior to the Amendments. Now the USEPA has until 1999 to propose a new Radon Regulation that will set limits based on a risk assessment study and a study of the health benefits from the various radon mitigation measures.

The effect of the study requirements may have benefit in that the radon limits may be set at a number higher than the 200 pCi/L considered previously. However, the study requirement also has the negative effect of causing the rule making process to again be delayed until some time in the future (1999 minimum) leading to further uncertainty in the design of water facilities that will be utilized far into the future.

The likely schedule for promulgation of these rules pose quite a dilemma for utilities designing and

constructing new water facilities between now and 1999, as future, unknown, rule changes will need to be taken into account in the design of these facilities. Flexibility in the design of the facilities must be considered carefully and process units selected today must be evaluated for suitability of their use in the future.

Arsenic Regulations

The Safe Drinking Water Act Amendments of 1996 require USEPA to propose an arsenic regulation by January 2000 and to finalize the regulation by January 2001.

The likely schedule for promulgation of these rules pose quite a dilemma for utilities designing and constructing new water facilities between now and 2000 as future, unknown, rule changes will need to be taken into account in the design of these facilities. The new facilities will most assuredly be required to comply with the regulations in the future. Flexibility in the design of the facilities must be considered carefully and process units selected today must be evaluated for suitability of their use in the future.

Sulfate Regulations

On December 20, 1994, USEPA published a proposed regulation for sulfate that would limit the concentration of this compound to 500 mg/L. The proposed regulation would allow water systems to choose between central treatment and an alternative compliance option which included public education/notification and delivery of bottled water to sensitive sub-populations (infants, travelers, and new residents).

The 1996 Amendments require USEPA, in conjunction with the Center for Disease Control (CDC) to conduct a joint study that would "establish a reliable dose-response relationship for adverse health effects." The study is to be completed by February 1999. However, it appears that USEPA will run late completing this study as the study methodology has not been agreed to by the USEPA or the CDC and therefore, the study has not as yet begun.

For water utilities located in Florida, where sulfur bearing waters are common, this regulation may require treatment plant modifications in the future to comply with the rule.

Again, the likely schedule for promulgation of these new rules pose quite a dilemma for utilities designing and constructing new water facilities between now and 1999 or 2000 as future, unknown, rule changes will need to be taken into account in the design of these facilities as the new facilities will most assuredly be required to comply with new regulations in the future. Flexibility in the design of the facilities must be considered carefully and process units selected today must be evaluated for suitability of their use in the future.

Inorganic and Synthetic Organic Chemical Regulations

USEPA released a draft Contaminant Identification Method (CIM) in December 1996. This list

contained between 100 and 200 contaminants not previously regulated. A study group will narrow this list down to 20 to 30 contaminants. These candidates will form the first Drinking Water Contaminate Candidate List (DWCCL). The DWCCL, with its 20 to 30 contaminants, are to be published in February 1999. It will serve as the foundation of USEPA's future rule making activities.

It is anticipated that at least five (5) contaminants from the DWCCL will be considered for regulation by the year 2001.

As before, the likely schedule for promulgation of these rules pose quite a dilemma for utilities designing and constructing new water facilities between now and 2001 as future, unknown, rule changes will need to be taken into account in the design of these facilities as the new facilities will most assuredly be required to comply with new regulations in the future. Flexibility in the design of the facilities must be considered carefully and process units selected today must be evaluated for suitability of their use in the future.

Source Water Protection

The SDWA Amendments require the USEPA to publish guidelines, by August 1997, for delineating and assessing source waters (raw water sources), developing petition programs, and developing alternative monitoring requirements for water sources. The effect of these guidelines may be that utilities will need to obtain additional buffer areas around their water sources (wells or impoundments) as a means of protecting the source from contamination.

Operational/Administrative Issues

The 1996 SDWA Amendment also addresses a number of utility operational issues dealing with staff certification, capacity development, consumer confidence reporting, etc.

Each of these issues may have a direct, unknown, impact on the operation and maintenance costs associated with the water facilities. Therefore, any forecasting of O&M costs for new facilities will have a certain margin of error associated with them due to future regulatory issues.

FDEP Changes

Since FDEP is delegated to operate the USEPA's Drinking Water Program in Florida, any change in the USEPA regulations will require a parallel change to the FDEP regulations.

Rule changes unique to FDEP may occur due to special conditions present in Florida that are not universally encountered in other states. We are not aware of any such special conditions at this time, however, as the USEPA rules become more complex over the next 10 years, it is quite possible that special conditions may become known and will have to be addressed.

SWFWMD Changes

Water consumption and allocation rule changes are constantly being considered. While we are not aware of any rule changes pending at this time, the worsening problems being experienced in the North Tampa Bay Water Use Caution Area will likely cause additional regulation in the future.

Section 5-Existing Corrosion Control Program

A. Overview

This section of the report discusses the standard approach to correcting discolored water problems caused by copper sulfide formation as identified in the FPSC Order. This approach relies on the corrosion control program presently in use to prevent the dissolution of copper from the customer's plumbing into his water, thereby reducing the quantity of copper available to react with any sulfide that may be present. The copper sulfide formation reaction can not proceed if copper is not present in solution or copper pipe is not exposed to the attack of the sulfide.

B. Corrosion Control Basics

The corrosion control system consists of a chemical tank, pump and injector. The chemical pump removes corrosion inhibitor (a mixture of polyphosphate and orthophosphate) from its storage tank by way of a suction lift. This chemical is then placed under pressure by the pump and injected into the finished water stream at an existing well/treatment facility.

Once the chemical reaches the customer's home, it passes through his plumbing. When the chemical comes into contact with copper plumping, it first cleans any scale from the inner surfaces of the piping. Then, a thin film (only a few hundredths of an inch thick) of orthophosphate coats the copper piping surfaces. This coating prevents the water (and anything it contains, such as sulfide) from coming into contact with the copper.

If the water and any corrosive constituents that it may contain can not come into contact with the copper piping, then the copper will not be corroded. If no corrosion takes place, then no copper will be dissolved into the water. If no copper is available to combine with sulfide then no copper sulfide can be produced and the discolored water problem should not exist.

C. Operation of the Program

In actual operation, a number of factors can influence the level of success obtained with this type of corrosion control program.

In order for the corrosion inhibitor to function properly, it has to be applied at the optimum concentration. Finding this optimum concentration can take a substantial amount of time. Time is required to test the effectiveness of the inhibitor, adjust the feed rate of the chemical, wait for the new chemical dosage to spread throughout the distribution system, wait for the cleaning and coating action of the chemical to take place and then retest to see if the new dosage is optimum. This test, set new dosage, wait, retest loop may have to be completed a number of times before the optimum dosage is found.

Another factor that can greatly influence the effectiveness of the corrosion control program is the degree to which the inhibitor chemical reaches the copper plumbing of the customer's home. Customer's in-home water treatment units can actually remove the inhibitor chemical before it can reach the plumbing; thereby, rendering the corrosion control program ineffective. There is substantial doubt that the corrosion control program will benefit those customer's with in-home water treatment units. This is why the USEPA directs utilities performing compliance testing under the Lead and Copper Rule to eliminate those homes with in-home treatment units from their sampling pool of representative sampling sites.

The quantity of water used by the customer will also have an effect on the time that it will take for the customer to see the benefits of the program. It will take longer for the chemical to clean and coat the plumbing if the customer uses very little water. This is because the quantity of chemical applied to the plumbing is directly proportional to the quantity of water used. To reach the same level of inhibitor chemical applied to the plumping, more time will be required if less water is used per day.

D. Performance

The corrosion control program was put into operation the first week of April 1996. Since that time it has been monitored regularly.

During the early stages of the operation of the program, a special test system was installed in several locations throughout the service area. These test systems consisted of special test racks that allowed for the periodic measurement of the amount of copper that was being dissolved from copper bars placed in the Utility's finished water. The results of this special testing was used to set the primary dosage of the inhibitor chemical. Recently, a number of actual customer tap water samples were analyzed for copper. The results showed that the copper concentrations had fallen substantially in the majority of the samples. However, it is our opinion that further fine-tuning of the chemical dosage (which is underway as this paper is being written) will yield still lower copper concentrations.

The test results, coupled with the reduction in discolored water complaints received by the Utility in the last several months leads us to conclude that the corrosion control system is improving the discolored water situation substantially, and that, with further fine-tuning, additional reductions in the occurrence of discolored water can be realized.

Section 6-Enhanced Water Treatment Alternatives Individual Water Systems

A. Overview

This section of the report discusses retrofitting the existing eight water well/treatment plants to remove hydrogen sulfide and providing two new well/treatment plants (to meet 1998 projected demands) as required in the FPSC order. The FPSC is hopeful that the removal of hydrogen sulfide from the finished water will reduce the incidence of discolored and/or odorous water being experienced by a small, localized number of customers located in the southeastern service area. This alternative, as studied here, will increase the water system capacity to meet the 1998 design year water demands, however, the modified system will not meet water demands after that date.

The FPSC's assumption that removing hydrogen sulfide from the finished water would reduce water discoloration and odor would generally comport with conventional theory. The water odor reported is generally caused when sulfate, present in the water, is reduced back to hydrogen sulfide by the action of sulfur reducing bacteria which live in the customer's hot water tank and piping (especially where the chlorine is removed by in-home treatment units). This is why these concerns occur primarily at the customer's hot water tap. The water discoloration is generally caused by the subsequent bonding of the sulfide and dissolved copper, forming, copper sulfide, a black-green substance. This also would logically occur primarily at the customer's hot water tap.

It is well documented that copper piping systems corrode at a higher rate in many parts of Florida than in other parts of the Country. This is largely due to the raw water characteristics found in many Florida communities and from the use of in-home water treatment units that can modify the water chemistry from that supplied by the utility to make it very corrosive.

If all sulfur were to be removed from the finished water, then, in theory, the water odor and discoloration problems would be greatly reduced. However, new research has shown that this assumption may not be correct.

As this report is being written, a team from the University of Colorado is preparing a research paper that reports on a detailed investigation into the very problems being experienced here. To the best of our knowledge, the University of Colorado team is the only research group studying the mechanism by which copper sulfide is formed.

The initial draft of the University of Colorado study report have concluded that once the copper sulfide compound has been formed and has attached to the walls of the copper piping, removal of the source of sulfide in the water did not eliminate the formation of the copper sulfide. The conclusion reached by the researchers was that the copper sulfide acted as a catalyst and until it was physically and completely removed from the existing piping, copper corrosion and the formation of

discolored water would continue. Complete removal of existing copper sulfide deposits would require a scouring of all copper pipes within the customer's home which is not feasible under any existing technology.

Early indications are that the Colorado study will shed considerable doubt that the removal of hydrogen sulfide from the finished water would correct the problems being experienced by some of Aloha's customers.. The researchers have tentatively concluded that additional research would need to be conducted to find a cost effective method for removing the copper sulfide from the copper piping if the corrosion and discoloration problems were to be reduced significantly. However, it is still possible that the water odor may be reduced if the hydrogen sulfide is removed from the finished water.

It is important to note that the Seven Springs Water System water quality meets, and in many cases, far exceeds the minimum quality requirements of the USEPA and FDEP and that of many other water companies. Table 3-1, presented in Section 3 previously, shows typical water quality for Seven Springs and for other utilities.

As discussed in Section 5, pending USEPA and FDEP regulations may soon require this utility to add additional treatment equipment to increase the efficiency of removing other contaminants (such as THMs) or to remove contaminants not now regulated. These potential changes must be considered when any modification to the existing facilities is considered. Since further THM reduction is considered to be an almost certain eventuality, the inclusion of a dual disinfection system (using ozone and chlorine) must be included in any proposed modification to the facilities.

Based on the water demands projected, and anticipated increases in the treatment requirements, it would appear imprudent to construct very costly modifications to the existing individual water wells/treatment facilities only to have this new construction rendered useless within a few years. Therefore, we have included an additional alternative (Alternative Two) that evaluates that modification of the entire water system, supply, treatment, storage and pumping at two new sites and at one retrofitted existing water storage site. Alternative Two is discussed in Section 7.

C. Alternatives Considered

Four technologies were considered, tray aeration, packed tower aeration, reverse osmosis and ion exchange. Figures 6-1, 6-2, 6-3 and 6-4 show typical process diagrams that would implement these technologies. After considerable research, Aloha and its consultants are not aware of any other alternative technologies presently available to address removal of hydrogen sulfide.

Of the four technologies, reverse osmosis and ion exchange were not extensively studied. As discussed later in this Section, the use of these technologies for the removal of hydrogen sulfide is not a standard use of the technology. No data was available, in text books or from equipment manufacturer's, regarding the use of these technologies for the removal of hydrogen sulfide. Letters from ion exchange and reverse osmosis technology experts stating that these technologies are not appropriate for the removal of hydrogen sulfide are included in Appendix B. These technologies are

briefly discussed here, however, detailed cost estimates were not prepared for them.

Tray aeration and packed tower aeration are appropriate technologies for the removal of hydrogen sulfide. However, based on the preliminary drafts of the University of Colorado study report, hydrogen sulfide concentrations must be reduced to very low values (<0.07 mg/L) if one is to prevent the formation of copper sulfide. Therefore, tray aeration, which is only 50 to 65% efficient in the removal of hydrogen sulfide, is not a viable alternative. Under conventional theory, packed tower aeration, with extensive modifications to increase its performance, is the only technology that is capable of reducing hydrogen sulfide concentrations to low enough concentrations to prevent new copper sulfide from forming in virgin piping. It must be kept in mind that the draft University of Colorado study report states that the piping systems which have copper sulfide already attached may not fully benefit from the reduced hydrogen sulfide concentrations until the existing copper sulfide compound is removed completely (for which there is no known method at this time).

It is important to note that the process train shown in the figures and the cost estimates are based on theoretical water chemistry. Actual pilot testing will need to be completed and the process train and/or cost estimates adjusted prior to any final design work commencing. Also, the alternatives presented in this Section do not in any way provide for any increased capacity of the water system; the modifications discussed here will only provide for a reduction in the hydrogen sulfide concentration of the finished water.

D. Tray Aeration

Figure 6-1 graphically presents the process flow diagram for this alternative. Sulfur, in aqueous solution, exists in several forms dependent on the pH (relative level of acidity and alkalinity). At low pH, approximately 5.0, it exists almost entirely as hydrogen sulfide, a gas. If the pH is greater than this value, the sulfur can exist in a number of forms, some of which are a solid and not a gas. Therefore, if one wishes to remove as much sulfur as possible from the water, the pH should first be reduced to 5.0.

After pH adjustment, the water will be applied to a tray aerator. A tray aerator is a device that allows water to cascade over a number of impediments in its path as it falls by gravity from an elevated tray to lower trays. As the water cascades over these trays, it is mixed with air. This mixing action causes the hydrogen sulfide to be driven from the water and into the surrounding atmosphere.

After the hydrogen sulfide gas has been stripped (gassed-off) into the surrounding atmosphere, the pH of the water is again adjusted to that required for further treatment (pH 7.5 to 8.0).

After tray aeration, the water is now at atmospheric pressure and must be pressurized so that it can be transferred to a storage tank. On its way to the storage tank, ozone (a powerful disinfectant) and chlorine (a less effective disinfectant) are injected into the water stream. Ozone is utilized as the primary disinfectant (it is better able to kill viruses and other resistant pathogens) and chlorine is added because it has a residual effect that ozone does not. This residual effect is utilized to maintain

the water disinfection throughout the water distribution system.

High service pumps pressurize the water and send it to the distribution system.

A storage tank is required to allow the treatment equipment to operate continuously for 8 to 12 hours a day. Water from the tank is sent to the distribution system as it is required at much shorter intervals in an intermittent manner. The treatment equipment would not function properly if they were to be turned on and off frequently as the chemical systems take time to come into equilibrium when they are first turned-on.

Additional system capacity, beyond the capacity of the existing facilities, will be required in the 1998 design year. Appendices C, D and E present a detailed analysis and discussion of the 1998 and 2015 design year water demands. This capacity (approximately 0.5 mgd) will be provided by the construction of two completely new water well/treatment facilities. These facilities will be identical to the modified facilities described herein.

This system, will remove approximately 50 to 65 % of the hydrogen sulfide in the raw water. The estimated costs to add this equipment to all eight well sites is $9,780,805 for capital costs and $1,180,000 for pilot testing, engineering, permitting and start-up expenses. The estimated cost to operate this system is $3,406,866 per year. Detailed costs estimates can be found in Section 8.

Manufacturer's data for the equipment required for this alternative can be found in Appendix B.

This alternative is not viable for the following reasons:

1. The 50 to 65% reduction is not great enough, based on the University of Colorado study findings, to make any measurable difference in the formation of copper sulfide.
2. The hydrogen sulfide gas liberated from the water is discharged into the surrounding atmosphere. This gas has a very bad odor (rotten egg), can eat paint off homes and cars it comes in contact with, and in high enough concentrations it can be a health hazard and fire/explosion hazard. It is doubtful that the FDEP would allow the release of this gas into the atmosphere without treatment based on the fact that the existing facilities are located near homes and businesses.
3. The existing well sites do not contain sufficient land area to construct the necessary equipment.
4. Should future regulation changes require additional treatment units be installed to comply, it will be very difficult and expensive, if not impossible all together, to further modify these individual facilities.
5. No future water supply, treatment, storage or distribution capacity beyond the projected 1998 design year demands have been included in the development of the costs for this alternative. The provision of this capacity will soon be required due to growth of the system. Substantial additional costs will be incurred, beyond those presented here to provide this capacity in the future.
6. The existing facilities do not have sufficient capacity to meet the projected 2015 water

demands. Therefore, the capital cost expended may be at risk if the facilities are abandoned or modified for use as raw water pumping stations.

7. The capital and operating costs associated with this alternative are substantial and greater than those associated with Alternative 2, however, Alternative 2 is more efficient in removing H_2S and provides for treatment, storage, pumping and distribution capacity to meet the 2015 projected water demands which this alternative does not.

E. Packed Tower Aeration

Figure 6-2 graphically presents the process flow diagram for this alternative. Sulfur, in aqueous solution, exists in several forms dependent on the pH (relative level of acidity and alkalinity). At low pH, approximately 5.0, it exists almost entirely as hydrogen sulfide, a gas. If the pH is greater that this value, the sulfur can exist in a number of forms, some of which are a solid and not a gas. Therefore, if one wishes to remove as much sulfur as possible from the water, the pH should first be reduced to pH 5.0.

After pH adjustment, the water will be applied to a packed tower aerator. A packed tower aerator is a device that allows water to enter a tower case and then cascade over a number of specially designed impediments (packing) in its path as it falls by gravity from an elevated spray system to a lower storage sump. Air is forced into the water's path as it falls by use of an electric blower. As the water cascades over the packing, it is mixed with the large quantity of air being forced into the tower. This mixing action causes the hydrogen sulfide to be driven from the water. The hydrogen sulfide gas that has been stripped (gassed-off) from the water is contained with this system. This contained hydrogen sulfide gas is them treated (pre-stripped and carbon stripped) prior to its being released into the surrounding atmosphere.

The pH of the water is again adjusted to that required for further treatment (pH 7.5 to 8.0) after the packed tower stripper. After packed tower aeration, the water is now at atmospheric pressure and must be pressurized so that it can be transferred to a storage tank. On its way to the storage tank, ozone (a powerful disinfectant) and chlorine (a less effective disinfectant) are injected into the water stream. Ozone is utilized as the primary disinfectant (it is better able to kill viruses and other resistant pathogens) and chlorine is added because it has a residual effect that ozone does not. This residual effect is utilized to maintain the water disinfection throughout the water distribution system.

High service pumps pressurize the water and send it to the distribution system.

A storage tank is required to allow the treatment equipment to operate continuously for 8 to 12 hours a day. Water from the tank is sent to the distribution system as it is required at much shorter intervals in an intermittent manner. The treatment equipment would not function properly if they were to be turned on and off frequently as the chemical systems take time to come into equilibrium when they are first turned-on.

Additional system capacity, beyond the capacity of the existing facilities, will be required in the 1998 design year. Appendices C, D and E present a detailed analysis and discussion of the 1998 and

2015 design year water demands. This capacity (approximately 0.5 mgd) will be provided by constructing two completely new water well/treatment facilities. These facilities will be identical to the modified facilities described herein.

This system, will remove approximately 95% of the hydrogen sulfide in the raw water. The estimated costs to add this equipment to all eight well sites is $12,457,583 for capital costs and $1,400,900 for pilot testing, engineering, permitting and start-up expenses. The estimated cost to operate this system is $3,707,466 per year. Detailed costs estimates can be found in Section 8.

Manufacturer's data for the equipment required for this alternative can be found in Appendix B.

This alternative is not viable for the following reasons:

1. The existing well sites do not contain sufficient land area to construct the necessary equipment.
2. Should future regulation changes require additional treatment units be installed to comply, it will be very difficult and expensive, if not impossible all together, to further modify these individual facilities.
3. No future water supply, treatment, storage or distribution capacity beyond the projected 1998 design year demands have been included in the development of the costs for this alternative. The provision of this capacity will soon be required due to growth of the system. Substantial additional costs will be incurred, beyond those presented here to provide this capacity in the future.
4. The existing facilities do not have sufficient capacity to meet the projected 2015 water demands. Therefore, the capital cost expended may be at risk if the facilities are abandoned or modified for use as raw water pumping stations.
5. The capital and operating costs associated with this alternative are substantial and much greater than those associated with Alternative 2, however, Alternative 2 provides for treatment, storage, pumping and distribution capacity to meet the 2015 projected water demands which this alternative does not.

One additional concern with this alternative is that the oxygen concentration of the water leaving the packed tower will be very high (over 5 mg/L). Oxygen levels over 2 mg/L are considered to be undesirable as they tend to be corrosive. Therefore, de-gassification may need to be added, at potentially great additional expense, to the process train if it is found to be needed during pilot testing. Also, corrosion control chemicals may be required (as practiced at this time); this will be determined during pilot testing.

F. Reverse Osmosis

As can be seen in Figure 6-3, adding reverse osmosis only add a layer of complexity to the packed tower alternative. No measurable benefit regarding hydrogen sulfide removal will be realized. As described above, the reverse osmosis process is not utilized to remove hydrogen sulfide. Its primary purpose is the removal of dissolved salts from water. Two letters, from reverse osmosis experts, are

included in Appendix 5 which confirms these statements. No additional study or analysis was undertaken considering this alternative.

G. Ion Exchange

As described earlier, the ion exchange process is not utilized to remove hydrogen sulfide. Its primary purpose is the removal of undesirable anions and cations from water (iron, aluminum, lead, zinc, etc. As shown in Figure 6-4, it is possible, in theory, to convert hydrogen sulfide gas, via oxidation by chlorination or ozonation, to sulfate. Then this sulfate can be removed by ion exchange. However, in order to accomplish this, a dual cation-anion exchanger will be required that would remove **all** the minerals in the water, producing de-ionized water. This water would have a very bad flavor unless exactly measured quantities of minerals were added back into the water stream. This would result in a very costly and very difficult to operate system that would not be practical. No additional study or analysis was undertaken considering this alternative.

One letter, from an ion exchange expert, is included in Appendix 5 which confirms these statements.

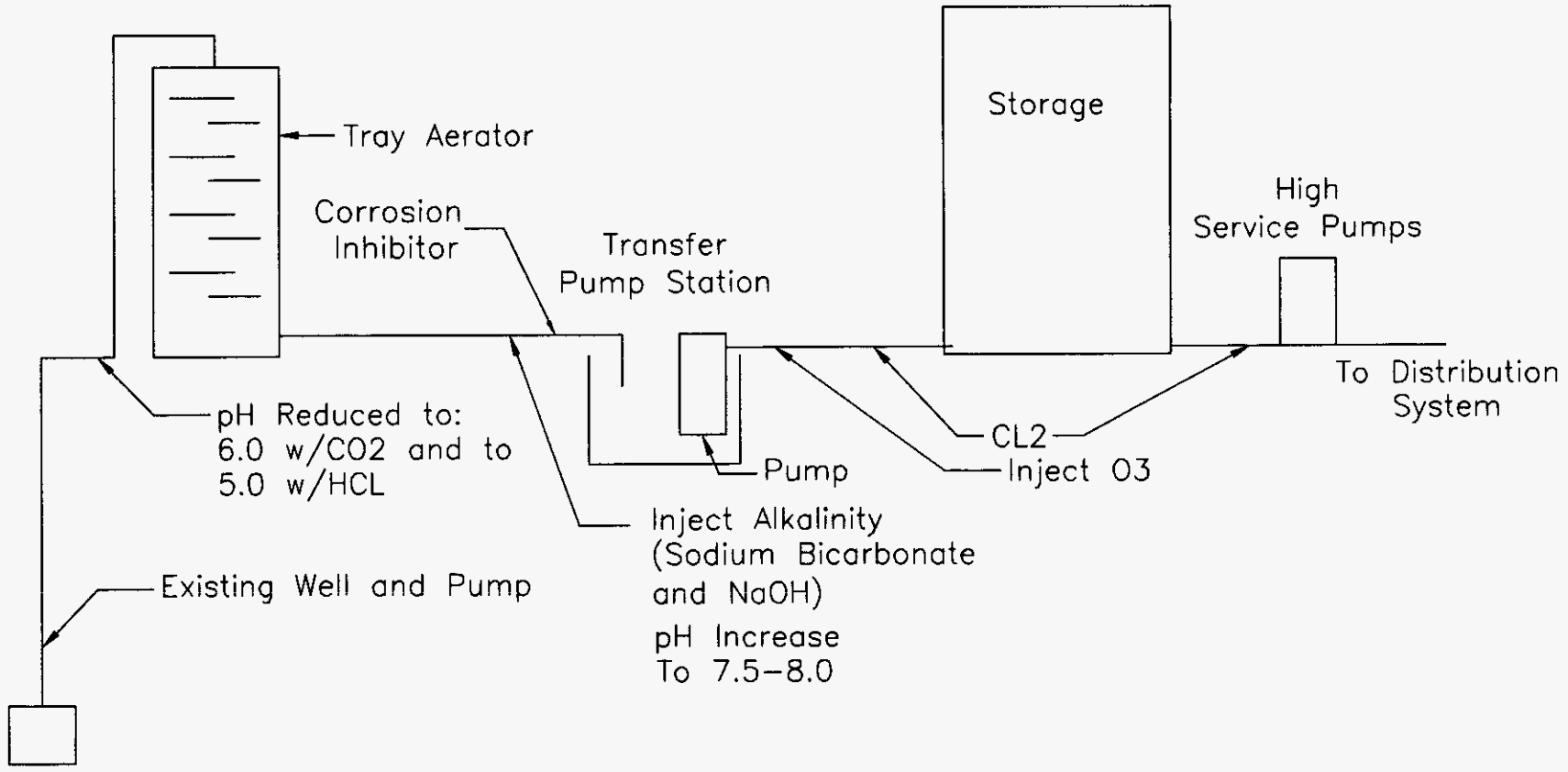


Figure 6-1

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Process Diagram

Alternative One/A
Tray Aeration
Treatment Upgrade/System Expansion

PROJECT NO. AUI-011-1-R1
DATE May 2, 1997
SCALE None
SHEET 01 OF 01

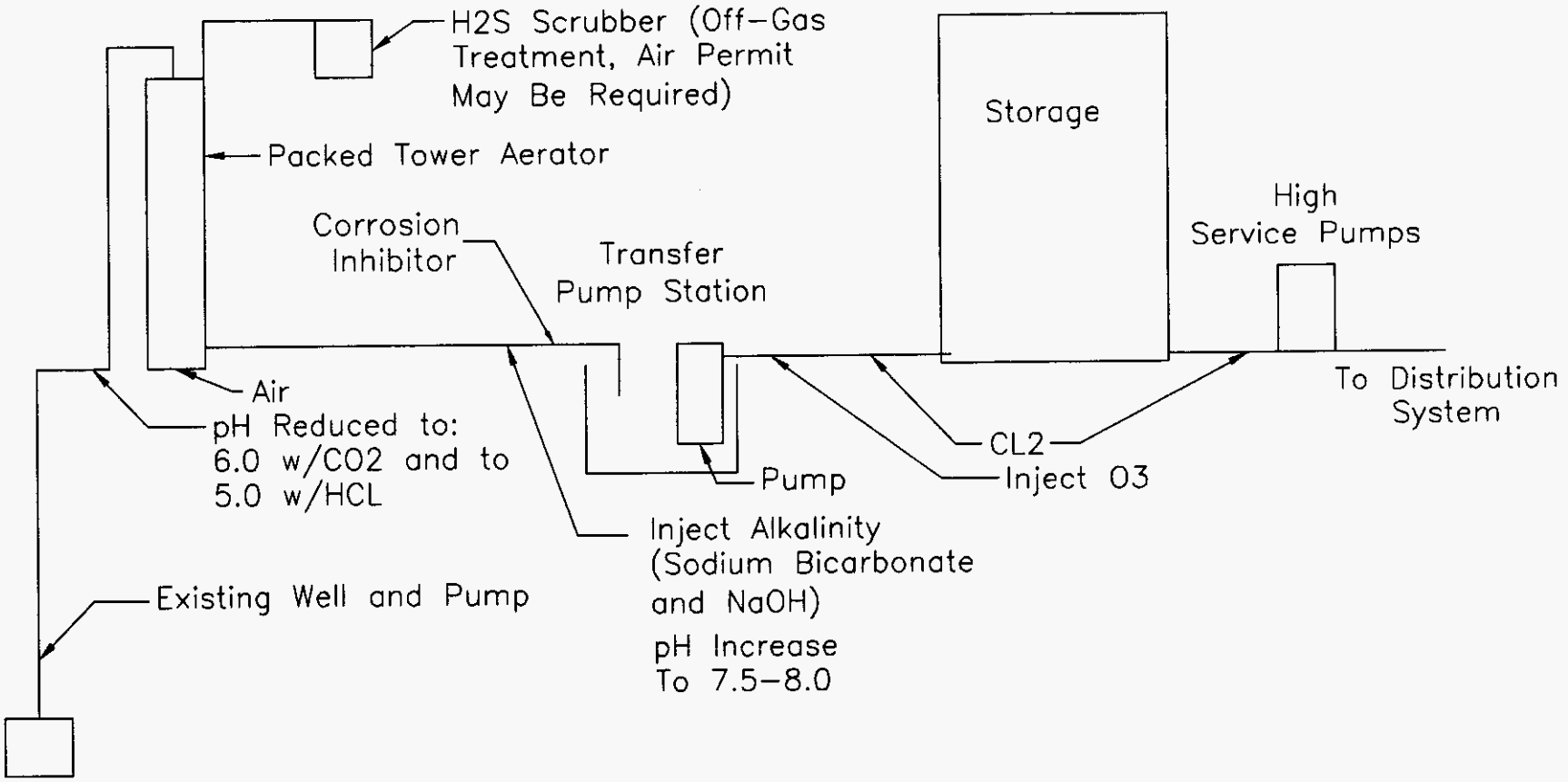


Figure 6-2

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Process Diagram

Alternative One/B
Packed Tower Aeration
Treatment Upgrade/System Expansion

PROJECT NO. AUS-08-1-R
DATE May 8, 1997
SCALE None
SHEET 01 OF 01

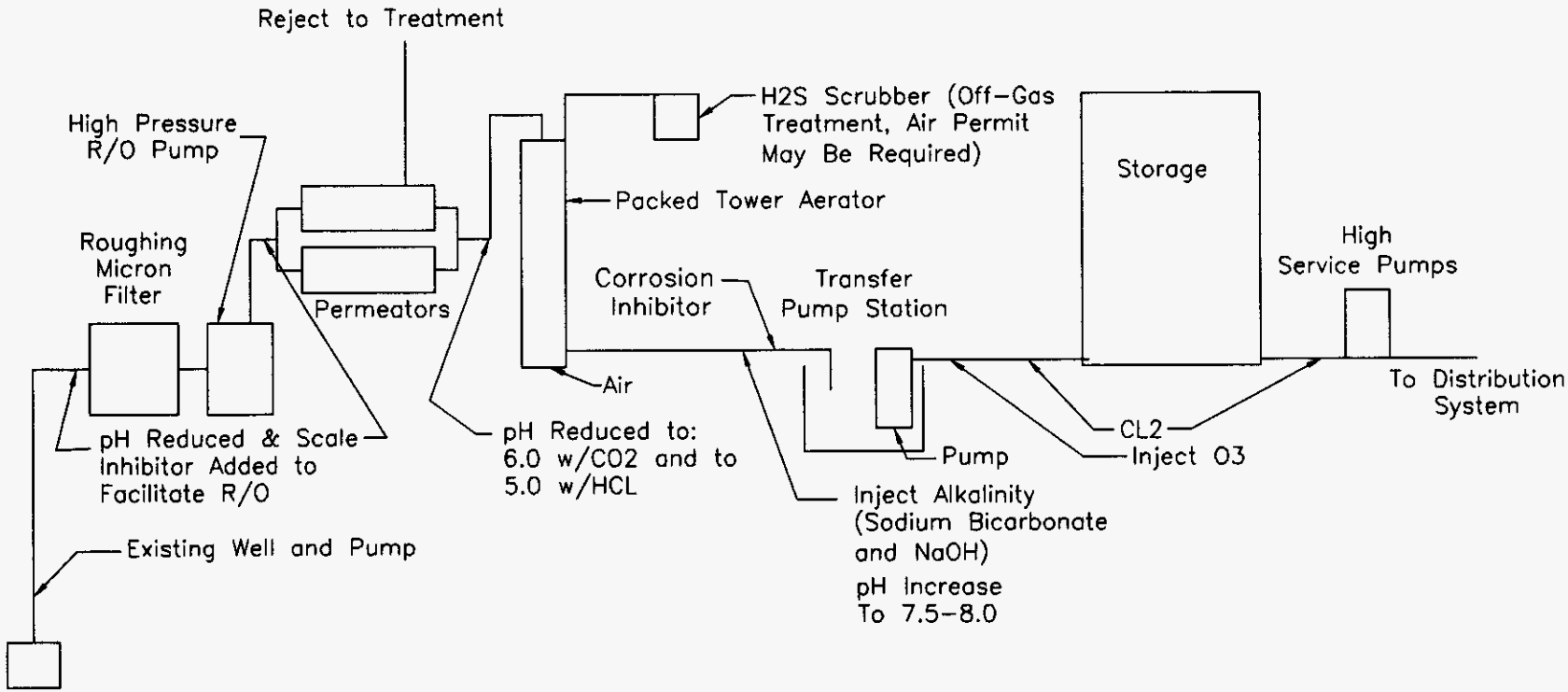


Figure 6-3

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Process Diagram

Alternative One/C
Reverse Osmosis
Treatment Upgrade/System Expansion

PROJECT NO. ALS-011-1-R
DATE May 2, 1997
SCALE None
SHEET 01 OF 01

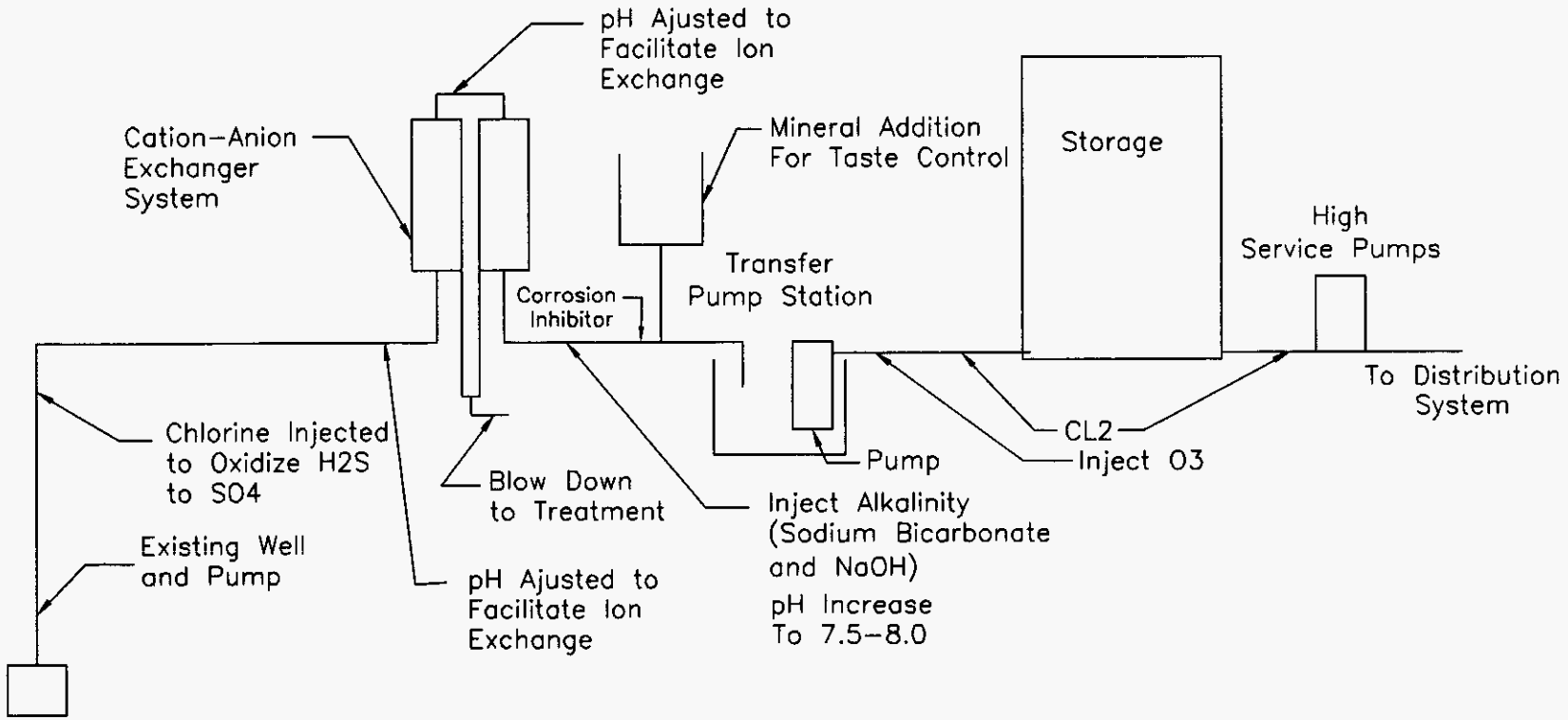


Figure 6-4

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Process Diagram

Alternative One/D
Ion Exchange
Treatment Upgrade/System Expansion

PROJECT NO. AUI-OTI-1-R
DATE May 2, 1997
SCALE None
SHEET 01 OF 01

Section 7-Enhanced Water Treatment Alternatives Centralized Water System

A. Overview

This section of the report discusses the provision of additional water supply wells, packed tower aeration facilities, additional finished water storage tanks and high service pumping units for three (3) centralized water facilities as an alternative for upgrading the Seven Springs Water System. This cost-effective alternative will provide for hydrogen sulfide removal as well as increased total system capacity. This centralized system will be capable of meeting the immediate 1998 water supply, treatment, storage and pumping needs of the Seven Springs Water System. In addition, with the addition of just new raw water supply capacity (1.75 mgd), the system as detailed here will serve the 2015 design year complete system water demands as well.

As was discussed in the last Section, merely retrofitting the existing facilities to include a means of removing hydrogen sulfide is very short sighted and potentially risky. We believe that rapidly accelerating water use demands and impending regulation changes require the consolidation and upgrading of the existing eight water well/treatment plants to serve as raw water pumping stations, modification of the existing water storage and pumping facility to become a regional treatment, storage and pumping facility, and construction of two new treatment, storage and pumping facilities.

Note that the additional 1.75 mgd raw water capacity must be developed as it does not now exist. Due to the SWFWMD ban on new water well construction that will result in new water withdrawals, the Utility must look elsewhere for this needed capacity. Several possible options are the purchase of existing land areas which presently have a water well that is permitted by SWFWMD, purchasing raw water from a regional supplier and/or developing a deep well supply source and modifying the treatment train to provide treatment for the type of high sodium concentration water that will be obtained. The process diagrams and cost estimates provided in this report do not consider these options.

The process train shown in the figures and the cost estimates are based on theoretical water chemistry. Actual pilot testing will need to be completed and the process train and/or cost estimates adjusted prior to any final design work commencing.

One additional concern with this alternative is that the oxygen concentration of the water leaving the packed tower will be very high (over 5 mg/L). Oxygen levels over 2 mg/L are considered to be undesirable as they tend to be corrosive. Therefore, de-gassification may need to be added, at potentially substantial additional cost, to the process train if it is found to be needed during pilot testing. Also, corrosion control chemicals may be required (as practiced at this time); this will be determined during pilot testing.

B. Mitchell Road WTP

The existing water storage and pumping facility will be retrofitted to include the equipment shown in Figure 7-1. The facility will be rated at 1,300 gpm treatment capacity and will have 0.5 mg of storage capacity. It is located as shown in Figure D-1 in appendix D.

The facility will include hydrogen sulfide removal and enhanced dual disinfection. The process Flow Diagram for this facility is presented graphically in Figure 7-4.

C. Industrial Park WTP

This new water storage and pumping facility will include the equipment shown in Figure 7-2. The facility will be rated at 2,000 gpm treatment capacity and will have 1.0 mg of storage capacity. It will be located as shown in Figure D-1 in appendix D.

The facility will include hydrogen sulfide removal and enhanced dual disinfection. The process Flow Diagram for this facility is presented graphically in Figure 7-4.

D. Wyndtree WTP

This new water storage and pumping facility will include the equipment shown in Figure 7-3. The facility will be rated at 2,000 gpm treatment capacity and will have 1.0 mg of storage capacity. It will be located as shown in Figure D-1 in appendix D.

The facility will include hydrogen sulfide removal and enhanced dual disinfection. The process Flow Diagram for this facility is presented graphically in Figure 7-4.

E. Transmission System Improvements

In order to transport raw water from the existing wells (and the proposed wells) to the new treatment facilities and finished water from the new treatment facilities to the distribution system, a number of piping modifications and extensions must be completed. These modifications are discussed in detail in Appendices D and E. These modifications will provide the increased water distribution capacity needed to meet the 2015 water demands. Without these modifications, the increased quantity of water produced at the new water facilities would not be able to be transported to the customers.

F. New and Modified Water Wells

Several of the existing water wells are not located properly to supply water cost-effectively to the new water plants. These wells will need to be relocated and upgraded. In addition, additional water wells will be needed to meet the 1998 and 2015 water demands. These new wells and modifications are discussed in detail in Appendices D and E.

These well modifications will only supply the 1998 water demands. An additional source of raw water rated at 1.75 mgd will be needed to meet the 2015 water demands. This water source is as yet not defined and therefore, no cost figures have been included for this item. It is possible that this water may need to be supplied by water from a lower aquifer (requiring additional treatment) or by purchase from another entity.

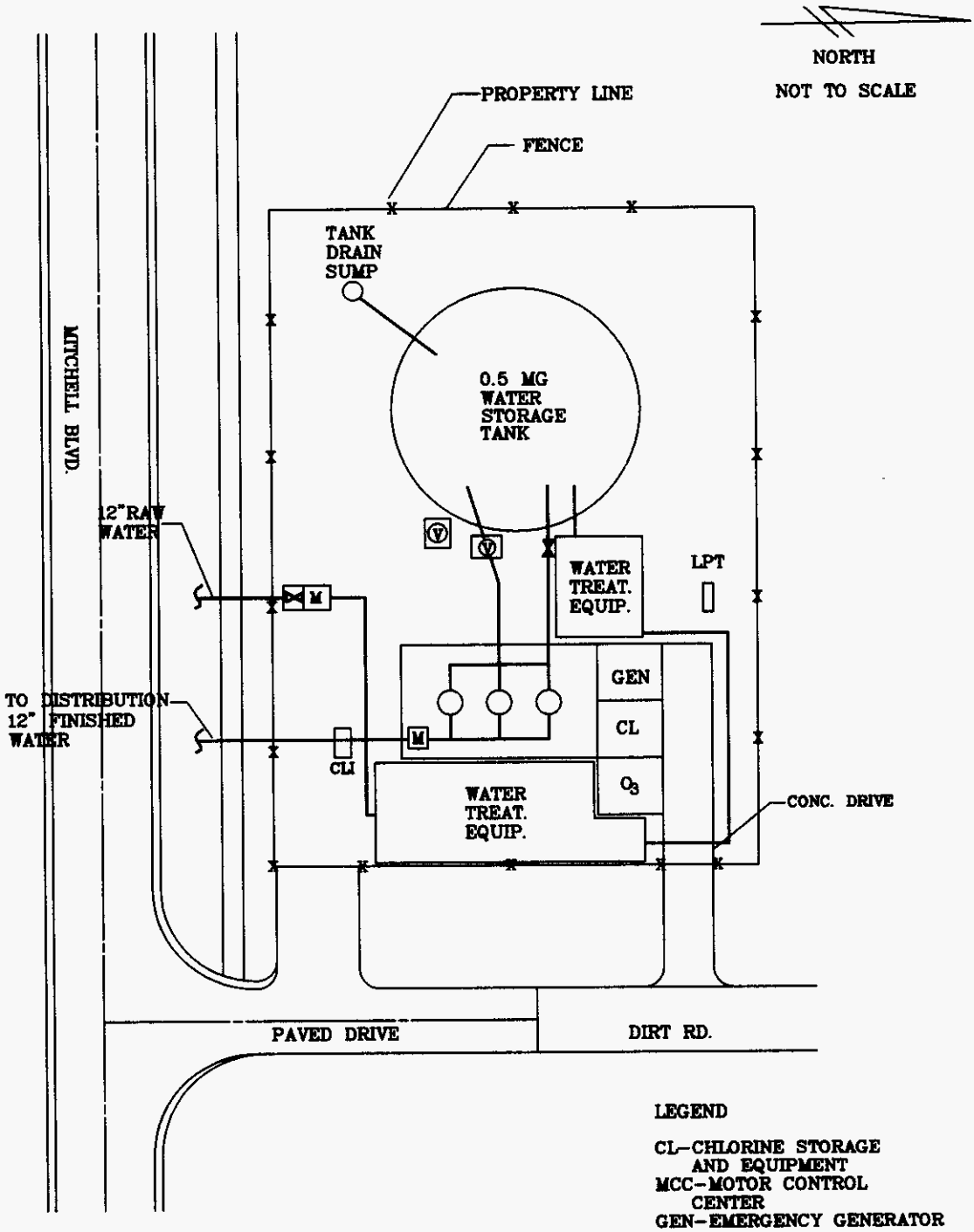
G. Removal of Hydrogen Sulfide Efficiency and Estimated Costs

Each facility, will remove approximately 95% of the hydrogen sulfide in the raw water. The estimated cost to add this equipment to construct all the facilities in this Section is $9,485,692 for capital costs and $1,424,000 for pilot testing, engineering, permitting and start-up expenses. The estimated cost to operate this system is $2,891,490 per year based on 1998 water demand flow rates. Detailed costs estimates can be found in Section 9.

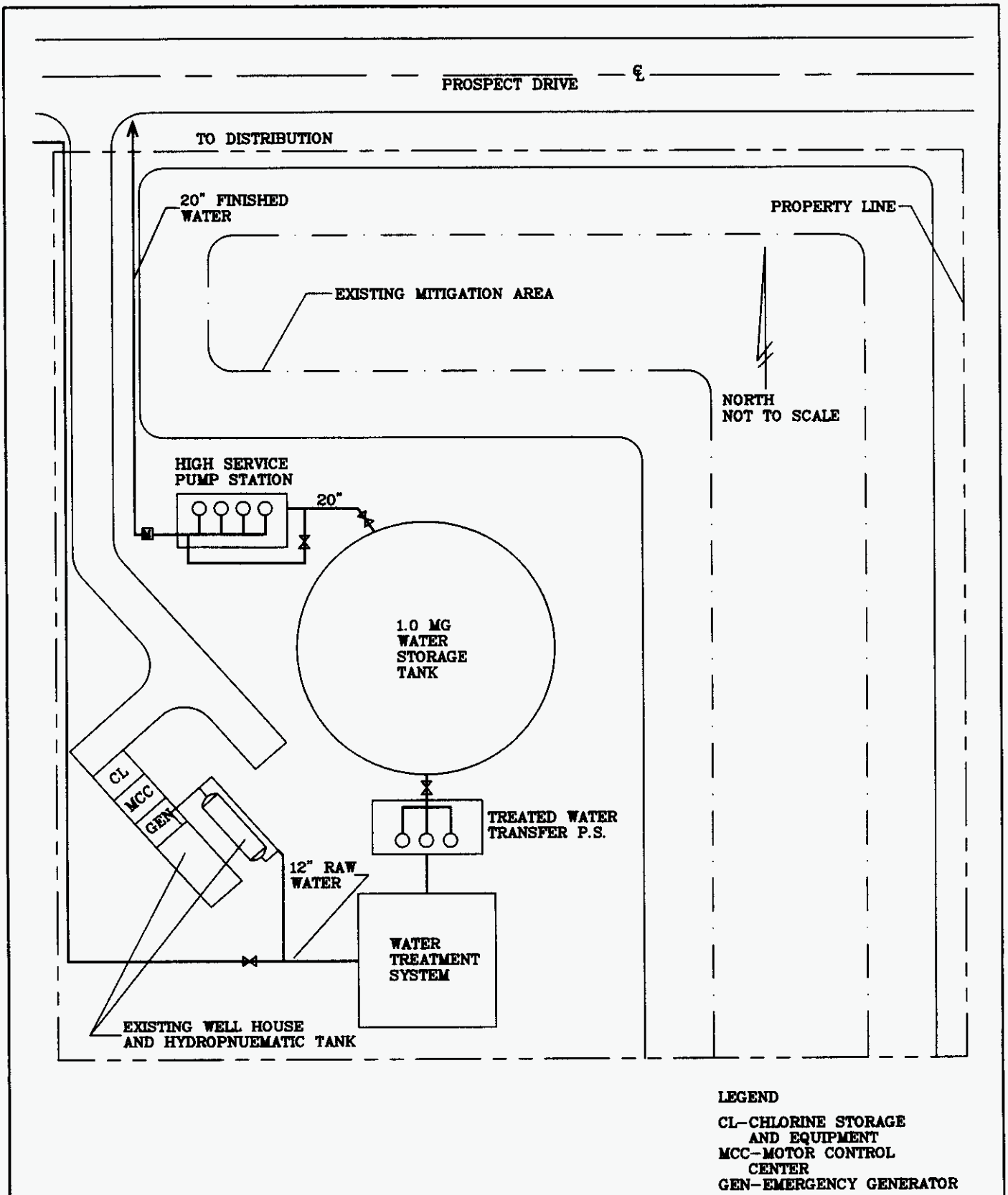
This alternative is considered superior to Alternatives 1A and 1B because:

1. This alternative not only makes provision for hydrogen sulfide removal, but, also provides for the long term utilization of the facilities by adding new water supply, storage, pumping and distribution system improvements that will allow for the continued use of the facilities well into the next century.
2. The water treatment units proposed for this alternative are sized to treat the quantity of water projected to be demanded daily in 2015.
3. The storage and pumping facilities proposed for this alternative are sized to store and pump the quantity of water projected to be demanded daily in 2015.
4. The distribution system modifications proposed for this alternative are sized to deliver the quantity of water projected to be demanded daily in 2015.
5. Future process modifications, caused by future regulation changes, will be relatively easy to implement. The proposed facilities will have sufficient space available so that additional process units can be added easily.
6. The consolidation of the existing multiple treatment facilities into three regional facilities will allow for realization of marginal cost benefits in the operation of the facilities.
7. Because of the forward thinking development of this alternative, there is less risk of obsolesce than there is with the Alternatives 1A and 1B.
8. This alternate is much more efficient in removing H_2S that alternative 1B (95% vs. 50-65%).
9. The capital costs associated with this alternative are slightly less than and the operating costs are substantially less than those associated with Alternative 1A, however this alternative is more efficient in removing H_2S and provides for treatment, storage, pumping and distribution capacity to meet the 2015 projected water demands which Alternative 1A does not.
10. The capital and operating costs associated with this alternative are substantially less than those associated with Alternative 1B, however this alternative provides

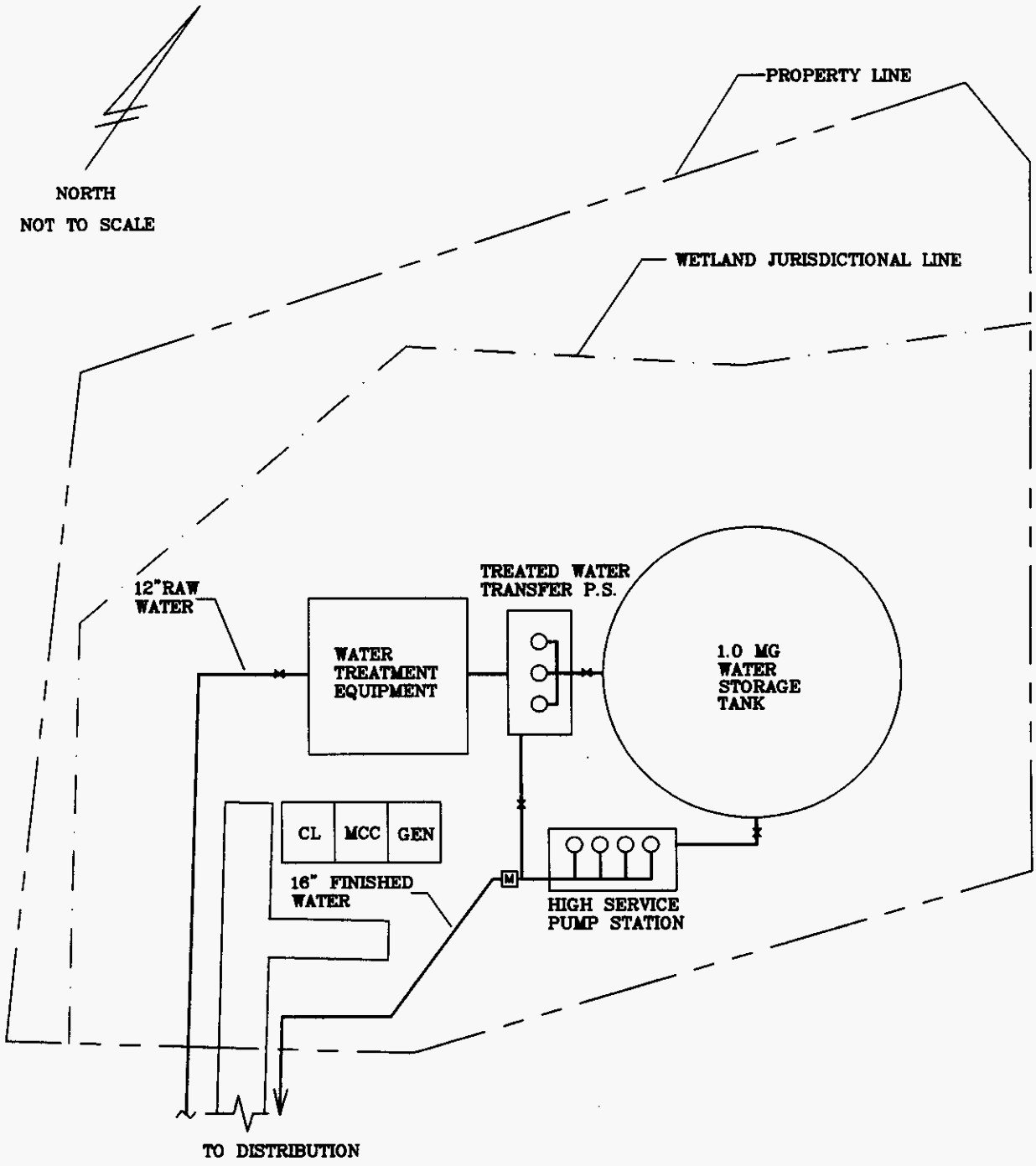
for treatment, storage, pumping and distribution capacity to meet the 2015 projected water demands which Alternative 1A does not.



Civil Engineering Associates Inc. 720 E. FLETCHER AVE. TAMPA FLORIDA	SEVEN SPRINGS WATER SYSTEM MITCHELL ROAD WATER PLANT	FIGURE 7-1



Civil Engineering Associates Inc. 720 E. FLETCHER AVE. TAMPA FLORIDA	SEVEN SPRINGS WATER SYSTEM INDUSTRIAL PARK WATER PLANT	FIGURE 7-2



LEGEND

CL–CHLORINE STORAGE AND EQUIPMENT
MCC–MOTOR CONTROL CENTER
GEN–EMERGENCY GENERATOR

Civil Engineering Associates Inc. 720 E. FLETCHER AVE. TAMPA FLORIDA	SEVEN SPRINGS WATER SYSTEM WYNDTREE WATER PLANT	FIGURE 7–3

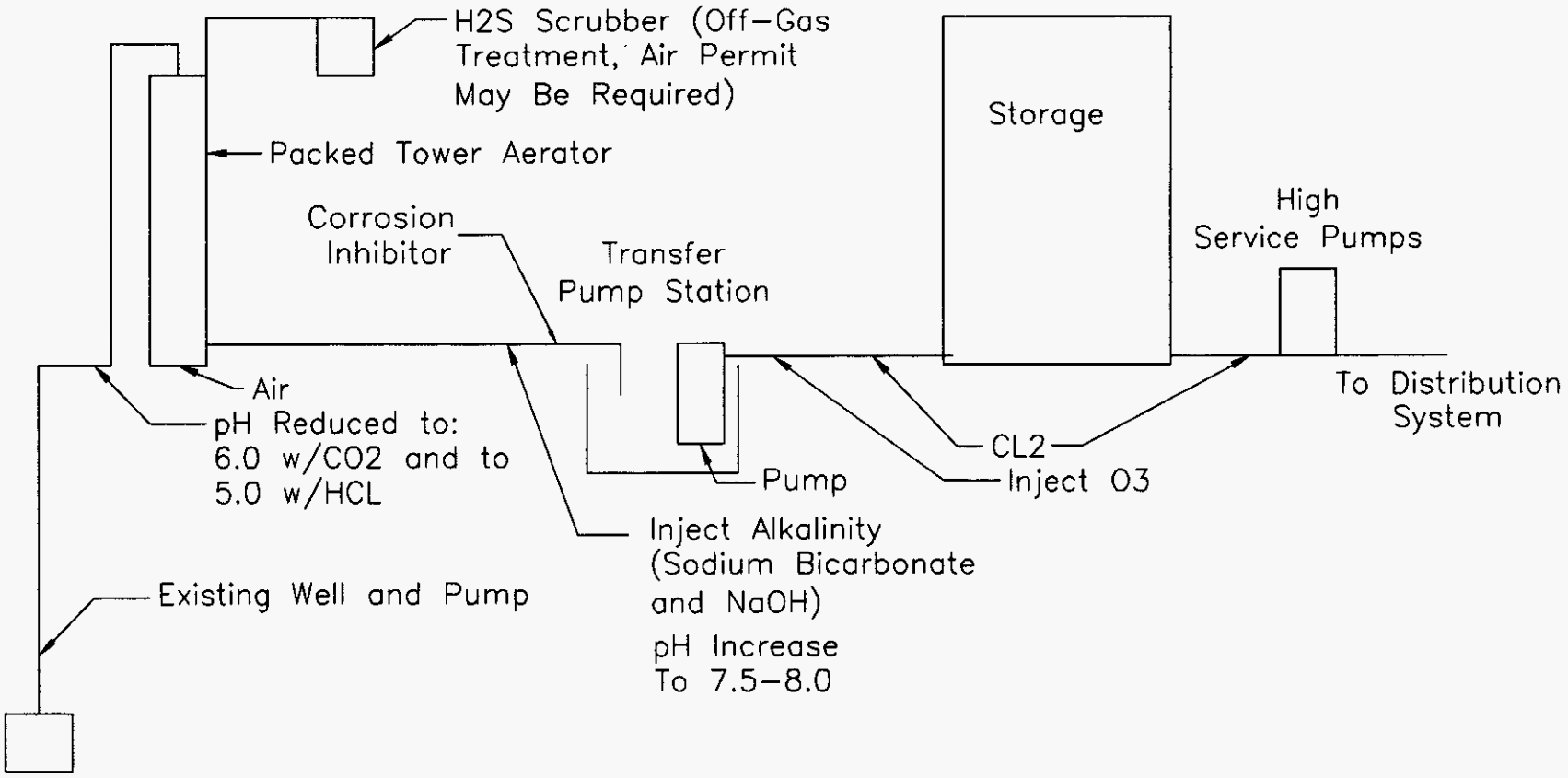


Figure 7-4

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Process Diagram

Alternative Two
Packed Tower Aeration
Treatment Upgrade/System Expansion

PROJECT NO. AUI-011-1-A
DATE May 2, 1997
SCALE None
SHEET 01 OF 01

Section 8-Cost Estimates to Modify Individual Facilities

A. Capital Cost Estimate

Detailed capital cost spreadsheets can be found at the end of this Section.

The capital cost estimates were developed by obtaining equipment budget cost estimates from representative vendors. These budget costs were then adjusted to include costs for sales tax, contractor installation, contractor overhead and profit, and contingencies.

It is important to note that the process train shown in the figures and the cost estimates are based on theoretical water chemistry. Actual pilot testing will need to be completed and the process train and/or cost estimates adjusted prior to any final design work commencing.

Also, these cost estimates do include any capacity increases beyond the capacity of the system anticipated in the 1998 design year. No provision has been made for future system capacity increases with the modifications described in this Section. Population and water demand projections indicate that this existing water system will require major capacity increases within the next 3 years.

De-gassification may need to be added, at potentially substantial additional cost, to the process train if it is found to be needed during pilot testing. Also, corrosion control chemicals may be required (as practiced at this time); this will be determined during pilot testing.

B. Operation and Maintenance Cost Estimates

Operation and maintenance costs were obtained by calculating the quantity of chemicals and power required in the operation of the process units associated with each option. Current day representative chemical and power unit costs were applied to the estimated use quantities and a yearly value was obtained. Labor was estimated based on the assignment of two operators to each facility while it is in operation. Two operators are required as dangerous conditions (chemical handling) will exist. In the past, it was not uncommon to find one operator covering a facility by himself. This practice lead to numerous severe injuries and deaths. Today, two operators are provided per shift to prevent these types of costly accidents (both from human suffering and legal liability points of view).

C. Engineering Cost Estimates

Engineering costs estimates include the expenses associated with pilot testing, design, permitting, observing construction, and starting up the facilities.

Capital Costs

Seven Springs Water System

Water Facilities Upgrade Study Report

Capital Cost Budget Estimate Summary–Tray Aeration–Alternative One/A

Facility/Item	Estimated Budget Cost
Existing Well Number One Modifications	$1,109,563
Existing Well Number Two Modifications	$949,018
Existing Well Number Three Modifications	$763,773
Existing Well Number Four Modifications	$763,773
Existing Well Number Six Modifications	$945,930
Existing Well Number Seven Modifications	$945,930
Existing Well Number Eight Modifications	$949,018
Existing Well Number Nine Modifications	$949,018
New Well Number 10	$1,202,391
New Well Number 11	$1,202,391
Total	$9,780,805

Seven Springs Water System

Water Facilities Upgrade Study Report

Capital Cost Budget Estimate–Existing Well Number One Modification–Tray Aerator

Component	Raw Cost	Installation (30%)	Contractor O&P (15%)	Sales Tax (7.5%)	Sub-Total
Chemical Storage and Feed Equipment					
Carbon Dioxide	$75,000	$22,500	$14,625	$5,625	$117,750
Hydrochloric Acid	$10,000	$3,000	$1,950	$750	$15,700
Sodium Bicarbonate	$7,000	$2,100	$1,365	$525	$10,990
Sodium Hydroxide	$11,000	$3,300	$2,145	$825	$17,270
Unit Process Equipment					
Tray Aerator*	$23,000	$6,900	$4,485	$1,725	$36,110
Ozone Disinfection Unit	$80,000	$24,000	$15,600	$6,000	$125,600
Treated Water Transfer Pump Station	$75,000	$22,500	$14,625	$5,625	$117,750
250,000 Gallon Storage Tank	$94,000	$28,200	$18,330	$7,050	$147,580
Compound Loop Chlorination System	$14,500	$4,350	$2,828	$1,088	$22,765
High Service Pumping System	94,000	$28,200	$18,330	$7,050	$147,580
Concrete Slabs/Building Modifications	$41,000	$12,300	$7,995	$3,075	$64,370
Sitework (4%)					$32,939
Electrical (10%)					$82,347
Construction Contingencies (15%)					$140,813
Land Acquisition Allowance (1 Acre)					$30,000
				Total	**$1,109,563**

*** Tray Aeration is only 50 to 65% efficient in removing H2S. This alternative does not include any off-gas treatment; H2S would be released into surrounding area which would not be desirable nor permittable. This option is not viable.**

Seven Springs Water System

Water Facilities Upgrade Study Report

Capital Cost Budget Estimate–Existing Well Number Two Modification–Tray Aerator

Component	Raw Cost	Installation (30%)	Contractor O&P (15%)	Sales Tax (7.5%)	Sub-Total
Chemical Storage and Feed Equipment					
Carbon Dioxide	$65,000	$19,500	$12,675	$4,875	$102,050
Hydrochloric Acid	$7,500	$2,250	$1,463	$563	$11,775
Sodium Bicarbonate	$4,000	$1,200	$780	$300	$6,280
Sodium Hydroxide	$8,500	$2,550	$1,658	$638	$13,345
Unit Process Equipment					
Tray Aerator*	$18,000	$5,400	$3,510	$1,350	$28,260
Ozone Disinfection Unit	$62,000	$18,600	$12,090	$4,650	$97,340
Treated Water Transfer Pump Station	$75,000	$22,500	$14,625	$5,625	$117,750
250,000 Gallon Storage Tank	$94,000	$28,200	$18,330	$7,050	$147,580
Compound Loop Chlorination System	$14,500	$4,350	$2,828	$1,088	$22,765
High Service Pumping System	57,000	$17,100	$11,115	$4,275	$89,490
Concrete Slabs/Building Modifications	$41,000	$12,300	$7,995	$3,075	$64,370
Sitework (4%)					$28,040
Electrical (10%)					$70,101
Construction Contingencies (15%)					$119,872
Land Acquisition Allowance (1 Acre)					$30,000
				Total	**$949,018**

*** Tray Aeration is only 50 to 65% efficient in removing H2S. This alternative does not include any off-gas treatment; H2S would be released into surrounding area which would not be desirable nor permittable. This option is not viable.**

Seven Springs Water System

Water Facilities Upgrade Study Report

Capital Cost Budget Estimate–Existing Well Number Three Modification–Tray Aerator

Component	Raw Cost	Installation (30%)	Contractor O&P (15%)	Sales Tax (7.5%)	Sub-Total
Chemical Storage and Feed Equipment					
Carbon Dioxide	$60,000	$18,000	$11,700	$4,500	$94,200
Hydrochloric Acid	$5,000	$1,500	$975	$375	$7,850
Sodium Bicarbonate	$3,500	$1,050	$683	$263	$5,495
Sodium Hydroxide	$5,500	$1,650	$1,073	$413	$8,635
Unit Process Equipment					
Tray Aerator*	$12,000	$3,600	$2,340	$900	$18,840
Ozone Disinfection Unit	$44,000	$13,200	$8,580	$3,300	$69,080
Treated Water Transfer Pump Station	$75,000	$22,500	$14,625	$5,625	$117,750
100,000 Gallon Storage Tank	$60,000	$18,000	$11,700	$4,500	$94,200
Compound Loop Chlorination System	$14,500	$4,350	$2,828	$1,088	$22,765
High Service Pumping System	36,000	$10,800	$7,020	$2,700	$56,520
Concrete Slabs/Building Modifications	$41,000	$12,300	$7,995	$3,075	$64,370
Sitework (4%)					$22,388
Electrical (10%)					$55,971
Construction Contingencies (15%)					$95,710
Land Acquisition Allowance (1 Acre)					$30,000
				Total	**$763,773**

*** Tray Aeration is only 50 to 65% efficient in removing H2S. This alternative does not include any off-gas treatment; H2S would be released into surrounding area which would not be desirable nor permittable. This option is not viable.**

Seven Springs Water System

Water Facilities Upgrade Study Report

Capital Cost Budget Estimate–Existing Well Number Four Modification–Tray Aerator

Component	Raw Cost	Installation (30%)	Contractor O&P (15%)	Sales Tax (7.5%)	Sub-Total
Chemical Storage and Feed Equipment					
Carbon Dioxide	$60,000	$18,000	$11,700	$4,500	$94,200
Hydrochloric Acid	$5,000	$1,500	$975	$375	$7,850
Sodium Bicarbonate	$3,500	$1,050	$683	$263	$5,495
Sodium Hydroxide	$5,500	$1,650	$1,073	$413	$8,635
Unit Process Equipment					
Tray Aerator*	$12,000	$3,600	$2,340	$900	$18,840
Ozone Disinfection Unit	$44,000	$13,200	$8,580	$3,300	$69,080
Treated Water Transfer Pump Station	$75,000	$22,500	$14,625	$5,625	$117,750
100,000 Gallon Storage Tank	$60,000	$18,000	$11,700	$4,500	$94,200
Compound Loop Chlorination System	$14,500	$4,350	$2,828	$1,088	$22,765
High Service Pumping System	*36,000*	$10,800	$7,020	$2,700	$56,520
Concrete Slabs/Building Modifications	$41,000	$12,300	$7,995	$3,075	$64,370
Sitework (4%)					$22,388
Electrical (10%)					$55,971
Construction Contingencies (15%)					$95,710
Land Acquisition Allowance (1 Acre)					$30,000
				Total	**$763,773**

*** Tray Aeration is only 50 to 65% efficient in removing H2S. This alternative does not include any off-gas treatment; H2S would be released into surrounding area which would not be desirable nor permittable. This option is not viable.**

Seven Springs Water System

Water Facilities Upgrade Study Report

Capital Cost Budget Estimate–Existing Well Number Six Modification–Tray Aerator

Component	Raw Cost	Installation (30%)	Contractor O&P (15%)	Sales Tax (7.5%)	Sub-Total
Chemical Storage and Feed Equipment					
Carbon Dioxide	$65,000	$19,500	$12,675	$4,875	$102,050
Hydrochloric Acid	$7,000	$2,100	$1,365	$525	$10,990
Sodium Bicarbonate	$4,000	$1,200	$780	$300	$6,280
Sodium Hydroxide	$7,500	$2,250	$1,463	$563	$11,775
Unit Process Equipment					
Tray Aerator*	$18,000	$5,400	$3,510	$1,350	$28,260
Ozone Disinfection Unit	$62,000	$18,600	$12,090	$4,650	$97,340
Treated Water Transfer Pump Station	$75,000	$22,500	$14,625	$5,625	$117,750
250,000 Gallon Storage Tank	$94,000	$28,200	$18,330	$7,050	$147,580
Compound Loop Chlorination System	$14,500	$4,350	$2,828	$1,088	$22,765
High Service Pumping System	57,000	$17,100	$11,115	$4,275	$89,490
Concrete Slabs/Building Modifications	$41,000	$12,300	$7,995	$3,075	$64,370
Sitework (4%)					$27,946
Electrical (10%)					$69,865
Construction Contingencies (15%)					$119,469
Land Acquisition Allowance (1 Acre)					$30,000
				Total	$945,930

*** Tray Aeration is only 50 to 65% efficient in removing H2S. This alternative does not include any off-gas treatment; H2S would be released into surrounding area which would not be desirable nor permittable. This option is not viable.**

Seven Springs Water System

Water Facilities Upgrade Study Report

Capital Cost Budget Estimate–Existing Well Number Seven Modification–Tray Aerator

Component	Raw Cost	Installation (30%)	Contractor O&P (15%)	Sales Tax (7.5%)	Sub-Total
Chemical Storage and Feed Equipment					
Carbon Dioxide	$65,000	$19,500	$12,675	$4,875	$102,050
Hydrochloric Acid	$7,000	$2,100	$1,365	$525	$10,990
Sodium Bicarbonate	$4,000	$1,200	$780	$300	$6,280
Sodium Hydroxide	$7,500	$2,250	$1,463	$563	$11,775
Unit Process Equipment					
Tray Aerator*	$18,000	$5,400	$3,510	$1,350	$28,260
Ozone Disinfection Unit	$62,000	$18,600	$12,090	$4,650	$97,340
Treated Water Transfer Pump Station	$75,000	$22,500	$14,625	$5,625	$117,750
250,000 Gallon Storage Tank	$94,000	$28,200	$18,330	$7,050	$147,580
Compound Loop Chlorination System	$14,500	$4,350	$2,828	$1,088	$22,765
High Service Pumping System	57,000	$17,100	$11,115	$4,275	$89,490
Concrete Slabs/Building Modifications	$41,000	$12,300	$7,995	$3,075	$64,370
Sitework (4%)					$27,946
Electrical (10%)					$69,865
Construction Contingencies (15%)					$119,469
Land Acquisition Allowance (1 Acre)					$30,000
				Total	$945,930

*** Tray Aeration is only 50 to 65% efficient in removing H2S. This alternative does not include any off-gas treatment; H2S would be released into surrounding area which would not be desirable nor permittable. This option is not viable.**

Seven Springs Water System

Water Facilities Upgrade Study Report

Capital Cost Budget Estimate–Existing Well Number Eight Modification–Tray Aerator

Component	Raw Cost	Installation (30%)	Contractor O&P (15%)	Sales Tax (7.5%)	Sub-Total
Chemical Storage and Feed Equipment					
Carbon Dioxide	$65,000	$19,500	$12,675	$4,875	$102,050
Hydrochloric Acid	$7,500	$2,250	$1,463	$563	$11,775
Sodium Bicarbonate	$4,000	$1,200	$780	$300	$6,280
Sodium Hydroxide	$8,500	$2,550	$1,658	$638	$13,345
Unit Process Equipment					
Tray Aerator*	$18,000	$5,400	$3,510	$1,350	$28,260
Ozone Disinfection Unit	$62,000	$18,600	$12,090	$4,650	$97,340
Treated Water Transfer Pump Station	$75,000	$22,500	$14,625	$5,625	$117,750
250,000 Gallon Storage Tank	$94,000	$28,200	$18,330	$7,050	$147,580
Compound Loop Chlorination System	$14,500	$4,350	$2,828	$1,088	$22,765
High Service Pumping System	57,000	$17,100	$11,115	$4,275	$89,490
Concrete Slabs/Building Modifications	$41,000	$12,300	$7,995	$3,075	$64,370
Sitework (4%)					$28,040
Electrical (10%)					$70,101
Construction Contingencies (15%)					$119,872
Land Acquisition Allowance (1 Acre)					$30,000
				Total	**$949,018**

*** Tray Aeration is only 50 to 65% efficient in removing H2S. This alternative does not include any off-gas treatment; H2S would be released into surrounding area which would not be desirable nor permittable. This option is not viable.**

Seven Springs Water System

Water Facilities Upgrade Study Report

Capital Cost Budget Estimate–Existing Well Number Nine Modification–Tray Aerator

Component	Raw Cost	Installation (30%)	Contractor O&P (15%)	Sales Tax (7.5%)	Sub-Total
Chemical Storage and Feed Equipment					
Carbon Dioxide	$65,000	$19,500	$12,675	$4,875	$102,050
Hydrochloric Acid	$7,500	$2,250	$1,463	$563	$11,775
Sodium Bicarbonate	$4,000	$1,200	$780	$300	$6,280
Sodium Hydroxide	$8,500	$2,550	$1,658	$638	$13,345
Unit Process Equipment					
Tray Aerator*	$18,000	$5,400	$3,510	$1,350	$28,260
Ozone Disinfection Unit	$62,000	$18,600	$12,090	$4,650	$97,340
Treated Water Transfer Pump Station	$75,000	$22,500	$14,625	$5,625	$117,750
250,000 Gallon Storage Tank	$94,000	$28,200	$18,330	$7,050	$147,580
Compound Loop Chlorination System	$14,500	$4,350	$2,828	$1,088	$22,765
High Service Pumping System	57,000	$17,100	$11,115	$4,275	$89,490
Concrete Slabs/Building Modifications	$41,000	$12,300	$7,995	$3,075	$64,370
Sitework (4%)					$28,040
Electrical (10%)					$70,101
Construction Contingencies (15%)					$119,872
Land Acquisition Allowance (1 Acre)					$30,000
				Total	**$949,018**

*** Tray Aeration is only 50 to 65% efficient in removing H2S. This alternative does not include any off-gas treatment; H2S would be released into surrounding area which would not be desirable nor permittable. This option is not viable.**

Seven Springs Water System

Water Facilities Upgrade Study Report

Capital Cost Budget Estimate–New Well Number Ten–Tray Aerator

Component	Raw Cost	Installation (30%)	Contractor O&P (15%)	Sales Tax (7.5%)	Sub-Total
Chemical Storage and Feed Equipment					
Carbon Dioxide	$65,000	$19,500	$12,675	$4,875	$102,050
Hydrochloric Acid	$7,500	$2,250	$1,463	$563	$11,775
Sodium Bicarbonate	$4,000	$1,200	$780	$300	$6,280
Sodium Hydroxide	$8,500	$2,550	$1,658	$638	$13,345
Unit Process Equipment					
Tray Aerator*	$18,000	$5,400	$3,510	$1,350	$28,260
Ozone Disinfection Unit	$62,000	$18,600	$12,090	$4,650	$97,340
New Well and Pump	$113,100	$33,930	$22,055	$8,483	$177,567
Treated Water Transfer Pump Station	$75,000	$22,500	$14,625	$5,625	$117,750
250,000 Gallon Storage Tank	$94,000	$28,200	$18,330	$7,050	$147,580
Compound Loop Chlorination System	$14,500	$4,350	$2,828	$1,088	$22,765
High Service Pumping System	57,000	$17,100	$11,115	$4,275	$89,490
Concrete Slabs/Building Modifications	$51,000	$15,300	$9,945	$3,825	$80,070
Sitework (4%)					$35,771
Electrical (10%)					$89,427
Construction Contingencies (15%)					$152,921
Land Acquisition Allowance (1 Acre)					$30,000
				Total	**$1,202,391**

*** Tray Aeration is only 50 to 65% efficient in removing H2S. This alternative does not include any off-gas treatment; H2S would be released into surrounding area which would not be desirable nor permittable. This option is not viable.**

Seven Springs Water System

Water Facilities Upgrade Study Report

Capital Cost Budget Estimate–New Well Number Eleven–Tray Aerator

Component	Raw Cost	Installation (30%)	Contractor O&P (15%)	Sales Tax (7.5%)	Sub-Total
Chemical Storage and Feed Equipment					
Carbon Dioxide	$65,000	$19,500	$12,675	$4,875	$102,050
Hydrochloric Acid	$7,500	$2,250	$1,463	$563	$11,775
Sodium Bicarbonate	$4,000	$1,200	$780	$300	$6,280
Sodium Hydroxide	$8,500	$2,550	$1,658	$638	$13,345
Unit Process Equipment					
Tray Aerator*	$18,000	$5,400	$3,510	$1,350	$28,260
Ozone Disinfection Unit	$62,000	$18,600	$12,090	$4,650	$97,340
New Well and Pump	$113,100	$33,930	$22,055	$8,483	$177,567
Treated Water Transfer Pump Station	$75,000	$22,500	$14,625	$5,625	$117,750
250,000 Gallon Storage Tank	$94,000	$28,200	$18,330	$7,050	$147,580
Compound Loop Chlorination System	$14,500	$4,350	$2,828	$1,088	$22,765
High Service Pumping System	57,000	$17,100	$11,115	$4,275	$89,490
Concrete Slabs/Building Modifications	$51,000	$15,300	$9,945	$3,825	$80,070
Sitework (4%)					$35,771
Electrical (10%)					$89,427
Construction Contingencies (15%)					$152,921
Land Acquisition Allowance (1 Acre)					$30,000
				Total	**$1,202,391**

*** Tray Aeration is only 50 to 65% efficient in removing H2S. This alternative does not include any off-gas treatment; H2S would be released into surrounding area which would not be desirable nor permittable. This option is not viable.**

Seven Springs Water System

Water Facilities Upgrade Study Report

Capital Cost Budget Estimate Summary–Packed Tower Aeration–Alternative One/B

Facility/Item	Estimated Budget Cost
Existing Well Number One Modifications	$1,387,429
Existing Well Number Two Modifications	$1,218,651
Existing Well Number Three Modifications	$986,066
Existing Well Number Four Modifications	$986,066
Existing Well Number Six Modifications	$1,219,680
Existing Well Number Seven Modifications	$1,192,923
Existing Well Number Eight Modifications	$1,248,496
Existing Well Number Nine Modifications	$1,255,700
New Well Number 10	$1,481,286
New Well Number 11	$1,481,286
Total	$12,457,583

Seven Springs Water System

Water Facilities Upgrade Study Report

Capital Cost Budget Estimate–Existing Well Number One Modification–Packed Tower

Component	Raw Cost	Installation (30%)	Contractor O&P (15%)	Sales Tax (7.5%)	Sub-Total
Chemical Storage and Feed Equipment					
Carbon Dioxide	$75,000	$22,500	$14,625	$5,625	$117,750
Hydrochloric Acid	$10,000	$3,000	$1,950	$750	$15,700
Sodium Bicarbonate	$7,000	$2,100	$1,365	$525	$10,990
Sodium Hydroxide	$11,000	$3,300	$2,145	$825	$17,270
Unit Process Equipment					
Packed Tower H2S Stripper/Scrubber	$83,000	$24,900	$16,185	$6,225	$130,310
Off-Gas Pre-Stripper*	$0	$0	$0	$0	$0
Off-Gas Carbon Contactor	$75,000	$22,500	$14,625	$5,625	$117,750
Ozone Disinfection Unit	$80,000	$24,000	$15,600	$6,000	$125,600
Treated Water Transfer Pump Station	$75,000	$22,500	$14,625	$5,625	$117,750
250,000 Gallon Storage Tank	$94,000	$28,200	$18,330	$7,050	$147,580
Compound Loop Chlorination System	$14,500	$4,350	$2,828	$1,088	$22,765
High Service Pumping System	94,000	$28,200	$18,330	$7,050	$147,580
Concrete Slabs/Building Modifications	$41,000	$12,300	$7,995	$3,075	$64,370
Sitework (4%)					$41,417
Electrical (10%)					$103,542
Construction Contingencies (15%)					$177,056
Land Acquisition Allowance (1 Acre)					$30,000
				Total	**$1,387,429**

* Off-Gas Pre-Stripper not required at all sites.

Seven Springs Water System

Water Facilities Upgrade Study Report

Capital Cost Budget Estimate–Existing Well Number Two Modification–Packed Tower

Component	Raw Cost	Installation (30%)	Contractor O&P (15%)	Sales Tax (7.5%)	Sub-Total
Chemical Storage and Feed Equipment					
Carbon Dioxide	$65,000	$19,500	$12,675	$4,875	$102,050
Hydrochloric Acid	$7,500	$2,250	$1,463	$563	$11,775
Sodium Bicarbonate	$4,000	$1,200	$780	$300	$6,280
Sodium Hydroxide	$8,500	$2,550	$1,658	$638	$13,345
Unit Process Equipment					
Packed Tower H2S Stripper/Scrubber	$91,000	$27,300	$17,745	$6,825	$142,870
Off-Gas Pre-Stripper*	$7,000	$2,100	$1,365	$525	$10,990
Off-Gas Carbon Contactor	$51,000	$15,300	$9,945	$3,825	$80,070
Ozone Disinfection Unit	$62,000	$18,600	$12,090	$4,650	$97,340
Treated Water Transfer Pump Station	$75,000	$22,500	$14,625	$5,625	$117,750
250,000 Gallon Storage Tank	$94,000	$28,200	$18,330	$7,050	$147,580
Compound Loop Chlorination System	$14,500	$4,350	$2,828	$1,088	$22,765
High Service Pumping System	57,000	$17,100	$11,115	$4,275	$89,490
Concrete Slabs/Building Modifications	$41,000	$12,300	$7,995	$3,075	$64,370
Sitework (4%)					$36,267
Electrical (10%)					$90,668
Construction Contingencies (15%)					$155,041.43
Land Acquisition Allowance (1 Acre)					$30,000
				Total	**$1,218,651**

* Off-Gas Pre-Stripper not required at all sites.

Seven Springs Water System

Water Facilities Upgrade Study Report

Capital Cost Budget Estimate–Existing Well Number Three Modification–Packed Tower

Component	Raw Cost	Installation (30%)	Contractor O&P (15%)	Sales Tax (7.5%)	Sub-Total
Chemical Storage and Feed Equipment					
Carbon Dioxide	$60,000	$18,000	$11,700	$4,500	$94,200
Hydrochloric Acid	$5,000	$1,500	$975	$375	$7,850
Sodium Bicarbonate	$3,500	$1,050	$683	$263	$5,495
Sodium Hydroxide	$5,500	$1,650	$1,073	$413	$8,635
Unit Process Equipment					
Packed Tower H2S Stripper/Scrubber	$55,000	$16,500	$10,725	$4,125	$86,350
Off-Gas Pre-Stripper*	$0	$0	$0	$0	$0
Off-Gas Carbon Contactor	$65,000	$19,500	$12,675	$4,875	$102,050
Ozone Disinfection Unit	$44,000	$13,200	$8,580	$3,300	$69,080
Treated Water Transfer Pump Station	$75,000	$22,500	$14,625	$5,625	$117,750
100,000 Gallon Storage Tank	$60,000	$18,000	$11,700	$4,500	$94,200
Compound Loop Chlorination System	$14,500	$4,350	$2,828	$1,088	$22,765
High Service Pumping System	36,000	$10,800	$7,020	$2,700	$56,520
Concrete Slabs/Building Modifications	$41,000	$12,300	$7,995	$3,075	$64,370
Sitework (4%)					$29,171
Electrical (10%)					$72,927
Construction Contingencies (15%)					$124,704
Land Acquisition Allowance (1 Acre)					$30,000
				Total	**$986,066**

* Off-Gas Pre-Stripper not required at all sites.

Seven Springs Water System

Water Facilities Upgrade Study Report

Capital Cost Budget Estimate–Existing Well Number Four Modification–Packed Tower

Component	Raw Cost	Installation (30%)	Contractor O&P (15%)	Sales Tax (7.5%)	Sub-Total
Chemical Storage and Feed Equipment					
Carbon Dioxide	$60,000	$18,000	$11,700	$4,500	$94,200
Hydrochloric Acid	$5,000	$1,500	$975	$375	$7,850
Sodium Bicarbonate	$3,500	$1,050	$683	$263	$5,495
Sodium Hydroxide	$5,500	$1,650	$1,073	$413	$8,635
Unit Process Equipment					
Packed Tower H2S Stripper/Scrubber	$55,000	$16,500	$10,725	$4,125	$86,350
Off-Gas Pre-Stripper*	$0	$0	$0	$0	$0
Off-Gas Carbon Contactor	$65,000	$19,500	$12,675	$4,875	$102,050
Ozone Disinfection Unit	$44,000	$13,200	$8,580	$3,300	$69,080
Treated Water Transfer Pump Station	$75,000	$22,500	$14,625	$5,625	$117,750
100,000 Gallon Storage Tank	$60,000	$18,000	$11,700	$4,500	$94,200
Compound Loop Chlorination System	$14,500	$4,350	$2,828	$1,088	$22,765
High Service Pumping System	36,000	$10,800	$7,020	$2,700	$56,520
Concrete Slabs/Building Modifications	$41,000	$12,300	$7,995	$3,075	$64,370
Sitework (4%)					$29,171
Electrical (10%)					$72,927
Construction Contingencies (15%)					$124,704
Land Acquisition Allowance (1 Acre)					$30,000
				Total	**$986,066**

* Off-Gas Pre-Stripper not required at all sites.

Seven Springs Water System

Water Facilities Upgrade Study Report

Capital Cost Budget Estimate–Existing Well Number Six Modification–Packed Tower

Component	Raw Cost	Installation (30%)	Contractor O&P (15%)	Sales Tax (7.5%)	Sub-Total
Chemical Storage and Feed Equipment					
Carbon Dioxide	$65,000	$19,500	$12,675	$4,875	$102,050
Hydrochloric Acid	$7,000	$2,100	$1,365	$525	$10,990
Sodium Bicarbonate	$4,000	$1,200	$780	$300	$6,280
Sodium Hydroxide	$7,500	$2,250	$1,463	$563	$11,775
Unit Process Equipment					
Packed Tower H2S Stripper/Scrubber	$73,000	$21,900	$14,235	$5,475	$114,610
Off-Gas Pre-Stripper*	$0	$0	$0	$0	$0
Off-Gas Carbon Contactor	$78,000	$23,400	$15,210	$5,850	$122,460
Ozone Disinfection Unit	$62,000	$18,600	$12,090	$4,650	$97,340
Treated Water Transfer Pump Station	$75,000	$22,500	$14,625	$5,625	$117,750
250,000 Gallon Storage Tank	$94,000	$28,200	$18,330	$7,050	$147,580
Compound Loop Chlorination System	$14,500	$4,350	$2,828	$1,088	$22,765
High Service Pumping System	57,000	$17,100	$11,115	$4,275	$89,490
Concrete Slabs/Building Modifications	$41,000	$12,300	$7,995	$3,075	$64,370
Sitework (4%)					$36,298
Electrical (10%)					$90,746
Construction Contingencies (15%)					$155,176
Land Acquisition Allowance (1 Acre)					$30,000
				Total	**$1,219,680**

* Off-Gas Pre-Stripper not required at all sites.

Seven Springs Water System

Water Facilities Upgrade Study Report

Capital Cost Budget Estimate–Existing Well Number Seven Modification–Packed Tower

Component	Raw Cost	Installation (30%)	Contractor O&P (15%)	Sales Tax (7.5%)	Sub-Total
Chemical Storage and Feed Equipment					
Carbon Dioxide	$65,000	$19,500	$12,675	$4,875	$102,050
Hydrochloric Acid	$7,000	$2,100	$1,365	$525	$10,990
Sodium Bicarbonate	$4,000	$1,200	$780	$300	$6,280
Sodium Hydroxide	$7,500	$2,250	$1,463	$563	$11,775
Unit Process Equipment					
Packed Tower H2S Stripper/Scrubber	$73,000	$21,900	$14,235	$5,475	$114,610
Off-Gas Pre-Stripper*	$0	$0	$0	$0	$0
Off-Gas Carbon Contactor	$65,000	$19,500	$12,675	$4,875	$102,050
Ozone Disinfection Unit	$62,000	$18,600	$12,090	$4,650	$97,340
Treated Water Transfer Pump Station	$75,000	$22,500	$14,625	$5,625	$117,750
250,000 Gallon Storage Tank	$94,000	$28,200	$18,330	$7,050	$147,580
Compound Loop Chlorination System	$14,500	$4,350	$2,828	$1,088	$22,765
High Service Pumping System	57,000	$17,100	$11,115	$4,275	$89,490
Concrete Slabs/Building Modifications	$41,000	$12,300	$7,995	$3,075	$64,370
Sitework (4%)					$35,482
Electrical (10%)					$88,705
Construction Contingencies (15%)					$151,686
Land Acquisition Allowance (1 Acre)					$30,000
				Total	**$1,192,923**

* Off-Gas Pre-Stripper not required at all sites.

Seven Springs Water System

Water Facilities Upgrade Study Report

Capital Cost Budget Estimate–Existing Well Number Eight Modification–Packed Tower

Component	Raw Cost	Installation (30%)	Contractor O&P (15%)	Sales Tax (7.5%)	Sub-Total
Chemical Storage and Feed Equipment					
Carbon Dioxide	$65,000	$19,500	$12,675	$4,875	$102,050
Hydrochloric Acid	$7,500	$2,250	$1,463	$563	$11,775
Sodium Bicarbonate	$4,000	$1,200	$780	$300	$6,280
Sodium Hydroxide	$8,500	$2,550	$1,658	$638	$13,345
Unit Process Equipment					
Packed Tower H2S Stripper/Scrubber	$91,000	$27,300	$17,745	$6,825	$142,870
Off-Gas Pre-Stripper*	$7,500	$2,250	$1,463	$563	$11,775
Off-Gas Carbon Contactor	$65,000	$19,500	$12,675	$4,875	$102,050
Ozone Disinfection Unit	$62,000	$18,600	$12,090	$4,650	$97,340
Treated Water Transfer Pump Station	$75,000	$22,500	$14,625	$5,625	$117,750
250,000 Gallon Storage Tank	$94,000	$28,200	$18,330	$7,050	$147,580
Compound Loop Chlorination System	$14,500	$4,350	$2,828	$1,088	$22,765
High Service Pumping System	57,000	$17,100	$11,115	$4,275	$89,490
Concrete Slabs/Building Modifications	$41,000	$12,300	$7,995	$3,075	$64,370
Sitework (4%)					$37,178
Electrical (10%)					$92,944
Construction Contingencies (15%)					$158,934
Land Acquisition Allowance (1 Acre)					$30,000
				Total	**$1,248,496**

* Off-Gas Pre-Stripper not required at all sites.

Seven Springs Water System

Water Facilities Upgrade Study Report

Capital Cost Budget Estimate–Existing Well Number Nine Modification–Packed Tower

Component	Raw Cost	Installation (30%)	Contractor O&P (15%)	Sales Tax (7.5%)	Sub-Total
Chemical Storage and Feed Equipment					
Carbon Dioxide	$65,000	$19,500	$12,675	$4,875	$102,050
Hydrochloric Acid	$7,500	$2,250	$1,463	$563	$11,775
Sodium Bicarbonate	$4,000	$1,200	$780	$300	$6,280
Sodium Hydroxide	$8,500	$2,550	$1,658	$638	$13,345
Unit Process Equipment					
Packed Tower H2S Stripper/Scrubber	$91,000	$27,300	$17,745	$6,825	$142,870
Off-Gas Pre-Stripper*	$11,000	$3,300	$2,145	$825	$17,270
Off-Gas Carbon Contactor	$65,000	$19,500	$12,675	$4,875	$102,050
Ozone Disinfection Unit	$62,000	$18,600	$12,090	$4,650	$97,340
Treated Water Transfer Pump Station	$75,000	$22,500	$14,625	$5,625	$117,750
250,000 Gallon Storage Tank	$94,000	$28,200	$18,330	$7,050	$147,580
Compound Loop Chlorination System	$14,500	$4,350	$2,828	$1,088	$22,765
High Service Pumping System	57,000	$17,100	$11,115	$4,275	$89,490
Concrete Slabs/Building Modifications	$41,000	$12,300	$7,995	$3,075	$64,370
Sitework (4%)					$37,397
Electrical (10%)					$93,494
Construction Contingencies (15%)					$159,874
Land Acquisition Allowance (1 Acre)					$30,000
				Total	**$1,255,700**

* Off-Gas Pre-Stripper not required at all sites.

Seven Springs Water System

Water Facilities Upgrade Study Report

Capital Cost Budget Estimate–New Well Number Ten–Packed Tower

Component	Raw Cost	Installation (30%)	Contractor O&P (15%)	Sales Tax (7.5%)	Sub-Total
Chemical Storage and Feed Equipment					
Carbon Dioxide	$65,000	$19,500	$12,675	$4,875	$102,050
Hydrochloric Acid	$7,500	$2,250	$1,463	$563	$11,775
Sodium Bicarbonate	$4,000	$1,200	$780	$300	$6,280
Sodium Hydroxide	$8,500	$2,550	$1,658	$638	$13,345
Unit Process Equipment					
Packed Tower H2S Stripper/Scrubber	$91,000	$27,300	$17,745	$6,825	$142,870
Off-Gas Pre-Stripper*	$7,500	$2,250	$1,463	$563	$11,775
Off-Gas Carbon Contactor	$65,000	$19,500	$12,675	$4,875	$102,050
Ozone Disinfection Unit	$62,000	$18,600	$12,090	$4,650	$97,340
New Well and Pump	$113,100	$33,930	$22,055	$8,483	$177,567
Treated Water Transfer Pump Station	$75,000	$22,500	$14,625	$5,625	$117,750
250,000 Gallon Storage Tank	$94,000	$28,200	$18,330	$7,050	$147,580
Compound Loop Chlorination System	$14,500	$4,350	$2,828	$1,088	$22,765
High Service Pumping System	57,000	$17,100	$11,115	$4,275	$89,490
Concrete Slabs/Building Modifications	$41,000	$12,300	$7,995	$3,075	$64,370
Sitework (4%)					$44,280
Electrical (10%)					$110,701
Construction Contingencies (15%)					$189,298
Land Acquisition Allowance (1 Acre)					$30,000
				Total	**$1,481,286**

* Off-Gas Pre-Stripper not required at all sites.

Seven Springs Water System

Water Facilities Upgrade Study Report

Capital Cost Budget Estimate–New Well Number Eleven–Packed Tower

Component	Raw Cost	Installation (30%)	Contractor O&P (15%)	Sales Tax (7.5%)	Sub-Total
Chemical Storage and Feed Equipment					
Carbon Dioxide	$65,000	$19,500	$12,675	$4,875	$102,050
Hydrochloric Acid	$7,500	$2,250	$1,463	$563	$11,775
Sodium Bicarbonate	$4,000	$1,200	$780	$300	$6,280
Sodium Hydroxide	$8,500	$2,550	$1,658	$638	$13,345
Unit Process Equipment					
Packed Tower H2S Stripper/Scrubber	$91,000	$27,300	$17,745	$6,825	$142,870
Off-Gas Pre-Stripper*	$7,500	$2,250	$1,463	$563	$11,775
Off-Gas Carbon Contactor	$65,000	$19,500	$12,675	$4,875	$102,050
Ozone Disinfection Unit	$62,000	$18,600	$12,090	$4,650	$97,340
New Well and Pump	$113,100	$33,930	$22,055	$8,483	$177,567
Treated Water Transfer Pump Station	$75,000	$22,500	$14,625	$5,625	$117,750
250,000 Gallon Storage Tank	$94,000	$28,200	$18,330	$7,050	$147,580
Compound Loop Chlorination System	$14,500	$4,350	$2,828	$1,088	$22,765
High Service Pumping System	57,000	$17,100	$11,115	$4,275	$89,490
Concrete Slabs/Building Modifications	$41,000	$12,300	$7,995	$3,075	$64,370
Sitework (4%)					$44,280
Electrical (10%)					$110,701
Construction Contingencies (15%)					$189,298
Land Acquisition Allowance (1 Acre)					$30,000
				Total	**$1,481,286**

* Off-Gas Pre-Stripper not required at all sites.

O&M Costs

Seven Springs Water System

Water Facilities Upgrade Study Report

O&M Cost Budget Estimate–Existing Wells Modification–Tray Aeration

Facility	Carbon Dioxide	Hydrochloric Acid	Air Stripper	Off-Gas Pre-Scrub	Off-Gas Carbon	Sodium Bi-Carb	Sodium Hydroxide	Ozone	Sub-Total
Well Number 1 Power and Chemicals	$13,800	$36,800	$0	$0	$0	$18,800	$138,100	$4,000	$211,500
Well Number 2 Power and Chemicals	$8,100	$19,400	$0	$0	$0	$10,600	$70,100	$2,400	$110,600
Well Number 3 Power and Chemicals	$4,400	$9,000	$0	$0	$0	$5,500	$29,200	$1,500	$49,600
Well Number 4 Power and Chemicals	$4,400	$9,000	$0	$0	$0	$5,500	$29,200	$1,500	$49,600
Well Number 6 Power and Chemicals	$7,500	$17,700	$0	$0	$0	$9,700	$63,300	$2,300	$100,500
Well Number 7 Power and Chemicals	$7,500	$17,700	$0	$0	$0	$9,700	$63,300	$2,300	$100,500
Well Number 8 Power and Chemicals	$8,100	$19,400	$0	$0	$0	$10,600	$70,000	$2,400	$110,500
Well Number 9 Power and Chemicals	$8,100	$19,400	$0	$0	$0	$10,500	$70,000	$2,400	$110,400
New Well 10 Power and Chemicals	$8,100	$19,400	$0	$0	$0	$10,600	$70,000	$2,400	$110,500
New Well 11 Power and Chemicals	$8,100	$19,400	$0	$0	$0	$10,600	$70,000	$2,400	$110,500
Transfer & High Service Pumps Power									$128,333
Operations/Maintenance Personnel									$2,141,333
Administration									$73,000
								Total	$3,406,866

Note: 1. Operations and maintenance personnel costs estimated at 16 persons, 12 hours per day, 365 days per year at $25/hour.
Administrative personnel costs estimated at 4 hours per day 365 days per year at $50/hour.
2. Transfer & high service pumping calculated at 33% average power load (160 hp) for 24 hours/day at $0.1/kwh.

Seven Springs Water System

Water Facilities Upgrade Study Report

O&M Cost Budget Estimate–Existing Wells Modification–Packed Tower Aeration

Facility	Carbon Dioxide	Hydrochloric Acid	Air Stripper	Off-Gas Pre-Scrub	Off-Gas Carbon	Sodium Bi-Carb	Sodium Hydroxide	Ozone	Sub-Total
Well Number 1 Power and Chemicals	$13,800	$36,800	$3,000	$0	$12,500	$18,800	$138,100	$4,000	$227,000
Well Number 2 Power and Chemicals	$8,100	$19,400	$5,800	$20,500	$6,700	$10,600	$70,100	$2,400	$143,600
Well Number 3 Power and Chemicals	$4,400	$9,000	$2,300	$0	$10,200	$5,500	$29,200	$1,500	$62,100
Well Number 4 Power and Chemicals	$4,400	$9,000	$2,300	$0	$10,200	$5,500	$29,200	$1,500	$62,100
Well Number 6 Power and Chemicals	$7,500	$17,700	$2,300	$0	$14,200	$9,700	$63,300	$2,300	$117,000
Well Number 7 Power and Chemicals	$7,500	$17,700	$2,300	$0	$10,300	$9,700	$63,300	$2,300	$113,100
Well Number 8 Power and Chemicals	$8,100	$19,400	$5,800	$24,000	$9,100	$10,600	$70,000	$2,400	$149,400
Well Number 9 Power and Chemicals	$8,100	$19,400	$5,800	$65,800	$9,700	$10,500	$70,000	$2,400	$191,700
New Well 10 Power and Chemicals	$8,100	$19,400	$5,800	$24,000	$9,100	$10,600	$70,000	$2,400	$149,400
New Well 11 Power and Chemicals	$8,100	$19,400	$5,800	$24,000	$9,100	$10,600	$70,000	$2,400	$149,400
Transfer & High Service Pumps Power									$128,333
Operations/Maintenance Personnel									$2,141,333
Administration									$73,000
								Total	$3,707,466

Note: 1. Operations and maintenance personnel costs estimated at 16 persons, 12 hours per day, 365 days per year at $25/hour.
Administrative personnel costs estimated at 4 hours per day 365 days per year at $50/hour.
2. Transfer & high service pumping calculated at 33% average power load (160 hp) for 24 hours/day at $0.1/kwh.

Engineering Costs

Seven Springs Water System

Water Facilities Upgrade Study Report

Engineering Cost Budget Estimate Summary–Tray Aeration–Alternative One/A

Task	Estimated Budget Cost
Water Facilities Upgrade Report	$45,000
Pilot Testing	$340,000
Design, Permitting, Construction Observation, O&M Manual, Start-Up, Certifications, Warrantee Inspection	$795,400
Total	$1,180,400

Seven Springs Water System

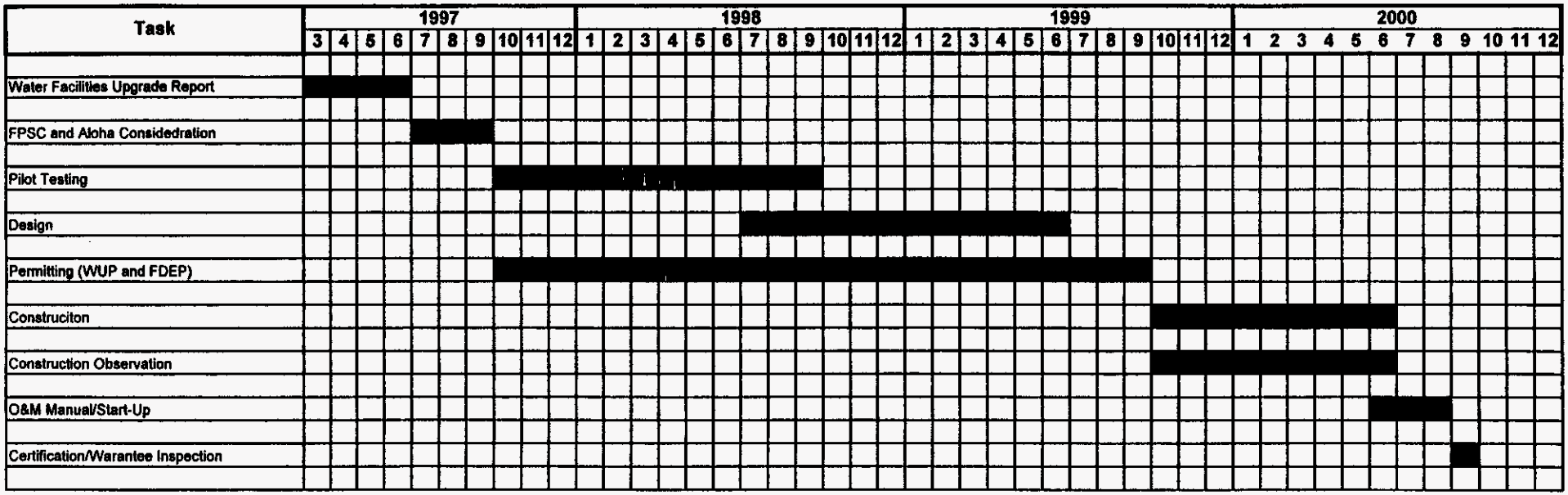
Water Facilities Upgrade Study Report

Engineering Cost Budget Estimate Summary–Packed Tower Aeration–Alternative One/B

Task	Estimated Budget Cost
Water Facilities Upgrade Report	$45,000
Pilot Testing	$340,000
Design, Permitting, Construction Observation, O&M Manual, Start-Up, Certifications, Warrantee Inspection	$1,015,900
Total	$1,400,900

Project Schedule

Project Schedule



Section 9-Cost Estimates to Construct Centralized Facilities

A. Capital Cost Estimate

Detailed capital cost spreadsheets can be found at the end of this Section.

The capital cost estimates were developed by obtaining equipment budget cost estimates from representative vendors. These budget costs were then adjusted to include costs for sales tax, contractor installation, contractor overhead and profit, and contingencies.

Unlike the estimates in Section 8 for individual treatment upgrades, the modifications described in this Section provide for major capacity increases over the existing system. With the exception of the a new raw water source of 1.75 mgd capacity, the modifications described will allow the centralized water system to meet the all 2015 design year water treatment demands (based on current USEPA and FDEP regulations, however, these regulations may change requiring the addition of additional process units in the future at extra cost). Also, the capital cost of the additional raw water source needed to increase the system capacity to meet 2015 demands from the 1998 demand level are not included as the source of this additional raw water source has not yet been defined.

It is important to note that the process train shown in the figures and the cost estimates are based on theoretical water chemistry. Actual pilot testing will need to be completed and the process train and/or cost estimates adjusted prior to any final design work commencing. De-gassification may need to be added, at potentially substantial additional cost, to the process train if it is found to be needed during pilot testing. Also, corrosion control chemicals may be required (as practiced at this time); this will be determined during pilot testing.

B. Operation and Maintenance Cost Estimates

Operation and maintenance costs were obtained by calculating the quantity of chemicals and power required in the operation of the process units associated with each option. Current day representative chemical and power unit costs were applied to the estimated use quantities and a yearly value was obtained. Labor was estimated based on the assignment of two operators to each facility while it is in operation. Two operators are required as dangerous conditions (chemical handling) will exist.

C. Engineering Cost Estimates

Engineering costs estimates include the expenses associated with pilot testing, design, permitting, observing construction, and starting up the facilities.

Capital Costs

Seven Springs Water System

Water Facilities Upgrade Study Report

Capital Cost Budget Estimate Summary–Proposed WTPs–Alternative Two

Facility/Item	Estimated Budget Cost
Mitchell Road WTP	$1,509,279
Wyndtree WTP	$2,699,165
Industrial Park WTP	$2,674,259
Well Modifications	$811,572
WTP Sub Total	$7,694,275
1998 Piping Modifications	$1,095,939
2015 Piping Modifications	$695,478
Piping Sub Total	$1,791,417
Total	$9,485,692

Seven Springs Water System

Water Facilities Upgrade Study Report

Capital Cost Budget Estimate–Proposed Mitchell Road WTP

Component	Raw Cost	Installation (30%)	Contractor O&P (15%)	Sales Tax (7.5%)	Sub-Total
Chemical Storage and Feed Equipment					
Carbon Dioxide	$100,000	$30,000	$19,500	$7,500	$157,000
Hydrochloric Acid	$20,000	$6,000	$3,900	$1,500	$31,400
Sodium Bicarbonate	$10,000	$3,000	$1,950	$750	$15,700
Sodium Hydroxide	$25,000	$7,500	$4,875	$1,875	$39,250
Unit Process Equipment					
Packed Tower H2S Stripper/Scrubber	$147,000	$44,100	$28,665	$11,025	$230,790
Off-Gas Pre-Stripper	$18,000	$5,400	$3,510	$1,350	$28,260
Off-Gas Carbon Contactor	$100,000	$30,000	$19,500	$7,500	$157,000
Ozone Disinfection Unit	$91,000	$27,300	$17,745	$6,825	$142,870
Treated Water Transfer Pump Station	$70,500	$21,150	$13,748	$5,288	$110,685
500,000 Gallon Water Storage Tank*	$0	$0	$0	$0	$0
Compound Loop Chlorination System	$5,500	$1,650	$1,073	$413	$8,635
Chlorine Room Scrubber (OSHA)	$2,700	$810	$527	$203	$4,239
High Service Pumping System*	$0	$0	$0	$0	$0
Electrical Generator	$35,000	$10,500	$6,825	$2,625	$54,950
Flow Meters & Recorders	$4,700	$1,410	$917	$353	$7,379
Pressure Relief Valve Assembly	$8,700	$2,610	$1,697	$653	$13,659
SCADA System	$23,500	$7,050	$4,583	$1,763	$36,895
Concrete Slabs/Building Modifications	$41,000	$12,300	$7,995	$3,075	$64,370
Operations Building*	$0	$0	$0	$0	$0
Yard Piping	$16,100	$4,830	$3,140	$1,208	$25,277
Sitework (4%)					$45,134
Electrical (10%)					$112,836
Construction Contingencies (15%)					$192,949
Land Acquisition Allowance (1 Acre)					$30,000
				Total	**$1,509,279**

* Present at existing facility. Will not be replaced.

Seven Springs Water System

Water Facilities Upgrade Study Report

Capital Cost Budget Estimate–Proposed Wyndtree WTP

Component	Raw Cost	Installation (30%)	Contractor O&P (15%)	Sales Tax (7.5%)	Sub-Total
Chemical Storage and Feed Equipment					
Carbon Dioxide	$110,000	$33,000	$21,450	$8,250	$172,700
Hydrochloric Acid	$25,000	$7,500	$4,875	$1,875	$39,250
Sodium Bicarbonate	$14,000	$4,200	$2,730	$1,050	$21,980
Sodium Hydroxide	$30,000	$9,000	$5,850	$2,250	$47,100
Unit Process Equipment					
Packed Tower H2S Stripper/Scrubber	$161,000	$48,300	$31,395	$12,075	$252,770
Off-Gas Pre-Stripper	$40,000	$12,000	$7,800	$3,000	$62,800
Off-Gas Carbon Contactor	$130,000	$39,000	$25,350	$9,750	$204,100
Ozone Disinfection Unit	$91,000	$27,300	$17,745	$6,825	$142,870
Treated Water Transfer Pump Station	$70,500	$21,150	$13,748	$5,288	$110,685
1,000,000 Gallon Water Storage Tank	$178,000	$53,400	$34,710	$13,350	$279,460
Compound Loop Chlorination System	$29,000	$8,700	$5,655	$2,175	$45,530
Chlorine Room Scrubber (OSHA)	$27,000	$8,100	$5,265	$2,025	$42,390
High Service Pumping System	$191,000	$57,300	$37,245	$14,325	$299,870
Electrical Generator	$35,000	$10,500	$6,825	$2,625	$54,950
Flow Meters & Recorders	$14,000	$4,200	$2,730	$1,050	$21,980
Pressure Relief Valve Assembly	$8,700	$2,610	$1,697	$653	$13,659
SCADA System	$23,500	$7,050	$4,583	$1,763	$36,895
Concrete/Chemical&Mechanical Building	$67,000	$20,100	$13,065	$5,025	$105,190
Operations Building	$20,000	$6,000	$3,900	$1,500	$31,400
Yard Piping	$32,100	$9,630	$6,260	$2,408	$50,397
Sitework (4%)					$81,439
Electrical (10%)					$203,598
Construction Contingencies (15%)					$348,152
Land Acquisition Allowance (1 Acre)					$30,000
				Total	$2,699,165

Seven Springs Water System

Water Facilities Upgrade Study Report

Capital Cost Budget Estimate–Proposed Industrial Park WTP

Component	Raw Cost	Installation (30%)	Contractor O&P (15%)	Sales Tax (7.5%)	Sub-Total
Chemical Storage and Feed Equipment					
Carbon Dioxide	$110,000	$33,000	$21,450	$8,250	$172,700
Hydrochloric Acid	$25,000	$7,500	$4,875	$1,875	$39,250
Sodium Bicarbonate	$14,000	$4,200	$2,730	$1,050	$21,980
Sodium Hydroxide	$30,000	$9,000	$5,850	$2,250	$47,100
Unit Process Equipment					
Packed Tower H2S Stripper/Scrubber	$161,000	$48,300	$31,395	$12,075	$252,770
Off-Gas Pre-Stripper	$25,000	$7,500	$4,875	$1,875	$39,250
Off-Gas Carbon Contactor	$130,000	$39,000	$25,350	$9,750	$204,100
Ozone Disinfection Unit	$91,000	$27,300	$17,745	$6,825	$142,870
Treated Water Transfer Pump Station	$70,500	$21,150	$13,748	$5,288	$110,685
1,000,000 Gallon Water Storage Tank	$178,000	$53,400	$34,710	$13,350	$279,460
Compound Loop Chlorination System	$29,000	$8,700	$5,655	$2,175	$45,530
Chlorine Room Scrubber (OSHA)	$27,000	$8,100	$5,265	$2,025	$42,390
High Service Pumping System	$191,000	$57,300	$37,245	$14,325	$299,870
Electrical Generator	$35,000	$10,500	$6,825	$2,625	$54,950
Flow Meters & Recorders	$14,000	$4,200	$2,730	$1,050	$21,980
Pressure Relief Valve Assembly	$8,700	$2,610	$1,697	$653	$13,659
SCADA System	$23,500	$7,050	$4,583	$1,763	$36,895
Concrete/Chemical&Mechanical Building	$67,000	$20,100	$13,065	$5,025	$105,190
Operations Building	$20,000	$6,000	$3,900	$1,500	$31,400
Yard Piping	$35,000	$10,500	$6,825	$2,625	$54,950
Sitework (4%)					$80,679
Electrical (10%)					$201,698
Construction Contingencies (15%)					$344,903
Land Acquisition Allowance (1 Acre)					$30,000
				Total	**$2,674,259**

Seven Springs Water System

Water Facilities Upgrade Study Report

Capital Cost Budget Estimate–Well Improvements

Component	Raw Cost	Installation (30%)	Contractor O&P (15%)	Sales Tax (7.5%)	Sub-Total
1998 Well Improvements					
Modification of Existing Well # 1	$30,700	$9,210	$5,987	$2,303	$48,199
Construction of Relocated Well #7A	$96,300	$28,890	$18,779	$7,223	$151,191
Construction of Relocated Well #6A	$96,300	$28,890	$18,779	$7,223	$151,191
Construction of New Well #10	$113,100	$33,930	$22,055	$8,483	$177,567
Construction of New Well #11	$113,100	$33,930	$22,055	$8,483	$177,567
2015 Well Improvements					
Not Yet Defined (See Section 7)					
Construction Contingencies (15%)					$105,857
				Total	**$811,572**

Note: These improvements are discussed in Appendix D

Seven Springs Water System

Water Facilities Upgrade Study Report

Capital Cost Budget Estimate--1998/2015 Transmission System Improvements

Component	Raw Cost	Installation (30%)	Contractor O&P (15%)	Sales Tax (7.5%)	Sub-Total
1998 Water Main Improvements					
For Industrial Park WTP	$374,000	$112,200	$72,930	$28,050	$587,180
For Wyndtree WTP	$36,100	$10,830	$7,040	$2,708	$56,677
For Mitchell Road WTP	$61,500	$18,450	$11,993	$4,613	$96,555
On Old SR 54	$135,400	$40,620	$26,403	$10,155	$212,578
2015 Water Main Improvements					
On SR 54	$52,100	$15,630	$10,160	$3,908	$81,797
On Little Road North	$195,300	$58,590	$38,084	$14,648	$306,621
On Little Road South	$137,800	$41,340	$26,871	$10,335	$216,346
Construction Contingencies (15%)					$233,663.10
				Total	**$1,791,417**

Note: These improvements are discussed in Appendix D

O&M Costs

Seven Springs Water System

Water Facilities Upgrade Study Report

O&M Cost Budget Estimate–Proposed WTPs 1998 Design Year Flows

Facility	Carbon Dioxide	Hydrochloric Acid	Air Stripper	Off-Gas Pre-Scrub	Off-Gas Carbon	Sodium Bi-Carb	Sodium Hydroxide	Ozone	Sub-Total
Mitchell Road WTP	$20,800	$60,500	$4,500	$78,700	$11,100	$29,800	$233,700	$4,700	$443,800
Wyndtree WTP	$27,100	$80,300	$4,500	$105,500	$15,000	$170,400	$311,800	$5,700	$720,300
Industrial Park Plant	$27,100	$80,300	$4,500	$311,790	$17,300	$170,400	$311,800	$5,700	$928,890
Transfer & High Service Pumps Power									$105,000
Operations/Maintenance Personnel									$657,000
Administration									$36,500
								Total	$2,891,490

Note: 1. Operations and maintenance personnel costs estimated at 6 persons, 12 hours per day, 365 days per year at $25/hour.
Administrative personnel costs estimated at 2 hours per day 365 days per year at $50/hour.
2. Transfer & high service pumping calculated at 33% average power load (160 hp) for 24 hours/day at $0.1/kwh.

Seven Springs Water System

Water Facilities Upgrade Study Report

O&M Cost Budget Estimate–Proposed WTPs 2015 Design Year Flows

Facility	Carbon Dioxide	Hydrochloric Acid	Air Stripper	Off-Gas Pre-Scrub	Off-Gas Carbon	Sodium Bi-Carb	Sodium Hydroxide	Ozone	Sub-Total
Mitchell Road WTP	$36,400	$106,112	$7,800	$138,000	$19,400	$52,200	$410,000	$8,300	$778,212
Wyndtree WTP	$47,600	$140,800	$7,800	$185,000	$26,300	$299,000	$547,000	$10,000	$1,263,500
Industrial Park Plant	$47,400	$140,800	$7,800	$547,000	$30,300	$299,000	$547,000	$10,000	$1,629,300
Transfer & High Service Pumps Power									$185,000
Operations/Maintenance Personnel									$1,314,000
Administration									$36,500
								Total	$5,206,512

Note: 1. Operations and maintenance personnel costs estimated at 6 persons, 24 hours per day, 365 days per year at $25/hour.
Administrative personnel costs estimated at 2 hours per day 365 days per year at $50/hour.
2. Transfer & high service pumping calculated at 33% average power load (160 hp) for 24 hours/day at $0.1/kwh.

Engineering Costs

Seven Springs Water System

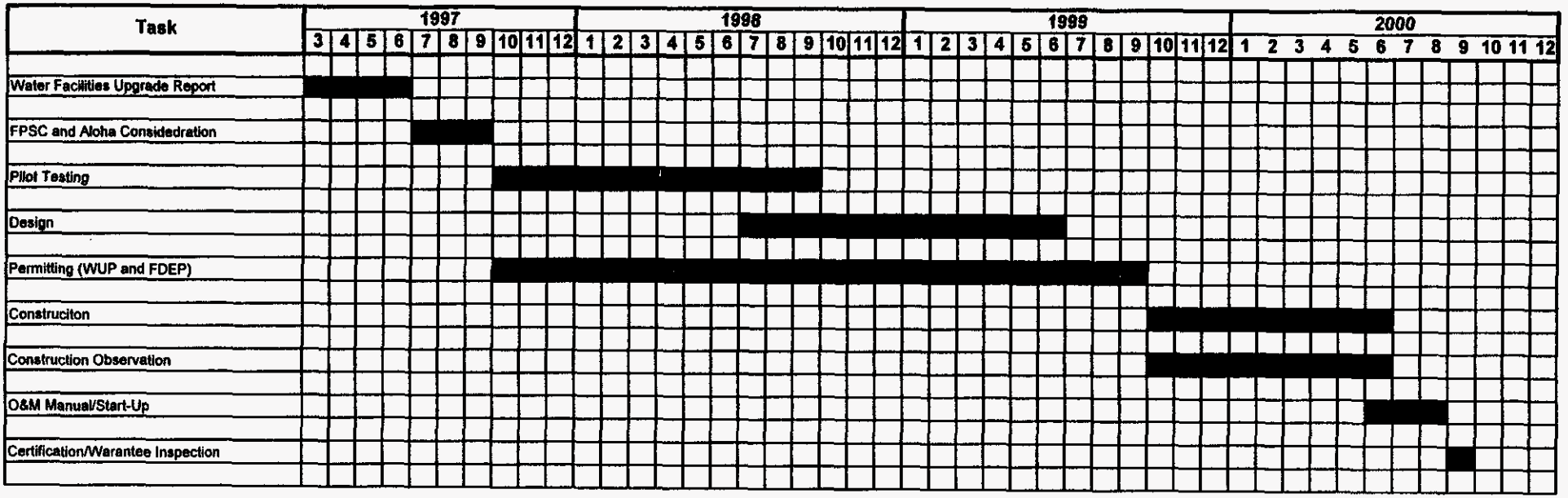
Water Facilities Upgrade Study Report

Engineering Cost Budget Estimate Summary–Proposed WTPs–Alternative Two

Task	Estimated Budget Cost
Water Facilities Upgrade Report	$45,000
Pilot Testing	$340,000
Design, Permitting, Construction Observation, O&M Manual, Start-Up, Certifications, Warrantee Inspection	$1,039,000
Total	$1,424,000

Project Schedule

Project Schedule



Section 10-Recommendations

The Seven Springs Water System service area is being developed at very high rates. By 2015 it is estimated that the demand for water will be almost 75% greater than today. In fact, the current water system is nearing full utilization (2.04 mgd) based on SWFWMD Water Use Permit capacity.

Severe space limitations exist at the majority of the present water well/treatment facility sites and no readily available property exists within a reasonable distance upon which additional facilities could be constructed. Each of the well sites is now surrounded by residential and commercial properties; any of the anticipated chemical treatment facilities constructed at the wells could pose a safety risk and/or quality of life reduction for the residential and commercial neighbors. In addition, operator time required at each facility, because of the presence of the chemical treatment units, adds substantially to the cost of operation of the individual treatment facilities as compared to the centralized treatment alternative.

Proposed and impending USEPA and FDEP regulations, with high probability, will require treatment and storage modifications to the existing water well/treatment facilities within the next 2 to five years.

The level of sulfide and sulfate in the Seven Springs Water System finished water is average for Florida utilities and currently meets USEPA and FDEP requirements. Aloha has implemented a corrosion control program, that has been approved by the FDEP. Recent testing has shown that this program is effectively reducing the corrosion of copper plumbing. Additional fine-tuning of the dosage rates for the corrosion inhibitor chemical is underway. It is anticipated that additional copper corrosion rate reductions will take place as a result of this fine-tuning.

The costs associated with retrofitting the existing water well/treatment facilities to include equipment to remove hydrogen sulfide and construct two new well/treatment facilities (identical to the existing facilities) is over nine million dollars ($9,000,000) for tray aeration and twelve million dollars ($12,000,000) for packed tower aeration. Equally high are the estimated yearly operating costs of over three million dollars per year ($3,000,000/year) for either tray or packed tower aeration. These retrofits will not increase the capacity of the existing water system to supply additional water over the demands projected for the 1998 design year. Substantial capacity increases will be needed by the year 2000 in addition to the modifications proposed in Alternatives 1A and 1B here.

The costs associated with centralization of treatment including the conversion of the existing water wells to raw water pumping stations, relocating two of the wells, constructing two new wells, constructing modifications to the existing storage and pumping facility, constructing two new water treatment, storage and pumping facilities and constructing a number of distribution system piping modifications are much less than the costs associated with modifying the existing individual

facilities, over nine million dollars ($9,000,000). The operating costs associated with the centralized treatment alternative are also much lower than that of the other alternatives, over two million dollars per year ($2,000,000/year at 1998 design flows). With the addition of an additional 1.75 mgd raw water supply (not provided for in this alternative) and increased operating time of the treatment facilities, these modifications will allow the centralized facilities to meet the 2015 projected water demands, which Alternatives 1A and 1B do not. This alternative also provides for greatly increased water storage capacity. The distribution system improvements will allow water to reach the end uses much more quickly which has the effect of improving water quality as well as increasing pressure supplied. These benefits are not provided by Alternatives 1A and 1B.

The process engineering completed during the preparation of this report was done without the benefit of pilot testing. Process selections and sizing was based on empirical data provided by equipment suppliers, data obtained from reference materials and the experience of the author. Pilot testing must be completed prior to the final process selection and sizing. Pilot testing has also been strongly recommended by the FDEP in our discussions with them during the completion of this report.

A draft report of a recent study, completed at the University of Colorado, indicates that hydrogen sulfide concentrations must be reduced to almost undetectable concentrations if copper sulfide induced copper corrosion is to be prevented. This study also reports that copper tubing with existing copper sulfide precipitates will continue to experience elevated corrosion rates even though the source of sulfide is removed until the precipitates are completely removed.

Based on the data presented in this report and the comments listed on this page we recommend the following:

1. Due to the extremely high capital and O&M costs associated with Alternates 1A, 1B and 2 and the effect that these costs will have on water rates (estimated to be at least a four fold increase), we recommend that the Utility's existing program to control copper corrosion and discolored water from copper sulfide formation be continued. This is especially true, given that no substantial benefit may be realized by those customers with in-home treatment systems where the majority of the water discoloration and odor problems have been observed. Recent testing indicates that the existing corrosion control program has been quite effective in reducing copper corrosion. Sharp declines in the number of discolored water complaints indicate that water discoloration is also diminishing. Additional fine-tuning of the dosage of the corrosion inhibitor is underway and further copper corrosion rate reductions are anticipated. Aloha's finished water is routinely tested for odor. The results of this testing has shown the finished water to exhibit odor values that are well within USEPA and FDEP standards. However, future system modifications that will be made to comply with future regulation changes will further improve finished water quality.
2. Should the Commission determine that the existing corrosion control program is not sufficient and that the regulatory and cost uncertainties of Alternative 2 are acceptable, we recommend that Aloha work with the Commission to obtain an immediate phased

rate increase to implement Alternative 2. Alternative 2 has been chosen over Alternatives 1A and 1B because: it is less costly that either 1A or 1B in both capital and operating costs (substantially less than 1B); it provides for treatment, storage, pumping and distribution capacity needed through the year 2015, which 1A and 1B do not; it provides for relatively easy modification of the facilities to meet future regulatory requirements, which 1A and 1B do not; and it provides for substantially higher removal of H_2S than 1A.The first phase of the work: completing pilot testing, completing design work and obtaining the necessary permitting should begin as soon as the rates can be put into effect to pay for these activities. Additional phases of the work: construction, start-up and certification should begin as soon as the first phase of the work is complete and as soon as the rates can be put into effect to pay for these activities as well.

Appendix A

Current and Pending/Future Regulatory Agency Rules Reference Data

Safe Drinking Water Act

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This document has been excerpted from the American Water Works Association's SDWA Advisor on CD-ROM. Sections that are new or substantially revised by the SDWA Amendments of 1996 appear in ***bold italic.***

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~~pursuant thereto, the Administrator shall issue an order under subsection (g) requiring the public water system to comply with such regulation or requirement or the Administrator shall commence a civil action under subsection (b).~~

(2) ENFORCEMENT IN NONPRIMACY STATES.–

(A) IN GENERAL.– If, on the basis of information available to the Administrator, the Administrator finds, with respect to a period in which a State does not have primary enforcement responsibility for public water systems, that a public water system in the State–

(i) for which a variance under section 1415 or an exemption under section 1416 is not in effect, does not comply with any applicable requirement; or

(ii) for which a variance under section 1415 or an exemption under section 1416 is in effect, does not comply with any schedule or other requirement imposed pursuant to the variance or exemption;

the Administrator shall issue an order under subsection (g) requiring the public water system to comply with the requirement, or commence a civil action under subsection (b).

(B) NOTICE.– If the Administrator takes any action pursuant to this paragraph, the Administrator shall notify an appropriate local elected official, if any, with jurisdiction over the public water system of the action prior to the time that the action is taken.

(b) The Administrator may bring a civil action in the appropriate United States district court to require compliance with ~~a national primary drinking water regulation,~~ ***any applicable requirement*** with an order issued under subsection (g), or with any schedule or other requirement imposed pursuant to a variance or exemption granted under section 1415 or 1416 if-

(1) authorized under paragraph (1) or (2) of subsection (a), or

(2) if requested by (A) the chief executive officer of the State in which is located the public water system which is not in compliance with such regulation or requirement, or (B) the agency of such State which has jurisdiction over compliance by public water systems in the State with national primary drinking water regulations or State drinking water regulations.

The court may enter, in an action brought under this subsection, such judgment as protection of public health may require, taking into consideration the time necessary to comply and the availability of alternative water supplies; and, if, the court determines that there has been a violation of the regulation or schedule or other requirement with respect to which the action was brought, the court may, taking into account the seriousness of the violation, the population at risk, and other appropriate factors, impose on the violator a civil penalty of not to exceed $25,000 for each day in which such violation occurs.

~~(c) Each owner or operator of a public water system shall give notice to the persons served by it-~~

~~(1) of any failure on the part of the public water system to-~~

~~(A) comply with an applicable maximum contaminant level or treatment technique requirement of, or a testing procedure prescribed by, a national primary drinking~~

The Safe Drinking Water Act

This document presents the entire text of the Safe Drinking Water Act, as amended by the Safe Drinking Water Act Amendments of 1986, the Lead Contamination Control Act of 1988, and the SDWA Amendments of 1996. Changes to the Act made by the 1996 Amendments are shown as follows: ~~strike-outs~~, ***additions***.

Title XIV-Safety of Public Water Systems

SHORT TITLE

SEC. 1400. This title may be cited as the 'Safe Drinking Water Act.'

Part A Definitions

DEFINITIONS

SEC. 1401. For purposes of this title:

(1) The term "primary drinking water regulation" means a regulation which-

(A) applies to public water systems;

(B) specifies contaminants which, in the judgment of the Administrator, may have any adverse effect on the health of persons;

(C) specifies for each such contaminant either-

(i) a maximum contaminant level, if, in the judgment of the Administrator, it is economically or technologically feasible to ascertain the level of such contaminant in water in public water systems, or

(ii) if, in the judgment of the Administrator, it is not economically or technologically feasible to so ascertain the level of such contaminant, each treatment technique known to the Administrator which leads to a reduction in the level of such contaminant sufficient to satisfy the requirements of section 1412; and

(D) contains criteria and procedures to assure a supply of drinking water which dependably complies with such maximum contaminant levels; including ***accepted methods for*** quality control and testing procedures to insure compliance with such levels and to insure proper operation and maintenance of the system, and requirements as to (i) the minimum quality of water which may be taken into the system and (ii) siting for new

facilities for public water systems. ***At any time after promulgation of a regulation referred to in this paragraph, the Administrator may add equally effective quality control and testing procedures by guidance published in the Federal Register. Such procedures shall be treated as an alternative for public water systems to the quality control and testing procedures listed in the regulation.***

(2) The term "secondary drinking water regulation" means a regulation which applies to public water systems and which specifies the maximum contaminant levels which, in the judgment of the Administrator, are requisite to protect the public welfare. Such regulations may apply to any contaminant in drinking water (A) which may adversely affect the odor or appearance of such water and consequently may cause a substantial number of the persons served by the public water system providing such water to discontinue its use, or (B) which may otherwise adversely affect the public welfare. Such regulations may vary according to geographic and other circumstances.

(3) The term "maximum contaminant level" means the maximum permissible level of a contaminant in water which is delivered to any user of a public water system.

~~(4) The~~ ***(4) Public Water System.—***

(A) In General.—The term "public water system" means a system for the provision to the public of ~~piped water for human consumption~~ ***water for human consumption through pipes or other constructed conveyances***, if such system has at least fifteen service connections or regularly serves at least twenty-five individuals. Such term includes

~~(A)~~ ***(i)*** any collection, treatment, storage, and distribution facilities under control of the operator of such system and used primarily in connection with such system, and

~~(B)~~ ***(ii)*** any collection or pretreatment storage facilities not under such control which are used primarily in connection with such system.

(B) Connection.—

(i) IN GENERAL- For purposes of subparagraph (A), a connection to a system that delivers water by a constructed conveyance other than a pipe shall not be considered a connection, if—

(I) the water is used exclusively for purposes other than residential uses (consisting of drinking, bathing, and cooking, or other similar uses);

(II) the Administrator or the State (in the case of a State exercising primary enforcement responsibility for public water systems) determines that alternative water to achieve the equivalent level of public health protection provided by the applicable national primary drinking water regulation is provided for residential or similar uses for drinking and cooking; or

(III) the Administrator or the State (in the case of a State exercising primary enforcement responsibility for public water systems) determines that the water provided for residential or similar uses for drinking, cooking, and bathing is centrally treated or treated at the point of entry by the provider, a pass-through entity, or the user to achieve the equivalent level of protection provided by the applicable national primary drinking water regulations.

(ii) IRRIGATION DISTRICTS- An irrigation district in existence prior to May 18, 1994, that provides primarily agricultural service through a piped water system with only incidental residential or similar use shall not be considered to be a public water system if the system or the residential or similar users of the system comply with subclause (II) or (III) of clause (i).

(C) TRANSITION PERIOD- A water supplier that would be a public water system only as a result of modifications made to this paragraph by the Safe Drinking Water Act Amendments of 1996 shall not be considered a public water system for purposes of the Act until the date that is two years after the date of enactment of this subparagraph. If a water supplier does not serve 15 service connections (as defined in subparagraphs (A) and (B)) or 25 people at any time after the conclusion of the 2-year period, the water supplier shall not be considered a public water system.'.

(5) The term "supplier of water" means any person who owns or operates a public water system.

(6) The term "contaminant" means any physical, chemical, biological, or radiological substance or matter in water.

(7) The term "Administrator" means the Administrator of the Environmental Protection Agency.

(8) The term "Agency" means the Environmental Protection Agency.

(9) The term "Council" means the National Drinking Water Advisory Council established under section 1446.

(10) The term "municipality" means a city, town, or other public body created by or pursuant to State law, or an *Indian Tribe* authorized by law.

(11) The term "Federal agency" means any department, agency, or instrumentality of the United States.

(12) The term "person" means an individual, corporation, company, association, partnership, State, municipality, or Federal agency (and includes officers, employees, and agents of any corporation, company, association, State, municipality, or Federal agency).

(13) ~~The~~ ***(A) Except as provided in subparagraph (B), the*** term "State" includes, in addition to the several States, only the District of Columbia, Guam, the Commonwealth of Puerto Rico, the Northern Mariana Islands, the Virgin Islands, American Samoa, and the Trust Territory of the Pacific Islands.

(B) For purposes of section 1452, the term 'State' means each of the 50 States, the District of Columbia, and the Commonwealth of Puerto Rico.

(14) The term "Indian Tribe" means any Indian tribe having a Federally recognized governing body carrying out substantial governmental duties and powers over any area. ***For purposes of section 1452, the term includes any Native village (as defined in section 3(c) of the Alaska Native Claims Settlement Act (43 U.S.C. 1602(c)).***

(15) Community Water System.—The term 'community water system' means a public water system that–

(A) serves at least 15 service connections used by year-round residents of the area served by the system; or

(B) regularly serves at least 25 year-round residents.

(16) Noncommunity Water System--The term 'noncommunity water system' means a public water system that is not a community water system.

Part B Public Water Systems

COVERAGE

SEC. 1411. Subject to sections 1415 and 1416, national primary drinking water regulations under this part shall apply to each public water system in each State; except that such regulations shall not apply to a public water system-

(1) which consists only of distribution and storage facilities (and does not have any collection and treatment facilities)

(2) which obtains all of its water from, but is not owned or operated by, a public water system to which such regulations apply;

(3) which does not sell water to any person; and

(4) which is not a carrier which conveys passengers in interstate commerce.

NATIONAL DRINKING WATER REGULATIONS

SEC. 1412. (a)(1) Effective on the enactment of the Safe Drinking Water Act Amendments of 1986, each national interim or revised primary drinking water regulation promulgated under this section before such enactment shall be deemed to be a national primary drinking water regulation under subsection (b). No such regulation shall be required to comply with the standards set forth in subsection (b)(4) unless such regulation is amended to establish a different maximum contaminant level after the enactment of such amendments.

(2) After the enactment of the Safe Drinking Water Act Amendments of 1986, each recommended maximum contaminant level published before the enactment of such amendments shall be treated as a maximum contaminant level goal.

(3) Whenever a national primary drinking water regulation is proposed under ~~paragraph (1), (2), or (3) of~~ subsection (b) for any contaminant, the maximum contaminant level goal for such contaminant shall be proposed simultaneously. Whenever a national primary drinking water regulation is promulgated under ~~paragraph (1), (2), or (3) of~~ subsection (b) for any contaminant, the maximum contaminant level goal for such contaminant shall be published simultaneously.

(4) Paragraph (3) shall not apply to any recommended maximum contaminant level published before the enactment of the Safe Drinking Water Act Amendments of 1986.

~~(b)(1) In the case of those contaminants listed in the Advance Notice of Proposed Rulemaking published in volume 47, *Federal Register*, page 9352, and in volume 48, *Federal Register*, page 45502, the Administrator shall publish maximum contaminant level goals and promulgate national primary drinking water regulations~~

~~(A) not later than 12 months after the enactment of the Safe Drinking Water Act Amendments of 1986 for not less than 9 of those listed contaminants;~~

~~(B) not later than 24 months after such enactment for not less than 40 of those listed contaminants; and~~

~~(C) not later than 36 months after such enactment for the remainder of such listed contaminants.~~

~~(2)(A) If the Administrator identifies a drinking water contaminant the regulation of which, in the judgment of the Administrator, is more likely to be protective of public health (taking into account the schedule for regulation under paragraph (1)), the Administrator may publish a maximum contaminant level goal and promulgate a national primary drinking water regulation for such identified contaminant in lieu of regulating the contaminant referred to in such paragraph. There may be no more than 7 contaminants in paragraph (1) for which substitutions may be made. Regulation of a contaminant identified under this paragraph shall be in accordance with the schedule applicable to the contaminant for which the substitution is made.~~

~~(B) If the Administrator identifies one or more contaminants for substitution under this paragraph, the Administrator shall publish in the *Federal Register* not later than one year after the enactment of the Safe Drinking Water Act Amendments of 1986 a list of contaminants proposed for substitutions, the contaminants referred to in paragraph (1) for which substitutions are to be made, and the basis for the judgment that regulation of such proposed substitute contaminants is more likely to be protective of public health (taking into account the schedule for regulation under such paragraph). Following a period of 60 days for public comment, the Administrator shall publish in the *Federal Register* a final list of contaminants to be substituted and contaminants referred to in paragraph (1) for which substitutions are to be made, together with responses to significant comments.~~

~~(C) Any contaminant referred to in paragraph (1) for which a substitution is made, pursuant to subparagraph (A) of this paragraph, shall be included on the priority list to be published by the Administrator not later than January 1, 1988, pursuant to paragraph (3)(A).~~

~~(D) The Administrator's decision to regulate a contaminant identified pursuant to this paragraph in lieu of a contaminant referred to in paragraph (1) shall not be subject to judicial review.~~

~~(3)(A) The Administrator shall publish maximum contaminant level goals and promulgate national primary drinking water regulations for each contaminant (other than a contaminant referred to in paragraph (1) or (2) for which a national primary drinking water regulation was promulgated) which, in the judgment of the Administrator, may have any adverse effect on the health of persons and which is known or anticipated to occur in public water systems. Not later than January 1, 1988, and at 3 year intervals thereafter, the Administrator shall publish a list of contaminants which are known or anticipated to occur in public water systems and which may require regulation under this Act.~~

~~(B) For the purpose of establishing the list under subparagraph (A), the Administrator shall form an advisory working group including members from the National Toxicology Program and the Environmental Protection Agency's Offices of Drinking Water, Pesticides, Toxic Substances, Ground Water, Solid Waste and Emergency Response and any others the Administrator deems appropriate. The Administrator's consideration of priorities shall include, but not be limited to, substances referred to in section 101(14) of the Comprehensive Environmental Response, Compensation, and Liability Act of 1980, and substances registered as pesticides under the Federal Insecticide, Fungicide, and Rodenticide Act.~~

~~(C) Not later than 24 months after the listing of contaminants under subparagraph (A), the Administrator shall publish proposed maximum contaminant level goals and national primary drinking water regulations for not less than 25 contaminants from the list established under subparagraph (A).~~

~~(D) Not later than 36 months after the listing of contaminants under subparagraph (A), the Administrator shall publish a maximum contaminant goal and promulgate a national primary drinking water regulation for those contaminants for which proposed maximum contaminant level goals and proposed national primary drinking water regulations were published under subparagraph (C).~~

(b) STANDARDS–

(1) IDENTIFICATION OF CONTAMINANTS FOR LISTING–

(A) GENERAL AUTHORITY.– The Administrator shall, in accordance with the procedures established by this subsection, publish a maximum contaminant level goal and promulgate a national primary drinking water regulation for a contaminant (other than a contaminant referred to in paragraph (2) for which a national primary drinking water regulation has been promulgated as of the date of enactment of the Safe Drinking Water Act Amendments of 1996) if the Administrator determines that–

(i) the contaminant may have an adverse effect on the health of persons;

(ii) the contaminant is known to occur or there is a substantial likelihood that the contaminant will occur in public water systems with a frequency and at levels of public health concern; and

(iii) in the sole judgment of the Administrator, regulation of such contaminant presents a meaningful opportunity for health risk reduction for persons served by public water systems.

(B) REGULATION OF UNREGULATED CONTAMINANTS.–

(i) LISTING OF CONTAMINANTS FOR CONSIDERATION.– (I) Not later than 18 months after the date of enactment of the Safe Drinking Water Act Amendments of 1996 and every 5 years thereafter, the Administrator, after consultation with the scientific community, including the Science Advisory Board, after notice and opportunity for public comment, and after considering the occurrence data base established under section 1445(g), shall publish a list of contaminants which, at the time of publication, are not subject to any proposed or promulgated national primary drinking water regulation, which are known or anticipated to occur in public water systems, and which may require regulation under this title.

(II) The unregulated contaminants considered under subclause (I) shall include, but not be limited to, substances referred to in section 101(14) of the Comprehensive Environmental Response, Compensation, and Liability Act of 1980, and substances registered as pesticides under the Federal Insecticide, Fungicide, and Rodenticide Act.

(III) The Administrator's decision whether or not to select an unregulated contaminant for a list under this clause shall not be subject to judicial review.

(ii) DETERMINATION TO REGULATE.-- (I) Not later than 5 years after the date of enactment of the Safe Drinking Water Act Amendments of 1996, and every 5 years thereafter, the Administrator shall, after notice of the preliminary determination and opportunity for public comment, for not fewer than 5 contaminants included on the list published under clause (i), make determinations of whether or not to regulate such contaminants.

(II) A determination to regulate a contaminant shall be based on findings that the criteria of clauses (i), (ii), and (iii) of subparagraph (A) are satisfied. Such findings shall be based on the best available public health information, including the occurrence data base established under section 1445(g).

(III) The Administrator may make a determination to regulate a contaminant that does not appear on a list under clause (i) if the determination to regulate is made pursuant to subclause (II).

(IV) A determination under this clause not to regulate a contaminant shall be considered final agency action and subject to judicial review.

(iii) REVIEW.-- Each document setting forth the determination for a contaminant under clause (ii) shall be available for public comment at such time as the determination is published.

(C) PRIORITIES.-- In selecting unregulated contaminants for consideration under subparagraph (B), the Administrator shall select contaminants that present the greatest public health concern. The Administrator, in making such selection, shall take into consideration, among other factors of public health concern, the effect of such contaminants upon subgroups that comprise a meaningful portion of the general population (such as infants, children, pregnant women, the elderly, individuals with a history of serious illness, or other subpopulations) that are identifiable as being at greater risk of adverse health effects due to exposure to contaminants in drinking water than the general population.

(D) URGENT THREATS TO PUBLIC HEALTH.-- The Administrator may promulgate an interim national primary drinking water regulation for a contaminant without making a determination for the contaminant under paragraph (4)(C), or completing the analysis under paragraph (3)(C), to address an urgent threat to public health as determined by the Administrator after consultation with and written response to any comments provided by the Secretary of Health and Human Services, acting through the director of the Centers for Disease Control and Prevention or the director of the National Institutes of Health. A determination for any contaminant in accordance with paragraph (4)(C) subject to an interim regulation under this subparagraph shall be issued, and a completed analysis meeting the requirements of paragraph (3)(C) shall be

published, not later than 3 years after the date on which the regulation is promulgated and the regulation shall be repromulgated, or revised if appropriate, not later than 5 years after that date.

(E) REGULATION.– For each contaminant that the Administrator determines to regulate under subparagraph (B), the Administrator shall publish maximum contaminant level goals and promulgate, by rule, national primary drinking water regulations under this subsection. The Administrator shall propose the maximum contaminant level goal and national primary drinking water regulation for a contaminant not later than 24 months after the determination to regulate under subparagraph (B), and may publish such proposed regulation concurrent with the determination to regulate. The Administrator shall publish a maximum contaminant level goal and promulgate a national primary drinking water regulation within 18 months after the proposal thereof. The Administrator, by notice in the Federal Register, may extend the deadline for such promulgation for up to 9 months.

(F) HEALTH ADVISORIES AND OTHER ACTIONS.– The Administrator may publish health advisories (which are not regulations) or take other appropriate actions for contaminants not subject to any national primary drinking water regulation.

(2) SCHEDULES AND DEADLINES.–

(A) IN GENERAL.– In the case of the contaminants listed in the Advance Notice of Proposed Rulemaking published in volume 47, Federal Register, page 9352, and in volume 48, Federal Register, page 45502, the Administrator shall publish maximum contaminant level goals and promulgate national primary drinking water regulations–

(i) not later than 1 year after June 19, 1986, for not fewer than 9 of the listed contaminants;

(ii) not later than 2 years after June 19, 1986, for not fewer than 40 of the listed contaminants; and

(iii) not later than 3 years after June 19, 1986, for the remainder of the listed contaminants.

(B) SUBSTITUTION OF CONTAMINANTS.– If the Administrator identifies a drinking water contaminant the regulation of which, in the judgment of the Administrator, is more likely to be protective of public health (taking into account the schedule for regulation under subparagraph (A)) than a contaminant referred to in subparagraph (A), the Administrator may publish a maximum contaminant level goal and promulgate a national primary drinking water regulation for the identified contaminant in lieu of regulating the contaminant referred to in subparagraph (A). Substitutions may be made for not more than 7 contaminants referred to in subparagraph (A). Regulation of a contaminant identified under this subparagraph shall be in accordance with the schedule applicable to the contaminant for which the substitution is made.

(C) DISINFECTANTS AND DISINFECTION BYPRODUCTS.– The Administrator shall promulgate an Interim Enhanced Surface Water Treatment Rule, a Final Enhanced Surface Water Treatment Rule, a Stage I Disinfectants and Disinfection Byproducts Rule, and a Stage II Disinfectants and Disinfection Byproducts Rule in accordance with the schedule published in volume 59, Federal Register, page 6361 (February 10, 1994), in table III.13 of the proposed Information Collection Rule. If a delay occurs with respect to the promulgation of any rule in the schedule referred to in

this subparagraph, all subsequent rules shall be completed as expeditiously as practicable but no later than a revised date that reflects the interval or intervals for the rules in the schedule.

(3) RISK ASSESSMENT, MANAGEMENT, AND COMMUNICATION.–

(A) USE OF SCIENCE IN DECISIONMAKING.– In carrying out this section, and, to the degree that an Agency action is based on science, the Administrator shall use–

(i) the best available, peer-reviewed science and supporting studies conducted in accordance with sound and objective scientific practices; and

(ii) data collected by accepted methods or best available methods (if the reliability of the method and the nature of the decision justifies use of the data).

(B) PUBLIC INFORMATION.– In carrying out this section, the Administrator shall ensure that the presentation of information on public health effects is comprehensive, informative, and understandable. The Administrator shall, in a document made available to the public in support of a regulation promulgated under this section, specify, to the extent practicable–

(i) each population addressed by any estimate of public health effects;

(ii) the expected risk or central estimate of risk for the specific populations;

(iii) each appropriate upper-bound or lower-bound estimate of risk;

(iv) each significant uncertainty identified in the process of the assessment of public health effects and studies that would assist in resolving the uncertainty; and

(v) peer-reviewed studies known to the Administrator that support, are directly relevant to, or fail to support any estimate of public health effects and the methodology used to reconcile inconsistencies in the scientific data.

(C) HEALTH RISK REDUCTION AND COST ANALYSIS.–

(i) MAXIMUM CONTAMINANT LEVELS.– When proposing any national primary drinking water regulation that includes a maximum contaminant level, the Administrator shall, with respect to a maximum contaminant level that is being considered in accordance with paragraph (4) and each alternative maximum contaminant level that is being considered pursuant to paragraph (5) or (6)(A), publish, seek public comment on, and use for the purposes of paragraphs (4), (5), and (6) an analysis of each of the following:

(I) Quantifiable and nonquantifiable health risk reduction benefits for which there is a factual basis in the rulemaking record to conclude that such benefits are likely to occur as the result of treatment to comply with each level.

(II) Quantifiable and nonquantifiable health risk reduction benefits for which there is a factual basis in the rulemaking record to conclude that such benefits are likely to occur from reductions in co-occurring contaminants that may be attributed solely to compliance with the maximum contaminant level, excluding benefits resulting from compliance with other proposed or promulgated regulations.

(III) Quantifiable and nonquantifiable costs for which there is a factual basis in the rulemaking record to conclude that such costs are likely to occur solely as a result of compliance with the maximum contaminant level, including monitoring, treatment, and other costs and excluding costs resulting from compliance with other proposed or promulgated regulations.

(IV) The incremental costs and benefits associated with each alternative maximum contaminant level considered.

(V) The effects of the contaminant on the general population and on groups within the general population such as infants, children, pregnant women, the elderly, individuals with a history of serious illness, or other subpopulations that are identified as likely to be at greater risk of adverse health effects due to exposure to contaminants in drinking water than the general population.

(VI) Any increased health risk that may occur as the result of compliance, including risks associated with co-occurring contaminants.

(VII) Other relevant factors, including the quality and extent of the information, the uncertainties in the analysis supporting subclauses (I) through (VI), and factors with respect to the degree and nature of the risk.

(ii) TREATMENT TECHNIQUES- When proposing a national primary drinking water regulation that includes a treatment technique in accordance with paragraph (7)(A), the Administrator shall publish and seek public comment on an analysis of the health risk reduction benefits and costs likely to be experienced as the result of compliance with the treatment technique and alternative treatment techniques that are being considered, taking into account, as appropriate, the factors described in clause (i).

(iii) APPROACHES TO MEASURE AND VALUE BENEFITS.— The Administrator may identify valid approaches for the measurement and valuation of benefits under this subparagraph, including approaches to identify consumer willingness to pay for reductions in health risks from drinking water contaminants.

(iv) AUTHORIZATION.— There are authorized to be appropriated to the Administrator, acting through the Office of Ground Water and Drinking Water, to conduct studies, assessments, and analyses in support of regulations or the development of methods, $35,000,000 for each of fiscal years 1996 through 2003.

~~(4) Each~~

(4) GOALS AND STANDARDS.—

(A) MAXIMUM CONTAMINANT LEVEL GOALS.—Each maximum contaminant level goal established under this subsection shall be set at the level at which no known or anticipated adverse effects on the health of persons occur and which allows an adequate margin of safety. ~~Each national~~

(B) MAXIMUM CONTAMINANT LEVELS.—Except as provided in paragraphs (5) and (6), each national primary drinking water regulation for a contaminant for which a maximum contaminant level goal is established under this subsection shall specify a ~~maximum level~~ ***maximum contaminant level*** for such contaminant which is as close to the maximum contaminant level goal as is feasible.

(C) DETERMINATION.—At the time the Administrator proposes a national primary drinking water regulation under this paragraph, the Administrator shall publish a determination as to whether the benefits of the maximum contaminant level justify, or do not justify, the costs based on the analysis conducted under paragraph (3)(C).

~~(5) For the~~

(D) DEFINITION OF FEASIBLE.—For the purposes of this subsection, the term "feasible" means feasible with the use of the best technology, treatment techniques, and other means which the Administrator finds, after examination for efficacy under field conditions and not solely under laboratory conditions, are available (taking cost into consideration). For the purpose of ~~paragraph (4)~~ ***this paragraph***, granular activated carbon is feasible for the control of synthetic organic chemicals, and any technology, treatment technique, or other means found to be the best available for the control of synthetic organic chemicals must be at least as effective in controlling synthetic organic chemicals as granular activated carbon.

~~(6) Each national~~

(E) FEASIBLE TECHNOLOGIES.—

(i) IN GENERAL.—Each national primary drinking water regulation which establishes a maximum contaminant level shall list the technology, treatment techniques, and other means which the Administrator finds to be feasible for purposes of meeting such maximum contaminant level, but a regulation under this ~~paragraph~~ ***subsection*** shall not require that any specified technology, treatment technique, or other means be used for purposes of meeting such maximum contaminant level.

(ii) LIST OF TECHNOLOGIES FOR SMALL SYSTEMS.— The Administrator shall include in the list any technology, treatment technique, or other means that is affordable, as determined by the Administrator in consultation with the States, for small public water systems serving—

(I) a population of 10,000 or fewer but more than 3,300;

(II) a population of 3,300 or fewer but more than 500; and

(III) a population of 500 or fewer but more than 25;

and that achieves compliance with the maximum contaminant level or treatment technique, including packaged or modular systems and point-of-entry or point-of-use treatment units. Point-of-entry and point-of-use treatment units shall be owned, controlled and maintained by the public water system or by a person under contract with the public water system to ensure proper operation and maintenance and compliance with the maximum contaminant level or treatment technique and equipped with mechanical warnings to ensure that customers are automatically notified of operational problems. The Administrator shall not include in the list any point-of-use treatment technology, treatment technique, or other means to achieve compliance with a maximum contaminant level or treatment technique requirement for a microbial contaminant (or an indicator of a microbial contaminant). If the American National Standards Institute has issued product standards applicable to a specific type of point-of-entry or point-of-use treatment unit, individual units of that type shall not be accepted for compliance with a maximum contaminant level or treatment technique requirement unless they are independently

certified in accordance with such standards. In listing any technology, treatment technique, or other means pursuant to this clause, the Administrator shall consider the quality of the source water to be treated.

(iii) LIST OF TECHNOLOGIES THAT ACHIEVE COMPLIANCE.– Except as provided in clause (v), not later than 2 years after the date of enactment of this clause and after consultation with the States, the Administrator shall issue a list of technologies that achieve compliance with the maximum contaminant level or treatment technique for each category of public water systems described in subclauses (I), (II), and (III) of clause (ii) for each national primary drinking water regulation promulgated prior to the date of enactment of this paragraph.

(iv) ADDITIONAL TECHNOLOGIES.– The Administrator may, at any time after a national primary drinking water regulation has been promulgated, supplement the list of technologies describing additional or new or innovative treatment technologies that meet the requirements of this paragraph for categories of small public water systems described in subclauses (I), (II), and (III) of clause (ii) that are subject to the regulation.

(v) TECHNOLOGIES THAT MEET SURFACE WATER TREATMENT RULE.– Within one year after the date of enactment of this clause, the Administrator shall list technologies that meet the Surface Water Treatment Rule for each category of public water systems described in subclauses (I), (II), and (III) of clause (ii).

(5) ADDITIONAL HEALTH RISK CONSIDERATIONS.–

(A) IN GENERAL.– Notwithstanding paragraph (4), the Administrator may establish a maximum contaminant level for a contaminant at a level other than the feasible level, if the technology, treatment techniques, and other means used to determine the feasible level would result in an increase in the health risk from drinking water by–

(i) increasing the concentration of other contaminants in drinking water; or

(ii) interfering with the efficacy of drinking water treatment techniques or processes that are used to comply with other national primary drinking water regulations.

(B) ESTABLISHMENT OF LEVEL.– If the Administrator establishes a maximum contaminant level or levels or requires the use of treatment techniques for any contaminant or contaminants pursuant to the authority of this paragraph–

(i) the level or levels or treatment techniques shall minimize the overall risk of adverse health effects by balancing the risk from the contaminant and the risk from other contaminants the concentrations of which may be affected by the use of a treatment technique or process that would be employed to attain the maximum contaminant level or levels; and

(ii) the combination of technology, treatment techniques, or other means required to meet the level or levels shall not be more stringent than is feasible (as defined in paragraph (4)(D)).

(6) ADDITIONAL HEALTH RISK REDUCTION AND COST CONSIDERATIONS.–

(A) IN GENERAL.– Notwithstanding paragraph (4), if the Administrator

determines based on an analysis conducted under paragraph (3)(C) that the benefits of a maximum contaminant level promulgated in accordance with paragraph (4) would not justify the costs of complying with the level, the Administrator may, after notice and opportunity for public comment, promulgate a maximum contaminant level for the contaminant that maximizes health risk reduction benefits at a cost that is justified by the benefits.

(B) EXCEPTION.– The Administrator shall not use the authority of this paragraph to promulgate a maximum contaminant level for a contaminant, if the benefits of compliance with a national primary drinking water regulation for the contaminant that would be promulgated in accordance with paragraph (4) experienced by–

(i) persons served by large public water systems; and

(ii) persons served by such other systems as are unlikely, based on information provided by the States, to receive a variance under section 1415(e) (relating to small system variances);

would justify the costs to the systems of complying with the regulation. This subparagraph shall not apply if the contaminant is found almost exclusively in small systems eligible under section 1415(e) for a small system variance.

(C) DISINFECTANTS AND DISINFECTION BYPRODUCTS.– The Administrator may not use the authority of this paragraph to establish a maximum contaminant level in a Stage I or Stage II national primary drinking water regulation (as described in paragraph (2)(C)) for contaminants that are disinfectants or disinfection byproducts, or to establish a maximum contaminant level or treatment technique requirement for the control of cryptosporidium. The authority of this paragraph may be used to establish regulations for the use of disinfection by systems relying on ground water sources as required by paragraph (8).

(D) JUDICIAL REVIEW.– A determination by the Administrator that the benefits of a maximum contaminant level or treatment requirement justify or do not justify the costs of complying with the level shall be reviewed by the court pursuant to section 1448 only as part of a review of a final national primary drinking water regulation that has been promulgated based on the determination and shall not be set aside by the court under that section unless the court finds that the determination is arbitrary and capricious.

(7)(A) The Administrator is authorized to promulgate a national primary drinking water regulation that requires the use of a treatment technique in lieu of establishing a maximum contaminant level, if the Administrator makes a finding that it is not economically or technologically feasible to ascertain the level of the contaminant. In such case, the Administrator shall identify those treatment techniques which, in the Administrator's judgment, would prevent known or anticipated adverse effects on the health of persons to the extent feasible. Such regulations shall specify each treatment technique known to the Administrator which meets the requirements of this paragraph, but the Administrator may grant a variance from any specified treatment technique in accordance with section 1415 (a)(3).

(B) Any schedule referred to in this subsection for the promulgation of a national primary drinking water regulation for any contaminant shall apply in the same manner if the regulation requires a treatment technique in lieu of establishing a maximum contaminant level.

(C)(i) Not later than 18 months after the enactment of the Safe Drinking Water Act Amendments of 1986, the Administrator shall propose and promulgate national primary drinking water regulations specifying criteria under which filtration (including coagulation and sedimentation, as appropriate) is required as a treatment technique for public water systems supplied by surface water sources. In promulgating such rules, the Administrator shall consider the quality of source waters, protection afforded by watershed management, treatment practices (such as disinfection and length of water storage) and other factors relevant to protection of health.

(ii) In lieu of the provisions of section 1415 the Administrator shall specify procedures by which the State determines which public water systems within its jurisdiction shall adopt filtration under the criteria of clause (i). The State may require the public water system to provide studies or other information to assist in this determination. The procedures shall provide notice and opportunity for public hearing on this determination. If the State determines that filtration is required, the State shall prescribe a schedule for compliance by the public water system with the filtration requirement. A schedule shall require compliance within 18 months of a determination made under clause (iii).

(iii) Within 18 months from the time that the Administrator establishes the criteria and procedures under this subparagraph, a State with primary enforcement responsibility shall adopt any necessary regulations to implement this subparagraph. Within 12 months of adoption of such regulations the State shall make determinations regarding filtration for all the public water systems within its jurisdiction supplied by surface waters.

(iv) If a State does not have primary enforcement responsibility for public water systems, the Administrator shall have the same authority to make the determination in clause (ii) in such State as the State would have under that clause. Any filtration requirement or schedule under this subparagraph shall be treated as if it were a requirement of a national primary drinking water regulation.

(v) As an additional alternative to the regulations promulgated pursuant to clauses (i) and (iii), including the criteria for avoiding filtration contained in 40 CFR 141.71, a State exercising primary enforcement responsibility for public water systems may, on a case-by-case basis, and after notice and opportunity for public comment, establish treatment requirements as an alternative to filtration in the case of systems having uninhabited, undeveloped watersheds in consolidated ownership, and having control over access to, and activities in, those watersheds, if the State determines (and the Administrator concurs) that the quality of the source water and the alternative treatment requirements established by the State ensure greater removal or inactivation efficiencies of pathogenic organisms for which national primary drinking water regulations have been promulgated or that are of public health concern than would be achieved by the combination of filtration and chlorine disinfection (in compliance with this section).

(8) ***DISINFECTION.-- At any time after the end of the 3-year period that begins on the date of enactment of the Safe Drinking Water Act Amendments of 1996, but not later than the date on which the Administrator promulgates a Stage II rulemaking for disinfectants and disinfection byproducts (as described in paragraph (2)(C)), the Administrator shall also promulgate national primary drinking water regulations requiring disinfection as a treatment technique for all public water systems, including surface water systems and, as necessary, ground water systems. After consultation with***

the States, the Administrator shall (as part of the regulations) promulgate criteria that the Administrator, or a State that has primary enforcement responsibility under section 1413, shall apply to determine whether disinfection shall be required as a treatment technique for any public water system served by ground water. ~~Not later than 36 months after the enactment of the Safe Drinking Water Act Amendments of 1986, the Administrator shall propose and promulgate national primary drinking water regulations requiring disinfection as a treatment technique for all public water systems.~~ The Administrator shall simultaneously promulgate a rule specifying criteria that will be used by the Administrator (or delegated State authorities) to grant variances from this requirement according to the provisions of section 1415(a)(1)(B) and 1415(a)(3). In implementing section ~~1442(g)~~ ***1442(e)*** the Administrator or the delegated State authority shall, where appropriate, give special consideration to providing technical assistance to small public water systems in complying with the regulations promulgated under this paragraph.

~~(9) National primary drinking water regulations shall be amended whenever changes in technology, treatment techniques, and other means permit greater protection of the health of persons, but in any event such regulations shall be reviewed at least once every 3 years. Such review shall include an analysis of innovations or changes in technology, treatment techniques or other activities that have occured over the previous 3 year period and that may provide for greater protection of the health of persons. The findings of such review shall be published in the *Federal Register*. If, after opportunity for public comment, the Administrator concludes that the technology, treatment techniques, or other means resulting from such innovations or changes are not feasible within the meaning of paragraph (5), an explanation of such conclusion shall be published in the *Federal Register*.~~

(9) REVIEW AND REVISION.— The Administrator shall, not less often than every 6 years, review and revise, as appropriate, each national primary drinking water regulation promulgated under this title. Any revision of a national primary drinking water regulation shall be promulgated in accordance with this section, except that each revision shall maintain, or provide for greater, protection of the health of persons.

~~(10) National primary drinking water regulations promulgated under this subsection (and amendments thereto) shall take effect eighteen months after the date of their promulgation. Regulations under subsection (a) shall be superseded by regulations under this subsection to the extent provided by the regulations under this subsection.~~

(10) EFFECTIVE DATE.— A national primary drinking water regulation promulgated under this section (and any amendment thereto) shall take effect on the date that is 3 years after the date on which the regulation is promulgated unless the Administrator determines that an earlier date is practicable, except that the Administrator, or a State (in the case of an individual system), may allow up to 2 additional years to comply with a maximum contaminant level or treatment technique if the Administrator or State (in the case of an individual system) determines that additional time is necessary for capital improvements.

(11) No national primary drinking water regulation may require the addition of any substance for preventive health care purposes unrelated to contamination of drinking water.

(12) CERTAIN CONTAMINANTS.—

(A) ARSENIC-

(i) SCHEDULE AND STANDARD.— Notwithstanding the deadlines set forth in paragraph (1), the Administrator shall promulgate a national primary

drinking water regulation for arsenic pursuant to this subsection, in accordance with the schedule established by this paragraph.

(ii) STUDY PLAN.— Not later than 180 days after the date of enactment of this paragraph, the Administrator shall develop a comprehensive plan for study in support of drinking water rulemaking to reduce the uncertainty in assessing health risks associated with exposure to low levels of arsenic. In conducting such study, the Administrator shall consult with the National Academy of Sciences, other Federal agencies, and interested public and private entities.

(iii) COOPERATIVE AGREEMENTS.— In carrying out the study plan, the Administrator may enter into cooperative agreements with other Federal agencies, State and local governments, and other interested public and private entities.

(iv) PROPOSED REGULATIONS.— The Administrator shall propose a national primary drinking water regulation for arsenic not later than January 1, 2000.

(v) FINAL REGULATIONS.— Not later than January 1, 2001, after notice and opportunity for public comment, the Administrator shall promulgate a national primary drinking water regulation for arsenic.

(vi) AUTHORIZATION.— There are authorized to be appropriated $2,500,000 for each of fiscal years 1997 through 2000 for the studies required by this paragraph.

(B) SULFATE.—

(i) ADDITIONAL STUDY.— Prior to promulgating a national primary drinking water regulation for sulfate, the Administrator and the Director of the Centers for Disease Control and Prevention shall jointly conduct an additional study to establish a reliable dose-response relationship for the adverse human health effects that may result from exposure to sulfate in drinking water, including the health effects that may be experienced by groups within the general population (including infants and travelers) that are potentially at greater risk of adverse health effects as the result of such exposure. The study shall be conducted in consultation with interested States, shall be based on the best available, peer-reviewed science and supporting studies conducted in accordance with sound and objective scientific practices, and shall be completed not later than 30 months after the date of enactment of the Safe Drinking Water Act Amendments of 1996.

(ii) DETERMINATION.— The Administrator shall include sulfate among the 5 or more contaminants for which a determination is made pursuant to paragraph (3)(B) not later than 5 years after the date of enactment of the Safe Drinking Water Act Amendments of 1996.

(iii) PROPOSED AND FINAL RULE.— Notwithstanding the deadlines set forth in paragraph (2), the Administrator may, pursuant to the authorities of this subsection and after notice and opportunity for public comment, promulgate a final national primary drinking water regulation for sulfate. Any such regulation shall include requirements for public notification and options for the provision of alternative water supplies to populations at risk as a means of complying with the regulation in lieu of a best available treatment technology or other means.

(13) RADON IN DRINKING WATER.—

(A) NATIONAL PRIMARY DRINKING WATER REGULATION.— Notwithstanding paragraph (2), the Administrator shall withdraw any national primary drinking water regulation for radon proposed prior to the date of enactment of this paragraph and shall propose and promulgate a regulation for radon under this section, as amended by the Safe Drinking Water Act Amendments of 1996.

(B) RISK ASSESSMENT AND STUDIES.—

(i) ASSESSMENT BY NAS.— Prior to proposing a national primary drinking water regulation for radon, the Administrator shall arrange for the National Academy of Sciences to prepare a risk assessment for radon in drinking water using the best available science in accordance with the requirements of paragraph (3). The risk assessment shall consider each of the risks associated with exposure to radon from drinking water and consider studies on the health effects of radon at levels and under conditions likely to be experienced through residential exposure. The risk assessment shall be peer-reviewed.

(ii) STUDY OF OTHER MEASURES.— The Administrator shall arrange for the National Academy of Sciences to prepare an assessment of the health risk reduction benefits associated with various mitigation measures to reduce radon levels in indoor air. The assessment may be conducted as part of the risk assessment authorized by clause (i) and shall be used by the Administrator to prepare the guidance and approve State programs under subparagraph (G).

(iii) OTHER ORGANIZATION.— If the National Academy of Sciences declines to prepare the risk assessment or studies required by this subparagraph, the Administrator shall enter into a contract or cooperative agreement with another independent, scientific organization to prepare such assessments or studies.

(C) HEALTH RISK REDUCTION AND COST ANALYSIS.— Not later than 30 months after the date of enactment of this paragraph, the Administrator shall publish, and seek public comment on, a health risk reduction and cost analysis meeting the requirements of paragraph (3)(C) for potential maximum contaminant levels that are being considered for radon in drinking water. The Administrator shall include a response to all significant public comments received on the analysis with the preamble for the proposed rule published under subparagraph (D).

(D) PROPOSED REGULATION.— Not later than 36 months after the date of enactment of this paragraph, the Administrator shall propose a maximum contaminant level goal and a national primary drinking water regulation for radon pursuant to this section.

(E) FINAL REGULATION.— Not later than 12 months after the date of the proposal under subparagraph (D), the Administrator shall publish a maximum contaminant level goal and promulgate a national primary drinking water regulation for radon pursuant to this section based on the risk assessment prepared pursuant to subparagraph (B) and the health risk reduction and cost analysis published pursuant to subparagraph (C). In considering the risk assessment and the health risk reduction and cost analysis in connection with the promulgation of such a standard, the Administrator shall take into account the costs and benefits of control programs for radon from other sources.

(F) ALTERNATIVE MAXIMUM CONTAMINANT LEVEL.— If the

maximum contaminant level for radon in drinking water promulgated pursuant to subparagraph (E) is more stringent than necessary to reduce the contribution to radon in indoor air from drinking water to a concentration that is equivalent to the national average concentration of radon in outdoor air, the Administrator shall, simultaneously with the promulgation of such level, promulgate an alternative maximum contaminant level for radon that would result in a contribution of radon from drinking water to radon levels in indoor air equivalent to the national average concentration of radon in outdoor air. If the Administrator promulgates an alternative maximum contaminant level under this subparagraph, the Administrator shall, after notice and opportunity for public comment and in consultation with the States, publish guidelines for State programs, including criteria for multimedia measures to mitigate radon levels in indoor air, to be used by the States in preparing programs under subparagraph (G). The guidelines shall take into account data from existing radon mitigation programs and the assessment of mitigation measures prepared under subparagraph (B).

(G) MULTIMEDIA RADON MITIGATION PROGRAMS.–

(i) IN GENERAL.– A State may develop and submit a multimedia program to mitigate radon levels in indoor air for approval by the Administrator under this subparagraph. If, after notice and the opportunity for public comment, such program is approved by the Administrator, public water systems in the State may comply with the alternative maximum contaminant level promulgated under subparagraph (F) in lieu of the maximum contaminant level in the national primary drinking water regulation promulgated under subparagraph (E).

(ii) ELEMENTS OF PROGRAMS.– State programs may rely on a variety of mitigation measures including public education, testing, training, technical assistance, remediation grant and loan or incentive programs, or other regulatory or nonregulatory measures. The effectiveness of elements in State programs shall be evaluated by the Administrator based on the assessment prepared by the National Academy of Sciences under subparagraph (B) and the guidelines published by the Administrator under subparagraph (F).

(iii) APPROVAL.– The Administrator shall approve a State program submitted under this paragraph if the health risk reduction benefits expected to be achieved by the program are equal to or greater than the health risk reduction benefits that would be achieved if each public water system in the State complied with the maximum contaminant level promulgated under subparagraph (E). The Administrator shall approve or disapprove a program submitted under this paragraph within 180 days of receipt. A program that is not disapproved during such period shall be deemed approved. A program that is disapproved may be modified to address the objections of the Administrator and be resubmitted for approval.

(iv) REVIEW.– The Administrator shall periodically, but not less often than every 5 years, review each multimedia mitigation program approved under this subparagraph to determine whether it continues to meet the requirements of clause (iii) and shall, after written notice to the State and an opportunity for the State to correct any deficiency in the program, withdraw approval of programs that no longer comply with such requirements.

(v) EXTENSION.– If, within 90 days after the promulgation of an alternative maximum contaminant level under subparagraph (F), the Governor of a State submits a letter to the Administrator committing to develop a multimedia mitigation

program under this subparagraph, the effective date of the national primary drinking water regulation for radon in the State that would be applicable under paragraph (10) shall be extended for a period of 18 months.

(vi) LOCAL PROGRAMS.— In the event that a State chooses not to submit a multimedia mitigation program for approval under this subparagraph or has submitted a program that has been disapproved, any public water system in the State may submit a program for approval by the Administrator according to the same criteria, conditions, and approval process that would apply to a State program. The Administrator shall approve a multimedia mitigation program if the health risk reduction benefits expected to be achieved by the program are equal to or greater than the health risk reduction benefits that would result from compliance by the public water system with the maximum contaminant level for radon promulgated under subparagraph (E).

(14) RECYCLING OF FILTER BACKWASH.— The Administrator shall promulgate a regulation to govern the recycling of filter backwash water within the treatment process of a public water system. The Administrator shall promulgate such regulation not later than 4 years after the date of enactment of the Safe Drinking Water Act Amendments of 1996 unless such recycling has been addressed by the Administrator's Enhanced Surface Water Treatment Rule prior to such date.

(15) VARIANCE TECHNOLOGIES.—

(A) IN GENERAL.— At the same time as the Administrator promulgates a national primary drinking water regulation for a contaminant pursuant to this section, the Administrator shall issue guidance or regulations describing the best treatment technologies, treatment techniques, or other means (referred to in this paragraph as `variance technology') for the contaminant that the Administrator finds, after examination for efficacy under field conditions and not solely under laboratory conditions, are available and affordable, as determined by the Administrator in consultation with the States, for public water systems of varying size, considering the quality of the source water to be treated. The Administrator shall identify such variance technologies for public water systems serving—

(i) a population of 10,000 or fewer but more than 3,300;

(ii) a population of 3,300 or fewer but more than 500; and

(iii) a population of 500 or fewer but more than 25,

if, considering the quality of the source water to be treated, no treatment technology is listed for public water systems of that size under paragraph (4)(E). Variance technologies identified by the Administrator pursuant to this paragraph may not achieve compliance with the maximum contaminant level or treatment technique requirement of such regulation, but shall achieve the maximum reduction or inactivation efficiency that is affordable considering the size of the system and the quality of the source water. The guidance or regulations shall not require the use of a technology from a specific manufacturer or brand.

(B) LIMITATION.— The Administrator shall not identify any variance technology under this paragraph, unless the Administrator has determined, considering the quality of the source water to be treated and the expected useful life of the technology, that the variance technology is protective of public health.

(C) ADDITIONAL INFORMATION.— The Administrator shall include in the guidance or regulations identifying variance technologies under this paragraph any assumptions supporting the public health determination referred to in subparagraph (B), where such assumptions concern the public water system to which the technology may be applied, or its source waters. The Administrator shall provide any assumptions used in determining affordability, taking into consideration the number of persons served by such systems. The Administrator shall provide as much reliable information as practicable on performance, effectiveness, limitations, costs, and other relevant factors including the applicability of variance technology to waters from surface and underground sources.

(D) REGULATIONS AND GUIDANCE.— Not later than 2 years after the date of enactment of this paragraph and after consultation with the States, the Administrator shall issue guidance or regulations under subparagraph (A) for each national primary drinking water regulation promulgated prior to the date of enactment of this paragraph for which a variance may be granted under section 1415(e). The Administrator may, at any time after a national primary drinking water regulation has been promulgated, issue guidance or regulations describing additional variance technologies. The Administrator shall, not less often than every 7 years, or upon receipt of a petition supported by substantial information, review variance technologies identified under this paragraph. The Administrator shall issue revised guidance or regulations if new or innovative variance technologies become available that meet the requirements of this paragraph and achieve an equal or greater reduction or inactivation efficiency than the variance technologies previously identified under this subparagraph. No public water system shall be required to replace a variance technology during the useful life of the technology for the sole reason that a more efficient variance technology has been listed under this subparagraph.

(c) The Administrator shall publish proposed national secondary drinking water regulations within 270 days after the date of enactment of this title. Within 90 days after publication of any such regulation, he shall promulgate such regulation with such modifications as he deems appropriate. Regulations under this subsection may be amended from time to time.

(d) Regulations under this section shall be prescribed in accordance with section 553 of title 5, United States Code (relating to rulemaking), except that the Administrator shall provide opportunity of public hearing prior to promulgation of such regulations. In proposing and promulgating regulations under this section, the Administrator shall consult with the Secretary and the National Drinking Water Advisory Council.

(e) The Administrator shall request comments from the Science Advisory Board (established under the Environmental Research, Development, and Demonstration Act of 1978) prior to proposal of a maximum contaminant level goal and national primary drinking water regulation. The Board shall respond, as it deems appropriate, within the time period applicable for promulgation of the national primary drinking water standard concerned. This subsection shall, under no circumstances, be used to delay final promulgation of any national primary drinking water standard.

STATE PRIMARY ENFORCEMENT RESPONSIBILITY

SEC. 1413. (a) For purposes of this title, a State has primary enforcement responsibility for public water systems during any period for which the Administrator determines (pursuant to

regulations prescribed under subsection (b)) that such State-

~~(1) has adopted drinking water regulations which are no less stringent than the national primary drinking water regulations in effect under sections 1412(a) and 1412(b);~~

(1) has adopted drinking water regulations that are no less stringent than the national primary drinking water regulations promulgated by the Administrator under subsections (a) and (b) of section 1412 not later than 2 years after the date on which the regulations are promulgated by the Administrator, except that the Administrator may provide for an extension of not more than 2 years if, after submission and review of appropriate, adequate documentation from the State, the Administrator determines that the extension is necessary and justified;

(2) has adopted and is implementing adequate procedures for the enforcement of such State regulations, including conducting such monitoring and making such inspections as the Administrator may require by regulation;

(3) will keep such records and make such reports with respect to its activities under paragraphs (1) and (2) as the Administrator may require by regulation;

(4) if it permits variances or exemptions, or both, from the requirements of its drinking water regulations which meet the requirements of paragraph (1), permits such variances and exemptions under conditions and in a manner which is not less stringent than the conditions under, and the manner in, which variances and exemptions may be granted under sections 1415 and 1416; ~~and~~

(5) has adopted and can implement an adequate plan for the provision of safe drinking water under emergency circumstances, ***including earthquakes, floods, hurricanes, and other natural disasters, as appropriate; and***

(6) has adopted authority for administrative penalties (unless the constitution of the State prohibits the adoption of the authority) in a maximum amount–

(A) in the case of a system serving a population of more than 10,000, that is not less than $1,000 per day per violation; and

(B) in the case of any other system, that is adequate to ensure compliance (as determined by the State);

except that a State may establish a maximum limitation on the total amount of administrative penalties that may be imposed on a public water system per violation.

(b)(1) The Administrator shall, by regulation (proposed within 180 days of the date of the enactment of this title), prescribe the manner in which a State may apply to the Administrator for a determination that the requirements of paragraphs (1), (2), (3), and (4) of subsection (a) are satisfied with respect to the State, the manner in which the determination is made, the period for which the determination will be effective, and the manner in which the Administrator may determine that such requirements are no longer met. Such regulations shall require that before a determination of the Administrator that such requirements are met or are no longer met with respect to a State may become effective, the Administrator shall notify such State of the determination and the reasons thereof and shall provide an opportunity for public hearing on the determination. Such regulations shall be promulgated (with such modifications as the Administrator deems appropriate) within 90 days of the publication of the proposed regulations in the *Federal Register*. The Administrator shall

promptly notify in writing the chief executive officer of each State of the promulgation of regulations under this paragraph. Such notice shall contain a copy of the regulations and shall specify a State's authority under this title when it is determined to have primary enforcement responsibility for public water systems.

(2) When an application is submitted in accordance with the Administrator's regulations under paragraph (1), the Administrator shall within 90 days of the date on which such application is submitted (A) make the determination applied for, or (B) deny the application and notify the applicant in writing of the reasons for his denial.

(c) INTERIM PRIMARY ENFORCEMENT AUTHORITY.-- A State that has primary enforcement authority under this section with respect to each existing national primary drinking water regulation shall be considered to have primary enforcement authority with respect to each new or revised national primary drinking water regulation during the period beginning on the effective date of a regulation adopted and submitted by the State with respect to the new or revised national primary drinking water regulation in accordance with subsection (b)(1) and ending at such time as the Administrator makes a determination under subsection (b)(2)(B) with respect to the regulation.

ENFORCEMENT OF DRINKING WATER REGULATIONS

SEC. 1414. (a)(1)(A) Whenever the Administrator finds during a period during which a State has primary enforcement responsibility for public water systems (within the meaning of section 1413 (a)) that any public water system-

(i) for which a variance under section 1415 or an exemption under section 1416 is not in effect, does not comply with ~~any national primary drinking water regulation in effect under section 1412,~~ ***any applicable requirement,*** or

(ii) for which a variance under section 1415 or an exemption under section 1416 is in effect, does not comply with any schedule or other requirement imposed pursuant thereto, he shall so notify the State and such public water system and provide such advice and technical assistance to such State and public water system as may be appropriate to bring the system into compliance ~~with such regulation or requirement~~ ***with the requirement*** by the earliest feasible time.

(B) If, beyond the thirtieth day after the Administrator's notification under subparagraph (A), the State has not commenced appropriate enforcement action, the Administrator shall issue an order under subsection (g) requiring the public water system to comply with such regulation or requirement or the Administrator shall commence a civil action under subsection (b).

~~(2) Whenever, on the basis of information available to him, the Administrator finds during a period which a State does not have primary enforcement responsibility for public water systems that a public water system in such State-~~

~~(A) for which a variance under section 1415 (a)(2) or an exemption under section 1416(f) is not in effect, does not comply with any national primary drinking water regulation in effect under section 1412, or~~

~~(B) for which a variance under section 1415(a)(2) or an exemption under section 1416(f) is in effect, does not comply with any schedule or other requirement imposed~~

~~pursuant thereto, the Administrator shall issue an order under subsection (g) requiring the public water system to comply with such regulation or requirement or the Administrator shall commence a civil action under subsection (b).~~

(2) ENFORCEMENT IN NONPRIMACY STATES.–

(A) IN GENERAL.– If, on the basis of information available to the Administrator, the Administrator finds, with respect to a period in which a State does not have primary enforcement responsibility for public water systems, that a public water system in the State–

(i) for which a variance under section 1415 or an exemption under section 1416 is not in effect, does not comply with any applicable requirement; or

(ii) for which a variance under section 1415 or an exemption under section 1416 is in effect, does not comply with any schedule or other requirement imposed pursuant to the variance or exemption;

the Administrator shall issue an order under subsection (g) requiring the public water system to comply with the requirement, or commence a civil action under subsection (b).

(B) NOTICE.– If the Administrator takes any action pursuant to this paragraph, the Administrator shall notify an appropriate local elected official, if any, with jurisdiction over the public water system of the action prior to the time that the action is taken.

(b) The Administrator may bring a civil action in the appropriate United States district court to require compliance with ~~a national primary drinking water regulation,~~ ***any applicable requirement*** with an order issued under subsection (g), or with any schedule or other requirement imposed pursuant to a variance or exemption granted under section 1415 or 1416 if-

(1) authorized under paragraph (1) or (2) of subsection (a), or

(2) if requested by (A) the chief executive officer of the State in which is located the public water system which is not in compliance with such regulation or requirement, or (B) the agency of such State which has jurisdiction over compliance by public water systems in the State with national primary drinking water regulations or State drinking water regulations.

The court may enter, in an action brought under this subsection, such judgment as protection of public health may require, taking into consideration the time necessary to comply and the availability of alternative water supplies; and, if, the court determines that there has been a violation of the regulation or schedule or other requirement with respect to which the action was brought, the court may, taking into account the seriousness of the violation, the population at risk, and other appropriate factors, impose on the violator a civil penalty of not to exceed $25,000 for each day in which such violation occurs.

~~(c) Each owner or operator of a public water system shall give notice to the persons served by it-~~

~~(1) of any failure on the part of the public water system to-~~

~~(A) comply with an applicable maximum contaminant level or treatment technique requirement of, or a testing procedure prescribed by, a national primary drinking~~

~~water regulation, or~~

~~(B) perform monitoring required by section 1445(a), and~~

~~(2) if the public water system is subject to a variance granted under section 1415(a)(1)(A) or 1415(a)(2) for an inability to meet a maximum contaminant level requirement or is subject to an exemption granted under section 1416, of~~

~~(A) the existence of such variance or exemption, and~~

~~(B) any failure to comply with the requirements of any schedule prescribed pursuant to the variance or exemption.~~

~~The Administrator shall by regulation prescribe the form, manner, and frequency for giving notice under this subsection. Within 15 months after the enactment of the Safe Drinking Water Act Amendments of 1986, the Administrator shall amend such regulations to provide for different types and frequencies of notice based on the differences between violations which are intermittent or infrequent and violations which are continuous or frequent. Such regulations shall also take into account the seriousness of any potential adverse health effects which may be involved. Notice of any violation of a maximum contaminant level or any other violation designated by the Administrator as posing a serious potential adverse health effect shall be given as soon as possible, but in no case later than 14 days after the violation. Notice of a continuous violation of a regulation other than a maximum contaminant level shall be given no less frequently than every 3 months. Notice of violations judged to be less serious shall be given no less frequently than annually. The Administrator shall specify the types of notice to be used to provide information as promptly and effectively as possible taking into account both the seriousness of any potential adverse health effects and the likelihood of reaching all affected persons. Notification of violations shall include notice by general circulation newspaper serving the area and, whenever appropriate, shall also include a press release to electronic media and individual mailings. Notice under this subsection shall provide a clear and readily understandable explanation of the violation, any potential adverse health effects, the steps that the system is taking to correct such violation, and the necessity for seeking alternative water supplies, if any, until the violation is corrected. Until such amended regulations are promulgated, the regulations in effect on the date of the enactment of the Safe Drinking Water Act Amendments of 1986 shall remain in effect. The Administrator may also require the owner or operator of a public water system to give notice to the persons served by it of contaminant levels of any unregulated contaminant required to be monitored under section 1445(a). Any person who violates this subsection or regulations issued under this subsection shall be subject to a civil penalty of not to exceed $25,000.~~

(c) NOTICE TO PERSONS SERVED.—

(1) IN GENERAL.— Each owner or operator of a public water system shall give notice of each of the following to the persons served by the system:

(A) Notice of any failure on the part of the public water system to—

(i) comply with an applicable maximum contaminant level or treatment technique requirement of, or a testing procedure prescribed by, a national primary drinking water regulation; or

(ii) perform monitoring required by section 1445(a).

(B) If the public water system is subject to a variance granted under subsection

(a)(1)(A), (a)(2), or (e) of section 1415 for an inability to meet a maximum contaminant level requirement or is subject to an exemption granted under section 1416, notice of–

(i) the existence of the variance or exemption; and

(ii) any failure to comply with the requirements of any schedule prescribed pursuant to the variance or exemption.

(C) Notice of the concentration level of any unregulated contaminant for which the Administrator has required public notice pursuant to paragraph (2)(E).

(2) FORM, MANNER, AND FREQUENCY OF NOTICE.–

(A) IN GENERAL.– The Administrator shall, by regulation, and after consultation with the States, prescribe the manner, frequency, form, and content for giving notice under this subsection. The regulations shall–

(i) provide for different frequencies of notice based on the differences between violations that are intermittent or infrequent and violations that are continuous or frequent; and

(ii) take into account the seriousness of any potential adverse health effects that may be involved.

(B) STATE REQUIREMENTS.–

(i) IN GENERAL.– A State may, by rule, establish alternative notification requirements–

(I) with respect to the form and content of notice given under and in a manner in accordance with subparagraph (C); and

(II) with respect to the form and content of notice given under subparagraph (D).

(ii) CONTENTS.– The alternative requirements shall provide the same type and amount of information as required pursuant to this subsection and regulations issued under subparagraph (A).

(iii) RELATIONSHIP TO SECTION 1413.– Nothing in this subparagraph shall be construed or applied to modify the requirements of section 1413.

(C) VIOLATIONS WITH POTENTIAL TO HAVE SERIOUS ADVERSE EFFECTS ON HUMAN HEALTH.– Regulations issued under subparagraph (A) shall specify notification procedures for each violation by a public water system that has the potential to have serious adverse effects on human health as a result of short-term exposure. Each notice of violation provided under this subparagraph shall–

(i) be distributed as soon as practicable after the occurrence of the violation, but not later than 24 hours after the occurrence of the violation;

(ii) provide a clear and readily understandable explanation of–

(I) the violation;

(II) the potential adverse effects on human health;

(g) ENVIRONMENTAL FINANCE CENTERS.–

(1) IN GENERAL.– The Administrator shall provide initial funding for one or more university-based environmental finance centers for activities that provide technical assistance to State and local officials in developing the capacity of public water systems. Any such funds shall be used only for activities that are directly related to this title.

(2) NATIONAL CAPACITY DEVELOPMENT CLEARINGHOUSE.– The Administrator shall establish a national public water system capacity development clearinghouse to receive and disseminate information with respect to developing, improving, and maintaining financial and managerial capacity at public water systems. The Administrator shall ensure that the clearinghouse does not duplicate other federally supported clearinghouse activities.

(3) CAPACITY DEVELOPMENT TECHNIQUES.– The Administrator may request an environmental finance center funded under paragraph (1) to develop and test managerial, financial, and institutional techniques for capacity development. The techniques may include capacity assessment methodologies, manual and computer based public water system rate models and capital planning models, public water system consolidation procedures, and regionalization models.

(4) AUTHORIZATION OF APPROPRIATIONS.– There are authorized to be appropriated to carry out this subsection $1,500,000 for each of the fiscal years 1997 through 2003.

(5) LIMITATION.– No portion of any funds made available under this subsection may be used for lobbying expenses.

Part C Protection of Underground Sources of Drinking Water

REGULATIONS FOR STATE PROGRAMS

SEC. 1421. (a)(1) The Administrator shall publish proposed regulations for State underground injection control programs within 180 days after the date of enactment of this title. Within 180 days after publication of such proposed regulations, he shall promulgate such regulations with such modifications as he deems appropriate. Any regulation under this subsection may be amended from time to time.

(2) Any regulation under this section shall be proposed and promulgated in accordance with section 553 of title 5, United States Code (relating to rulemaking), except that the Administrator shall provide opportunity for public hearing prior to promulgation of such regulations. In proposing and promulgating regulations under this section, the Administrator shall consult with the Secretary, the National Drinking Water Advisory Council, and other appropriate Federal entities and with interested State entities.

(b)(1) Regulations under subsection (a) for State underground injection programs shall contain minimum requirements for effective programs to prevent underground injection which endangers drinking water sources within the meaning of subsection (d)(2). Such regulations shall require that a State program, in order to be approved under section 1422-

requirements determined to be significant by the Administrator after consultation with the States.

(ii) DISTRIBUTION.-- The State shall publish and distribute summaries of the report and indicate where the full report is available for review.

(B) ANNUAL REPORT BY ADMINISTRATOR.-- Not later than July 1, 1998, and annually thereafter, the Administrator shall prepare and make available to the public an annual report summarizing and evaluating reports submitted by States pursuant to subparagraph (A) and notices submitted by public water systems serving Indian Tribes provided to the Administrator pursuant to subparagraph (C) or (D) of paragraph (2) and making recommendations concerning the resources needed to improve compliance with this title. The report shall include information about public water system compliance on Indian reservations and about enforcement activities undertaken and financial assistance provided by the Administrator on Indian reservations, and shall make specific recommendations concerning the resources needed to improve compliance with this title on Indian reservations.

(4) CONSUMER CONFIDENCE REPORTS BY COMMUNITY WATER SYSTEMS.--

(A) ANNUAL REPORTS TO CONSUMERS.-- The Administrator, in consultation with public water systems, environmental groups, public interest groups, risk communication experts, and the States, and other interested parties, shall issue regulations within 24 months after the date of enactment of this paragraph to require each community water system to mail to each customer of the system at least once annually a report on the level of contaminants in the drinking water purveyed by that system (referred to in this paragraph as a `consumer confidence report'). Such regulations shall provide a brief and plainly worded definition of the terms `maximum contaminant level goal', `maximum contaminant level', `variances', and `exemptions' and brief statements in plain language regarding the health concerns that resulted in regulation of each regulated contaminant. The regulations shall also include a brief and plainly worded explanation regarding contaminants that may reasonably be expected to be present in drinking water, including bottled water. The regulations shall also provide for an Environmental Protection Agency toll-free hotline that consumers can call for more information and explanation.

(B) CONTENTS OF REPORT.-- The consumer confidence reports under this paragraph shall include, but not be limited to, each of the following:

(i) Information on the source of the water purveyed.

(ii) A brief and plainly worded definition of the terms `maximum contaminant level goal', `maximum contaminant level', `variances', and `exemptions' as provided in the regulations of the Administrator.

(iii) If any regulated contaminant is detected in the water purveyed by the public water system, a statement setting forth (I) the maximum contaminant level goal, (II) the maximum contaminant level, (III) the level of such contaminant in such water system, and (IV) for any regulated contaminant for which there has been a violation of the maximum contaminant level during the year concerned, the brief statement in plain language regarding the health concerns that resulted in regulation of such contaminant, as provided by the Administrator in regulations under subparagraph (A).

(iv) Information on compliance with national primary drinking water regulations, as required by the Administrator, and notice if the system is operating under a variance or exemption and the basis on which the variance or exemption was granted.

(v) Information on the levels of unregulated contaminants for which monitoring is required under section 1445(a)(2) (including levels of cryptosporidium and radon where States determine they may be found).

(vi) A statement that the presence of contaminants in drinking water does not necessarily indicate that the drinking water poses a health risk and that more information about contaminants and potential health effects can be obtained by calling the Environmental Protection Agency hotline. A public water system may include such additional information as it deems appropriate for public education. The Administrator may, for not more than 3 regulated contaminants other than those referred to in subclause (IV) of clause (iii), require a consumer confidence report under this paragraph to include the brief statement in plain language regarding the health concerns that resulted in regulation of the contaminant or contaminants concerned, as provided by the Administrator in regulations under subparagraph (A).

(C) COVERAGE.– The Governor of a State may determine not to apply the mailing requirement of subparagraph (A) to a community water system serving fewer than 10,000 persons. Any such system shall–

(i) inform, in the newspaper notice required by clause (iii) or by other means, its customers that the system will not be mailing the report as required by subparagraph (A);

(ii) make the consumer confidence report available upon request to the public; and

(iii) publish the report referred to in subparagraph (A) annually in one or more local newspapers serving the area in which customers of the system are located.

(D) ALTERNATIVE TO PUBLICATION.– For any community water system which, pursuant to subparagraph (C), is not required to meet the mailing requirement of subparagraph (A) and which serves 500 persons or fewer, the community water system may elect not to comply with clause (i) or (iii) of subparagraph (C). If the community water system so elects, the system shall, at a minimum–

(i) prepare an annual consumer confidence report pursuant to subparagraph (B); and

(ii) provide notice at least once per year to each of its customers by mail, by door-to-door delivery, by posting or by other means authorized by the regulations of the Administrator that the consumer confidence report is available upon request.

(E) ALTERNATIVE FORM AND CONTENT.– A State exercising primary enforcement responsibility may establish, by rule, after notice and public comment, alternative requirements with respect to the form and content of consumer confidence reports under this paragraph.

(d) Whenever, on the basis of information available to him, the Administrator finds that within a reasonable time after national secondary drinking water regulations have been promulgated, one or more public water systems in a State do not comply with such

secondary regulations, and that such noncompliance appears to result from a failure of such State to take reasonable action to assure that public water systems throughout such State meet such secondary regulations, he shall so notify the State.

(e) Nothing in this title shall diminish any authority of a State or political subdivision to adopt or enforce any law or regulation respecting drinking water regulations or public water systems, but no such law or regulation shall relieve any person of any requirement otherwise applicable under this title.

(f) If the Administrator makes a finding of noncompliance (described in subparagraph (A) or (B) of subsection (a)(1)) with respect to a public water system in a State which has primary enforcement responsibility, the Administrator may, for the purpose of assisting that State in carrying out such responsibility and upon the petition of such State or public water system or persons served by such system, hold, after appropriate notice, public hearings for the purpose of gathering information from technical or other experts, Federal, State, or other public officials, representatives of such public water system, persons served by such system, and other interested persons on-

(1) the ways in which such system can within the earliest feasible time be brought into compliance with the regulation or requirement with respect to which such finding was made, and

(2) the means for the maximum feasible protection of the public health during any period in which such system is not in compliance with a national primary drinking water regulation or requirement applicable to a variance or exemption.

On the basis of such hearings the Administrator shall issue recommendations which shall be sent to such State and public water system and shall be made available to the public and communications media.

(g)(1) In any case in which the Administrator is authorized to bring a civil action under this section or under section 1445 with respect to any ~~regulation, schedule, or other~~ ***applicable*** requirement, the Administrator also may issue an order to require compliance with such ~~regulation, schedule, or other~~ ***applicable*** requirement.

(2) An order issued under this subsection shall not take ~~effect until after notice and opportunity for public hearing and,~~ ***effect,*** in the case of a State having primary enforcement responsibility for public water systems in that State, until after the Administrator has provided the State with an opportunity to confer with the Administrator regarding the ~~proposed order~~ ***order.*** A copy of any order ~~proposed to be~~ issued under this subsection shall be sent to the appropriate State agency of the State involved if the State has primary enforcement responsibility for public water systems in that State. Any order issued under this subsection shall state with reasonable specificity the nature of the violation. In any case in which an order under this subsection is issued to a corporation, a copy of such order shall be issued to appropriate corporate officers.

(3)(A) Any person who violates, or fails or refuses to comply with, an order under this subsection shall be liable to the United States for a civil penalty of not more than $25,000 per day of violation.

~~(B) Whenever any civil penalty sought by the Administrator under this paragraph does not exceed a total of $5,000, the penalty shall be assessed by the Administrator after notice and opportunity for a hearing on the record in accordance with section 554 of title 5 of the United States Code.~~

(B) In a case in which a civil penalty sought by the Administrator under this paragraph does not exceed $5,000, the penalty shall be assessed by the Administrator after notice and opportunity for a public hearing (unless the person against whom the penalty is assessed requests a hearing on the record in accordance with section 554 of title 5, United States Code). In a case in which a civil penalty sought by the Administrator under this paragraph exceeds $5,000, but does not exceed $25,000, the penalty shall be assessed by the Administrator after notice and opportunity for a hearing on the record in accordance with section 554 of title 5, United States Code.

(C) Whenever any civil penalty sought by the Administrator under this ~~paragraph exceeds $5,000,~~ ***subsection for a violation of an applicable requirement exceeds $25,000,*** the penalty shall be assessed by a civil action brought by the Administrator in the appropriate United States district court (as determined under the provisions of title 28 of the United States Code).

(D) If any person fails to pay an assessment of a civil penalty after it has become a final and unappealable order, or after the appropriate court of appeals has entered final judgment in favor of the Administrator, the Attorney General shall recover the amount for which such person is liable in any appropriate district court of the United States. In any such action, the validity and appropriateness of the final order imposing the civil penalty shall not be subject to review.

(h) CONSOLIDATION INCENTIVE.–

(1) IN GENERAL.– An owner or operator of a public water system may submit to the State in which the system is located (if the State has primary enforcement responsibility under section 1413) or to the Administrator (if the State does not have primary enforcement responsibility) a plan (including specific measures and schedules) for–

(A) the physical consolidation of the system with 1 or more other systems;

(B) the consolidation of significant management and administrative functions of the system with 1 or more other systems; or

(C) the transfer of ownership of the system that may reasonably be expected to improve drinking water quality.

(2) CONSEQUENCES OF APPROVAL.– If the State or the Administrator approves a plan pursuant to paragraph (1), no enforcement action shall be taken pursuant to this part with respect to a specific violation identified in the approved plan prior to the date that is the earlier of the date on which consolidation is completed according to the plan or the date that is 2 years after the plan is approved.

(i) DEFINITION OF APPLICABLE REQUIREMENT.– In this section, the term `applicable requirement' means–

(1) a requirement of section 1412, 1414, 1415, 1416, 1417, 1441, or 1445;

(2) a regulation promulgated pursuant to a section referred to in paragraph (1);

(3) a schedule or requirement imposed pursuant to a section referred to in paragraph (1); and

(4) a requirement of, or permit issued under, an applicable State program for which

the Administrator has made a determination that the requirements of section 1413 have been satisfied, or an applicable State program approved pursuant to this part.

VARIANCES

SEC. 1415. (a) Notwithstanding any other provision of this part, variances from national primary drinking water regulations may be granted as follows:

(1)(A) A State which has primary enforcement responsibility for public water systems may grant one or more variances from an applicable national primary drinking water regulation to one or more public water systems within its jurisdiction, which, because of characteristics of the raw water sources which are reasonably available to the systems, cannot meet the requirements respecting the maximum contaminant levels of such drinking water regulation. A variance may ~~only be issued to a system after the system's application of~~ ***be issued to a system on condition that the system install*** the best technology, treatment techniques, or other means, which the Administrator finds are available (taking costs into consideration) ***and based upon an evaluation satisfactory to the State that indicates that alternative sources of water are not reasonably available to the system.*** The Administrator shall propose and promulgate his finding of the best available technology, treatment techniques, or other means available for each contaminant for purposes of this subsection at the time he proposes and promulgates a maximum contaminant level for each such contaminant. The Administrator's finding of best available technology, treatment techniques, or other means for purposes of this subsection may vary depending on the number of persons served by the system or for other physical conditions related to engineering feasibility and costs of compliance with maximum contaminant levels as considered appropriate by the Administrator. Before a State may grant a variance under this subparagraph, the State must find that the variance will not result in an unreasonable risk to health. If a State grants a public water system a variance under this subparagraph the State shall prescribe at the time the variance is granted, a schedule for-

(i) compliance (including increments of progress) by the public water system with each contaminant level requirement with respect to which the variance was granted, and

(ii) implementation by the public water system of such additional control measures as the State may require for each contaminant, subject to such contaminant level requirement, during the period ending on the date compliance with such requirement is required. Before a schedule prescribed by a State pursuant to this subparagraph may take effect, the State shall provide notice and opportunity for a public hearing on the schedule. A notice given pursuant to the preceding sentence may cover the prescribing of more than one such schedule and hearing held pursuant to such notice shall include each of the schedules covered by the notice. A schedule prescribed pursuant to this subparagraph for a public water system granted a variance shall require compliance by the system with each contaminant level requirement with respect to which the variance was granted as expeditiously as practicable (as the State may reasonably determine).

(B) A State which has primary enforcement responsibility for public water systems may grant to one or more public water systems within its jurisdiction one or more variances from any provisions of a national primary drinking water regulation which requires the use of a specified treatment technique with respect to a contaminant if the public water system applying for the variance demonstrates to the satisfaction of the State that such

treatment technique is not necessary to protect the health of persons because of the nature of the raw water source of such system. A variance granted under this subparagraph shall be conditioned on such monitoring and other requirements as the Administrator may prescribe.

(C) Before a variance proposed to be granted by a State under subparagraph (A) or (B) may take effect, such State shall provide notice and opportunity for public hearing on the proposed variance. A notice given pursuant to the preceding sentence may cover the granting of more than one variance and a hearing held pursuant to such notice shall include each of the variances covered by the notice. The State shall promptly notify the Administrator of all variances granted by it. Such notification shall contain the reason for the variance (and in the case of a variance under subparagraph (A), the basis for the finding required by that subparagraph before the granting of the variance) and documentation of the need for the variance.

(D) Each public water system's variance granted by a State under subparagraph (A) shall be conditioned by the State upon compliance by the public water system with the schedule prescribed by the State pursuant to that subparagraph. The requirements of each schedule prescribed by a State pursuant to that subparagraph shall be enforceable by the State under its laws. Any requirements of a schedule on which a variance granted under that subparagraph is conditioned may be enforced under section 1414 as if such requirement was part of a national primary drinking water regulation.

(E) Each schedule prescribed by a State pursuant to subparagraph (A) shall be deemed approved by the Administrator unless the variance for which it was prescribed is revoked by the Administrator under such subparagraph.

(F) Not later than 18 months after the effective date of the interim national primary drinking water regulations the Administrator shall complete a comprehensive review of the variances granted under subparagraph (A) (and schedules prescribed pursuant thereto) and under subparagraph (B) by the States during the one-year period beginning on such effective date. The Administrator shall conduct such subsequent review of variances and schedules as he deems necessary to carry out the purposes of this title, but each subsequent review shall be completed within each 3-year period following the completion of the first review under this subparagraph. Before conducting any review under this subparagraph, the Administrator shall publish notice of the proposed review in the *Federal Register*. Such notice shall (i) provide information respecting the location of data and other information respecting the variances to be reviewed (including data and other information concerning new scientific matters bearing on such variances), and (ii) advise of the opportunity to submit comments on the variances reviewed and on the need for continuing them. Upon completion of any such review, the Administrator shall publish in the *Federal Register* the results of his review together with findings responsive to comments submitted in connection with such review.

(G)(i) If the Administrator finds that a State has, in a substantial number of instances, abused its discretion in granting variances under subparagraph (A) or (B) or that in a substantial number of cases the State has failed to prescribe schedules in accordance with subparagraph (A), the Administrator shall notify the State of his findings. In determining if a State has abused its discretion in granting variances in a substantial number of instances, the Administrator shall consider the number of persons who are affected by the variances and if the requirements applicable to the granting of the variances were complied with. A notice under this clause shall-

(I) identify each public water system with respect to which the

finding was made,

(II) specify the reasons for the finding, and

(III) as appropriate, propose revocations of specific variances or propose revised schedules or other requirements for specific public water systems granted variances, or both.

(ii) The Administrator shall provide reasonable notice and public hearing on the provisions of each notice given pursuant to clause (i) of this subparagraph. After a hearing on a notice pursuant to such clause, the Administrator shall (I) rescind the finding for which the notice was given and promptly notify the State of such rescission, or (II) promulgate (with such modifications as he deems appropriate) such variance revocations and revised schedules or other requirements proposed in such notice as he deems appropriate. Not later than 180 days after the date a notice is given pursuant to clause (i) of this subparagraph, the Administrator shall complete the hearing on the notice and take the action required by the preceding sentence.

(iii) If a State is notified under clause (i) of this subparagraph of a finding of the Administrator made with respect to a variance granted a public water system within that State or to a schedule or other requirement for a variance and if, before a revocation of such variance or a revision of such schedule or other requirement promulgated by the Administrator take effect, the State takes corrective action with respect to such variance or schedule or other requirement which the Administrator determines makes his finding inapplicable to such variance or schedule or other requirement, the Administrator shall rescind the application of his finding to that variance or schedule or other requirement. No variance revocation or revised schedule or other requirement may take effect before the expiration of 90 days following the date of the notice in which the revocation or revised schedule or other requirement was proposed.

(2) If a State does not have primary enforcement responsibility for public water systems, the Administrator shall have the same authority to grant variances in such State as the State would have under paragraph (I) if it had primary enforcement responsibility.

(3) The Administrator may grant a variance from any treatment technique requirement of a national primary drinking water regulation upon a showing by any person that an alternative treatment technique not included in such requirement is at least as efficient in lowering the level of the contaminant with respect to which such requirement was prescribed. A variance under this paragraph shall be conditioned on the use of the alternative treatment technique which is the basis of the variance.

(b) Any schedule or other requirement on which a variance granted under paragraph (1)(B) or (2) of subsection (a) is conditioned may be enforced under section 1414 as if such schedule or other requirement was part of a national primary drinking water regulation.

(c) If an application for variance under subsection (a) is made, the State receiving the application or the Administrator, as the case may be, shall act upon such application within a reasonable period (as determined under regulations prescribed by the Administrator) after the date of its submission.

(d) For purposes of this section, the term "treatment technique requirement" means a requirement in a national primary drinking water regulation which specifies for a contaminant (in accordance with section 1401(1)(C)(ii) each treatment technique known to the Administrator which leads to a reduction in the level of such contaminant sufficient to

satisfy the requirements of section ~~1412(b)(3)~~ *1412(b).*

(e) SMALL SYSTEM VARIANCES.–

(1) IN GENERAL.– A State exercising primary enforcement responsibility for public water systems under section 1413 (or the Administrator in nonprimacy States) may grant a variance under this subsection for compliance with a requirement specifying a maximum contaminant level or treatment technique contained in a national primary drinking water regulation to–

(A) public water systems serving 3,300 or fewer persons; and

(B) with the approval of the Administrator pursuant to paragraph (9), public water systems serving more than 3,300 persons but fewer than 10,000 persons, if the variance meets each requirement of this subsection.

(2) AVAILABILITY OF VARIANCES.– A public water system may receive a variance pursuant to paragraph (1), if–

(A) the Administrator has identified a variance technology under section 1412(b)(15) that is applicable to the size and source water quality conditions of the public water system;

(B) the public water system installs, operates, and maintains, in accordance with guidance or regulations issued by the Administrator, such treatment technology, treatment technique, or other means; and

(C) the State in which the system is located determines that the conditions of paragraph (3) are met.

(3) CONDITIONS FOR GRANTING VARIANCES.– A variance under this subsection shall be available only to a system–

(A) that cannot afford to comply, in accordance with affordability criteria established by the Administrator (or the State in the case of a State that has primary enforcement responsibility under section 1413), with a national primary drinking water regulation, including compliance through–

(i) treatment;

(ii) alternative source of water supply; or

(iii) restructuring or consolidation (unless the Administrator (or the State in the case of a State that has primary enforcement responsibility under section 1413) makes a written determination that restructuring or consolidation is not practicable); and

(B) for which the Administrator (or the State in the case of a State that has primary enforcement responsibility under section 1413) determines that the terms of the variance ensure adequate protection of human health, considering the quality of the source water for the system and the removal efficiencies and expected useful life of the treatment technology required by the variance.

(4) COMPLIANCE SCHEDULES.– A variance granted under this subsection shall require compliance with the conditions of the variance not later than 3 years after the

date on which the variance is granted, except that the Administrator (or the State in the case of a State that has primary enforcement responsibility under section 1413) may allow up to 2 additional years to comply with a variance technology, secure an alternative source of water, restructure or consolidate if the Administrator (or the State) determines that additional time is necessary for capital improvements, or to allow for financial assistance provided pursuant to section 1452 or any other Federal or State program.

(5) DURATION OF VARIANCES.– The Administrator (or the State in the case of a State that has primary enforcement responsibility under section 1413) shall review each variance granted under this subsection not less often than every 5 years after the compliance date established in the variance to determine whether the system remains eligible for the variance and is conforming to each condition of the variance.

(6) INELIGIBILITY FOR VARIANCES.– A variance shall not be available under this subsection for–

(A) any maximum contaminant level or treatment technique for a contaminant with respect to which a national primary drinking water regulation was promulgated prior to January 1, 1986; or

(B) a national primary drinking water regulation for a microbial contaminant (including a bacterium, virus, or other organism) or an indicator or treatment technique for a microbial contaminant.

(7) REGULATIONS AND GUIDANCE.–

(A) IN GENERAL.– Not later than 2 years after the date of enactment of this subsection and in consultation with the States, the Administrator shall promulgate regulations for variances to be granted under this subsection. The regulations shall, at a minimum, specify–

(i) procedures to be used by the Administrator or a State to grant or deny variances, including requirements for notifying the Administrator and consumers of the public water system that a variance is proposed to be granted (including information regarding the contaminant and variance) and requirements for a public hearing on the variance before the variance is granted;

(ii) requirements for the installation and proper operation of variance technology that is identified (pursuant to section 1412(b)(15)) for small systems and the financial and technical capability to operate the treatment system, including operator training and certification;

(iii) eligibility criteria for a variance for each national primary drinking water regulation, including requirements for the quality of the source water (pursuant to section 1412(b)(15)(A)); and `(iv) information requirements for variance applications.

(B) AFFORDABILITY CRITERIA.– Not later than 18 months after the date of enactment of the Safe Drinking Water Act Amendments of 1996, the Administrator, in consultation with the States and the Rural Utilities Service of the Department of Agriculture, shall publish information to assist the States in developing affordability criteria. The affordability criteria shall be reviewed by the States not less often than every 5 years to determine if changes are needed to the criteria.

(8) REVIEW BY THE ADMINISTRATOR.—

(A) IN GENERAL.— The Administrator shall periodically review the program of each State that has primary enforcement responsibility for public water systems under section 1413 with respect to variances to determine whether the variances granted by the State comply with the requirements of this subsection. With respect to affordability, the determination of the Administrator shall be limited to whether the variances granted by the State comply with the affordability criteria developed by the State.

(B) NOTICE AND PUBLICATION.— If the Administrator determines that variances granted by a State are not in compliance with affordability criteria developed by the State and the requirements of this subsection, the Administrator shall notify the State in writing of the deficiencies and make public the determination.

(9) APPROVAL OF VARIANCES.— A State proposing to grant a variance under this subsection to a public water system serving more than 3,300 and fewer than 10,000 persons shall submit the variance to the Administrator for review and approval prior to the issuance of the variance. The Administrator shall approve the variance if it meets each of the requirements of this subsection. The Administrator shall approve or disapprove the variance within 90 days. If the Administrator disapproves a variance under this paragraph, the Administrator shall notify the State in writing of the reasons for disapproval and the variance may be resubmitted with modifications to address the objections stated by the Administrator.

(10) OBJECTIONS TO VARIANCES.—

(A) BY THE ADMINISTRATOR.— The Administrator may review and object to any variance proposed to be granted by a State, if the objection is communicated to the State not later than 90 days after the State proposes to grant the variance. If the Administrator objects to the granting of a variance, the Administrator shall notify the State in writing of each basis for the objection and propose a modification to the variance to resolve the concerns of the Administrator. The State shall make the recommended modification or respond in writing to each objection. If the State issues the variance without resolving the concerns of the Administrator, the Administrator may overturn the State decision to grant the variance if the Administrator determines that the State decision does not comply with this subsection.

(B) PETITION BY CONSUMERS.— Not later than 30 days after a State exercising primary enforcement responsibility for public water systems under section 1413 proposes to grant a variance for a public water system, any person served by the system may petition the Administrator to object to the granting of a variance. The Administrator shall respond to the petition and determine whether to object to the variance under subparagraph (A) not later than 60 days after the receipt of the petition.

(C) TIMING.— No variance shall be granted by a State until the later of the following:

(i) 90 days after the State proposes to grant a variance.

(ii) If the Administrator objects to the variance, the date on which the State makes the recommended modifications or responds in writing to each objection.

EXEMPTIONS

SEC. 1416. (a) A State which has primary enforcement responsibility may exempt any public water system within the State's jurisdiction from any requirement respecting a maximum contaminant level or any treatment technique requirement, or from both, of an applicable national primary drinking water regulation upon a finding that-

(1) due to compelling factors (which may include economic factors, ***including qualification of the public water system as a system serving a disadvantage community pursuant to section 1452(d)***), the public water system is unable to comply with such contaminant level or treatment technique requirement ***or to implement measures to develop an alternative source of water supply***,

(2) the public water system was in operation on the effective date of such contaminant level or treatment technique requirement or for a system that was not in operation by that date, only if no reasonable alternative source of drinking water is available to such new system, ~~and~~

(3) the granting of the exemption will not result in an unreasonable risk to health; ***and***

(4) management or restructuring changes (or both) cannot reasonably be made that will result in compliance with this title or, if compliance cannot be achieved, improve the quality of the drinking water.

(b)(1) If a State grants a public water system an exemption under subsection (a), the State shall prescribe, at the time the exemption is granted, a schedule for-

(A) compliance ~~(including increments of progress)~~ ***(including increments of progress or measures to develop an alternative source of water supply)*** by the public water system with each contaminant level ~~requirement and treatment~~ ***requirement or treatment*** technique requirement with respect to which the exemption was granted, and

(B) implementation by the public water system of such control measures as the State may require for each contaminant, subject to such contaminant level requirement or treatment technique requirement, during the period ending on the date compliance with such requirement is required.

Before a schedule prescribed by a State pursuant to this subsection may take effect, the State shall provide notice and opportunity for a public hearing on the schedule. A notice given pursuant to the preceding sentence may cover the prescribing of more than one such schedule and a hearing held pursuant to such notice shall include each of the schedules covered by the notice.

(2)(A) A schedule prescribed pursuant to this subsection for a public water system granted an exemption under subsection (a) shall require compliance by the system with each contaminant level and treatment technique requirement with respect to which the exemption was granted as expeditiously as practicable (as the State may reasonably determine) but ~~(except as provided in subparagraph (B))~~

~~(i) in the case of an exemption granted with respect to a contaminant level or treatment technique requirement prescribed by the national primary drinking water regulations promulgated under section 1412(a), not later than 12 months after enactment of the SDWA Amendments of 1986; and~~

~~(ii) in the case of an exemption granted with respect to a contaminant level or treatment technique requirement prescribed by national primary drinking water regulations, other than a regulation referred to in section 1412(a), 12 months after the date of the issuance of the exemption.~~

~~(B) The final date for compliance provided in any schedule in the case of any exemption may be extended by the State (in the case of a State which has primary enforcement responsibility) or by the Administrator (in any other case) for a period not to exceed 3 years after the date of the issuance of the exemption if~~ ***not later than 3 years after the otherwise applicable compliance date established in section 1412(b)(10).***

(B) No exemption shall be granted unless the public water system establishes that-

(i) the system cannot meet the standard without capital improvements which cannot be completed ~~within the period of such exemption;~~ ***prior to the date established pursuant to section 1412(b)(10).***

(ii) in the case of a system which needs financial assistance for the necessary improvements, the system has entered into an agreement to obtain such financial assistance ***or assistance pursuant to section 1452, or any other Federal or State program is reasonably likely to be available within the period of the exemption***; or

(iii) the system has entered into an enforceable agreement to become a part of a regional public water system; and the system is taking all practicable steps to meet the standard.

(C) In the case of a system which does not serve more than ~~500 service connections~~ ***a population of 3,300*** and which needs financial assistance for the necessary improvements, an exemption granted under clause (i) or (ii) of subparagraph (B) may be renewed for one or more additional 2-year periods, ***but not to exceed a total of 6 years,*** if the system establishes that it is taking all practicable steps to meet the requirements of subparagraph (B).

(D) LIMITATION.--A public water system may not receive an exemption under this section if the system was granted a variance under section 1415(e).

(3) Each public water system's exemption granted by a State under subsection (a) shall be conditioned by the State upon compliance by the public water system with the schedule prescribed by the State pursuant to this subsection. The requirements of each schedule prescribed by a State pursuant to this subsection shall be enforceable by the State under its laws. Any requirement of a schedule on which an exemption granted under this section is conditioned may be enforced under section 1414 as if such requirement was part of a national primary drinking water regulation.

(4) Each schedule prescribed by a State pursuant to this subsection shall be deemed approved by the Administrator unless the exemption for which it was prescribed is revoked by the Administrator under subsection (d)(2) or the schedule is revised by the Administrator under such subsection.

(c) Each State which grants an exemption under subsection (a) shall promptly notify the Administrator of the granting of such exemption. Such notification shall contain the reasons for the exemption (including the basis for the finding required by subsection (a)(3) before

the exemption may be granted) and document the need for the exemption.

(d)(1) Not later than 18 months after the effective date of the interim national primary drinking water regulations the Administrator shall complete a comprehensive review of the exemptions granted (and schedules prescribed pursuant thereto) by the States during the one-year period beginning on such effective date. The Administrator shall conduct such subsequent reviews of exemptions and schedules as he deems necessary to carry out the purposes of this title, but each subsequent review shall be completed within each 3-year period following the completion of the first review under this subparagraph. Before conducting any review under this subparagraph, the Administrator shall publish notice of the proposed review in the *Federal Register*. Such notice shall (A) provide information respecting the location of data and other information respecting the exemptions to be reviewed (including data and other information concerning new scientific matters bearing on such exemptions), and (B) advise of the opportunity to submit comments on the exemptions reviewed and on the need for continuing them. Upon completion of any such review, the Administrator shall publish in the *Federal Register* the results of his review together with findings responsive to comments submitted in connection with such review.

(2)(A) If the Administrator finds that a State has, in a substantial number of instances, abused its discretion in granting exemptions under subsection (a) or failed to prescribe schedules in accordance with subsection (b), the Administrator shall notify the State of his finding. In determining if a State has abused its discretion in granting exemptions in a substantial number of instances, the Administrator shall consider the number of persons who are affected by the exemptions and if the requirements applicable to the granting of the exemptions were complied with. A notice under this paragraph shall-

(i) identify each exempt public water system with respect to which the finding was made,

(ii) specify the reasons for the finding, and

(iii) as appropriate, propose revocations of specific exemptions or propose revised schedules for specific exempt public water systems, or both.

(B) The Administrator shall provide reasonable notice and public hearing on the provisions of each notice given pursuant to subparagraph (A). After a hearing on a notice pursuant to subparagraph (A), the Administrator shall (i) rescind the finding for which the notice was given and promptly notify the State of such rescission, or (ii) promulgate (with such modifications as he deems appropriate) such exemption revocations and revised schedules proposed in such notice as he deems appropriate. Not later than 180 days after the date a notice is given pursuant to subparagraph (A), the Administrator shall complete the hearing on the notice and take the action required by the preceding sentence.

(C) If a State is notified under subparagraph (A) of a finding of the Administrator made with respect to an exemption granted a public water system within that State or to a schedule prescribed pursuant to such an exemption and if before a revocation of such exemption or a revision of such schedule promulgated by the Administrator takes effect the State takes corrective action with respect to such exemption or schedule which the Administrator determines makes his finding inapplicable to such exemption or schedule, the Administrator shall rescind the application of his finding to that exemption or schedule. No exemption revocation or revised schedule may take effect before the expiration of 90 days following the date of the notice in which the revocation or revised schedule was proposed.

(e) For purposes of this section, the term "treatment technique requirement" means a

requirement in a national primary drinking water regulation which specifies for a contaminant (in accordance with section 1401(1)(C)(ii)) each treatment technique known to the Administrator which leads to a reduction in the level of such contaminant sufficient to satisfy the requirements of section 1412(b).

(f) If a State does not have primary enforcement responsibility for public water systems, the Administrator shall have the same authority to exempt public water systems in such State from maximum contaminant level requirements and treatment technique requirements under the same conditions and in the same manner as the State would be authorized to grant exemptions under this section if it had primary enforcement responsibility.

(g) If an application for an exemption under this section is made, the State receiving the application or the Administrator, as the case may be, shall act upon such application within a reasonable period (as determined under regulations prescribed by the Administrator) after the date of its submission.

PROHIBITION ON USE OF LEAD PIPES, SOLDER, AND FLUX

SEC. 1417. (a) In General-

~~(1) PROHIBITION Any pipe, solder, or flux, which is used after the enactment of the Safe Drinking Water Act Amendments of 1986, in the installation or repair of~~

~~(A) any public water system, or~~

~~(B) any plumbing in a residential or nonresidential facility providing water for human consumption which is connected to a public water system, shall be lead free (within the meaning of subsection (d)). This paragraph shall not apply to leaded joints necessary for the repair of cast iron pipes.~~

(1) PROHIBITIONS.–

(A) IN GENERAL.– No person may use any pipe, any pipe or plumbing fitting or fixture, any solder, or any flux, after June 19, 1986, in the installation or repair of–

(i) any public water system; or

(ii) any plumbing in a residential or nonresidential facility providing water for human consumption, that is not lead free (within the meaning of subsection (d)).

(B) LEADED JOINTS.– Subparagraph (A) shall not apply to leaded joints necessary for the repair of cast iron pipes.

(2) PUBLIC NOTICE REQUIREMENTS

(A) IN GENERAL.--Each ***owner or operator of a*** public water system shall identify and provide notice to persons that may be affected by lead contamination of their drinking water where such contamination results from either or both of the following:

(i) The lead content in the construction materials of the public water distribution system.

(ii) Corrosivity of the water supply sufficient to cause leaching of lead.

The notice shall be provided in such manner and form as may be reasonably required by the Administrator. Notice under this paragraph shall be provided notwithstanding the absence of a violation of any national drinking water standard.

(B) CONTENTS OF NOTICE-Notice under this paragraph shall provide a clear and readily understandable explanation of-

(i) the potential sources of lead in the drinking water,

(ii) potential adverse health effects,

(iii) reasonably available methods of mitigating known or potential lead content in drinking water,

(iv) any steps the system is taking to mitigate lead content in drinking water, and

(v) the necessity for seeking alternative water supplies, if any.

(3) UNLAWFUL ACTS.– Effective 2 years after the date of enactment of this paragraph, it shall be unlawful–

(A) for any person to introduce into commerce any pipe, or any pipe or plumbing fitting or fixture, that is not lead free, except for a pipe that is used in manufacturing or industrial processing;

(B) for any person engaged in the business of selling plumbing supplies, except manufacturers, to sell solder or flux that is not lead free; or

(C) for any person to introduce into commerce any solder or flux that is not lead free unless the solder or flux bears a prominent label stating that it is illegal to use the solder or flux in the installation or repair of any plumbing providing water for human consumption.

(b) STATE ENFORCEMENT-

(1) ENFORCEMENT OF PROHIBITION-The requirements of subsection (a)(1) shall be enforced in all States effective 24 months after the enactment of this section. States shall enforce such requirements through State or local plumbing codes, or such other means of enforcement as the State may determine to be appropriate.

(2) ENFORCEMENT OF PUBLIC NOTICE REQUIREMENTS-The requirements of subsection (a)(2) shall apply in all States effective 24 months after the enactment of this section.

(c) PENALTIES-If the Administrator determines that a State is not enforcing the requirements of subsection (a) as required pursuant to subsection (b), the Administrator may withhold up to 5 percent of Federal funds available to that State for State program grants under section 1443(a).

(d) DEFINITION OF LEAD FREE-For purposes of this section, the term "lead free"-

(1) when used with respect to solders and flux refers to solders and flux containing not more than 0.2 percent ~~lead, and~~ ***lead;***

(2) when used with respect to pipes and pipe fittings refers to pipes and pipe fittings

containing not more than 8.0 percent ~~lead.~~ *lead, and*

(3) when used with respect to plumbing fittings and fixtures, refers to plumbing fittings and fixtures in compliance with standards established in accordance with subsection (e).

(e) PLUMBING FITTINGS AND FIXTURES.–

(1) IN GENERAL.– The Administrator shall provide accurate and timely technical information and assistance to qualified third-party certifiers in the development of voluntary standards and testing protocols for the leaching of lead from new plumbing fittings and fixtures that are intended by the manufacturer to dispense water for human ingestion.

(2) STANDARDS.–

(A) IN GENERAL.– If a voluntary standard for the leaching of lead is not established by the date that is 1 year after the date of enactment of this subsection, the Administrator shall, not later than 2 years after the date of enactment of this subsection, promulgate regulations setting a health-effects-based performance standard establishing maximum leaching levels from new plumbing fittings and fixtures that are intended by the manufacturer to dispense water for human ingestion. The standard shall become effective on the date that is 5 years after the date of promulgation of the standard.

(B) ALTERNATIVE REQUIREMENT.– If regulations are required to be promulgated under subparagraph (A) and have not been promulgated by the date that is 5 years after the date of enactment of this subsection, no person may import, manufacture, process, or distribute in commerce a new plumbing fitting or fixture, intended by the manufacturer to dispense water for human ingestion, that contains more than 4 percent lead by dry weight.

MONITORING OF CONTAMINANTS

SEC. 1418. (a) INTERIM MONITORING RELIEF AUTHORITY.–

(1) IN GENERAL.– A State exercising primary enforcement responsibility for public water systems may modify the monitoring requirements for any regulated or unregulated contaminants for which monitoring is required other than microbial contaminants (or indicators thereof), disinfectants and disinfection byproducts or corrosion byproducts for an interim period to provide that any public water system serving 10,000 persons or fewer shall not be required to conduct additional quarterly monitoring during an interim relief period for such contaminants if–

(A) monitoring, conducted at the beginning of the period for the contaminant concerned and certified to the State by the public water system, fails to detect the presence of the contaminant in the ground or surface water supplying the public water system; and

(B) the State, considering the hydrogeology of the area and other relevant factors, determines in writing that the contaminant is unlikely to be detected by further monitoring during such period.

(2) TERMINATION; TIMING OF MONITORING.– The interim relief period referred to in paragraph (1) shall terminate when permanent monitoring relief is adopted

and approved for such State, or at the end of 36 months after the date of enactment of the Safe Drinking Water Act Amendments of 1996, whichever comes first. In order to serve as a basis for interim relief, the monitoring conducted at the beginning of the period must occur at the time determined by the State to be the time of the public water system's greatest vulnerability to the contaminant concerned in the relevant ground or surface water, taking into account in the case of pesticides the time of application of the pesticide for the source water area and the travel time for the pesticide to reach such waters and taking into account, in the case of other contaminants, seasonality of precipitation and contaminant travel time.

(b) PERMANENT MONITORING RELIEF AUTHORITY.–

(1) IN GENERAL.– Each State exercising primary enforcement responsibility for public water systems under this title and having an approved source water assessment program may adopt, in accordance with guidance published by the Administrator, tailored alternative monitoring requirements for public water systems in such State (as an alternative to the monitoring requirements for chemical contaminants set forth in the applicable national primary drinking water regulations) where the State concludes that (based on data available at the time of adoption concerning susceptibility, use, occurrence, or wellhead protection, or from the State's drinking water source water assessment program) such alternative monitoring would provide assurance that it complies with the Administrator's guidelines. The State program must be adequate to assure compliance with, and enforcement of, applicable national primary drinking water regulations. Alternative monitoring shall not apply to regulated microbiological contaminants (or indicators thereof), disinfectants and disinfection byproducts, or corrosion byproducts. The preceding sentence is not intended to limit other authority of the Administrator under other provisions of this title to grant monitoring flexibility.

(2) GUIDELINES.–

(A) IN GENERAL.– The Administrator shall issue, after notice and comment and at the same time as guidelines are issued for source water assessment under section 1453, guidelines for States to follow in proposing alternative monitoring requirements under paragraph (1) for chemical contaminants. The Administrator shall publish such guidelines in the Federal Register. The guidelines shall assure that the public health will be protected from drinking water contamination. The guidelines shall require that a State alternative monitoring program apply on a contaminant-by-contaminant basis and that, to be eligible for such alternative monitoring program, a public water system must show the State that the contaminant is not present in the drinking water supply or, if present, it is reliably and consistently below the maximum contaminant level.

(B) DEFINITION.– For purposes of subparagraph (A), the phrase `reliably and consistently below the maximum contaminant level' means that, although contaminants have been detected in a water supply, the State has sufficient knowledge of the contamination source and extent of contamination to predict that the maximum contaminant level will not be exceeded. In determining that a contaminant is reliably and consistently below the maximum contaminant level, States shall consider the quality and completeness of data, the length of time covered and the volatility or stability of monitoring results during that time, and the proximity of such results to the maximum contaminant level. Wide variations in the analytical results, or analytical results close to the maximum contaminant level, shall not be considered to be reliably and consistently below the maximum contaminant level.

(3) EFFECT OF DETECTION OF CONTAMINANTS.— The guidelines issued by the Administrator under paragraph (2) shall require that if, after the monitoring program is in effect and operating, a contaminant covered by the alternative monitoring program is detected at levels at or above the maximum contaminant level or is no longer reliably or consistently below the maximum contaminant level, the public water system must either—

(A) demonstrate that the contamination source has been removed or that other action has been taken to eliminate the contamination problem; or

(B) test for the detected contaminant pursuant to the applicable national primary drinking water regulation.

(4) STATES NOT EXERCISING PRIMARY ENFORCEMENT RESPONSIBILITY.— The Governor of any State not exercising primary enforcement responsibility under section 1413 on the date of enactment of this section may submit to the Administrator a request that the Administrator modify the monitoring requirements established by the Administrator and applicable to public water systems in that State. After consultation with the Governor, the Administrator shall modify the requirements for public water systems in that State if the request of the Governor is in accordance with each of the requirements of this subsection that apply to alternative monitoring requirements established by States that have primary enforcement responsibility. A decision by the Administrator to approve a request under this clause shall be for a period of 3 years and may subsequently be extended for periods of 5 years.

(c) TREATMENT AS NPDWR.— All monitoring relief granted by a State to a public water system for a regulated contaminant under subsection (a) or (b) shall be treated as part of the national primary drinking water regulation for that contaminant.

(d) OTHER MONITORING RELIEF.— Nothing in this section shall be construed to affect the authority of the States under applicable national primary drinking water regulations to alter monitoring requirements through waivers or other existing authorities. The Administrator shall periodically review and, as appropriate, revise such authorities.

OPERATOR CERTIFICATION

SEC. 1419. (a) GUIDELINES.— Not later than 30 months after the date of enactment of the Safe Drinking Water Act Amendments of 1996 and in cooperation with the States, the Administrator shall publish guidelines in the Federal Register, after notice and opportunity for comment from interested persons, including States and public water systems, specifying minimum standards for certification (and recertification) of the operators of community and nontransient noncommunity public water systems. Such guidelines shall take into account existing State programs, the complexity of the system, and other factors aimed at providing an effective program at reasonable cost to States and public water systems, taking into account the size of the system.

(b) STATE PROGRAMS.— Beginning 2 years after the date on which the Administrator publishes guidelines under subsection (a), the Administrator shall withhold 20 percent of the funds a State is otherwise entitled to receive under section 1452 unless the State has adopted and is implementing a program for the certification of operators of community

and nontransient noncommunity public water systems that meets the requirements of the guidelines published pursuant to subsection (a) or that has been submitted in compliance with subsection (c) and that has not been disapproved.

(c) EXISTING PROGRAMS.— For any State exercising primary enforcement responsibility for public water systems or any other State which has an operator certification program, the guidelines under subsection (a) shall allow the State to enforce such program in lieu of the guidelines under subsection (a) if the State submits the program to the Administrator within 18 months after the publication of the guidelines unless the Administrator determines (within 9 months after the State submits the program to the Administrator) that such program is not substantially equivalent to such guidelines. In making this determination, an existing State program shall be presumed to be substantially equivalent to the guidelines, notwithstanding program differences, based on the size of systems or the quality of source water, providing the State program meets the overall public health objectives of the guidelines. If disapproved, the program may be resubmitted within 6 months after receipt of notice of disapproval.

(d) EXPENSE REIMBURSEMENT.—

(1) IN GENERAL.— The Administrator shall provide reimbursement for the costs of training, including an appropriate per diem for unsalaried operators, and certification for persons operating systems serving 3,300 persons or fewer that are required to undergo training pursuant to this section.

(2) STATE GRANTS.— The reimbursement shall be provided through grants to States with each State receiving an amount sufficient to cover the reasonable costs for training all such operators in the State, as determined by the Administrator, to the extent required by this section. Grants received by a State pursuant to this paragraph shall first be used to provide reimbursement for training and certification costs of persons operating systems serving 3,300 persons or fewer. If a State has reimbursed all such costs, the State may, after notice to the Administrator, use any remaining funds from the grant for any of the other purposes authorized for grants under section 1452.

(3) AUTHORIZATION.— There are authorized to be appropriated to the Administrator to provide grants for reimbursement under this section $30,000,000 for each of fiscal years 1997 through 2003.

(4) RESERVATION.— If the appropriation made pursuant to paragraph (3) for any fiscal year is not sufficient to satisfy the requirements of paragraph (1), the Administrator shall, prior to any other allocation or reservation, reserve such sums as necessary from the funds appropriated pursuant to section 1452(m) to provide reimbursement for the training and certification costs mandated by this subsection.

CAPACITY DEVELOPMENT

SEC. 1420. (a) STATE AUTHORITY FOR NEW SYSTEMS.— A State shall receive only 80 percent of the allotment that the State is otherwise entitled to receive under section 1452 (relating to State loan funds) unless the State has obtained the legal authority or other means to ensure that all new community water systems and new nontransient, noncommunity water systems commencing operation after October 1, 1999, demonstrate technical, managerial, and financial capacity with respect to each national primary

drinking water regulation in effect, or likely to be in effect, on the date of commencement of operations.

(b) SYSTEMS IN SIGNIFICANT NONCOMPLIANCE.–

(1) LIST.– Beginning not later than 1 year after the date of enactment of this section, each State shall prepare, periodically update, and submit to the Administrator a list of community water systems and nontransient, noncommunity water systems that have a history of significant noncompliance with this title (as defined in guidelines issued prior to the date of enactment of this section or any revisions of the guidelines that have been made in consultation with the States) and, to the extent practicable, the reasons for noncompliance.

(2) REPORT.– Not later than 5 years after the date of enactment of this section and as part of the capacity development strategy of the State, each State shall report to the Administrator on the success of enforcement mechanisms and initial capacity development efforts in assisting the public water systems listed under paragraph (1) to improve technical, managerial, and financial capacity.

(3) WITHHOLDING.– The list and report under this subsection shall be considered part of the capacity development strategy of the State required under subsection (c) of this section for purposes of the withholding requirements of section 1452(a)(1)(G)(i) (relating to State loan funds).

(c) CAPACITY DEVELOPMENT STRATEGY.–

(1) IN GENERAL.– Beginning 4 years after the date of enactment of this section, a State shall receive only–

(A) 90 percent in fiscal year 2001;

(B) 85 percent in fiscal year 2002; and

(C) 80 percent in each subsequent fiscal year, of the allotment that the State is otherwise entitled to receive under section 1452 (relating to State loan funds), unless the State is developing and implementing a strategy to assist public water systems in acquiring and maintaining technical, managerial, and financial capacity.

(2) CONTENT.– In preparing the capacity development strategy, the State shall consider, solicit public comment on, and include as appropriate–

(A) the methods or criteria that the State will use to identify and prioritize the public water systems most in need of improving technical, managerial, and financial capacity;

(B) a description of the institutional, regulatory, financial, tax, or legal factors at the Federal, State, or local level that encourage or impair capacity development;

(C) a description of how the State will use the authorities and resources of this title or other means to–

(i) assist public water systems in complying with national primary drinking water regulations;

(ii) encourage the development of partnerships between public water

systems to enhance the technical, managerial, and financial capacity of the systems; and

(iii) assist public water systems in the training and certification of operators;

(D) a description of how the State will establish a baseline and measure improvements in capacity with respect to national primary drinking water regulations and State drinking water law; and

(E) an identification of the persons that have an interest in and are involved in the development and implementation of the capacity development strategy (including all appropriate agencies of Federal, State, and local governments, private and nonprofit public water systems, and public water system customers).

(3) REPORT.– Not later than 2 years after the date on which a State first adopts a capacity development strategy under this subsection, and every 3 years thereafter, the head of the State agency that has primary responsibility to carry out this title in the State shall submit to the Governor a report that shall also be available to the public on the efficacy of the strategy and progress made toward improving the technical, managerial, and financial capacity of public water systems in the State.

(4) REVIEW.– The decisions of the State under this section regarding any particular public water system are not subject to review by the Administrator and may not serve as the basis for withholding funds under section 1452.

(d) FEDERAL ASSISTANCE.–

(1) IN GENERAL.– The Administrator shall support the States in developing capacity development strategies.

(2) INFORMATIONAL ASSISTANCE.–

(A) IN GENERAL.– Not later than 180 days after the date of enactment of this section, the Administrator shall–

(i) conduct a review of State capacity development efforts in existence on the date of enactment of this section and publish information to assist States and public water systems in capacity development efforts; and

(ii) initiate a partnership with States, public water systems, and the public to develop information for States on recommended operator certification requirements.

(B) PUBLICATION OF INFORMATION.– The Administrator shall publish the information developed through the partnership under subparagraph (A)(ii) not later than 18 months after the date of enactment of this section.

(3) PROMULGATION OF DRINKING WATER REGULATIONS.– In promulgating a national primary drinking water regulation, the Administrator shall include an analysis of the likely effect of compliance with the regulation on the technical, financial, and managerial capacity of public water systems.

(4) GUIDANCE FOR NEW SYSTEMS.– Not later than 2 years after the date of enactment of this section, the Administrator shall publish guidance developed in consultation with the States describing legal authorities and other means to ensure that

all new community water systems and new nontransient, noncommunity water systems demonstrate technical, managerial, and financial capacity with respect to national primary drinking water regulations.

(e) VARIANCES AND EXEMPTIONS.– Based on information obtained under subsection (c)(3), the Administrator shall, as appropriate, modify regulations concerning variances and exemptions for small public water systems to ensure flexibility in the use of the variances and exemptions. Nothing in this subsection shall be interpreted, construed, or applied to affect or alter the requirements of section 1415 or 1416.

(f) SMALL PUBLIC WATER SYSTEMS TECHNOLOGY ASSISTANCE CENTERS.–

(1) GRANT PROGRAM.– The Administrator is authorized to make grants to institutions of higher learning to establish and operate small public water system technology assistance centers in the United States.

(2) RESPONSIBILITIES OF THE CENTERS.– The responsibilities of the small public water system technology assistance centers established under this subsection shall include the conduct of training and technical assistance relating to the information, performance, and technical needs of small public water systems or public water systems that serve Indian Tribes.

(3) APPLICATIONS.– Any institution of higher learning interested in receiving a grant under this subsection shall submit to the Administrator an application in such form and containing such information as the Administrator may require by regulation.

(4) SELECTION CRITERIA.– The Administrator shall select recipients of grants under this subsection on the basis of the following criteria:

(A) The small public water system technology assistance center shall be located in a State that is representative of the needs of the region in which the State is located for addressing the drinking water needs of small and rural communities or Indian Tribes.

(B) The grant recipient shall be located in a region that has experienced problems, or may reasonably be foreseen to experience problems, with small and rural public water systems.

(C) The grant recipient shall have access to expertise in small public water system technology management.

(D) The grant recipient shall have the capability to disseminate the results of small public water system technology and training programs.

(E) The projects that the grant recipient proposes to carry out under the grant are necessary and appropriate.

(F) The grant recipient has regional support beyond the host institution.

(5) CONSORTIA OF STATES.– At least 2 of the grants under this subsection shall be made to consortia of States with low population densities.

(6) AUTHORIZATION OF APPROPRIATIONS.– There are authorized to be appropriated to make grants under this subsection $2,000,000 for each of the fiscal years 1997 through 1999, and $5,000,000 for each of the fiscal years 2000 through 2003.

(g) ENVIRONMENTAL FINANCE CENTERS.–

(1) IN GENERAL.– The Administrator shall provide initial funding for one or more university-based environmental finance centers for activities that provide technical assistance to State and local officials in developing the capacity of public water systems. Any such funds shall be used only for activities that are directly related to this title.

(2) NATIONAL CAPACITY DEVELOPMENT CLEARINGHOUSE.– The Administrator shall establish a national public water system capacity development clearinghouse to receive and disseminate information with respect to developing, improving, and maintaining financial and managerial capacity at public water systems. The Administrator shall ensure that the clearinghouse does not duplicate other federally supported clearinghouse activities.

(3) CAPACITY DEVELOPMENT TECHNIQUES.– The Administrator may request an environmental finance center funded under paragraph (1) to develop and test managerial, financial, and institutional techniques for capacity development. The techniques may include capacity assessment methodologies, manual and computer based public water system rate models and capital planning models, public water system consolidation procedures, and regionalization models.

(4) AUTHORIZATION OF APPROPRIATIONS.– There are authorized to be appropriated to carry out this subsection $1,500,000 for each of the fiscal years 1997 through 2003.

(5) LIMITATION.– No portion of any funds made available under this subsection may be used for lobbying expenses.

Part C Protection of Underground Sources of Drinking Water

REGULATIONS FOR STATE PROGRAMS

SEC. 1421. (a)(1) The Administrator shall publish proposed regulations for State underground injection control programs within 180 days after the date of enactment of this title. Within 180 days after publication of such proposed regulations, he shall promulgate such regulations with such modifications as he deems appropriate. Any regulation under this subsection may be amended from time to time.

(2) Any regulation under this section shall be proposed and promulgated in accordance with section 553 of title 5, United States Code (relating to rulemaking), except that the Administrator shall provide opportunity for public hearing prior to promulgation of such regulations. In proposing and promulgating regulations under this section, the Administrator shall consult with the Secretary, the National Drinking Water Advisory Council, and other appropriate Federal entities and with interested State entities.

(b)(1) Regulations under subsection (a) for State underground injection programs shall contain minimum requirements for effective programs to prevent underground injection which endangers drinking water sources within the meaning of subsection (d)(2). Such regulations shall require that a State program, in order to be approved under section 1422-

(A) shall prohibit, effective on the date on which the applicable underground injection control program takes effect, any underground injection in such State which is not authorized by a permit issued by the State (except that the regulations may permit a State to authorize underground injection by rule);

(B) shall require (i) in the case of a program which provides for authorization of underground injection by permit, that the applicant for the permit to inject must satisfy the State that the underground injection will not endanger drinking water sources, and (ii) in the case of a program which provides for such an authorization by rule, that no rule may be promulgated which authorizes any underground injection which endangers drinking water sources;

(C) shall include inspection, monitoring, recordkeeping, and reporting requirements; and

(D) shall apply (i) as prescribed by section 1447(b), to underground injections by Federal agencies, and (ii) to underground injections by any other person whether or not occurring on property owned or leased by the United States.

(2) Regulations of the Administrator under this section for State underground injection control programs may not prescribe requirements which interfere with or impede-

(A) the underground injection of brine or other fluids which are brought to the surface in connection with oil or natural gas production or natural gas storage, or

(B) any underground in injection for the secondary or tertiary recovery of oil or natural gas, unless such requirements are essential to assure that underground sources of drinking water will not be endangered by such injection.

(3)(A) The regulations of the Administrator under this section shall permit or provide for consideration of varying geologic, hydrological, or historical conditions in different States and in different areas within a State.

(B)(i) In prescribing regulations under this section, the Administrator shall, to the extent feasible, avoid promulgation of requirements which would unnecessarily disrupt State underground injection control programs which are in effect and being enforced in a substantial number of States.

(ii) For the purpose of this subparagraph, a regulation prescribed by the Administrator under this section shall be deemed to disrupt a State underground injection control program only if it would be infeasible to comply with both such regulation and the State underground injection control program.

(iii) For the purpose of this subparagraph, a regulation prescribed by the Administrator under this section shall be deemed unnecessary only if, without such regulation, underground sources of drinking water will not be endangered by any underground injection.

(C) Nothing in this section shall be construed to alter or affect the duty to assure that underground sources of drinking water will not be endangered by any underground injection.

(c)(1) The Administrator may, upon application of the Governor of a State which authorizes underground injection by means of permits, authorize such State to issue (without

regard to subsection (b)(1)(B)(i)) temporary permits for underground injection which may be effective until the expiration of four years after the date of enactment of this title, if-

(A) the Administrator finds that the State has demonstrated that it is unable and could not reasonably have been able to process all permit applications within the time available;

(B) the Administrator determines the adverse effect on the environment of such temporary permits is not unwarranted;

(C) such temporary permits will be issued only with respect to injection wells in operation on the date on which such State's permit program approved under this part first takes effect and for which there was inadequate time to process its permit application; and

(D) the Administrator determines the temporary permits require the use of adequate safeguards established by rules adopted by him.

(2) The Administrator may, upon application of the Governor of a State which authorizes underground injection by means of permits, authorize such State to issue (without regard to subsection (b)(1)(B)(i)), but after reasonable notice and hearing, one or more temporary permits, each of which is applicable to a particular injection well and to the underground injection of a particular fluid and which may be effective until the expiration of four years after the date of enactment of this title, if the State finds, on the record of such hearing-

(A) that technology (or other means) to permit safe injection of the fluid in accordance with the applicable underground injection control program is not generally available (taking costs into consideration);

(B) that injection of the fluid would be less harmful to health than the use of other available means of disposing of waste or producing the desired product; and

(C) that available technology or other means have been employed (and will be employed) to reduce the volume and toxicity of the fluid and to minimize the potentially adverse effect of the injection on the public health.

(d) For purposes of this part:

(1) The term "underground injection" means the subsurface emplacement of fluids by well injection. Such term does not include the underground injection of natural gas for purposes of storage.

(2) Underground injection endangers drinking water sources if such injection may result in the presence in underground water which supplies or can reasonably be expected to supply any public water system of any contaminant, and if the presence of such contaminant may result in such system's not complying with any national primary drinking water regulation or may otherwise adversely affect the health of persons.

STATE PRIMARY ENFORCEMENT RESPONSIBILITY

SEC. 1422. (a) Within 180 days after the date of enactment of this title, the Administrator shall list in the *Federal Register* each State for which in his judgment a State underground

injection control program may be necessary to assure that underground injection will not endanger drinking water sources. Such list may be amended from time to time.

(b)(1)(A) Each State listed under subsection (a) shall within 270 days after the date of promulgation of any regulation under section 1421 (or, if later, within 270 days after such State is first listed under subsection (a)) submit to the Administrator an application which contains a showing satisfactory to the Administrator that the State-

(i) has adopted after reasonable notice and public hearings, and will implement, an underground injection control program which meets the requirements of regulations in effect under section 1421; and

(ii) will keep such records and make such reports with respect to its activities under its underground injection control program as the Administrator may require by regulation.

The Administrator may, for good cause, extend the date for submission of an application by any State under this subparagraph for a period not to exceed an additional 270 days.

(B) Within 270 days of any amendment of a regulation under section 1421 revising or adding any requirement respecting State underground injection control programs, each State listed under subsection (a) shall submit (in such form and manner as the Administrator may require) a notice to the Administrator containing a showing satisfactory to him that the State underground injection control program meets the revised or added requirement.

(2) Within ninety days after the State's application under paragraph (1)(A) or notice under paragraph (1)(B) and after reasonable opportunity for presentation of views, the Administrator shall by rule either approve, disapprove, or approve in part and disapprove in part, the State's underground injection control program.

(3) If the Administrator approves the State's program under paragraph (2), the State shall have primary enforcement responsibility for underground water sources until such time as the Administrator determines, by rule, that such State no longer meets the requirements of clause (i) or (ii) of paragraph (1)(A) of this subsection.

(4) Before promulgating any rule under paragraph (2) or (3) of this subsection, the Administrator shall provide opportunity for public hearing respecting such rule.

(c) If the Administrator disapproves a State's program (or part thereof) under subsection (b)(2), if the Administrator determines under subsection (b)(3) that a State no longer meets the requirements of clause (i) or (ii) of subsection (b)(1)(A), or if a State fails to submit an application or notice before the date of expiration of the period specified in subsection (b)(1), the Administrator shall by regulation within 90 days after the date of such disapproval, determination, or expiration (as the case may be) prescribe (and may from time to time by regulation revise) a program applicable to such State meeting the requirements of section 1421(b). Such program may not include requirements which interfere with or impede-

(1) the underground injection of brine or other fluids which are brought to the surface in connection with oil or natural gas production or natural gas storage operations, or

(2) any underground injection for the secondary or tertiary recovery of oil or natural gas, unless such requirements are essential to assure that underground sources of drinking water

will not be endangered by such injection. Such program shall apply in such State to the extent that a program adopted by such State which the Administrator determines meet such requirements is not in effect. Before promulgating any regulation under this section, the Administrator shall provide opportunity for public hearing respecting such regulation.

(d) For purposes of this title, the term "applicable underground injection control program" with respect to a State means the program (or most recent amendment thereof) (1) which has been adopted by the State and which has been approved under subsection (b), or (2) which has been prescribed by the Administrator under subsection (c).

(e) An Indian Tribe may assume primary enforcement responsibility for underground injection control under this section consistent with such regulations as the Administrator has prescribed pursuant to Part C and section 1451 of this Act. The area over which such Indian Tribe exercises governmental jurisdiction need not have been listed under subsection (a) of this section, and such Tribe need not submit an application to assume primary enforcement responsibility within the 270-day deadline noted in subsection (b)(1)(A) of this section. Until an Indian Tribe assumes primary enforcement responsibility, the currently applicable underground injection control program shall continue to apply. If an applicable underground injection control program does not exist for an Indian Tribe, the Administrator shall prescribe such a program pursuant to subsection (c) of this section, and consistent with section 1412(b), within 270 days after the enactment of the Safe Drinking Water Act Amendments of 1986, unless an Indian Tribe first obtains approval to assume primary enforcement responsibility for underground injection control.

ENFORCEMENT OF PROGRAM

SEC. 1423. (a)(1) Whenever the Administrator finds during a period during which a State has primary enforcement responsibility for underground water sources (within the meaning of section 1422(b)(3)) or section 1425(c) that any person who is subject to a requirement of an applicable underground injection control program in such State is violating such requirement, he shall so notify the State and the person violating such requirement. If beyond the thirtieth day after the Administrator's notification the State has not commenced appropriate enforcement action, the Administrator shall issue an order under subsection (c) requiring the person to comply with such requirement or the Administrator shall commence a civil action under subsection (b).

(2) Whenever the Administrator finds during a period during which a State does not have primary enforcement responsibility for underground water sources that any person subject to any requirement of any applicable underground injection control program in such States is violating such requirement, the Administrator shall issue an order under subsection (c) requiring the person to comply with such requirement or the Administrator shall commence a civil action under subsection (b).

(b) CIVIL AND CRIMINAL ACTIONS-Civil actions referred to in paragraphs (1) and (2) of subsection (a) shall be brought in the appropriate United States district court. Such court shall have jurisdiction to require compliance with any requirement of an applicable underground injection program or with an order issued under subsection (c). The court may enter such judgment as protection of public health may require. Any person who violates any requirement of an applicable underground injection control program or an order requiring compliance under subsection (c)-

economic benefit (if any) resulting from the violation; (iii) any history of such violations; (iv) any good-faith efforts to comply with the applicable requirements; (v) the economic impact of the penalty on the violator; and (vi) such other matters as justice may require.

(5) Any violation with respect to which the Administrator has commenced and is diligently prosecuting an action, or has issued an order under this subsection assessing a penalty, shall not be subject to an action under subsection (b) of this section or section 1424(c) or 1449, except that the foregoing limitation on civil actions under section 1449 of this Act shall not apply with respect to any violation for which-

(A) a civil action under section 1449(a)(1) has been filed prior to commencement of an action under this subsection, or

(B) a notice of violation under section 1449(b)(1) has been given before commencement of an action under this subsection and an action under section 1449(a)(1) of this Act is filed before 120 days after such notice is given.

(6) Any person against whom an order is issued or who commented on a proposed order pursuant to paragraph (3) may file an appeal of such order with the United States District Court for the District of Columbia or the district in which the violation is alleged to have occurred. Such an appeal may only be filed within the 30-day period beginning on the date the order is issued. Appellant shall simultaneously send a copy of the appeal by certified mail to the Administrator and to the Attorney General. The Administrator shall promptly file in such court a certified copy of the record on which such order was imposed. The district court shall not set aside or remand such order unless there is not substantial evidence on the record, taken as a whole, to support the finding of a violation or, unless the Administrator's assessment of penalty or requirement for compliance constitutes an abuse of discretion. The district court shall not impose additional civil penalties for the same violation unless the Administrator's assessment of a penalty constitutes an abuse of discretion. Notwithstanding section 1448(a)(2), any order issued under paragraph (3) shall be subject to judicial review exclusively under this paragraph.

(7) If any person fails to pay an assessment of a civil penalty-

(A) after the order becomes effective under paragraph (3), or

(B) after a court, in an action brought under paragraph (6), has entered a final judgment in favor of the Administrator, the Administrator may request the Attorney General to bring a civil action in an appropriate district court to recover the amount assessed (plus costs, attorneys' fees, and interest at currently prevailing rates from the date the order is effective or the date of such final judgment, as the case may be). In such an action, the validity, amount, and appropriateness of such penalty shall not be subject to review.

(8) The Administrator may, in connection with administrative proceedings under this subsection, issue subpoenas compelling the attendance and testimony of witnesses and subpoenas duces tecum, and may request the Attorney General to bring an action to enforce any subpoena under this section. The district courts shall have jurisdiction to enforce such subpoenas and impose sanction.

(d) Nothing in this title shall diminish any authority of a State or political subdivision to adopt or enforce any law or regulation respecting underground injection but no such law or regulation shall relieve any person of any requirement otherwise applicable under this title.

INTERIM REGULATION OF UNDERGROUND INJECTION

SEC. 1424. (a)(1) Any person may petition the Administrator to have an area of a State (or States) designated as an area in which no new underground injection well may be operated during the period beginning on the date of the designation and ending on the date on which the applicable underground injection control program covering such area takes effect unless a permit for the operation of such well has been issued by the Administrator under subsection (b). The Administrator may so designate an area within a state if he finds that the area has one aquifer which is the sole or principal drinking water source for the area and which, if contaminated, would create a significant hazard to public health.

(2) Upon receipt of a petition under paragraph (1) of this subsection, the Administrator shall publish it in the *Federal Register* and shall provide an opportunity to interested persons to submit written data, views, or arguments thereon. Not later than the 30th day following the date of the publication of a petition under this paragraph in the *Federal Register*, the Administrator shall either make the designation for which the petition is submitted or deny the petition.

(b)(1) During the period beginning on the date an area is designated under subsection (a) and ending on the date the applicable underground injection control program covering such area takes effect, no new underground injection well may be operated in such area unless the Administrator has issued a permit for such operation.

(2) Any person may petition the Administrator for the issuance of a permit for the operation of such a well in such an area. A petition submitted under this paragraph shall be submitted in such manner and contain such information as the Administrator may require by regulation. Upon receipt of such a petition, the Administrator shall publish it in the *Federal Register*. The Administrator shall give notice of any proceeding on a petition and shall provide opportunity for agency hearing. The Administrator shall act upon such petition on the record of any hearing held pursuant to the preceding sentence respecting such petition. Within 120 days of the publication in the *Federal Register* of a petition submitted under this paragraph, the Administrator shall either issue the permit for which the petition was submitted or shall deny its issuance.

(3) The Administrator may issue a permit for the operation of a new underground injection well in an area designated under subsection (a) only if he finds that the operation of such well will not cause contamination of the aquifer of such area so as to create a significant hazard to public health. The Administrator may condition the issuance of such a permit upon the use of such control measures in connection with the operation of such well, for which the permit is to be issued, as he deems necessary to assure that the operation of the well will not contaminate the aquifer of the designated area in which the well is located so as to create a significant hazard to public health.

(c) Any person who operates a new underground injection well in violation of subsection (b), (1) shall be subject to a civil penalty of not more than $5,000 for each day in which such violation occurs, or (2) if such violation is willful, such person may, in lieu of the civil penalty authorized by clause (1) be fined not more than $10,000 for each day in which such violation occurs. If the Administrator has reason to believe that any person is violating or will violate subsection (b), he may petition the United States district court to issue a temporary restraining order or injunction (including a mandatory injunction) to enforce such

subsection.

(d) For purposes of this section, the term "new underground injection well" means an underground injection well whose operation was not approved by appropriate State and Federal agencies before the date of the enactment of this title.

(e) If the Administrator determines, on his own initiative or upon petition, that an area has an aquifer which is the sole or principal drinking water source for the area and which, if contaminated, would create a significant hazard to public health, he shall publish notice of that determination in the *Federal Register*. After the publication of any such notice, no commitment for Federal financial assistance (through a grant, contract, loan guarantee, or otherwise) may be entered into for any project which the Administrator determines may contaminate such aquifer through a recharge zone so as to create a significant hazard to public health, but a commitment for Federal financial assistance may, if authorized under another provision of law, be entered into a plan or design the project to assure that it will not so contaminate the aquifer.

OPTIONAL DEMONSTRATION BY STATES RELATING TO OIL OR NATURAL GAS

SEC. 1425. (a) For purposes of the Administrator's approval or disapproval under section 1422 of that portion of any State underground injection control program which relates to-

(1) the underground injection of brine or other fluids which are brought to the surface in connection with oil or natural gas production or natural gas storage operation, or,

(2) any underground injection for the secondary or tertiary recovery of oil or natural gas. In lieu of the showing required under subparagraph (A) of section 1422(b)(1) the State may demonstrate that such portion of the State program meets the requirements of subparagraphs (A) through (D) of section 1421(b)(1) and represents an effective program (including adequate recordkeeping and reporting) to prevent underground injection which endangers drinking water sources.

(b) if the Administrator revises or amends any requirement of a regulation under section 1421 relating to any aspect of the underground injection referred to in subsection (a), in the case of that portion of a State underground injection control program for which the demonstration referred to in subsection (a) has been made, in lieu of the showing required under section 1422(b)(1)(B) the State may demonstrate that, with respect to that aspect of such underground injection, the State program meets the requirements of subparagraphs (A) through (D) of section 1421(b)(1) and represents an effective program (including adequate recordkeeping and reporting) to prevent underground injection which endangers drinking water sources.

(c)(1) Section 1422(b)(3) shall not apply to that portion of any State underground injection control program approved by the Administrator pursuant to a demonstration under subsection (a) of this section (and under subsection (b) of this section where applicable).

(2) If pursuant to such a demonstration, the Administrator approves such portion of the State program, the State shall have primary enforcement responsibility with respect to that portion until such time as the Administrator determines, by rule, that such demonstration is no longer valid. Following such a determination, the Administrator may exercise the

authority of subsection (c) of section 1422 in the same manner as provided in such subsection with respect to a determination described in such subsections.

(3) Before promulgating any rule under paragraph (2), the Administrator shall provide opportunity for public hearing respecting such rule.

REGULATION OF STATE PROGRAMS

SEC. 1426. (a) MONITORING METHODS-Not later than 18 months after enactment of the Safe Drinking Water Act Amendments of 1986, the Administrator shall modify regulations issued under this Act for Class I injection wells to identify monitoring methods, in addition to those in effect on November 1, 1985, including groundwater monitoring. In accordance with such regulations, the Administrator, or delegated State authority, shall determine the applicability of such monitoring methods, wherever appropriate, at locations and in such a manner as to provide the earliest possible detection of fluid migration into, or in the direction of, underground sources of drinking water from such wells, based on its assessment of the potential for fluid migration from the injection zone that may be harmful to human health or the environment. For purposes of this subsection, a Class I injection well is defined in accordance with 40 CFR 146.05 as in effect on November 1, 1985.

(b) REPORT-The Administrator shall submit a report to Congress, no later than September 1987, summarizing the results of State surveys required by the Administrator under this section. The report shall include each of the following items of information:

(1) The numbers and categories of Class V wells which discharge nonhazardous waste into or above an underground source of drinking water.

(2) The primary contamination problems associated with different categories of these disposal wells.

(3) Recommendations for minimum design, construction, installation, and siting requirements that should be applied to protect underground sources of drinking water from such contamination wherever necessary.

SOLE SOURCE AQUIFER DEMONSTRATION PROGRAM

SEC. 1427. (a) PURPOSE-The purpose of this section is to establish procedures for development, implementation, and assessment of demonstration programs designed to protect critical aquifer protection areas located within areas designated as sole or principal source aquifers under section 1424(e) of this Act.

(b) DEFINITION-For purposes of this section, the term "critical aquifer protection area" means either of the following:

(1) All or part of an area located within an area for which an application or designation as a sole or principal source aquifer pursuant to section 1424(e) has been submitted and approved by the Administrator ~~not later than 24 months after the enactment of the Safe Drinking Water Act Amendments of 1986~~ and which satisfies the criteria established by the Administrator under subsection (d).

(2) All or part of an area which is within an aquifer designated as a sole source aquifer as the enactment of the Safe Drinking Water Act Amendments of 1986 and for which an areawide groundwater quality protection plan has been approved under section 208 of the Clean Water Act prior to such enactment.

(c) APPLICATION-Any State, municipal or local government or political subdivision thereof or any planning entity (including any interstate regional planning entity) that identifies a critical aquifer protection area over which it has authority or jurisdiction may apply to the Administrator for the selection of such area for a demonstration program under this section. Any applicant shall consult with other government or planning entities with authority or jurisdiction in such area prior to application. Applicants, other than the Governor, shall submit the application for a demonstration program jointly with the Governor.

(d) CRITERIA-Not later than 1 year after the enactment of the Safe Drinking Water Act Amendments of 1986, the Administrator shall, by rule, establish criteria for identifying critical aquifer protection areas under this section. In establishing such criteria, the Administrator shall consider each of the following:

(1) The vulnerability of the aquifer to contamination due to hydrogeologic characteristics.

(2) The number of persons or the portion of population using the groundwater as a drinking water source.

(3) The economic, social and environmental benefits that would result to the area from maintenance of groundwater of high quality.

(4) The economic, social and environmental benefits that would result from degradation of the quality of the groundwater.

(e) CONTENTS OF APPLICATION-An application submitted to the Administrator by an applicant for a demonstration program under this section shall meet each of the following requirements:

(1) The application shall propose boundaries for the critical aquifer protection area within its jurisdiction.

(2) The application shall designate or, if necessary, establish a planning entity (which shall be a public agency and which shall include representation of elected local and State governmental officials) to develop a comprehensive management plan (hereinafter in this section referred to as the "plan") for the critical protection area. Where a local government planning agency exists with adequate authority to carry out this section with respect to any proposed critical protection area, such agency shall be designated as the planning entity.

(3) The application shall establish procedures for public participation in the development of the plan, for review, approval, and adoption of the plan, and for assistance to municipalities and other public agencies with authority under State law to implement the plan.

(4) The application shall include a hydrogeologic assessment of surface and groundwater resources within the critical protection area.

(5) The application shall include a comprehensive management plan for the proposed

protection area.

(6) The application shall include the measures and schedule proposed for implementation of such plan.

(f) COMPREHENSIVE PLAN-

(1) The objective of a comprehensive management plan submitted by an applicant under this section shall be to maintain the quality of the groundwater in the critical protection area in a manner reasonably expected to protect human health, the environment and groundwater resources. In order to achieve such objective, the plan may be designed to maintain, to the maximum extent possible, the natural vegetative and hydrogeological conditions. Each of the following elements shall be included in such a protection plan:

(A) A map showing the detailed boundary of the critical protection area.

(B) An identification of existing and potential point and nonpoint sources of groundwater degradation.

(C) An assessment of the relationship between activities on the land surface and groundwater quality.

(D) Specific actions and management practice to be implemented in the critical protection area to prevent adverse impacts on groundwater quality.

(E) Identification of authority adequate to implement the plan, estimates of program costs, and sources of State matching funds.

(2) Such plan may also include the following:

(A) A determination of the quality of the existing groundwater recharged through the special protection area and the natural recharge capabilities of the special protection area watershed.

(B) Requirements designed to maintain existing underground drinking water quality or improve underground drinking water quality if prevailing conditions fail to meet drinking water standards, pursuant to this Act and State law.

(C) Limits on Federal, State, and local government, financially assisted activities and projects which may contribute to degradation of such groundwater or any loss of natural surface and subsurface infiltration of purification capability of the special protection watershed.

(D) A comprehensive statement of land use management including emergency contingency planning as it pertains to the maintenance of the quality of underground sources of drinking water or to the improvement of such sources if necessary to meet drinking water standards pursuant to this Act and State law.

(E) Actions in the special protection area which would avoid adverse impacts on water quality, recharge capabilities, or both.

(F) Consideration of specific techniques, which may include clustering, transfer of development rights, and other innovative measures sufficient to achieve the objectives of this section.

(G) Consideration of the establishment of a State institution to facilitate and

assist funding a development transfer credit system.

(H) A program for State and local implementation of the plan described in this subsection in a manner that will insure the continued, uniform, consistent protection of the critical protection area in accord with the purposes of this section.

(I) Pollution abatement measures, if appropriate.

(g) PLANS UNDER SECTION 208 OF THE CLEAN WATER ACT-A plan approved before the enactment of the Safe Drinking Water Act Amendments of 1986 under section 208 of the Clean Water Act to protect a sole source aquifer designated under section 1424(e) of this Act shall be considered a comprehensive management plan for the purposes of this section.

(h) CONSULTATION AND HEARINGS-During the development of a comprehensive management plan under this section, the planning entity shall consult with, and consider the comments of, appropriate officials of any municipality and State or Federal agency which has jurisdiction over lands and waters within the special protection area, other concerned organizations and technical and citizen advisory committees. The planning entity shall conduct public hearings at places within the special protection area for the purpose of providing the opportunity to comment on any aspect of the plan.

(i) APPROVAL OR DISAPPROVAL-Within 120 days after receipt of an application under this section, the Administrator shall approve or disapprove the application. The approval or disapproval shall be based on a determination that the critical protection area satisfies the criteria established under subsection (d) and that a demonstration program for the area would provide protection for groundwater quality consistent with the objective stated in subsection (f). The Administrator shall provide to the Governor a written explanation of the reasons for the disapproval of any such application. Any petitioner may modify and resubmit any application which is not approved. Upon approval of an application, the Administrator may enter into a cooperative agreement with the applicant to establish a demonstration program under this section.

(j) GRANTS AND REIMBURSEMENT-Upon entering a cooperative agreement under subsection (i), the Administrator may provide to the applicant, on a matching basis, a grant of 50 per centum of the costs of implementing the plan established under this section. The Administrator may also reimburse the applicant of an approved plan up to 50 per centum of the costs of developing such plan, except for a plan approved under section 208 of the Clean Water Act. The total amount of grants under this section for any one aquifer, designated under section 1424(e), shall not exceed $4,000,000 in any one fiscal year.

(k) ACTIVITIES FUNDED UNDER OTHER LAW-No funds authorized under this ~~subsection~~ ***section*** may be used to fund activities funded under other sections of this Act or the Clean Water Act, the Solid Waste Disposal Act, the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 or other environmental laws.

(l) REPORT-Not later than December 31, 1989, each State shall submit to the Administrator a report assessing the impact of the program on groundwater quality and identifying those measures found to be effective in protecting ground-water resources. No later than September 30, 1990, the Administrator shall submit to Congress a report summarizing the State reports, and assessing the accomplishments of the sole source aquifer demonstration program including an identification of protection methods found to be most effective and recommendations for their application to protect groundwater resources from contamination whenever necessary.

(m) SAVINGS PROVISION-Nothing under this section shall be construed to amend, supersede or abrogate rights to quantities of water which have been established by interstate water compacts, Supreme Court decrees, or State water laws; or any requirement imposed or right provided under any Federal or State environmental or public health statute.

(n) AUTHORIZATION-There are authorized to be appropriated to carry out this section not more than the following amounts:

Fiscal year:	**Amount**
1987	$10,000,000
1988	15,000,000
1989	17,500,000
1990	17,500,000
1991	17,500,000
1992-2003	***15,000,000***

Matching grants under this section may also be used to implement or update any water quality management plan for a sole or principal source aquifer approved (before the date of the enactment of this section) by the Administrator under section 208 of the Federal Water Pollution Control Act.

STATE PROGRAMS TO ESTABLISH WELLHEAD PROTECTION AREAS

SEC. 1428. (a) STATE PROGRAMS-The Governor or Governor's designee of each State shall, within 3 years of the date of enactment of the Safe Drinking Water Act Amendments of 1986, adopt and submit to the Administrator a State program to protect wellhead areas within their jurisdiction from contaminants which may have any adverse effects on the health of persons. Each State program under this section shall, at a minimum-

(1) specify the duties of State agencies, local governmental entities, and public waste supply systems with respect to the development and implementation of programs required by this section;

(2) for each wellhead, determine the wellhead protection area as defined in subsection (e) based on all reasonably available hydrogeologic information on groundwater flow, recharge and discharge and other information the State deems necessary to adequately determine the wellhead protection area;

(3) identify within each wellhead protection area all potential anthropogenic sources of contaminants which may have any adverse effect on the health of persons;

(4) describe a program that contains, as appropriate, technical assistance, financial assistance, implementation of control measures, education, training, and demonstration projects to protect the water supply within wellhead protection areas from such contaminants;

(5) include contingency plans for the location and provision of alternate drinking water supplies for each public water system in the event of well or wellfield contamination by such contaminants; and

(6) include a requirement that consideration be given to all potential sources of such Contaminants within the expected wellhead area of a new water well which serves a public water supply system.

(b) PUBLIC PARTICIPATION-To the maximum extent possible, each State shall establish procedures, including but not limited to the establishment of technical and citizens advisory committees, to encourage the public to participate in developing the protection program for wellhead areas ***and source water assessment programs under section 1453***. Such procedures shall include notice and opportunity for public hearing on the State program before it is submitted to the Administrator.

(c) DISAPPROVAL

(1) IN GENERAL ~~If, in the judgment of the Administrator, a State program (or portion thereof, including the definition of a wellhead protection area), is not adequate to protect public water systems as required by this section, the Administrator shall disapprove such program (or portion thereof).~~ ***If, in the judgment of the Administrator, a State program or portion thereof under subsection (a) is not adequate to protect public water systems as required by subsection (a) or a State program under section 1453 or section 1418(b) does not meet the applicable requirements of section 1453 or section 1418(b), the Administrator shall disapprove such program or portion thereof.*** A State program developed pursuant to subsection (a) shall be deemed to be adequate unless the Administrator determines, within 9 months of the receipt of a State program, that such program (or portion thereof) is inadequate for the purpose of protecting public water systems as required by this section from contaminants that may have any adverse effect on the health of persons. ***A State program developed pursuant to section 1453 or section 1418(b) shall be deemed to meet the applicable requirements of section 1453 or section 1418(b) unless the Administrator determines within 9 months of the receipt of the program that such program (or portion thereof) does not meet such requirements.*** If the Administrator determines that a proposed State program (or any portion thereof) ~~is inadequate~~ ***is disapproved***, the Administrator shall submit a written statement of the reasons for such determination to the Governor of the State.

(2) MODIFICATION AND RESUBMISSION-Within 6 months after receipt of the Administrator's written notice under paragraph (1) that any proposed State program (or portion thereof) ~~is inadequate~~ ***is disapproved,*** the Governor or Governor's designee, shall modify the program based upon the recommendations of the Administrator and resubmit the modified program to the Administrator.

(d) FEDERAL ASSISTANCE-After the date 3 years after the enactment of this section, no State shall receive funds authorized to be appropriated under this section except for the purpose of implementing the program and requirements of paragraphs (4) and (6) of subsection (a).

(e) DEFINITION OF WELLHEAD PROTECTION AREA-As used in this section, the term "wellhead protection area" means the surface and subsurface area surrounding a water well or wellfield, supplying a public water system, through which contaminants are reasonably likely to move toward and reach such water well or wellfield. The extent of a wellhead protection area, within a State, necessary to provide protection from contaminants which may have any adverse effect on the health of persons is to be determined by the State in the program submitted under subsection (a). Not later than one year after the enactment of the Safe Drinking Water Act Amendments of 1986, the Administrator shall issue technical

guidance which States may use in making such determinations. Such guidance may reflect such factors as the radius of influence around a well or wellfield, the depth of drawdown of the water table by such well or wellfield at any given point, the time or rate of travel of various contaminants in various hydrologic conditions, distance from the well or wellfield, or other factors affecting the likelihood of contaminants reaching the well or wellfield, taking into account available engineering pump tests or comparable data, field reconnaissance, topographic information, and the geology of the formation in which the well or wellfield is located.

(f) PROHIBITIONS

(1) ACTIVITIES UNDER OTHER LAWS-No funds authorized to be appropriated under this section may be used to support activities authorized by the Federal Water Pollution Control Act, the Solid Waste Disposal Act, the Comprehensive Environmental Response, Compensation, and Liability Act of 1980, or other sections of this Act.

(2) INDIVIDUAL SOURCES-No funds authorized to be appropriated under this section may be used to bring individual sources of contamination into compliance.

(g) IMPLEMENTATION-Each State shall make every reasonable effort to implement the State wellhead area protection program under this section within 2 years of submitting the program to the Administrator. Each State shall submit to the Administrator a biennial status report describing the State's progress in implementing the program. Such report shall include amendments to the State program for water wells sited during the biennial period.

(h) FEDERAL AGENCIES-Each department, agency, and instrumentality of the executive, legislative, and judicial branches of the Federal Government having jurisdiction over any potential source of contaminants identified by a State program pursuant to the provisions of subsection (a)(3) shall be subject to and comply with all requirements of the State program developed according to subsection (a)(4) applicable to such potential source of contaminants, both substantive and procedural, in the same manner, and to the same extent, as any other person is subject to such requirements, including payment of reasonable charges and fees. The President may exempt any potential source under the jurisdiction of any department, agency, or instrumentality in the executive branch if the President determines it to be in the paramount interest of the United States to do so. No such exemption shall be granted due to the lack of an appropriation unless the President shall have specifically requested such appropriation as part of the budgetary process and the Congress shall have failed to make available such requested appropriations.

(i) ADDITIONAL REQUIREMENT-

(1) IN GENERAL-In addition to the provisions of subsection (a) of this section, States in which there are more than 2,500 active wells at which annular injection is used as of January 1, 1986, shall include in their State program a certification that a State program exists and is being adequately enforced that provides protection from contaminants which may have any adverse effect on the health of persons and which are associated with the annular injection or surface disposal of brines associated with oil and gas production.

(2) DEFINITION-For purposes of this subsection, the term "annular injection" means the reinjection of brines associated with the production of oil or gas between the production and surface casings of a conventional oil or gas producing well.

(3) REVIEW-The Administrator shall conduct a review of each program certified under this section.

(4) DISAPPROVAL-If a State fails to include the certification required by this subsection or if in the judgment of the Administrator the State program certified under this subsection is not being adequately enforced, the Administrator shall disapprove the State program submitted under subsection (a) of this section.

(j) COORDINATION WITH OTHER LAWS-Nothing in this section shall authorize or require any department, agency, or other instrumentality of the Federal Government or State or local government to apportion, allocate or otherwise regulate the withdrawal or beneficial use of ground or surface waters, so as to abrogate or modify any existing rights to water established pursuant to State or Federal law, including interstate compacts.

(k) AUTHORIZATION OF APPROPRIATIONS-Unless the state program is disapproved under this section, the Administrator shall make grants to the State for not less than 50 or more than 90 percent of the costs incurred by a State (as determined by the Administrator) in developing and implementing each State program under this section. For purposes of making such grants there is authorized to be appropriated not more than the following amounts:

Fiscal year:	**Amount**
1987	$20,000,000
1988	20,000,000
1989	35,000,000
1990	35,000,000
1991	35,000,000
1992-2003	***30,000,000***

STATE GROUND WATER PROTECTION GRANTS

SEC. 1429. (a) IN GENERAL.— The Administrator may make a grant to a State for the development and implementation of a State program to ensure the coordinated and comprehensive protection of ground water resources within the State.

(b) GUIDANCE.— Not later than 1 year after the date of enactment of the Safe Drinking Water Act Amendments of 1996, and annually thereafter, the Administrator shall publish guidance that establishes procedures for application for State ground water protection program assistance and that identifies key elements of State ground water protection programs.

(c) CONDITIONS OF GRANTS.—

(1) IN GENERAL.— The Administrator shall award grants to States that submit an application that is approved by the Administrator. The Administrator shall determine the amount of a grant awarded pursuant to this paragraph on the basis of an assessment of the extent of ground water resources in the State and the likelihood that awarding the grant will result in sustained and reliable protection of ground water quality.

(2) INNOVATIVE PROGRAM GRANTS.— The Administrator may also award a grant pursuant to this subsection for innovative programs proposed by a State for the prevention of ground water contamination.

(3) ALLOCATION OF FUNDS.— The Administrator shall, at a minimum, ensure that, for each fiscal year, not less than 1 percent of funds made available to the Administrator by appropriations to carry out this section are allocated to each State that submits an application that is approved by the Administrator pursuant to this section.

(4) LIMITATION ON GRANTS.— No grant awarded by the Administrator may be used for a project to remediate ground water contamination.

(d) AMOUNT OF GRANTS.— The amount of a grant awarded pursuant to paragraph (1) shall not exceed 50 percent of the eligible costs of carrying out the ground water protection program that is the subject of the grant (as determined by the Administrator) for the 1-year period beginning on the date that the grant is awarded. The State shall pay a State share to cover the costs of the ground water protection program from State funds in an amount that is not less than 50 percent of the cost of conducting the program.

(e) EVALUATIONS AND REPORTS.— Not later than 3 years after the date of enactment of the Safe Drinking Water Act Amendments of 1996, and every 3 years thereafter, the Administrator shall evaluate the State ground water protection programs that are the subject of grants awarded pursuant to this section and report to the Congress on the status of ground water quality in the United States and the effectiveness of State programs for ground water protection.

(f) AUTHORIZATION OF APPROPRIATIONS.— There are authorized to be appropriated to carry out this section $15,000,000 for each of fiscal years 1997 through 2003.

Part D Emergency Powers

EMERGENCY POWERS

SEC. 1431. (a) Notwithstanding any other provision of this title, the Administrator, upon receipt of information that a contaminant which is present in or is likely to enter a public water system or an underground source of drinking water may present an imminent and substantial endangerment to the health of persons, and that appropriate State and local authorities have not acted to protect the health of such persons, may take such actions as he may deem necessary in order to protect the health of such persons. To the extent he determines it to be practicable in light of such imminent endangerment, the shall consult with the State and local authorities in order to confirm the correctness of the information on which action proposed to be taken under this subsection is based and to ascertain the action which such authorities are or will be taking. The action which the Administrator may take may include (but shall not be limited to) (1) issuing such orders as may be necessary to protect the health of persons who are or may be users of such system (including travelers), including orders requiring the provision of alternative water supplies by persons who caused or contributed to the endangerment, and (2) commencing a civil action for appropriate relief, including a restraining order or permanent or temporary injunction.

(b) Any person who violates or fails or refuses to comply with any order issued by the Administrator under subsection (a)(1) may, in an action brought in the appropriate United States district court to enforce such order, be subject to a civil penalty of not to exceed

~~$5,000~~ ***$15,000*** for each day in which such violation occurs or failure to comply continues.

TAMPERING WITH PUBLIC WATER SYSTEMS

SEC. 1432. (a) TAMPERING-Any person who tampers with a public water system shall be imprisoned for not more than 5 years, or fined in accordance with title 18 of the United States Code, or both.

(b) ATTEMPT OR THREAT-Any person who attempts to tamper, or makes a threat to tamper, with a public drinking water system will be imprisoned for not more than 3 years, or fined in accordance with title 18 of the United States Code, or both.

(c) CIVIL PENALTY-The Administrator may bring a civil action in the appropriate United States district court (as determined under the provisions of title 28 of the United States Code) against any person who tampers, attempts to tamper, or makes a threat to tamper with a public water system. The court may impose on such person a civil penalty of not more than $50,000 for such tampering or not more than $20,000 for such attempt or threat.

(d) DEFINITION OF "TAMPER"-For purposes of this section, the term "tamper" means-

(1) to introduce a contaminant into a public water system with the intention of harming persons; or

(2) to otherwise interfere with the operation of a public water system with the intention of harming persons.

Part E General Provisions

ASSURANCE OF AVAILABILITY OF ADEQUATE SUPPLIES OF CHEMICALS NECESSARY FOR TREATMENT OF WATER

SEC. 1441. (a) If any person who uses chlorine, activated carbon, lime, ammonia, soda ash, potassium permanganate, caustic soda, or other chemical or substance for the purpose of treating water in any public water system or in any public treatment works determines that the amount of such chemical or substance necessary to effectively treat such water is not reasonably available to him or will not be so available to him when required for the effective treatment of such water, such person may apply to the Administrator for a certification (hereinafter in this section referred to as a "certification of need") that the amount of such chemical or substance which such person requires to effectively treat such water is not reasonably available to him or will not be so available when required for the effective treatment of such water.

(b)(1) An application for a certification of need shall be in such form and submitted in such manner as the Administrator may require and shall (A) specify the persons the applicant determines are able to provide the chemical or substance with respect to which the application is submitted, (B) specify the persons from whom the applicant has sought such chemical or substance, and (C) contain such other information as the Administrator may require.

(2) Upon receipt of an application under this section, the Administrator shall (A) publish in the *Federal Register* a notice of the receipt of the application and a brief summary of it, (B) notify in writing each person whom the President or his delegate (after consultation with the Administrator) determines could be made subject to an order required to be issued upon the issuance of the certification of need applied for in such application, and (C) provide an opportunity for the submission of written comments on such application. The requirements of the preceding sentence of this paragraph shall not apply when the Administrator for good cause finds (and incorporates the finding with a brief statement of reasons therefore in the order issued) that waiver of such requirements is necessary in order to protect the public health.

(3) Within 30 days after-

(A) the date a notice is published under paragraph (2) in the *Federal Register* with respect to an application submitted under this section for the issuance of a certification of need, or

(B) the date on which such application is received if as authorized by the second sentence of such paragraph no notice is published with respect to such application, the Administrator shall take action either to issue or deny the issuance of a certification of need.

(c)(1) If the Administrator finds that the amount of a chemical or substance necessary for an applicant under an application submitted under this section to effectively treat water in a public water system or in a public treatment works is not reasonably available to the applicant or will not be so available to him when required for the effective treatment of such water, the Administrator shall issue a certification of need. Not later than seven days following the issuance of such certification, the President or his delegate shall issue an order requiring the provision to such person of such amounts of such chemical or substance as the Administrator deems necessary in the certification of need issued for such person. Such order shall apply to such manufacturers, producers, processors, distributors, and repackagers of such chemical or substance as the President or his delegate deems necessary and appropriate, except that such order may not apply to any manufacturer, producer, or processor of such chemical or substance who manufactures, produces, or processes (as the case may be) such chemical or substance solely for its own use. Persons subject to an order issued under this section shall be given a reasonable opportunity to consult with the President or his delegate with respect to the implementation of the order.

(2) Orders which are to be issued under paragraph (1) to manufacturers, producers, and processors of a chemical or substance shall be equitably apportioned, as far as practicable, among all manufacturers, producers, and processors of such chemical or substance; and orders which are to be issued under paragraph (1) to distributors and repackagers of a chemical or substance shall be equitably apportioned, as far as practicable, among all distributors and repackagers of such chemical or substance. In apportioning orders issued under paragraph (1) to manufacturers, producers, processors, distributors, and repackagers of chlorine, the President or his delegate shall, in carrying out the requirements of the preceding sentence, consider-

(A) the geographical relationship and established commercial relationships between such manufacturers, producers, processors, distributors, and repackagers and the persons for whom the orders are issued;

(B) in the case of orders to be issued to producers of chlorine, the (i) amount of chlorine historically supplied by each such producer to treat water in public water systems

and public treatment works, and (ii) share of each such producer of the total annual production of chlorine in the United States; and

(C) such other factors as the President or his delegate may determine are relevant to the apportionment of orders in accordance with the requirements of the preceding sentence.

(3) Subject to subsection (f), any person for whom a certification of need has been issued under this subsection may upon the expiration of the order issued under paragraph (1) upon such certification apply under this section for additional certifications.

(d) There shall be available as a defense to any action brought for breach of contract in a Federal or State court arising out of delay or failure to provide, sell, or offer for sale or exchange a chemical or substance subject to an order issued pursuant to subsection (c)(1), that such delay or failure was caused solely by compliance with such order.

(e)(1) Whoever knowingly fails to comply with any order issued pursuant to subsection (c)(1) shall be fined not more than $5,000 for each such failure to comply.

(2) Whoever fails to comply with any order issued pursuant to subsection (c)(1) shall be subject to a civil penalty of not more than $2,500 for each such failure to comply.

(3) Whenever the Administrator or the President or his delegate has reason to believe that any person is violating or will violate any order issued pursuant to subsection (c)(1), he may petition a United States district court to issue a temporary restraining order or preliminary or permanent injunction (including a mandatory injunction) to enforce the provisions of such order.

(f) No certification of need or order issued under this section may remain in effect for more than one year.

RESEARCH, TECHNICAL ASSISTANCE, INFORMATION, AND TRAINING OF PERSONNEL

SEC. 1442. (a)(1) The Administrator may conduct research, studies, and demonstrations relating to the causes, diagnosis, treatment, control, and prevention of physical and mental diseases and other impairments of man resulting directly or indirectly from contaminants in water, or to the provision of a dependably safe supply of drinking water, including-

(A) improved methods (i) to identify and measure the existence of contaminants in drinking water (including methods which may be used by State and local health and water officials), and (ii) to identify the source of such contaminants;

(B) improved methods to identify and measure the health effects of contaminants in drinking water;

(C) new methods of treating raw water to prepare it for drinking, so as to improve the efficiency of water treatment and to remove contaminants from water;

(D) improved methods for providing a dependably safe supply of drinking water, including improvements in water purification and distribution, and methods of assessing the health-related hazards of drinking water; and

~~The report required by this subparagraph shall identify and analyze the items required in clauses (i) through (v) separately with respect to public water systems serving small communities. The report required by this subparagraph shall include such recommendations as the Administrator deems appropriate.~~

(4) The Administrator shall conduct a survey and study of-

(A) disposal of waste (including residential waste) which may endanger underground water which supplies, or can reasonably be expected to supply, any public water systems, and

(B) means of control of such waste disposal.

Not later than one year after the date of enactment of this title, he shall transmit to the Congress the results of such survey and study, together with such recommendations as he deems appropriate.

(5) The Administrator shall carry out a study of methods of underground injection which do not result in the degradation of underground drinking water sources.

(6) The Administrator shall carry out a study of methods of preventing, detecting, and dealing with surface spills of contaminants which may degrade underground water sources for public water systems.

(7) The Administrator shall carry out a study of virus contamination of drinking water sources and means of control of such contamination.

(8) The Administrator shall carry out a study of the nature and extent of the impact on underground water which supplies or can reasonably be expected to supply public water systems of (A) abandoned injection or extraction wells; (B) intensive application of pesticides and fertilizers in underground water recharge areas; and (C) ponds, pools, lagoons, pits, or other surface disposal of contaminants in underground water recharge areas.

(9) The Administrator shall conduct a comprehensive study of public water supplies and drinking water sources to determine the nature, extent, sources of and means of control of contamination by chemicals or other substances suspected of being carcinogenic. Not later than six months after the date of enactment of this title, he shall transmit to the Congress the initial results of such study, together with such recommendations for further review and corrective action as he deems appropriate.

(10) The Administrator shall carry out a study of the reaction of chlorine and humic acids and the effects of the contaminants which result from such reaction on public health and on the safety of drinking water, including any carcinogenic effect.

~~(b) In carrying out this title, the Administrator is authorized to-~~

~~(1) collect and make available information pertaining to research, investigations, and demonstrations with respect to providing a dependably safe supply of drinking water together with appropriate recommendations in connection therewith;~~

~~(2) make available research facilities of the Agency to appropriate public authorities, institutions, and individuals engaged in studies and research relating to the purposes of this title;~~

~~(B)~~

(b) The Administrator is authorized to provide technical assistance and to make grants to States, or publicly owned water systems to assist in responding to and alleviating any emergency situation affecting public water systems (including sources of water for such systems) which the Administrator determines to present substantial danger to the public health. Grants provided under this subparagraph shall be used only to support those actions which (i) are necessary for preventing, limiting or mitigating danger to the public health in such emergency situation and (ii) would not, in the judgment of the Administrator, be taken without such emergency assistance. The Administrator may carry out the program authorized under this subparagraph as part of, and in accordance with the terms and conditions of, any other program of assistance for environmental emergencies which the Administrator is authorized to carry out under any other provision of law. No limitation on appropriations for any such other program shall apply to amounts appropriated under this subparagraph.

(c) Not later than eighteen months after the date of enactment of this subsection, the Administrator shall submit a report to Congress on the present and projected future availability of an adequate and dependable supply of safe drinking water to meet present and projected future need. Such report shall include an analysis of the future demand for drinking water and other competing uses of water, the availability and use of methods to conserve water or reduce demand, the adequacy of present measures to assure adequate and dependable supplies of safe drinking water, and the problems (financial, legal, or other) which need to be resolved in order to assure the availability of such supplies for the future. Existing information and data compiled by the National Water Commission and others shall be utilized to the extent possible.

(d) The Administrator shall-

(1) provide training for, and make grants for training (including postgraduate training) of

(A) personnel of State agencies which have primary enforcement responsibility and of agencies of units of local government to which enforcement responsibilities have been delegated by the State, and

(B) personnel who manage or operate public water systems, and

(2) make grants for postgraduate training of individuals (including grants to educational institutions for traineeships) for purposes of qualifying such individuals to work as personnel referred to in paragraph (1). Reasonable fees may be charged for training provided under paragraph (1)(B) to persons other than personnel of State or local agencies but such training shall be provided to personnel of State or local agencies without charge.

(3) make grants to and enter into contracts with, any public agency, educational institution, and any other organization, in accordance with procedures prescribed by the Administrator, under which he may pay all or part of the costs (as may be determined by the Administrator) of any project or activity which is designed-

(A) to develop, expand, or carry out a program (which may combine training education and employment) for training persons for occupations involving the public health aspects of providing safe drinking water;

(B) to train inspectors and supervisory personnel to train or supervise persons in occupations involving the public health aspects of providing safe drinking water; or

(C) to develop and expand the capability of programs of State and municipalities to carry out the purposes of this title (other than by carrying out State programs of public water system supervision or underground water source protection (as defined in section 1443(c)).

(e) TECHNICAL ASSISTANCE.– The Administrator may provide technical assistance to small public water systems to enable such systems to achieve and maintain compliance with applicable national primary drinking water regulations. Such assistance may include circuit-rider and multi-State regional technical assistance programs, training, and preliminary engineering evaluations. The Administrator shall ensure that technical assistance pursuant to this subsection is available in each State. Each nonprofit organization receiving assistance under this subsection shall consult with the State in which the assistance is to be expended or otherwise made available before using assistance to undertake activities to carry out this subsection. There are authorized to be appropriated to the Administrator to be used for such technical assistance $15,000,000 for each of the fiscal years 1997 through 2003. No portion of any State loan fund established under section 1452 (relating to State loan funds) and no portion of any funds made available under this subsection may be used for lobbying expenses. Of the total amount appropriated under this subsection, 3 percent shall be used for technical assistance to public water systems owned or operated by Indian Tribes.

(f) There are authorized to be appropriated to carry out the provisions of this section, other than subsection (a)(2)(B) and provisions relating to research, $15,000,000 for the fiscal year ending June 30, 1975; $25,000,000 for the fiscal year ending June 30, 1976; $35,000,000 for the fiscal year ending June 30, 1977; $17,000,000 for each of the fiscal years 1978 and 1979; $21,405,000 for the fiscal year ending September 30, 1980; $30,000,000 for the fiscal year ending September 30, 1981; $35,000,000 for the fiscal year ending September 30, 1982. There are authorized to be appropriated to carry out subsection (a)(2)(B) $8,000,000 for each of the fiscal years 1978 through 1982. There are authorized to be appropriated to carry out subsection (a)(2)(B) not more than the following amounts:

Fiscal year:	**Amount**
1987	$7,650,000
1988	7,650,000
1989	8,050,000
1990	8,050,000
1991	8,050,000

There are authorized to be appropriated to carry out the provisions of this section (other than subsection (g), subsection (a)(2)(B), and provisions relating to research), not more than the following amounts:

Fiscal year:	**Amount**
1987	$35,600,000
1988	35,600,000
1989	38,020,000
1990	38,020,000
1991	38,020,000

(g) The Administrator is authorized to provide technical assistance to small public water systems to enable such systems to achieve and maintain compliance with national drinking water regulations. Such assistance may include "circuit-rider" programs, training, and preliminary engineering studies. There are authorized to be appropriated to carry out this subsection $10,000,000 for each of the fiscal years 1987 through 1991. Not less than the greater of-

(1) 3 percent of the amounts appropriated under this subsection, or

(2) $280,000 shall be utilized for technical assistance to public water systems owned or operated by Indian tribes.

GRANTS FOR STATE PROGRAMS

SEC. 1443. (a)(1) From allotments made pursuant to paragraph (4), the Administrator may make grants to States to carry out public water system supervision programs.

(2) No grant may be made under paragraph (1) unless an application therefore has been submitted to the Administrator in such form and manner as he may require. The Administrator may not approve an application of a State for its first grant under paragraph (1) unless he determines that the State-

(A) has established or will establish within one year from the date of such grant a public water system supervision program, and

(B) will, within that one year, assume primary enforcement responsibility for public water system within the State.

No grant may be made to a State under paragraph (1) for any period beginning more than one year after the date of the State's first grant unless the State has assumed and maintained primary enforcement responsibility for public water systems within the State. The prohibitions contained in the preceding two sentences shall not apply to such grants when made to Indian Tribes.

(3) A grant under paragraph (1) shall be made to cover not more than 75 per centum of the grant recipient's costs (as determined under regulations of the Administrator) in carrying out, during the one-year period beginning on the date the grant is made, a public water system supervision program.

(4) In each fiscal year the Administrator shall, in accordance with regulations, allot the sums appropriated for such year under paragraph (5) among the States on the basis of population, geographical area, number of public water systems, and other relevant factors. No State shall receive less than 1 per centum of the annual appropriation for grants under paragraph (1): *Provided*, That the Administrator may by regulation, reduce such percentage in accordance with the criteria specified in this paragraph: And *provided further*, That such percentage shall not apply to grants allotted to Guam, American Samoa, or the Virgin Islands.

(5) The prohibition contained in the last sentence of paragraph (2) may be waived by the Administrator with respect to a grant to a State through fiscal year 1979, but such

prohibition may only be waived if, in the judgment of the Administrator-

(A) the State is making diligent effort to assume and maintain primary enforcement responsibility for public water systems within the State;

(B) the State has made significant progress toward assuming and maintaining such primary enforcement responsibility; and

(C) there is reason to believe the State will assume such primary enforcement responsibility by October 1, 1979.

The amount of any grant awarded for the fiscal years 1978 and 1979 pursuant to a waiver under this paragraph may not exceed 75 per centum of the allotment which the State would have received for such fiscal year if it had assumed and maintained such primary enforcement responsibility. The remaining 25 per centum of the amount allotted to such State for such fiscal year shall be retained by the Administrator, and the Administrator may award such amount to such State at such time as the State assumes such responsibility before the beginning of fiscal year 1980. At the beginning of each fiscal year 1979 and 1980 the amounts retained by the Administrator for any preceding fiscal year and not awarded by the beginning fiscal year 1979 or 1980 to the States to which such amounts were originally allotted may be removed from the original allotment and reallotted for fiscal year 1979 or 1980 (as the case may be) to States which have assumed primary enforcement responsibility by the beginning of such fiscal year.

(6) The Administrator shall notify the State of the approval or disapproval of any application for a grant under this section

(A) within ninety days after receipt of such application, or

(B) not later than the first day of the fiscal year for which the grant application is made, whichever is later.

~~(7) For the purposes of making grants under paragraph (1) there are authorized to be appropriated $15,000,000 for the fiscal year ending June 30, 1976, $25,000,000 for the fiscal year ending June 30, 1977, $35,000,000 for fiscal year 1978, $45,000,000 for fiscal year 1979, $29,450,000 for the fiscal year ending September 30, 1980, $32,000,000 for the fiscal year ending September 30, 1981, and $34,000,000 for the fiscal year ending September 30, 1982. For the purposes of making grants under paragraph (1) there are authorized to be appropriated not more than the following amounts:~~

~~Fiscal year:~~	~~Amount~~
~~1987~~	~~$37,200,000~~
~~1988~~	~~37,200,000~~
~~1989~~	~~40,150,000~~
~~1990~~	~~40,150,000~~
~~1991~~	~~40,150,000~~

(7) AUTHORIZATION.— For the purpose of making grants under paragraph (1), there are authorized to be appropriated $100,000,000 for each of fiscal years 1997 through 2003.

(8) RESERVATION OF FUNDS BY THE ADMINISTRATOR.— If the Administrator assumes the primary enforcement responsibility of a State public water system supervision program, the Administrator may reserve from funds made available

pursuant to this subsection an amount equal to the amount that would otherwise have been provided to the State pursuant to this subsection. The Administrator shall use the funds reserved pursuant to this paragraph to ensure the full and effective administration of a public water system supervision program in the State.

(9) STATE LOAN FUNDS.–

(A) RESERVATION OF FUNDS.– For any fiscal year for which the amount made available to the Administrator by appropriations to carry out this subsection is less than the amount that the Administrator determines is necessary to supplement funds made available pursuant to paragraph (8) to ensure the full and effective administration of a public water system supervision program in a State, the Administrator may reserve from the funds made available to the State under section 1452 (relating to State loan funds) an amount that is equal to the amount of the shortfall. This paragraph shall not apply to any State not exercising primary enforcement responsibility for public water systems as of the date of enactment of the Safe Drinking Water Act Amendments of 1996.

(B) DUTY OF ADMINISTRATOR.– If the Administrator reserves funds from the allocation of a State under subparagraph (A), the Administrator shall carry out in the State each of the activities that would be required of the State if the State had primary enforcement authority under section 1413.

(b)(1) From allotments made pursuant to paragraph (4), the Administrator may make grants to States to carry out underground water source protection programs.

(2) No grant may be made under paragraph (1) unless an application therefore has been submitted to the Administrator in such form and manner as he may require. No grant may be made to any State under paragraph (1) unless the State has assumed primary enforcement responsibility within two years after the date the Administrator promulgates regulations for State underground injection control programs under section 1421. The prohibition contained in the preceding sentence shall not apply to such grants when made to Indian Tribes.

(3) A grant under paragraph (1) shall be made to cover not more than 75 per centum of the grant recipient's costs (as determined under regulations of the Administrator) in carrying out, during the one-year period beginning on the date the grant is made, an underground water source protection program.

(4) In each fiscal year the Administrator shall, in accordance with regulations, allot the sums appropriated for such year under paragraph (5) among the States on the basis of population, geographical area, and other relevant factors.

(5) For purposes of making grants under paragraph (1) there are authorized to be appropriated $5,000,000 for the fiscal year ending June 30, 1976, $7,500,000 for the fiscal year ending June 30, 1977, $10,000,000 for each of the fiscal years 1978 and 1979, $7,795,000 for the fiscal year ending September 30, 1980, $18,000,000 for the fiscal year ending September 30, 1981, and $21,000,000 for the fiscal year ending September 30, 1982. For the purpose of making grants under paragraph (1) there are authorized to be appropriated not more than the following amounts:

Fiscal year:	**Amount**
1987	$19,700,000
1988	19,700,000
1989	20,850,000

1990	20,850,000
1991	20,850,000
1992-2003	*15,000,000*

(c) For purposes of this section:

(1) the term "public water system supervision program" means a program for the adoption and enforcement of drinking water regulations (with such variances and exemptions from such regulations under conditions and in a manner which is not less stringent than the conditions under, and the manner in, which variances and exemptions may be granted under section 1415 and 1416) which are no less stringent than the national primary drinking water regulations under section 1412, and for keeping records and making reports required by section 1413(a)(3).

(2) The term "underground water source protection program" means a program for the adoption and enforcement of a program which meets the requirements of regulations under section 1421 and for keeping records and making reports required by section 1422(b)(1)(A)(ii). Such term includes, where applicable, a program which meets the requirements of section 1425.

(d) NEW YORK CITY WATERSHED PROTECTION PROGRAM.–

(1) IN GENERAL.– The Administrator is authorized to provide financial assistance to the State of New York for demonstration projects implemented as part of the watershed program for the protection and enhancement of the quality of source waters of the New York City water supply system, including projects that demonstrate, assess, or provide for comprehensive monitoring and surveillance and projects necessary to comply with the criteria for avoiding filtration contained in 40 CFR 141.71. Demonstration projects which shall be eligible for financial assistance shall be certified to the Administrator by the State of New York as satisfying the purposes of this subsection. In certifying projects to the Administrator, the State of New York shall give priority to monitoring projects that have undergone peer review.

(2) REPORT.– Not later than 5 years after the date on which the Administrator first provides assistance pursuant to this paragraph, the Governor of the State of New York shall submit a report to the Administrator on the results of projects assisted.

(3) MATCHING REQUIREMENTS.– Federal assistance provided under this subsection shall not exceed 50 percent of the total cost of the protection program being carried out for any particular watershed or ground water recharge area.

(4) AUTHORIZATION.– There are authorized to be appropriated to the Administrator to carry out this subsection for each of fiscal years 1997 through 2003, $15,000,000 for the purpose of providing assistance to the State of New York to carry out paragraph (1).

SPECIAL STUDY AND DEMONSTRATION PROJECT GRANTS; GUARANTEED LOANS

SEC. 1444. (a) The Administrator may make grants to any person for the purposes of-

(1) assisting in the development and demonstration (including construction) of any

project which will demonstrate a new or improved method, approach, or technology, for providing a dependably safe supply of drinking water to the public; and

(2) assisting in the development and demonstration (including construction) of any project which will investigate and demonstrate health implications involved in the reclamation, recycling, and reuse of waste waters for drinking and the processes and methods for the preparation of safe and acceptable drinking water.

(b) Grants made by the Administrator under this section shall be subject to the following limitations:

(1) Grants under this section shall not exceed 66 2/3 per centum of the total cost construction of any facility, and 75 per centum of any other costs, as determined by the Administrator.

(2) Grants under this section shall not be made for any project involving the construction or modification of any facilities for any public water system in a State unless such project has been approved by the State agency charged with the responsibility for safety of drinking water (or if there is no such agency in a State, by the State health authority).

(3) Grants under this section shall not be made for any project unless the Administrator determines, after consulting the National Drinking Water Advisory Council, that such project will serve a useful purpose relating to the development and demonstration of new or improved techniques, methods, or technologies for the provision of safe water to the public for drinking.

(4) Priority for grants under this section shall be given where there are known or potential public health hazards which require advanced technology for the removal of particles which are too small to be removed by ordinary treatment technology.

(c) For the purposes of making grants under subsections (a) and (b) of this section there are authorized to be appropriated $7,500,000 for the fiscal year ending June 30, 1975; and $7,500,000 for the fiscal year ending June 30, 1976; and $10,000,000 for the fiscal year ending June 30, 1977.

(d) The Administrator during the fiscal years ending June 30, 1975, and June 30, 1976, shall carry out a program of guaranteeing loans made by private lenders to small public water systems for the purpose of enabling such systems to meet national primary drinking water regulations prescribed under section 1412. No such guarantee may be made with respect to a system unless (1) such system cannot reasonably obtain financial assistance necessary to comply with regulations from any other source, and (2) the Administrator determines that any facilities constructed with a loan guaranteed under this subsection is not likely to be made obsolete by subsequent changes in primary regulations. The aggregate amount of indebtedness guaranteed with respect to any system may not exceed $50,000. The aggregate amount of indebtedness guaranteed under this subsection may not exceed $50,000,000. The Administrator shall prescribe regulations to carry out this subsection.

RECORDS AND INSPECTIONS

~~(a)(1) Every person who is a supplier of water, who is or may be otherwise subject to a primary drinking water regulation prescribed under section 1412 or to an applicable underground injection control program (as defined in section 1422(c)), who is or may be~~

~~subject to the permit requirement of section 1424 or to an order issued under section 1441, or who is a grantee, shall establish and maintain such records, make such reports, conduct such monitoring, and provide such information as the Administrator may reasonably require by regulation to assist him in establishing regulations under this title, in determining whether such person has acted or is acting in compliance with this title, in administering any program of financial assistance under this title, in evaluating the health risks of unregulated contaminants, or in advising the public of such risks. In requiring a public water system to monitor under this subsection, the Administrator may take into consideration the system size and the contaminants likely to be found in the system's drinking water.~~

SEC. 1445. (a)(1)(A) Every person who is subject to any requirement of this title or who is a grantee, shall establish and maintain such records, make such reports, conduct such monitoring, and provide such information as the Administrator may reasonably require by regulation to assist the Administrator in establishing regulations under this title, in determining whether such person has acted or is acting in compliance with this title, in administering any program of financial assistance under this title, in evaluating the health risks of unregulated contaminants, or in advising the public of such risks. In requiring a public water system to monitor under this subsection, the Administrator may take into consideration the system size and the contaminants likely to be found in the system's drinking water.

(B) Every person who is subject to a national primary drinking water regulation under section 1412 shall provide such information as the Administrator may reasonably require, after consultation with the State in which such person is located if such State has primary enforcement responsibility for public water systems, on a case-by-case basis, to determine whether such person has acted or is acting in compliance with this title.

(C) Every person who is subject to a national primary drinking water regulation under section 1412 shall provide such information as the Administrator may reasonably require to assist the Administrator in establishing regulations under section 1412 of this title, after consultation with States and suppliers of water. The Administrator may not require under this subparagraph the installation of treatment equipment or process changes, the testing of treatment technology, or the analysis or processing of monitoring samples, except where the Administrator provides the funding for such activities. Before exercising this authority, the Administrator shall first seek to obtain the information by voluntary submission.

(D) The Administrator shall not later than 2 years after the date of enactment of this subparagraph, after consultation with public health experts, representatives of the general public, and officials of State and local governments, review the monitoring requirements for not fewer than 12 contaminants identified by the Administrator, and promulgate any necessary modifications.

~~(2) Not later than 18 months after enactment of the Safe Drinking Water Act Amendments of 1986, the Administrator shall promulgate regulations requiring every public water system to conduct a monitoring program for unregulated contaminants. The regulations shall require monitoring of drinking water supplied by the system and shall vary the frequency and schedule of monitoring requirements for systems based on the number of persons served by the system, the source of supply, and the contaminants likely to be found. Each system shall be required to monitor at least once every 5 years after the effective date of the Administrator's regulations unless the Administrator requires more frequent monitoring.~~

~~(3) Regulations under paragraph (2) shall list unregulated contaminants for which systems may be required to monitor, and shall include criteria by which the primary enforcement authority in each State could show cause for addition or deletion of contaminants from the designated list. The primary State enforcement authority may delete contaminants for an individual system, in accordance with these criteria, after obtaining approval of assessment of the contaminants potentially to be found in the system. The Administrator shall approve or disapprove such an assessment submitted by a State within 60 days. A State may add contaminants, in accordance with these criteria, without making an assessment, but in no event shall such additions increase Federal expenditures authorized by this section.~~

~~(4) Public water systems conducting monitoring of unregulated contaminants pursuant to this section shall provide the results of such monitoring to the primary enforcement authority.~~

~~(5) Notification of the availability of the results of the monitoring programs required under paragraph (2), and notification of the availability of the results of the monitoring program referred to in paragraph (6), shall be given to the persons served by the system and the Administrator.~~

~~(6) The Administrator may waive the monitoring requirement under paragraph (2) for a system which has conducted a monitoring program after January 1, 1983, if the Administrator determines the program to have been consistent with the regulations promulgated under this section.~~

~~(7) Any system supplying less than 150 service connections shall be treated as complying with this subsection if such system provides water samples or the opportunity for sampling according to rules established by the Administrator.~~

~~(8) There are authorized to be appropriated $30,000,000 in the fiscal year ending September 30, 1987, to remain available until expended to carry out the provisions of this subsection.~~

(2) MONITORING PROGRAM FOR UNREGULATED CONTAMINANTS.–

(A) ESTABLISHMENT.– The Administrator shall promulgate regulations establishing the criteria for a monitoring program for unregulated contaminants. The regulations shall require monitoring of drinking water supplied by public water systems and shall vary the frequency and schedule for monitoring requirements for systems based on the number of persons served by the system, the source of supply, and the contaminants likely to be found, ensuring that only a representative sample of systems serving 10,000 persons or fewer are required to monitor.

(B) MONITORING PROGRAM FOR CERTAIN UNREGULATED CONTAMINANTS.–

(i) INITIAL LIST.– Not later than 3 years after the date of enactment of the Safe Drinking Water Act Amendments of 1996 and every 5 years thereafter, the Administrator shall issue a list pursuant to subparagraph (A) of not more than 30 unregulated contaminants to be monitored by public water systems and to be included in the national drinking water occurrence data base maintained pursuant to subsection (g).

(ii) GOVERNORS' PETITION.– The Administrator shall include among the

list of contaminants for which monitoring is required under this paragraph each contaminant recommended in a petition signed by the Governor of each of 7 or more States, unless the Administrator determines that the action would prevent the listing of other contaminants of a higher public health concern.

(C) MONITORING PLAN FOR SMALL AND MEDIUM SYSTEMS.–

(i) IN GENERAL.– Based on the regulations promulgated by the Administrator, each State may develop a representative monitoring plan to assess the occurrence of unregulated contaminants in public water systems that serve a population of 10,000 or fewer in that State. The plan shall require monitoring for systems representative of different sizes, types, and geographic locations in the State.

(ii) GRANTS FOR SMALL SYSTEM COSTS.– From funds reserved under section 1452(o) or appropriated under subparagraph (H), the Administrator shall pay the reasonable cost of such testing and laboratory analysis as are necessary to carry out monitoring under the plan.

(D) MONITORING RESULTS.– Each public water system that conducts monitoring of unregulated contaminants pursuant to this paragraph shall provide the results of the monitoring to the primary enforcement authority for the system.

(E) NOTIFICATION.– Notification of the availability of the results of monitoring programs required under paragraph (2)(A) shall be given to the persons served by the system.

(F) WAIVER OF MONITORING REQUIREMENT.– The Administrator shall waive the requirement for monitoring for a contaminant under this paragraph in a State, if the State demonstrates that the criteria for listing the contaminant do not apply in that State.

(G) ANALYTICAL METHODS.– The State may use screening methods approved by the Administrator under subsection (i) in lieu of monitoring for particular contaminants under this paragraph.

(H) AUTHORIZATION OF APPROPRIATIONS.– There are authorized to be appropriated to carry out this paragraph $10,000,000 for each of the fiscal years 1997 through 2003.

(b)(1) Except as provided in paragraph (2), the Administrator, or representatives of the Administrator duly designated by him, upon presenting appropriate credentials and a written notice to any supplier of water or other person subject to (A) a national primary drinking water regulation prescribed under section 1412, (B) an applicable underground injection control program, or (C) any requirement to monitor an unregulated contaminant pursuant to subsection (a), or person in charge of any of the property of such supplier or other person referred to in clause (A), (B), or (C), is authorized to enter any establishment, facility, or other property of such supplier or other person in order to determine whether such supplier or other person has acted or is acting in compliance with this title, including for this purpose, inspection, at reasonable times, of records, files, papers, processes, controls, and facilities, or in order to test any feature of a public water system, including its raw water source. The Administrator or the Comptroller General (or any representative designated by either) shall have access for the purpose of audit and examination to any records, reports, or information of a grantee which are required to be maintained under subsection (a) or which are pertinent to any financial assistance under this title.

(2) No entry may be made under the first sentence of paragraph (1) in an establishment, facility, or other property of a supplier of water or other person subject to a national primary drinking water regulation if the establishment, facility, or other property is located in a State which has primary enforcement responsibility for public water systems unless, before written notice of such entry is made, the Administrator (or his representative) notifies the State agency charged with responsibility for safe drinking water of the reasons for such entry. The Administrator shall, upon a showing by the State agency that such an entry will be detrimental to the administration of the state's program of primary enforcement responsibility, take such showing into consideration in determining whether to make such entry. No State agency which receives notice under this paragraph of an entry proposed to be made under paragraph (1) may use the information contained in the notice to inform the person whose property is proposed to be entered of the proposed entry; and if a State agency so uses such information, notice to the agency under this paragraph is not required until such time as the Administrator determines the agency has provided him satisfactory assurances that it will no longer so use information contained in a notice under this paragraph.

(c) Whoever fails or refuses to comply with any requirement of subsection (a) or to allow the Administrator, the Comptroller General, or representatives of either, to enter and conduct any audit of inspection authorized by subsection (b) shall be subject to a civil penalty of not to exceed $25,000.

(d)(1) Subject to paragraph (2), upon a showing satisfactory to the Administrator by any person that any information required under this section from such person, if made public, would divulge trade secrets or secret processes of such person, the Administrator shall consider such information confidential in accordance with the purposes of section 1905 of title 18 of the United States Code. If the applicant fails to make a showing satisfactory to the Administrator, the Administrator shall give such applicant thirty days' notice before releasing the information to which the application relates (unless the public health or safety requires an earlier release of such information).

(2) Any information required under this section (A) may be disclosed to other officers, employees, or authorized representatives of the United States concerned with carrying out this title or to committees of the Congress, or when relevant in any proceeding under this title, and (B) shall be disclosed to the extent it deals with the level of contaminants in drinking water. For purposes of this subsection the term "information required under this section" means any papers, books, documents, or information, or any particular part thereof, reported to or otherwise obtained by the Administrator under this section.

(e) For purposes of this section, (1) the term "grantee" means any person who applies for or receives financial assistance, by grant, contract, or loan guarantee under this title, and (2) the term "person" includes a Federal agency.

(f) INFORMATION REGARDING DRINKING WATER COOLERS.--The Administrator may utilize the authorities of this section for purposes of part F. Any person who manufactures, imports, sells, or distributes drinking water coolers in interstate commerce shall be treated as a supplier of water for purposes of applying the provisions of this section in the case of persons subject to part F.

(g) OCCURRENCE DATA BASE.--

(1) IN GENERAL.-- Not later than 3 years after the date of enactment of the Safe Drinking Water Act Amendments of 1996, the Administrator shall assemble and maintain a national drinking water contaminant occurrence data base, using information on the

occurrence of both regulated and unregulated contaminants in public water systems obtained under subsection (a)(1)(A) or subsection (a)(2) and reliable information from other public and private sources.

(2) PUBLIC INPUT.– In establishing the occurrence data base, the Administrator shall solicit recommendations from the Science Advisory Board, the States, and other interested parties concerning the development and maintenance of a national drinking water contaminant occurrence data base, including such issues as the structure and design of the data base, data input parameters and requirements, and the use and interpretation of data.

(3) USE.– The data shall be used by the Administrator in making determinations under section 1412(b)(1) with respect to the occurrence of a contaminant in drinking water at a level of public health concern.

(4) PUBLIC RECOMMENDATIONS.– The Administrator shall periodically solicit recommendations from the appropriate officials of the National Academy of Sciences and the States, and any person may submit recommendations to the Administrator, with respect to contaminants that should be included in the national drinking water contaminant occurrence data base, including recommendations with respect to additional unregulated contaminants that should be listed under subsection (a)(2). Any recommendation submitted under this clause shall be accompanied by reasonable documentation that–

(A) the contaminant occurs or is likely to occur in drinking water; and

(B) the contaminant poses a risk to public health.

(5) PUBLIC AVAILABILITY.– The information from the data base shall be available to the public in readily accessible form.

(6) REGULATED CONTAMINANTS.– With respect to each contaminant for which a national primary drinking water regulation has been established, the data base shall include information on the detection of the contaminant at a quantifiable level in public water systems (including detection of the contaminant at levels not constituting a violation of the maximum contaminant level for the contaminant).

(7) UNREGULATED CONTAMINANTS.– With respect to contaminants for which a national primary drinking water regulation has not been established, the data base shall include–

(A) monitoring information collected by public water systems that serve a population of more than 10,000, as required by the Administrator under subsection (a);

(B) monitoring information collected from a representative sampling of public water systems that serve a population of 10,000 or fewer; and

(C) other reliable and appropriate monitoring information on the occurrence of the contaminants in public water systems that is available to the Administrator.

(h) AVAILABILITY OF INFORMATION ON SMALL SYSTEM TECHNOLOGIES.– For purposes of sections 1412(b)(4)(E) and 1415(e) (relating to small system variance program), the Administrator may request information on the characteristics of commercially available treatment systems and technologies, including the effectiveness and performance of the systems and technologies under various operating conditions. The

Administrator may specify the form, content, and submission date of information to be submitted by manufacturers, States, and other interested persons for the purpose of considering the systems and technologies in the development of regulations or guidance under sections 1412(b)(4)(E) and 1415(e).

(i) SCREENING METHODS.– The Administrator shall review new analytical methods to screen for regulated contaminants and may approve such methods as are more accurate or cost-effective than established reference methods for use in compliance monitoring.

NATIONAL DRINKING WATER ADVISORY COUNCIL

SEC. 1446. (a) There is established a National Drinking Water Advisory Council which shall consist of fifteen members appointed by the Administrator after consultation with the Secretary. Five members shall be appointed from the general public; five members shall be appointed from appropriate State and local agencies concerned with water hygiene and public water supply; and five members shall be appointed from representatives of private organizations or groups demonstrating an active interest in the field of water hygiene and public water supply ***of which two such members shall be associated with small, rural public water systems***. Each member of the Council shall hold office for a term of three years, except that-

(1) any member appointed to fill a vacancy occurring prior to the expiration of the term for which his predecessor was appointed shall be appointed for the remainder of such term; and

(2) the terms of the members first taking office shall expire as follows: Five shall expire three years after the date of enactment of this title, five shall expire two years after such date, and five shall expire one year after such date, as designated by the Administrator at the time of appointment.

The members of the Council shall be eligible for reappointment.

(b) The Council shall advise, consult with, and make recommendations to, the Administrator on matters relating to activities, functions, and policies of the Agency under this title.

(c) Members of the Council appointed under this section shall, while attending meetings or conferences of the Council or otherwise engaged in business of the Council, receive compensation and allowances at the rate to be fixed by the Administrator, but not exceeding the daily equivalent of the annual rate of basic pay in effect for grade GS-18 of the General Schedule for each day (including travel time) during which they are engaged in the actual performance of duties vested in the Council. While away from their homes or regular places of business in the performance of services for the Council, members of the Council shall be allowed travel expenses, including per diem in lieu of subsistence, in the same manner as persons employed intermittently in the Government service are allowed expenses under section 5703(b) or title 5 of the United States Code.

(d) Section 14(a) of the Federal Advisory Committee Act (relating to termination) shall not apply to the Council.

FEDERAL AGENCIES

~~(a) Each Federal agency (1) having jurisdiction over any federally owned or maintained public water system or (2) engaged in any activity resulting, or which may result in, underground injection which endangers drinking water (within the meaning of section 1421(d)(2)) shall be subject to, and comply with, all Federal, State, and local requirements, administrative authorities, and process and sanctions respecting the provisions of safe drinking water and respecting any underground injection program in the same manner, and to the same extent, as any nongovernmental entity. The preceding sentence shall apply (A) to any requirement whether substantive or procedural (including any recordkeeping or reporting requirement, any requirement respecting permits, and any other requirement whatsoever), (B) to the exercise of any Federal, State, or local administrative authority, and (C) to any process or sanction, whether enforced in Federal, State, or local courts or in any other manner. This subsection shall apply, notwithstanding any immunity of such agencies, under any law or rule of law. No officer, agent, or employee of the United States shall be personally liable for any civil penalty under this title with respect to any act or omission within the scope of his official duties.~~

~~(b) The Administrator shall waive compliance with subsection (a) upon request of the Secretary of Defense and upon a determination by the President that the requested waiver is necessary in the interest of national security. The Administrator shall maintain a written record of the basis upon which such waiver was granted and make such record available for in camera examination when relevant in a judicial proceeding under this title. Upon the issuance of such a waiver, the Administrator shall publish in the *Federal Register* a notice that the waiver was granted for national security purposes, unless, upon the request of the Secretary of Defense, the Administrator determines to omit such publication because the publication itself would be contrary to the interests of national security, in which event the Administrator shall submit notice to the Armed Services Committee of the Senate and House of Representatives.~~

SEC. 1447. ***(a) IN GENERAL.— Each department, agency, and instrumentality of the executive, legislative, and judicial branches of the Federal Government—***

(1) owning or operating any facility in a wellhead protection area;

(2) engaged in any activity at such facility resulting, or which may result, in the contamination of water supplies in any such area;

(3) owning or operating any public water system; or

(4) engaged in any activity resulting, or which may result in, underground injection which endangers drinking water (within the meaning of section 1421(d)(2)), shall be subject to, and comply with, all Federal, State, interstate, and local requirements, both substantive and procedural (including any requirement for permits or reporting or any provisions for injunctive relief and such sanctions as may be imposed by a court to enforce such relief), respecting the protection of such wellhead areas, respecting such public water systems, and respecting any underground injection in the same manner and to the same extent as any person is subject to such requirements, including the payment of reasonable service charges. The Federal, State, interstate, and local substantive and procedural requirements referred to in this subsection include, but are not limited to, all

administrative orders and all civil and administrative penalties and fines, regardless of whether such penalties or fines are punitive or coercive in nature or are imposed for isolated, intermittent, or continuing violations. The United States hereby expressly waives any immunity otherwise applicable to the United States with respect to any such substantive or procedural requirement (including, but not limited to, any injunctive relief, administrative order or civil or administrative penalty or fine referred to in the preceding sentence, or reasonable service charge). The reasonable service charges referred to in this subsection include, but are not limited to, fees or charges assessed in connection with the processing and issuance of permits, renewal of permits, amendments to permits, review of plans, studies, and other documents, and inspection and monitoring of facilities, as well as any other nondiscriminatory charges that are assessed in connection with a Federal, State, interstate, or local regulatory program respecting the protection of wellhead areas or public water systems or respecting any underground injection. Neither the United States, nor any agent, employee, or officer thereof, shall be immune or exempt from any process or sanction of any State or Federal Court with respect to the enforcement of any such injunctive relief. No agent, employee, or officer of the United States shall be personally liable for any civil penalty under any Federal, State, interstate, or local law concerning the protection of wellhead areas or public water systems or concerning underground injection with respect to any act or omission within the scope of the official duties of the agent, employee, or officer. An agent, employee, or officer of the United States shall be subject to any criminal sanction (including, but not limited to, any fine or imprisonment) under any Federal or State requirement adopted pursuant to this title, but no department, agency, or instrumentality of the executive, legislative, or judicial branch of the Federal Government shall be subject to any such sanction. The President may exempt any facility of any department, agency, or instrumentality in the executive branch from compliance with such a requirement if he determines it to be in the paramount interest of the United States to do so. No such exemption shall be granted due to lack of appropriation unless the President shall have specifically requested such appropriation as a part of the budgetary process and the Congress shall have failed to make available such requested appropriation. Any exemption shall be for a period not in excess of 1 year, but additional exemptions may be granted for periods not to exceed 1 year upon the President's making a new determination. The President shall report each January to the Congress all exemptions from the requirements of this section granted during the preceding calendar year, together with his reason for granting each such exemption.

(b) ADMINISTRATIVE PENALTY ORDERS.–

(1) IN GENERAL.– If the Administrator finds that a Federal agency has violated an applicable requirement under this title, the Administrator may issue a penalty order assessing a penalty against the Federal agency.

(2) PENALTIES.– The Administrator may, after notice to the agency, assess a civil penalty against the agency in an amount not to exceed $25,000 per day per violation.

(3) PROCEDURE.– Before an administrative penalty order issued under this subsection becomes final, the Administrator shall provide the agency an opportunity to confer with the Administrator and shall provide the agency notice and an opportunity for a hearing on the record in accordance with chapters 5 and 7 of title 5, United States Code.

(4) PUBLIC REVIEW.–

(A) IN GENERAL.– Any interested person may obtain review of an administrative penalty order issued under this subsection. The review may be obtained in

the United States District Court for the District of Columbia or in the United States District Court for the district in which the violation is alleged to have occurred by the filing of a complaint with the court within the 30-day period beginning on the date the penalty order becomes final. The person filing the complaint shall simultaneously send a copy of the complaint by certified mail to the Administrator and the Attorney General.

(B) RECORD.— The Administrator shall promptly file in the court a certified copy of the record on which the order was issued.

(C) STANDARD OF REVIEW.— The court shall not set aside or remand the order unless the court finds that there is not substantial evidence in the record, taken as a whole, to support the finding of a violation or that the assessment of the penalty by the Administrator constitutes an abuse of discretion.

(D) PROHIBITION ON ADDITIONAL PENALTIES.— The court may not impose an additional civil penalty for a violation that is subject to the order unless the court finds that the assessment constitutes an abuse of discretion by the Administrator.

(c) LIMITATION ON STATE USE OF FUNDS COLLECTED FROM FEDERAL GOVERNMENT.— Unless a State law in effect on the date of enactment of the Safe Drinking Water Act Amendments of 1996 or a State constitution requires the funds to be used in a different manner, all funds collected by a State from the Federal Government from penalties and fines imposed for violation of any substantive or procedural requirement referred to in subsection (a) shall be used by the State only for projects designed to improve or protect the environment or to defray the costs of environmental protection or enforcement.

~~(c)~~ ***(d)***(1) Nothing in the Safe Drinking Water Amendments of 1977 shall be construed to alter or affect the status of American Indian lands or water rights nor to waive any sovereignty over Indian lands guaranteed by treaty or statute.

(2) For the purposes of this Act, the term "Federal agency" shall not be construed to refer to or include any American Indian tribe, nor to the Secretary of the Interior in his capacity as trustee of Indian lands.

(e) WASHINGTON AQUEDUCT.— The Secretary of the Army shall not pass the cost of any penalty assessed under this title on to any customer, user, or other purchaser of drinking water from the Washington Aqueduct system, including finished water from the Dalecarlia or McMillan treatment plant.

JUDICIAL REVIEW

SEC. 1448. (a) A petition for review of-

(1) actions pertaining to the establishment of national primary drinking water regulations (including maximum contaminant level goals) may be filed only in the United States Court of Appeals for the District of Columbia circuit; and

(2) any other ***final*** action of the Administrator under this Act may be filed in the circuit in which the petitioner resides or transacts business which is directly affected by the action.

Any such petition shall be filed within the 45-day period beginning on the date of the

promulgation of the regulation ~~or issuance of the order~~ ***or any other final Agency action*** with respect to which review is sought or on the date of the determination with respect to which review is sought, and may be filed after the expiration of such 45-day period if the petition is based solely on grounds arising after the expiration of such period. Action of the Administrator with respect to which review could have been obtained under this subsection shall not be subject to judicial review in any civil or criminal proceeding for enforcement or in any civil action to enjoin enforcement. ***In any petition concerning the assessment of a civil penalty pursuant to section 1414(g)(3)(B), the petitioner shall simultaneously send a copy of the compliant by certified mail to the Administrator and the Attorney General. The court shall set aside and remand the penalty order if the court finds that there is not substantial evidence in the record to support the finding of a violation or that the assessment of the penalty by the Administrator constitutes an abuse of discretion.***

(b) The United States district courts shall have jurisdiction of actions brought to review (1) the granting of, or the refusing to grant, a variance or exemption under section 1415 or 1416 or (2) the requirements of any schedule prescribed for a variance or exemption under such section or the failure to prescribe such a schedule. Such an action may only be brought upon a petition for review filed with the court within the 45-day period beginning on the date the action sought to be reviewed is taken or, in the case of a petition to review the refusal to grant a variance or exemption or the failure to prescribe a schedule, within the 45-day period beginning on the date action is required to be taken on the variance, exemption, or schedule, as the case may be. A petition for such review may be filed after the expiration of such period. Action with respect to which review could have been obtained under this subsection shall not be subject to judicial review in any civil or criminal proceeding for enforcement or in any civil action to enjoin enforcement.

(c) In any judicial proceeding in which review is sought of a determination under this title required to be made on the record after notice and opportunity for hearing, if any party applies to the court for leave to adduce additional evidence and shows to the satisfaction of the court that such additional evidence is material and that there were reasonable grounds for the failure to adduce such evidence in the proceeding before the Administrator, the court may order such additional evidence (and evidence in rebuttal thereof) to be taken before the Administrator, in such manner and upon such terms and conditions as the court may deem proper. The Administrator may modify his findings as to the facts, or make new findings, by reason of the additional evidence so taken, and he shall file such modified or new findings, and his recommendation, if any, for the modification or setting aside of his original determination, with the return of such additional evidence.

CITIZEN'S CIVIL ACTION

SEC. 1449. (a) Except as provided in subsection (b) of this section, any person may commence a civil action on his own behalf-

(1) against any person (including (A) the United States, and (B) any other governmental instrumentality or agency to the extent permitted by the eleventh amendment to the Constitution) who is alleged to be in violation of any requirement prescribed by or under this title~~, or~~ ***;***

(2) against the Administrator where there is alleged a failure of the Administrator to perform any act or duty under this title which is not discretionary with the Administrator; ***or***

(3) for the collection of a penalty by the United States Government (and associated costs and interest) against any Federal agency that fails, by the date that is 18 months after the effective date of a final order to pay a penalty assessed by the Administrator under section 1429(b), to pay the penalty.

No action may be brought under paragraph (1) against a public water system for a violation of a requirement prescribed by or under this title which occurred within the 27-month period beginning on the first day of the month in which this title is enacted. The United States district courts shall have jurisdiction, without regard to the amount of controversy or the citizenship of the parties, to enforce in an action brought under this subsection any requirement prescribed by or under this title or to order the Administrator to perform an act, or duty described in paragraph (2), as the case may be.

(b) No civil action may be commenced-

(1) under subsection (a)(1) of this section respecting violation or a requirement prescribed by or under this title-

(A) prior to sixty days after the plaintiff has given notice of such violation (i) to the Administrator, (ii) to any alleged violator of such requirement and (iii) to the State in which the violation occurs, or

(B) if the Administrator, the Attorney General, or the State has commenced and is diligently prosecuting a civil action in a court of the United States to require compliance with such requirement, but in any such action in a court of the United States any person may intervene as a matter of right; or

(2) under subsection (a)(2) of this section prior to sixty days after the plaintiff has given notice of such action to the Administrator ***; or***

(3) under subsection (a)(3) prior to 60 days after the plaintiff has given notice of such action to the Attorney General and to the Federal agency.

Notice required by this subsection shall be given in such manner as the Administrator shall prescribe by regulation. No person may commence a civil action under subsection (a) to require a State to prescribe a schedule under section 1415 or 1416 for a variance or exemption, unless such person shows to the satisfaction of the court that the State has in a substantial number of cases failed to prescribe such schedules.

(c) In any action under this section, the Administrator or the Attorney General, if not a party, may intervene as a matter of right.

(d) The court, in issuing any final order in any action brought under subsection (a) of this section, may award costs of litigation (including reasonable attorney and expert witness fees) to any party whenever the court determines such an award is appropriate. The court may, if a temporary restraining order or preliminary injunction is sought, require the filing of a bond or equivalent security in accordance with the Federal Rules of Civil Procedure.

(e) Nothing in this section shall restrict any right which any person (or class of persons) may have under any statute or common law to seek enforcement of any requirement prescribed by or under this title or to seek any other relief. Nothing in this section or in any other law of the United States shall be construed to prohibit, exclude, or restrict any State or local government from-

(1) bringing any action or obtaining any remedy or sanction in any State or local court, or

(2) bringing any administrative action or obtaining any administrative remedy or sanction, against any agency of the United States under State or local law to enforce any requirement respecting the provision of safe drinking water or respecting any underground injection control program. Nothing in this section shall be construed to authorize judicial review of regulations or orders of the Administrator under this title, except as provided in section 1448. For provisions providing for application of certain requirements to such agencies in the same manner as to nongovernmental entities, see section 1447.

GENERAL PROVISIONS

SEC. 1450. (a)(1) The Administrator is authorized to prescribe such regulations as are necessary or appropriate to carry out his functions under this title.

(2) The Administrator may delegate any of his functions under this title (other than prescribing regulations) to any officer or employee of the Agency.

(b) The Administrator, with the consent of the head of any other agency of the United States, may utilize such officers and employees of such agency as he deems necessary to assist him in carrying out the purposes of this title.

(c) Upon the request of a State or interstate agency, the Administrator may assign personnel of the Agency to such State or interstate agency for the purposes of carrying out the provisions of this title.

(d)(1) The Administrator may make payments of grants under this title (after necessary adjustment on account of previously made underpayments or overpayments) in advance or by way of reimbursement, and in such installments and on such conditions as he may determine.

(2) Financial assistance may be made available in the form of grants only to individuals and nonprofit agencies or institutions. For purposes of this paragraph, the term "nonprofit agency or institution" means an agency or institution no part of the net earnings of which inure, or may lawfully inure, to the benefit of any private shareholder or individual.

(e) The Administrator shall take such action as may be necessary to assure compliance with provisions of the Act of March 3, 1931 (known as the Davis-Bacon Act; 40 U.S.C. 276a-276-a(5)). The Secretary of Labor shall have, with respect to the labor standards specified in this subsection, the authority and functions set forth in Reorganization Plan Numbered 14 of 1950 (15 F.R. 3176; 64 Stat. 1267) and section 2 of the Act of June 13, 1934 (40 U.S.C. 276c).

(f) The Administrator shall request the Attorney General to appear and represent him in any civil action instituted under this title to which the Administrator is a party. Unless, within a reasonable time, the Attorney General notifies the Administrator that he will appear in such action, attorneys appointed by the Administrator shall appear and represent him.

(g) The provisions of this title shall not be construed as affecting any authority of the Administrator under part G of title III of this Act.

(h) Not later than April 1 of each year, the Administrator shall submit to the Committee on Commerce of the Senate and the Committee on Interstate and Foreign Commerce of the House of Representatives a report respecting the activities of the Agency under this title and containing such recommendations for legislation as he considers necessary. The report of the Administrator under this subsection which is due not later than April 1, 1975, and each subsequent report of the Administrator under this subsection shall include a statement on the actual and anticipated cost to public water systems in each State of compliance with the requirements of this title. The Office of Management and Budget may review any report required by this subsection before its submission to such committees of Congress, but the Office may not revise any such report, require any revision in any such report, or delay its submission beyond the day prescribed for its submission, and may submit to such committees of Congress its comments respecting any such report.

(i)(1) No employer may discharge any employee or otherwise discriminate against any employee with respect to his compensation, terms, conditions, or privileges of employment because the employee (or any person acting pursuant to a request of the employee) has-

(A) commenced, caused to be commenced, or is about to commence or cause to be commenced a proceeding under this title or a proceeding for the administration or enforcement of drinking water regulations or underground injection control programs of a State.

(B) testified or is about to testify in any such proceeding, or

(C) assisted or participated or is about to assist or participate in any manner in such proceeding or in other action to carry out the purposes of this title.

(2)(A) Any employee who believes that he has been discharged or otherwise discriminated against by any person in violation of paragraph (1) may, within 30 days after such violation occurs, file (or have any person file on his behalf) a complaint with the Secretary of Labor (hereinafter in this subsection referred to as the "Secretary") alleging such discharge or discrimination. Upon receipt of such a complaint, the Secretary shall notify the person named in the complaint of the filing of the complaint.

(B)(i) Upon receipt of a complaint filed under subparagraph (A), the Secretary shall conduct an investigation of the violation alleged in the complaint. Within 30 days of the receipt of such complaint, the Secretary shall complete such investigation and shall notify in writing the complainant (and any person acting in his behalf) and the person alleged to have committed such violation of the results of the investigation conducted pursuant to this subparagraph. Within 90 days of the receipt of such complaint the secretary shall, unless the proceeding on the complaint is terminated by the Secretary on the basis of a settlement entered into by the Secretary and the person alleged to have committed such violation, issue an order either providing the relief prescribed by clause (ii) or denying the complaint. An order of the Secretary shall be made on the record after notice and opportunity for agency hearing. The Secretary may not enter into a settlement terminating a proceeding on a complaint without the participation and consent of the complainant.

(ii) If in response to a complaint filed under subparagraph (A) the Secretary determines that a violation of paragraph (1) has occurred, the Secretary shall order (I) the person who committed such violation to take affirmative action to abate the violation, (II) such person to reinstate the complainant to his former position together with the compensation (including back pay), terms, conditions, and privileges of his employment, (III) compensatory damages, and (IV) where appropriate, exemplary damages. If such an

order is issued, the Secretary, at the request of the complainant, shall assess against the person whom the order is issued a sum equal to the aggregate amount of all costs and expenses (including attorneys' fees) reasonably incurred, as determined by the Secretary, by the complainant for, or in connection with, the bringing of the complaint upon which the order was issued.

(3)(A) Any person adversely affected or aggrieved by an order issued under paragraph (2) may obtain review of the order in the United States Court of Appeals for the circuit in which the violation, with respect to which the order was issued, allegedly occurred. The petition for review must be filed within sixty days from the issuance of the secretary's order. Review shall conform to chapter 7 of title 5 of the United States Code. The commencement of proceedings under this subparagraph shall not, unless ordered by the court, operate as a stay of the Secretary's order.

(B) An order of the Secretary with respect to which review could have been obtained under subparagraph (A) shall not be subject to judicial review in any criminal or other civil proceeding.

(4) Whenever a person has failed to comply with an order issued under paragraph (2)(B), the Secretary shall file a civil action in the United States District Court for the district in which the violation was found to occur to enforce such order. In actions brought under this paragraph, the district court shall have jurisdiction to grant all appropriate relief including, but not limited to injunctive relief, compensatory, and exemplary damages.

(5) Any nondiscretionary duty imposed by this section is enforceable in mandamus proceeding brought under section 1361 of title 28 of the United States Code.

(6) Paragraph (1) shall not apply with respect to any employee who, acting without direction from his employer (or the employer's agent), deliberately causes a violation of any requirement of this title.

INDIAN TRIBES

SEC. 1451. (a) IN GENERAL-Subject to the provisions of subsection (b), the Administrator-

(1) is authorized to treat Indian Tribes as States under this title,

(2) may delegate to such Tribes primary enforcement responsibility for public water systems and for underground injection control, and

(3) may provide such Tribes grant and contract assistance to carry out functions provided by this title.

(b) EPA REGULATIONS-

(1) SPECIFIC PROVISIONS-The Administrator shall, within 18 months after the enactment of the Safe Drinking Water Act Amendments of 1986, promulgate final regulations specifying those provisions of this title for which it is appropriate to treat Indian Tribes as States. Such treatment shall be authorized only if:

(A) the Indian Tribe is recognized by the Secretary of the Interior and has a

governing body carrying out substantial governmental duties and powers;

(B) the functions to be exercised by the Indian Tribe are within the area of the Tribal Government's jurisdiction; and

(C) the Indian Tribe is reasonably expected to be capable, in the Administrator's judgment, of carrying out the functions to be exercised in a manner consistent with the terms and purposes of this title and of all applicable regulations.

(2) PROVISIONS WHERE TREATMENT AS STATE INAPPROPRIATE-For any provision of this title where treatment of Indian Tribes as identical to States is inappropriate, administratively infeasible or otherwise inconsistent with the purposes of this title, the Administrator may include in the regulations promulgated under this section, other means for administering such provision in a manner that will achieve the purpose of the provision. Nothing in this section shall be construed to allow Indian Tribes to assume or maintain primary enforcement responsibility for public water systems or for underground injection control in a manner less protective of the health of persons than such responsibility may be assumed or maintained by a State. An Indian tribe shall not be required to exercise criminal enforcement jurisdiction for purposes of complying with the preceding sentence.

STATE REVOLVING LOAN FUNDS

SEC. 1452. (a) GENERAL AUTHORITY.–

(1) GRANTS TO STATES TO ESTABLISH STATE LOAN FUNDS.–

(A) IN GENERAL.– The Administrator shall offer to enter into agreements with eligible States to make capitalization grants, including letters of credit, to the States under this subsection to further the health protection objectives of this title, promote the efficient use of fund resources, and for other purposes as are specified in this title.

(B) ESTABLISHMENT OF FUND.– To be eligible to receive a capitalization grant under this section, a State shall establish a drinking water treatment revolving loan fund (referred to in this section as a `State loan fund') and comply with the other requirements of this section. Each grant to a State under this section shall be deposited in the State loan fund established by the State, except as otherwise provided in this section and in other provisions of this title. No funds authorized by other provisions of this title to be used for other purposes specified in this title shall be deposited in any State loan fund.

(C) EXTENDED PERIOD.– The grant to a State shall be available to the State for obligation during the fiscal year for which the funds are authorized and during the following fiscal year, except that grants made available from funds provided prior to fiscal year 1997 shall be available for obligation during each of the fiscal years 1997 and 1998.

(D) ALLOTMENT FORMULA.– Except as otherwise provided in this section, funds made available to carry out this section shall be allotted to States that have entered into an agreement pursuant to this section (other than the District of Columbia) in accordance with–

(i) for each of fiscal years 1995 through 1997, a formula that is the same as the formula used to distribute public water system supervision grant funds under

section 1443 in fiscal year 1995, except that the minimum proportionate share established in the formula shall be 1 percent of available funds and the formula shall be adjusted to include a minimum proportionate share for the State of Wyoming and the District of Columbia; and

(ii) for fiscal year 1998 and each subsequent fiscal year, a formula that allocates to each State the proportional share of the State needs identified in the most recent survey conducted pursuant to subsection (h), except that the minimum proportionate share provided to each State shall be the same as the minimum proportionate share provided under clause (i).

(E) REALLOTMENT.– The grants not obligated by the last day of the period for which the grants are available shall be reallotted according to the appropriate criteria set forth in subparagraph (D), except that the Administrator may reserve and allocate 10 percent of the remaining amount for financial assistance to Indian Tribes in addition to the amount allotted under subsection (i) and none of the funds reallotted by the Administrator shall be reallotted to any State that has not obligated all sums allotted to the State pursuant to this section during the period in which the sums were available for obligation.

(F) NONPRIMACY STATES.– The State allotment for a State not exercising primary enforcement responsibility for public water systems shall not be deposited in any such fund but shall be allotted by the Administrator under this subparagraph. Pursuant to section 1443(a)(9)(A) such sums allotted under this subparagraph shall be reserved as needed by the Administrator to exercise primary enforcement responsibility under this title in such State and the remainder shall be reallotted to States exercising primary enforcement responsibility for public water systems for deposit in such funds. Whenever the Administrator makes a final determination pursuant to section 1413(b) that the requirements of section 1413(a) are no longer being met by a State, additional grants for such State under this title shall be immediately terminated by the Administrator. This subparagraph shall not apply to any State not exercising primary enforcement responsibility for public water systems as of the date of enactment of the Safe Drinking Water Act Amendments of 1996.

(G) OTHER PROGRAMS.–

(i) NEW SYSTEM CAPACITY.– Beginning in fiscal year 1999, the Administrator shall withhold 20 percent of each capitalization grant made pursuant to this section to a State unless the State has met the requirements of section 1420(a) (relating to capacity development) and shall withhold 10 percent for fiscal year 2001, 15 percent for fiscal year 2002, and 20 percent for fiscal year 2003 if the State has not complied with the provisions of section 1420(c) (relating to capacity development strategies). Not more than a total of 20 percent of the capitalization grants made to a State in any fiscal year may be withheld under the preceding provisions of this clause. All funds withheld by the Administrator pursuant to this clause shall be reallotted by the Administrator on the basis of the same ratio as is applicable to funds allotted under subparagraph (D). None of the funds reallotted by the Administrator pursuant to this paragraph shall be allotted to a State unless the State has met the requirements of section 1420 (relating to capacity development).

(ii) OPERATOR CERTIFICATION.– The Administrator shall withhold 20 percent of each capitalization grant made pursuant to this section unless the State has met the requirements of 1419 (relating to operator certification). All funds

withheld by the Administrator pursuant to this clause shall be reallotted by the Administrator on the basis of the same ratio as applicable to funds allotted under subparagraph (D). None of the funds reallotted by the Administrator pursuant to this paragraph shall be allotted to a State unless the State has met the requirements of section 1419 (relating to operator certification).

(2) USE OF FUNDS.– Except as otherwise authorized by this title, amounts deposited in a State loan fund, including loan repayments and interest earned on such amounts, shall be used only for providing loans or loan guarantees, or as a source of reserve and security for leveraged loans, the proceeds of which are deposited in a State loan fund established under paragraph (1), or other financial assistance authorized under this section to community water systems and nonprofit noncommunity water systems, other than systems owned by Federal agencies. Financial assistance under this section may be used by a public water system only for expenditures (not including monitoring, operation, and maintenance expenditures) of a type or category which the Administrator has determined, through guidance, will facilitate compliance with national primary drinking water regulations applicable to the system under section 1412 or otherwise significantly further the health protection objectives of this title. The funds may also be used to provide loans to a system referred to in section 1401(4)(B) for the purpose of providing the treatment described in section 1401(4)(B)(i)(III). The funds shall not be used for the acquisition of real property or interests therein, unless the acquisition is integral to a project authorized by this paragraph and the purchase is from a willing seller. Of the amount credited to any State loan fund established under this section in any fiscal year, 15 percent shall be available solely for providing loan assistance to public water systems which regularly serve fewer than 10,000 persons to the extent such funds can be obligated for eligible projects of public water systems.

(3) LIMITATION.–

(A) IN GENERAL.– Except as provided in subparagraph (B), no assistance under this section shall be provided to a public water system that–

(i) does not have the technical, managerial, and financial capability to ensure compliance with the requirements of this title; or

(ii) is in significant noncompliance with any requirement of a national primary drinking water regulation or variance.

(B) RESTRUCTURING.– A public water system described in subparagraph (A) may receive assistance under this section if–

(i) the use of the assistance will ensure compliance; and

(ii) if subparagraph (A)(i) applies to the system, the owner or operator of the system agrees to undertake feasible and appropriate changes in operations (including ownership, management, accounting, rates, maintenance, consolidation, alternative water supply, or other procedures) if the State determines that the measures are necessary to ensure that the system has the technical, managerial, and financial capability to comply with the requirements of this title over the long term.

(C) REVIEW.– Prior to providing assistance under this section to a public water system that is in significant noncompliance with any requirement of a national primary drinking water regulation or variance, the State shall conduct a review to determine whether subparagraph (A)(i) applies to the system.

(b) INTENDED USE PLANS.–

(1) IN GENERAL.– After providing for public review and comment, each State that has entered into a capitalization agreement pursuant to this section shall annually prepare a plan that identifies the intended uses of the amounts available to the State loan fund of the State.

(2) CONTENTS.– An intended use plan shall include–

(A) a list of the projects to be assisted in the first fiscal year that begins after the date of the plan, including a description of the project, the expected terms of financial assistance, and the size of the community served;

(B) the criteria and methods established for the distribution of funds; and

(C) a description of the financial status of the State loan fund and the short-term and long-term goals of the State loan fund.

(3) USE OF FUNDS.–

(A) IN GENERAL.– An intended use plan shall provide, to the maximum extent practicable, that priority for the use of funds be given to projects that–

(i) address the most serious risk to human health;

(ii) are necessary to ensure compliance with the requirements of this title (including requirements for filtration); and

(iii) assist systems most in need on a per household basis according to State affordability criteria.

(B) LIST OF PROJECTS.– Each State shall, after notice and opportunity for public comment, publish and periodically update a list of projects in the State that are eligible for assistance under this section, including the priority assigned to each project and, to the extent known, the expected funding schedule for each project.

(c) FUND MANAGEMENT.– Each State loan fund under this section shall be established, maintained, and credited with repayments and interest. The fund corpus shall be available in perpetuity for providing financial assistance under this section. To the extent amounts in the fund are not required for current obligation or expenditure, such amounts shall be invested in interest bearing obligations.

(d) ASSISTANCE FOR DISADVANTAGED COMMUNITIES.–

(1) LOAN SUBSIDY.– Notwithstanding any other provision of this section, in any case in which the State makes a loan pursuant to subsection (a)(2) to a disadvantaged community or to a community that the State expects to become a disadvantaged community as the result of a proposed project, the State may provide additional subsidization (including forgiveness of principal).

(2) TOTAL AMOUNT OF SUBSIDIES.– For each fiscal year, the total amount of loan subsidies made by a State pursuant to paragraph (1) may not exceed 30 percent of the amount of the capitalization grant received by the State for the year.

(3) DEFINITION OF DISADVANTAGED COMMUNITY.– In this subsection, the

term `disadvantaged community' means the service area of a public water system that meets affordability criteria established after public review and comment by the State in which the public water system is located. The Administrator may publish information to assist States in establishing affordability criteria.

(e) STATE CONTRIBUTION.– Each agreement under subsection (a) shall require that the State deposit in the State loan fund from State moneys an amount equal to at least 20 percent of the total amount of the grant to be made to the State on or before the date on which the grant payment is made to the State, except that a State shall not be required to deposit such amount into the fund prior to the date on which each grant payment is made for fiscal years 1994, 1995, 1996, and 1997 if the State deposits the State contribution amount into the State loan fund prior to September 30, 1999.

(f) TYPES OF ASSISTANCE.– Except as otherwise limited by State law, the amounts deposited into a State loan fund under this section may be used only–

(1) to make loans, on the condition that–

(A) the interest rate for each loan is less than or equal to the market interest rate, including an interest free loan;

(B) principal and interest payments on each loan will commence not later than 1 year after completion of the project for which the loan was made, and each loan will be fully amortized not later than 20 years after the completion of the project, except that in the case of a disadvantaged community (as defined in subsection (d)(3)), a State may provide an extended term for a loan, if the extended term–

(i) terminates not later than the date that is 30 years after the date of project completion; and

(ii) does not exceed the expected design life of the project;

(C) the recipient of each loan will establish a dedicated source of revenue (or, in the case of a privately owned system, demonstrate that there is adequate security) for the repayment of the loan; and

(D) the State loan fund will be credited with all payments of principal and interest on each loan;

(2) to buy or refinance the debt obligation of a municipality or an intermunicipal or interstate agency within the State at an interest rate that is less than or equal to the market interest rate in any case in which a debt obligation is incurred after July 1, 1993;

(3) to guarantee, or purchase insurance for, a local obligation (all of the proceeds of which finance a project eligible for assistance under this section) if the guarantee or purchase would improve credit market access or reduce the interest rate applicable to the obligation;

(4) as a source of revenue or security for the payment of principal and interest on revenue or general obligation bonds issued by the State if the proceeds of the sale of the bonds will be deposited into the State loan fund; and

(5) to earn interest on the amounts deposited into the State loan fund.

(g) ADMINISTRATION OF STATE LOAN FUNDS.–

(1) COMBINED FINANCIAL ADMINISTRATION.-- Notwithstanding subsection (c), a State may (as a convenience and to avoid unnecessary administrative costs) combine, in accordance with State law, the financial administration of a State loan fund established under this section with the financial administration of any other revolving fund established by the State if otherwise not prohibited by the law under which the State loan fund was established and if the Administrator determines that--

(A) the grants under this section, together with loan repayments and interest, will be separately accounted for and used solely for the purposes specified in subsection (a); and

(B) the authority to establish assistance priorities and carry out oversight and related activities (other than financial administration) with respect to assistance remains with the State agency having primary responsibility for administration of the State program under section 1413, after consultation with other appropriate State agencies (as determined by the State): Provided, that in nonprimacy States eligible to receive assistance under this section, the Governor shall determine which State agency will have authority to establish priorities for financial assistance from the State loan fund.

(2) COST OF ADMINISTERING FUND.-- Each State may annually use up to 4 percent of the funds allotted to the State under this section to cover the reasonable costs of administration of the programs under this section, including the recovery of reasonable costs expended to establish a State loan fund which are incurred after the date of enactment of this section, and to provide technical assistance to public water systems within the State. For fiscal year 1995 and each fiscal year thereafter, each State may use up to an additional 10 percent of the funds allotted to the State under this section--

(A) for public water system supervision programs under section 1443(a);

(B) to administer or provide technical assistance through source water protection programs;

(C) to develop and implement a capacity development strategy under section 1420(c); and

(D) for an operator certification program for purposes of meeting the requirements of section 1419, if the State matches the expenditures with at least an equal amount of State funds. At least half of the match must be additional to the amount expended by the State for public water supervision in fiscal year 1993. An additional 2 percent of the funds annually allotted to each State under this section may be used by the State to provide technical assistance to public water systems serving 10,000 or fewer persons in the State. Funds utilized under subparagraph (B) shall not be used for enforcement actions.

(3) GUIDANCE AND REGULATIONS.-- The Administrator shall publish guidance and promulgate regulations as may be necessary to carry out the provisions of this section, including--

(A) provisions to ensure that each State commits and expends funds allotted to the State under this section as efficiently as possible in accordance with this title and applicable State laws;

(B) guidance to prevent waste, fraud, and abuse; and `(C) guidance to avoid

the use of funds made available under this section to finance the expansion of any public water system in anticipation of future population growth. The guidance and regulations shall also ensure that the States, and public water systems receiving assistance under this section, use accounting, audit, and fiscal procedures that conform to generally accepted accounting standards.

(4) STATE REPORT.-- Each State administering a loan fund and assistance program under this subsection shall publish and submit to the Administrator a report every 2 years on its activities under this section, including the findings of the most recent audit of the fund and the entire State allotment. The Administrator shall periodically audit all State loan funds established by, and all other amounts allotted to, the States pursuant to this section in accordance with procedures established by the Comptroller General.

(h) NEEDS SURVEY.-- The Administrator shall conduct an assessment of water system capital improvement needs of all eligible public water systems in the United States and submit a report to the Congress containing the results of the assessment within 180 days after the date of enactment of the Safe Drinking Water Act Amendments of 1996 and every 4 years thereafter.

(i) INDIAN TRIBES.--

(1) IN GENERAL.-- 1 1/2 percent of the amounts appropriated annually to carry out this section may be used by the Administrator to make grants to Indian Tribes and Alaska Native villages that have not otherwise received either grants from the Administrator under this section or assistance from State loan funds established under this section. The grants may only be used for expenditures by tribes and villages for public water system expenditures referred to in subsection (a)(2).

(2) USE OF FUNDS.-- Funds reserved pursuant to paragraph (1) shall be used to address the most significant threats to public health associated with public water systems that serve Indian Tribes, as determined by the Administrator in consultation with the Director of the Indian Health Service and Indian Tribes.

(3) ALASKA NATIVE VILLAGES.-- In the case of a grant for a project under this subsection in an Alaska Native village, the Administrator is also authorized to make grants to the State of Alaska for the benefit of Native villages. An amount not to exceed 4 percent of the grant amount may be used by the State of Alaska for project management.

(4) NEEDS ASSESSMENT.-- The Administrator, in consultation with the Director of the Indian Health Service and Indian Tribes, shall, in accordance with a schedule that is consistent with the needs surveys conducted pursuant to subsection (h), prepare surveys and assess the needs of drinking water treatment facilities to serve Indian Tribes, including an evaluation of the public water systems that pose the most significant threats to public health.

(j) OTHER AREAS.-- Of the funds annually available under this section for grants to States, the Administrator shall make allotments in accordance with section 1443(a)(4) for the Virgin Islands, the Commonwealth of the Northern Mariana Islands, American Samoa, and Guam. The grants allotted as provided in this subsection may be provided by the Administrator to the governments of such areas, to public water systems in such areas, or to both, to be used for the public water system expenditures referred to in subsection (a)(2). The grants, and grants for the District of Columbia, shall not be deposited in State loan funds. The total allotment of grants under this section for all areas described in this subsection in any fiscal year shall not exceed 0.33 percent of the aggregate amount made

available to carry out this section in that fiscal year.

(k) OTHER AUTHORIZED ACTIVITIES.–

(1) IN GENERAL.– Notwithstanding subsection (a)(2), a State may take each of the following actions:

(A) Provide assistance, only in the form of a loan, to one or more of the following:

(i) Any public water system described in subsection (a)(2) to acquire land or a conservation easement from a willing seller or grantor, if the purpose of the acquisition is to protect the source water of the system from contamination and to ensure compliance with national primary drinking water regulations.

(ii) Any community water system to implement local, voluntary source water protection measures to protect source water in areas delineated pursuant to section 1453, in order to facilitate compliance with national primary drinking water regulations applicable to the system under section 1412 or otherwise significantly further the health protection objectives of this title. Funds authorized under this clause may be used to fund only voluntary, incentive-based mechanisms.

(iii) Any community water system to provide funding in accordance with section 1454(a)(1)(B)(i).

(B) Provide assistance, including technical and financial assistance, to any public water system as part of a capacity development strategy developed and implemented in accordance with section 1420(c).

(C) Make expenditures from the capitalization grant of the State for fiscal years 1996 and 1997 to delineate and assess source water protection areas in accordance with section 1453, except that funds set aside for such expenditure shall be obligated within 4 fiscal years.

(D) Make expenditures from the fund for the establishment and implementation of wellhead protection programs under section 1428.

(2) LIMITATION.– For each fiscal year, the total amount of assistance provided and expenditures made by a State under this subsection may not exceed 15 percent of the amount of the capitalization grant received by the State for that year and may not exceed 10 percent of that amount for any one of the following activities:

(A) To acquire land or conservation easements pursuant to paragraph (1)(A)(i).

(B) To provide funding to implement voluntary, incentive-based source water quality protection measures pursuant to clauses (ii) and (iii) of paragraph (1)(A).

(C) To provide assistance through a capacity development strategy pursuant to paragraph (1)(B).

(D) To make expenditures to delineate or assess source water protection areas pursuant to paragraph (1)(C).

(E) To make expenditures to establish and implement wellhead protection

programs pursuant to paragraph (1)(D).

(3) STATUTORY CONSTRUCTION.-- Nothing in this section creates or conveys any new authority to a State, political subdivision of a State, or community water system for any new regulatory measure, or limits any authority of a State, political subdivision of a State or community water system.

(l) SAVINGS.-- The failure or inability of any public water system to receive funds under this section or any other loan or grant program, or any delay in obtaining the funds, shall not alter the obligation of the system to comply in a timely manner with all applicable drinking water standards and requirements of this title.

(m) AUTHORIZATION OF APPROPRIATIONS.-- There are authorized to be appropriated to carry out the purposes of this section $599,000,000 for the fiscal year 1994 and $1,000,000,000 for each of the fiscal years 1995 through 2003. To the extent amounts authorized to be appropriated under this subsection in any fiscal year are not appropriated in that fiscal year, such amounts are authorized to be appropriated in a subsequent fiscal year (prior to the fiscal year 2004). Such sums shall remain available until expended.

(n) HEALTH EFFECTS STUDIES.-- From funds appropriated pursuant to this section for each fiscal year, the Administrator shall reserve $10,000,000 for health effects studies on drinking water contaminants authorized by the Safe Drinking Water Act Amendments of 1996. In allocating funds made available under this subsection, the Administrator shall give priority to studies concerning the health effects of cryptosporidium (as authorized by section 1458(c)), disinfection byproducts (as authorized by section 1458(c)), and arsenic (as authorized by section 1412(b)(12)(A)), and the implementation of a plan for studies of subpopulations at greater risk of adverse effects (as authorized by section 1458(a)).

(o) MONITORING FOR UNREGULATED CONTAMINANTS.-- From funds appropriated pursuant to this section for each fiscal year beginning with fiscal year 1998, the Administrator shall reserve $2,000,000 to pay the costs of monitoring for unregulated contaminants under section 1445(a)(2)(C).

(p) DEMONSTRATION PROJECT FOR STATE OF VIRGINIA.-- Notwithstanding the other provisions of this section limiting the use of funds deposited in a State loan fund from any State allotment, the State of Virginia may, as a single demonstration and with the approval of the Virginia General Assembly and the Administrator, conduct a program to demonstrate alternative approaches to intergovernmental coordination to assist in the financing of new drinking water facilities in the following rural communities in southwestern Virginia where none exists on the date of enactment of the Safe Drinking Water Act Amendments of 1996 and where such communities are experiencing economic hardship: Lee County, Wise County, Scott County, Dickenson County, Russell County, Buchanan County, Tazewell County, and the city of Norton, Virginia. The funds allotted to that State and deposited in the State loan fund may be loaned to a regional endowment fund for the purpose set forth in this subsection under a plan to be approved by the Administrator. The plan may include an advisory group that includes representatives of such counties.

(q) SMALL SYSTEM TECHNICAL ASSISTANCE.-- The Administrator may reserve up to 2 percent of the total funds appropriated pursuant to subsection (m) for each of the fiscal years 1997 through 2003 to carry out the provisions of section 1442(e) (relating to technical assistance for small systems), except that the total amount of funds made

available for such purpose in any fiscal year through appropriations (as authorized by section 1442(e)) and reservations made pursuant to this subsection shall not exceed the amount authorized by section 1442(e).

(r) EVALUATION.– The Administrator shall conduct an evaluation of the effectiveness of the State loan funds through fiscal year 2001. The evaluation shall be submitted to the Congress at the same time as the President submits to the Congress, pursuant to section 1108 of title 31, United States Code, an appropriations request for fiscal year 2003 relating to the budget of the Environmental Protection Agency.

SOURCE WATER QUALITY ASSESSMENT

SEC. 1453. (a) SOURCE WATER ASSESSMENT.–

(1) GUIDANCE.– Within 12 months after the date of enactment of the Safe Drinking Water Act Amendments of 1996, after notice and comment, the Administrator shall publish guidance for States exercising primary enforcement responsibility for public water systems to carry out directly or through delegation (for the protection and benefit of public water systems and for the support of monitoring flexibility) a source water assessment program within the State's boundaries. Each State adopting modifications to monitoring requirements pursuant to section 1418(b) shall, prior to adopting such modifications, have an approved source water assessment program under this section and shall carry out the program either directly or through delegation.

(2) PROGRAM REQUIREMENTS.– A source water assessment program under this subsection shall–

(A) delineate the boundaries of the assessment areas in such State from which one or more public water systems in the State receive supplies of drinking water, using all reasonably available hydrogeologic information on the sources of the supply of drinking water in the State and the water flow, recharge, and discharge and any other reliable information as the State deems necessary to adequately determine such areas; and

(B) identify for contaminants regulated under this title for which monitoring is required under this title (or any unregulated contaminants selected by the State, in its discretion, which the State, for the purposes of this subsection, has determined may present a threat to public health), to the extent practical, the origins within each delineated area of such contaminants to determine the susceptibility of the public water systems in the delineated area to such contaminants.

(3) APPROVAL, IMPLEMENTATION, AND MONITORING RELIEF.– A State source water assessment program under this subsection shall be submitted to the Administrator within 18 months after the Administrator's guidance is issued under this subsection and shall be deemed approved 9 months after the date of such submittal unless the Administrator disapproves the program as provided in section 1428(c). States shall begin implementation of the program immediately after its approval. The Administrator's approval of a State program under this subsection shall include a timetable, established in consultation with the State, allowing not more than 2 years for completion after approval of the program. Public water systems seeking monitoring relief in addition to the interim relief provided under section 1418(a) shall be eligible for monitoring relief, consistent with section 1418(b), upon completion of the assessment in the delineated source water

assessment area or areas concerned.

(4) TIMETABLE.— The timetable referred to in paragraph (3) shall take into consideration the availability to the State of funds under section 1452 (relating to State loan funds) for assessments and other relevant factors. The Administrator may extend any timetable included in a State program approved under paragraph (3) to extend the period for completion by an additional 18 months.

(5) DEMONSTRATION PROJECT.— The Administrator shall, as soon as practicable, conduct a demonstration project, in consultation with other Federal agencies, to demonstrate the most effective and protective means of assessing and protecting source waters serving large metropolitan areas and located on Federal lands.

(6) USE OF OTHER PROGRAMS.— To avoid duplication and to encourage efficiency, the program under this section may make use of any of the following:

(A) Vulnerability assessments, sanitary surveys, and monitoring programs.

(B) Delineations or assessments of ground water sources under a State wellhead protection program developed pursuant to this section.

(C) Delineations or assessments of surface or ground water sources under a State pesticide management plan developed pursuant to the Pesticide and Ground Water State Management Plan Regulation (subparts I and J of part 152 of title 40, Code of Federal Regulations), promulgated under section 3(d) of the Federal Insecticide, Fungicide, and Rodenticide Act (7 U.S.C. 136a(d)).

(D) Delineations or assessments of surface water sources under a State watershed initiative or to satisfy the watershed criterion for determining if filtration is required under the Surface Water Treatment Rule (section 141.70 of title 40, Code of Federal Regulations).

(E) Delineations or assessments of surface or ground water sources under programs or plans pursuant to the Federal Water Pollution Control Act.

(7) PUBLIC AVAILABILITY.— The State shall make the results of the source water assessments conducted under this subsection available to the public.

(b) APPROVAL AND DISAPPROVAL.— For provisions relating to program approval and disapproval, see section 1428(c).

SOURCE WATER PETITION PROGRAM

SEC. 1454. (a) PETITION PROGRAM.—

(1) IN GENERAL.—

(A) ESTABLISHMENT.— A State may establish a program under which an owner or operator of a community water system in the State, or a municipal or local government or political subdivision of a State, may submit a source water quality protection partnership petition to the State requesting that the State assist in the local development of a voluntary, incentive-based partnership, among the owner, operator, or government and other persons likely to be affected by the recommendations of the

partnership, to—

(i) reduce the presence in drinking water of contaminants that may be addressed by a petition by considering the origins of the contaminants, including to the maximum extent practicable the specific activities that affect the drinking water supply of a community;

(ii) obtain financial or technical assistance necessary to facilitate establishment of a partnership, or to develop and implement recommendations of a partnership for the protection of source water to assist in the provision of drinking water that complies with national primary drinking water regulations with respect to contaminants addressed by a petition; and

(iii) develop recommendations regarding voluntary and incentive-based strategies for the long-term protection of the source water of community water systems.

(B) FUNDING.— Each State may—

(i) use funds set aside pursuant to section 1452(k)(1)(A)(iii) by the State to carry out a program described in subparagraph (A), including assistance to voluntary local partnerships for the development and implementation of partnership recommendations for the protection of source water such as source water quality assessment, contingency plans, and demonstration projects for partners within a source water area delineated under section 1453(a); and

(ii) provide assistance in response to a petition submitted under this subsection using funds referred to in subsection (b)(2)(B).

(2) OBJECTIVES.— The objectives of a petition submitted under this subsection shall be to—

(A) facilitate the local development of voluntary, incentive-based partnerships among owners and operators of community water systems, governments, and other persons in source water areas; and

(B) obtain assistance from the State in identifying resources which are available to implement the recommendations of the partnerships to address the origins of drinking water contaminants that may be addressed by a petition (including to the maximum extent practicable the specific activities contributing to the presence of the contaminants) that affect the drinking water supply of a community.

(3) CONTAMINANTS ADDRESSED BY A PETITION.— A petition submitted to a State under this subsection may address only those contaminants—

(A) that are pathogenic organisms for which a national primary drinking water regulation has been established or is required under section 1412; or

(B) for which a national primary drinking water regulation has been promulgated or proposed and that are detected by adequate monitoring methods in the source water at the intake structure or in any collection, treatment, storage, or distribution facilities by the community water systems at levels—

(i) above the maximum contaminant level; or

(ii) that are not reliably and consistently below the maximum

contaminant level.

(4) CONTENTS.— A petition submitted under this subsection shall, at a minimum—

(A) include a delineation of the source water area in the State that is the subject of the petition;

(B) identify, to the maximum extent practicable, the origins of the drinking water contaminants that may be addressed by a petition (including to the maximum extent practicable the specific activities contributing to the presence of the contaminants) in the source water area delineated under section 1453;

(C) identify any deficiencies in information that will impair the development of recommendations by the voluntary local partnership to address drinking water contaminants that may be addressed by a petition;

(D) specify the efforts made to establish the voluntary local partnership and obtain the participation of—

(i) the municipal or local government or other political subdivision of the State with jurisdiction over the source water area delineated under section 1453; and

(ii) each person in the source water area delineated under section 1453—

(I) who is likely to be affected by recommendations of the voluntary local partnership; and

(II) whose participation is essential to the success of the partnership;

(E) outline how the voluntary local partnership has or will, during development and implementation of recommendations of the voluntary local partnership, identify, recognize and take into account any voluntary or other activities already being undertaken by persons in the source water area delineated under section 1453 under Federal or State law to reduce the likelihood that contaminants will occur in drinking water at levels of public health concern; and

(F) specify the technical, financial, or other assistance that the voluntary local partnership requests of the State to develop the partnership or to implement recommendations of the partnership.

(b) APPROVAL OR DISAPPROVAL OF PETITIONS.—

(1) IN GENERAL.— After providing notice and an opportunity for public comment on a petition submitted under subsection (a), the State shall approve or disapprove the petition, in whole or in part, not later than 120 days after the date of submission of the petition.

(2) APPROVAL.— The State may approve a petition if the petition meets the requirements established under subsection (a). The notice of approval shall, at a minimum, include for informational purposes—

(A) an identification of technical, financial, or other assistance that the State will provide to assist in addressing the drinking water contaminants that may be addressed

by a petition based on--

(i) the relative priority of the public health concern identified in the petition with respect to the other water quality needs identified by the State;

(ii) any necessary coordination that the State will perform of the program established under this section with programs implemented or planned by other States under this section; and

(iii) funds available (including funds available from a State revolving loan fund established under title VI of the Federal Water Pollution Control Act (33 U.S.C. 1381 et seq.)) or section 1452;

(B) a description of technical or financial assistance pursuant to Federal and State programs that is available to assist in implementing recommendations of the partnership in the petition, including--

(i) any program established under the Federal Water Pollution Control Act (33 U.S.C. 1251 et seq.);

(ii) the program established under section 6217 of the Coastal Zone Act Reauthorization Amendments of 1990 (16 U.S.C. 1455b);

(iii) the agricultural water quality protection program established under chapter 2 of subtitle D of title XII of the Food Security Act of 1985 (16 U.S.C. 3838 et seq.);

(iv) the sole source aquifer protection program established under section 1427;

(v) the community wellhead protection program established under section 1428;

(vi) any pesticide or ground water management plan;

(vii) any voluntary agricultural resource management plan or voluntary whole farm or whole ranch management plan developed and implemented under a process established by the Secretary of Agriculture; and

(viii) any abandoned well closure program; and

(C) a description of activities that will be undertaken to coordinate Federal and State programs to respond to the petition.

(3) DISAPPROVAL.-- If the State disapproves a petition submitted under subsection (a), the State shall notify the entity submitting the petition in writing of the reasons for disapproval. A petition may be resubmitted at any time if--

(A) new information becomes available;

(B) conditions affecting the source water that is the subject of the petition change; or

(C) modifications are made in the type of assistance being requested.

(c) GRANTS TO SUPPORT STATE PROGRAMS.--

(1) IN GENERAL.– The Administrator may make a grant to each State that establishes a program under this section that is approved under paragraph (2). The amount of each grant shall not exceed 50 percent of the cost of administering the program for the year in which the grant is available.

(2) APPROVAL.– In order to receive grant assistance under this subsection, a State shall submit to the Administrator for approval a plan for a source water quality protection partnership program that is consistent with the guidance published under subsection (d). The Administrator shall approve the plan if the plan is consistent with the guidance published under subsection (d).

(d) GUIDANCE.–

(1) IN GENERAL.– Not later than 1 year after the date of enactment of this section, the Administrator, in consultation with the States, shall publish guidance to assist–

(A) States in the development of a source water quality protection partnership program; and

(B) municipal or local governments or political subdivisions of a State and community water systems in the development of source water quality protection partnerships and in the assessment of source water quality.

(2) CONTENTS OF THE GUIDANCE.– The guidance shall, at a minimum–

(A) recommend procedures for the approval or disapproval by a State of a petition submitted under subsection (a);

(B) recommend procedures for the submission of petitions developed under subsection (a);

(C) recommend criteria for the assessment of source water areas within a State; and

(D) describe technical or financial assistance pursuant to Federal and State programs that is available to address the contamination of sources of drinking water and to develop and respond to petitions submitted under subsection (a).

(e) AUTHORIZATION OF APPROPRIATIONS.– There are authorized to be appropriated to carry out this section $5,000,000 for each of the fiscal years 1997 through 2003. Each State with a plan for a program approved under subsection (b) shall receive an equitable portion of the funds available for any fiscal year.

(f) STATUTORY CONSTRUCTION.– Nothing in this section–

(1)(A) creates or conveys new authority to a State, political subdivision of a State, or community water system for any new regulatory measure; or

(B) limits any authority of a State, political subdivision, or community water system; or

(2) precludes a community water system, municipal or local government, or political subdivision of a government from locally developing and carrying out a voluntary, incentive-based, source water quality protection partnership to address the origins of drinking water contaminants of public health concern.

WATER CONSERVATION PLAN

SEC. 1455. (a) GUIDELINES.-- Not later than 2 years after the date of enactment of the Safe Drinking Water Act Amendments of 1996, the Administrator shall publish in the Federal Register guidelines for water conservation plans for public water systems serving fewer than 3,300 persons, public water systems serving between 3,300 and 10,000 persons, and public water systems serving more than 10,000 persons, taking into consideration such factors as water availability and climate.

(b) LOANS OR GRANTS.-- Within 1 year after publication of the guidelines under subsection (a), a State exercising primary enforcement responsibility for public water systems may require a public water system, as a condition of receiving a loan or grant from a State loan fund under section 1452, to submit with its application for such loan or grant a water conservation plan consistent with such guidelines.

ASSISTANCE TO COLONIAS

SEC. 1456. (a) DEFINITIONS.-- As used in this section:

(1) BORDER STATE- The term `border State' means Arizona, California, New Mexico, and Texas.

(2) ELIGIBLE COMMUNITY- The term `eligible community' means a low-income community with economic hardship that--

(A) is commonly referred to as a colonia;

(B) is located along the United States-Mexico border (generally in an unincorporated area); and

(C) lacks a safe drinking water supply or adequate facilities for the provision of safe drinking water for human consumption.

(b) GRANTS TO ALLEVIATE HEALTH RISKS.-- The Administrator of the Environmental Protection Agency and the heads of other appropriate Federal agencies are authorized to award grants to a border State to provide assistance to eligible communities to facilitate compliance with national primary drinking water regulations or otherwise significantly further the health protection objectives of this title.

(c) USE OF FUNDS.-- Each grant awarded pursuant to subsection (b) shall be used to provide assistance to one or more eligible communities with respect to which the residents are subject to a significant health risk (as determined by the Administrator or the head of the Federal agency making the grant) attributable to the lack of access to an adequate and affordable drinking water supply system.

(d) COST SHARING.-- The amount of a grant awarded pursuant to this section shall not exceed 50 percent of the costs of carrying out the project that is the subject of the grant.

(e) AUTHORIZATION OF APPROPRIATIONS.– There are authorized to be appropriated to carry out this section $25,000,000 for each of the fiscal years 1997 through 1999.

ESTROGENIC SUBSTANCES SCREENING PROGRAM

SEC. 1457. In addition to the substances referred to in section 408(p)(3)(B) of the Federal Food, Drug, and Cosmetic Act (21 U.S.C. 346a(p)(3)(B)) the Administrator may provide for testing under the screening program authorized by section 408(p) of such Act, in accordance with the provisions of section 408(p) of such Act, of any other substance that may be found in sources of drinking water if the Administrator determines that a substantial population may be exposed to such substance.

DRINKING WATER STUDIES

SEC. 1458. (a) SUBPOPULATIONS AT GREATER RISK.–

(1) IN GENERAL.– The Administrator shall conduct a continuing program of studies to identify groups within the general population that may be at greater risk than the general population of adverse health effects from exposure to contaminants in drinking water. The study shall examine whether and to what degree infants, children, pregnant women, the elderly, individuals with a history of serious illness, or other subpopulations that can be identified and characterized are likely to experience elevated health risks, including risks of cancer, from contaminants in drinking water.

(2) REPORT.– Not later than 4 years after the date of enactment of this subsection and periodically thereafter as new and significant information becomes available, the Administrator shall report to the Congress on the results of the studies.

(b) BIOLOGICAL MECHANISMS.– The Administrator shall conduct biomedical studies to–

(1) understand the mechanisms by which chemical contaminants are absorbed, distributed, metabolized, and eliminated from the human body, so as to develop more accurate physiologically based models of the phenomena;

(2) understand the effects of contaminants and the mechanisms by which the contaminants cause adverse effects (especially noncancer and infectious effects) and the variations in the effects among humans, especially subpopulations at greater risk of adverse effects, and between test animals and humans; and

(3) develop new approaches to the study of complex mixtures, such as mixtures found in drinking water, especially to determine the prospects for synergistic or antagonistic interactions that may affect the shape of the dose-response relationship of the individual chemicals and microbes, and to examine noncancer endpoints and infectious diseases, and susceptible individuals and subpopulations.

(c) STUDIES ON HARMFUL SUBSTANCES IN DRINKING WATER.–

(1) DEVELOPMENT OF STUDIES.– The Administrator shall, not later than 180 days after the date of enactment of this section and after consultation with the Secretary of Health and Human Services, the Secretary of Agriculture, and, as appropriate, the heads of other Federal agencies, conduct the studies described in paragraph (2) to support the development and implementation of the most current version of each of the following:

(A) Enhanced Surface Water Treatment Rule (59 Fed. Reg. 38832 (July 29, 1994)).

(B) Disinfectant and Disinfection Byproducts Rule (59 Fed. Reg. 38668 (July 29, 1994)).

(C) Ground Water Disinfection Rule (availability of draft summary announced at (57 Fed. Reg. 33960; July 31, 1992)).

(2) CONTENTS OF STUDIES.– The studies required by paragraph (1) shall include, at a minimum, each of the following:

(A) Toxicological studies and, if warranted, epidemiological studies to determine what levels of exposure from disinfectants and disinfection byproducts, if any, may be associated with developmental and birth defects and other potential toxic end points.

(B) Toxicological studies and, if warranted, epidemiological studies to quantify the carcinogenic potential from exposure to disinfection byproducts resulting from different disinfectants.

(C) The development of dose-response curves for pathogens, including cryptosporidium and the Norwalk virus.

(3) AUTHORIZATION OF APPROPRIATIONS.– There are authorized to be appropriated to carry out this subsection $12,500,000 for each of fiscal years 1997 through 2003.

(d) WATERBORNE DISEASE OCCURRENCE STUDY.–

(1) SYSTEM.– The Director of the Centers for Disease Control and Prevention, and the Administrator shall jointly–

(A) within 2 years after the date of enactment of this section, conduct pilot waterborne disease occurrence studies for at least 5 major United States communities or public water systems; and

(B) within 5 years after the date of enactment of this section, prepare a report on the findings of the pilot studies, and a national estimate of waterborne disease occurrence.

(2) TRAINING AND EDUCATION.– The Director and Administrator shall jointly establish a national health care provider training and public education campaign to inform both the professional health care provider community and the general public about waterborne disease and the symptoms that may be caused by infectious agents, including microbial contaminants. In developing such a campaign, they shall seek comment from interested groups and individuals, including scientists, physicians, State and local governments, environmental groups, public water systems, and vulnerable

populations.

(3) FUNDING.— There are authorized to be appropriated for each of the fiscal years 1997 through 2001, $3,000,000 to carry out this subsection. To the extent funds under this subsection are not fully appropriated, the Administrator may use not more than $2,000,000 of the funds from amounts reserved under section 1452(n) for health effects studies for purposes of this subsection. The Administrator may transfer a portion of such funds to the Centers for Disease Control and Prevention for such purposes.

Part F Additional Requirements to Regulate the Safety of Drinking Water

DEFINITIONS

SEC. 1461. As used in this part-

(1) Drinking water cooler.-The term "drinking water cooler" means any mechanical device affixed to drinking water supply plumbing which actively cools water for human consumption.

(2) Lead free.-The term "lead free" means, with respect to a drinking water cooler, that each part of component of the cooler which may come in contact with drinking water contains not more than 8 percent lead, except that no drinking water cooler which contains any solder, flux, or storage tank interior surface which may come in contact with drinking water shall be considered lead free if the solder, flux, or storage tank interior surface contains more than 0.2 percent lead. The Administrator may establish more stringent requirements for treating any part or component of a drinking water cooler as lead free for purposes of this part whenever he determines that any such part may constitute an important source of lead in drinking water.

(3) Local educational agency.-The term "local educational agency" means-

(A) any local educational agency as defined in section 198 of the Elementary and Secondary Education Act of 1965 (20 U.S.C. 3381),

(B) the owner of any private, nonprofit elementary or secondary school building, and

(C) the governing authority of any school operating under the defense dependent's education system provided for under the Defense Dependent's Education Act of 1978 (20 U.S.C. 921 and following).

(4) Repair.-The term "repair" means, with respect to a drinking water cooler, to take such corrective action as is necessary to ensure that water cooler is lead free.

(5) Replacement.-The term "replacement," when used with respect to a drinking water cooler, means the permanent removal of the water cooler and the installation of a lead-free water cooler.

(6) School.-The term "school" means any elementary school or secondary school as defined in section 198 of the Elementary and Secondary Education Act of 1965 (20 U.S.C. 2854) and any kindergarten or day care facility.

(7) Lead-lined tank.-The term "lead-lined tank" means a water reservoir container in a

drinking water cooler which container is constructed of lead or which has an interior surface which is not lead free.

RECALL OF DRINKING WATER COOLERS WITH LEAD-LINED TANKS

SEC. 1462. For purposes of the Consumer Product Safety Act, all drinking water coolers identified by the Administrator on the list under section 1463 as having a lead-lined tank shall be considered to be imminently hazardous consumer products within the meaning of section 12 of such Act (15 U.S.C. 2061). After notice and opportunity for comment, including a public hearing, the Consumer Product Safety Commission shall issue an order requiring the manufacturers and importers of such coolers to repair, replace, or recall and provide a refund for such coolers within 1 year after the enactment of the Lead Contamination Control Act of 1988. For purpose of enforcement, such order shall be treated as an order under section 15(d) of that Act (15 U.S.C. 2064(d)).

DRINKING WATER COOLERS CONTAINING LEAD

SEC. 1463. (a) Publication of Lists.-The Administrator shall, after notice and opportunity for public comment, identify each brand and model of drinking water cooler which is not lead free, including each brand and model of drinking water cooler which has a lead-lined tank. For purposes of identifying the brand and model of drinking water coolers under this subsection, the Administrator shall use the best information available to the Environmental Protection Agency. Within 100 days after the enactment of this section, the Administrator shall publish a list of each brand and model of drinking water cooler identified under this subsection. Such list shall separately identify each brand and model of cooler which has a lead-lined tank. The Administrator shall continue to gather information regarding lead in drinking water coolers and shall revise and republish the list from time to time as may be appropriate as new information or analysis becomes available regarding lead contamination in drinking water coolers.

(b) Prohibition.-No person may sell in interstate commerce, or manufacture for sale in interstate commerce, any drinking water cooler listed under subsection (a) or any other drinking water cooler which is not lead free, including a lead-lined drinking water cooler.

(c) Criminal Penalty.-Any person who knowingly violates the prohibition contained in subsection (b) shall be imprisoned for not more than 5 years, or fined in accordance with title 18 of the United States Code, or both.

(d) Civil Penalty.-The Administrator may bring a civil action in the appropriate United States District Court (as determined under the provisions of title 28 of the United States Code) to impose a civil penalty on any person who violates subsection (b). In any such action the court may impose on such person a civil penalty of not more than $5,000 ($50,000 in the case of second or subsequent violation).

LEAD CONTAMINATION IN SCHOOL DRINKING WATER

SEC. 1464. (a) Distribution of Drinking Water Cooler List.-Within 100 days after the enactment of this section, the Administrator shall distribute to the States a list of each brand and model of drinking water cooler identified and listed by the Administrator under section 1463(a).

(b) Guidance Document and Testing Protocol.-The Administrator shall publish a guidance document and a testing protocol to assist schools in determining the source and degree of lead contamination in school drinking water supplies and in remedying such contamination. The guidance document shall also include guidelines for sample preservation. The guidance document shall include guidance to assist States, schools, and the general public in ascertaining the levels of lead contamination in drinking water coolers and in taking appropriate action to reduce or eliminate such contamination. The guidance document shall contain a testing protocol for the identification of drinking water coolers which contribute to lead contamination in drinking water. Such document and protocol may be revised, republished and redistributed as the Administrator deems necessary. The Administrator shall distribute the guidance document and testing protocol to the States within 100 days after the enactment of this section.

(c) Dissemination to Schools, Etc.-Each State shall provide for the dissemination to local educational agencies, private nonprofit elementary or secondary schools and to day care centers of the guidance document and testing protocol published under subsection (b), together with the list of drinking water coolers published under section 1463(a).

(d) Remedial Action Program.-

(1) Testing and remedying lead contamination.-Within 9 months after the enactment of this section, each State shall establish a program, consistent with this section, to assist local educational agencies in testing for, and remedying, lead contamination in drinking water coolers and from other sources of lead contamination at schools under the jurisdiction of such agencies.

(2) Public availability.-A copy of the results of any testing under paragraph (1) shall be available in the administrative offices of the local educational agency for inspection by the public, including teachers, other school personnel, and parents. The local educational agency shall notify parent, teacher, and employee organizations of the availability of such testing results.

(3) Coolers.-In the case of drinking water coolers, such program shall include measures for the reduction or elimination of lead contamination from those water coolers which are not lead free and which are located in schools. Such measures shall be adequate to ensure that within 15 months after the enactment of this subsection all such water coolers in schools under the jurisdiction of such agencies are repaired, replaced, permanently removed, or rendered inoperable unless the cooler is tested and found (within the limits of testing accuracy) not to contribute lead in drinking water.

FEDERAL ASSISTANCE FOR STATE PROGRAMS REGARDING LEAD CONTAMINATION IN SCHOOL DRINKING WATER

SEC. 1465. (a) School Drinking Water Programs.-The Administrator shall make grants to States to establish and carry out State programs under section 1464 to assist local

educational agencies in testing for, and remedying, lead contamination in drinking water from drinking water coolers and from other sources of lead contamination at schools under the jurisdiction of such agencies. Such grants may be used by states to reimburse local educational agencies for expenses incurred after the enactment of this section for such testing and remedial action.

(b) Limits.-Each grant under this section shall be used as by the State for testing water coolers in accordance with section 1464, for testing for lead contamination in other drinking water supplies under section 1464, or for remedial action under State programs under section 1464. Not more than 5 percent of the grant may be used for program administration.

(c) Authorization of Appropriations.-There are authorized to be appropriated to carry out this section not more than $30,000,000 for fiscal year 1989, $30,000,000 for fiscal year 1990, and $30,000,000 for fiscal year 1991.

FDEP Rules

CHAPTER 62-550
DRINKING WATER STANDARDS, MONITORING, AND REPORTING

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(b) Total trihalomethane potential may be used by a community water system that uses only ground water sources to reduce the monitoring frequency required by this paragraph upon written request to the Department and the Department's approval. Approved reduced monitoring frequency for total trihalomethane potential shall never be less than one sample per year. For the monitoring frequency to be reduced, the system shall submit to the Department the results of at least one sample analyzed for maximum total trihalomethanes potential for each treatment plant used by the system. Monitoring frequency shall be reduced if the Department finds that the results have a maximum total trihalomethanes potential of less than 0.10 milligrams per liter and that, based upon an assessment of the system and local conditions affecting it, the system is not likely to exceed 50 percent of the maximum contaminant level for total trihalomethanes.

(c) If at any time during which the reduced monitoring described in paragraph (a) or (b) of this subsection applies, the results from any analysis taken by the system for total trihalomethanes or maximum total trihalomethanes potential are equal to or greater than 0.10 milligrams per liter, such results shall be confirmed by at least one check sample taken promptly after the results are received. If the check sample confirms that the total trihalomethane or maximum trihalomethanes potential is greater than or equal to 0.10 milligrams per liter, the system shall immediately begin monitoring in accordance with the requirements of subsection (2) of this section, and such monitoring shall continue for at least four consecutive quarters before the frequency may be reduced again.

(d) In the event of any significant change to the system's raw water or treatment program, the system shall immediately analyze an additional sample for total trihalomethanes or total trihalomethanes potential. If the data submitted by the water system indicate that the levels of total trihalomethanes within the distribution system are subject to significant variations, the Department shall require more frequent monitoring.

(e) All samples required by paragraphs (a), (b), (c), and (d) of this subsection shall be taken at a point within the distribution system that reflects the maximum residence time of the water in the system.

(4) Compliance with Rule 62-550.310(2)(a), F.A.C., shall be determined by the Department based on a running annual average of samples collected by the system as described in subsection (2) or paragraph (3) of this section. If the average of sample results covering any four consecutive quarterly periods exceeds the maximum contaminant level, the supplier of water shall comply with Rule 62-550.500(8), F.A.C. The temporary monitoring frequency established by the Department pursuant to Rule 62-550.500(4), F.A.C., shall continue until the maximum contaminant level has not been exceeded in the average of successive samples for 12 months.

Specific Authority 403.853(3), 403.861(9), FS.
Law Implemented 403.853(1), (3), (7), 403.861(16, (1), FS.

PART I
PURPOSE AND INTENT

62-550.101 Authority, Intent, and Policy

Specific Authority 403.861(1), FS.
Law Implemented 403.851, FS.
History -- New 11-9-77; Formerly 17-22.101; Amended 1-18-89, Formerly 17-550.101, Repealed 12-9-96.

62-550.102 Intent and Scope.

(1) To assure that public water systems supply drinking water which meets minimum requirements, the Federal Government enacted PL 93-523, the "Safe Drinking Water Act." The scheme of that law was to give primary responsibility for public water systems programs to states to implement a public water system program. Also, the legislature of Florida has enacted the "Florida Safe Drinking Water Act," sections 403.850-403.864, F.S. This chapter and chapters 62-555 and 62-560, F.A.C., are promulgated to implement the requirements of the Florida Safe Drinking Water Act and to acquire and maintain primacy for Florida under the Federal Act. This chapter and chapter 62-555 and 62-560, F.A.C., adopt national primary and secondary drinking water standards of the Federal Government where possible, and otherwise create additional rules to fulfill state and Federal requirements.

(2) The Safe Drinking Water Act and the Florida Safe Drinking Water Act exclude certain public water systems from coverage. The drinking water rules in chapters 62-550, 62-555, and 62-560, F.A.C., apply to all public water systems except those which meet all of the following criteria:

(a) Consist of distribution and storage facilities only and do not have any collection or treatment facilities;

(b) Obtain all water from, but are not owned or operated by, a public water system to which such rules apply;

(c) Do not sell water to any person; and

(d) Are not carriers which convey passengers in interstate commerce.

(3) This Chapter sets the drinking water standards and monitoring requirements to be met by public water systems and the testing protocol required for certified laboratories.

(4) Chapter 62-555, F.A.C., sets the permitting requirements for public water systems including the location and construction of wells serving the system and the treatment plant. Construction of public water systems require permits and the use of lead free pipes, plumbing fixtures, solder and flux. General permits for public water systems are included. Engineering references are listed.

(5) Chapter 62-560, F.A.C., gives the description of the violations of chapters 62-550, 62-555, and 62-560, F.A.C., and the resulting penalties. In addition, this chapter describes the public notification requirements for a public water system not meeting a maximum contaminant level, or not being lead free. This chapter also describes the availability and processes for receiving variances, exemptions, and waivers. Additionally, best available technologies and treatment techniques are listed for various contaminants

Specific Authority 403.861(9), FS.
Law Implemented 403.851, 403.853(2), FS.
History -- New 11-9-77; Amended 1-13-81; Formerly 17-22.102; Amended 1-18-89, Formerly 17-550.102, Amended 12-9-96.
NOTE: Section 381.261, F.S., gives general supervision and control over all private water systems and public water systems not covered or included in the Florida Safe Drinking Water Act to the Department of Health and Rehabilitative Services (HRS). The Department interprets this as meaning that HRS has supervision and control of all water systems which meet all of the four exception criteria and which also have at least 15 service connections or which regularly serve at least 25 individuals daily at least 60 days out of the year. The Department also interprets Section 381.261, F.S., as meaning that HRS has supervision and control of all water systems that have less than 15 service connections or which regularly serve less than 25 individuals daily at least 60 days out of the year, or at least 25 individuals daily less than 60 days out of the year.

62-550.103 Effective Date.
Specific Authorit: 403.861(9), FS.
Law Implemented 120.54(13)(a), 403.861(9), FS.
History -- New 1-1-93, Formerly 17-550.103, Repealed 12-9-96.

PART II
DEFINITIONS

62-550.200 Definitions for Public Water Systems. For the purpose of this chapter and chapters 62-555 and 62-560, F.A.C., the following words, phrases, or terms shall have the following meaning:

(1) "ACTION LEVEL" is the concentration of lead or copper in water specified in the Code of Federal Regulations, title 40, part 141, section 80(c) (1995) (abbreviated as 40 C.F.R. part 141.80(c)) which determines, in some cases, the treatment requirements contained in 40 C.F.R. subpart I (1995), that a system is required to complete.

(2) "ADEQUATE Protection BY TREATMENT" means any one or any combination of the controlled processes of coagulation, sedimentation, absorption, adsorption, filtration, or other processes in addition to disinfection which produce a water that consistently meets the requirements of the standards in Rules 62-550.310 through .410, F.A.C., including processes which are appropriate to the source of supply; systems which are of adequate capacity to meet maximum demands without creating health hazards and which are located, designed, and constructed to eliminate or prevent violations of these rules; and conscientious operation by well-trained and competent personnel who meet the requirements of Chapter 62-16, F.A.C.

(3) "ANNULAR SPACE" means the space between two casings or the space between the outer casing and the wall of the bore hole.

(4) "APPROVED COUNTY PUBLIC HEALTH UNIT" means county public health units designated by the Department of Health and Rehabilitative Services and approved by the department as having qualified sanitary engineering staffs to perform the duties described in Section 403.862(1)(c), F.S.

(5) "BEST AVAILABLE TECHNOLOGY" or "BAT" means the best technology, treatment techniques, or other means promulgated by EPA and adopted by the Department. In promulgating BAT the EPA examines the efficacy under field conditions and not solely under laboratory conditions, and takes costs into consideration when determining what technology or treatment is available.

(6) "BOTTLED WATER" means water that is containerized or packaged and offered for human consumption or other consumer usage.

(7) "CASING" means the tubular material used to shut off or exclude a stratum or strata other than the source bed and conduct water from only the source bed to the surface.

(8) "CHECK SAMPLE" means a sample analysis or analyses used to confirm the results of another sample. Each sample for the analysis shall be taken or measured at the same location in the water system as the original sample.

(9) "COAGULATION" means a process using coagulant chemicals and mixing by which colloidal and suspended materials are destabilized and agglomerated into flocs.

(10) "COMMUNITY WATER SYSTEM" means a public water system which serves at least 15 service connections used by year-round residents or regularly serves at least 25 year-round residents.

(11) "COMPLIANCE CYCLE" means the nine-year cycle during which public water systems must monitor. Each compliance cycle consists of three three-year compliance periods. The first compliance cycle begins January 1, 1993 and ends December 31, 2001; the second begins January 1, 2002 and ends December 31, 2010; the third begins January 1, 2011 and ends December 31, 2019.

(12) "COMPLIANCE PERIOD" means a three-year period within a compliance cycle. Each compliance cycle has three three-year compliance periods. Within the first

compliance cycle, the first compliance period runs from January 1, 1993 to December 31, 1995; the second from January 1, 1996 to December 31, 1998; the third from January 1, 1999 to December 31, 2001.

(13) "CONFIRMATION SAMPLE" means a sample analysis or analyses taken to verify the results of an original analysis. Each sample for the analysis shall be taken or measured at the same location in the water system as the original sample. The results of the confirmation samples shall be averaged with the original sample to determine compliance.

(14) "CONFLUENT GROWTH" means a continuous bacterial growth covering the entire filtration area of a membrane filter used for coliform detection, or a portion thereof, in which bacterial colonies are not discrete.

(15) "CONTAMINANT" means any physical, chemical, biological, or radiological substance or matter in water.

(16) "CONVENTIONAL FILTRATION TREATMENT" means a series of processes including coagulation, flocculation, sedimentation, and filtration resulting in substantial particulate removal.

(17) "CORROSION INHIBITOR" means a substance capable of reducing the corrosivity of water toward metal plumbing materials, especially lead and copper, by forming a protective film on the interior surface of those materials.

(18) "CROSS-CONNECTION" means any physical arrangement whereby a public water supply is connected, directly or indirectly, with any other water supply system, sewer, drain, conduit, pool, storage reservoir, plumbing fixture, or other device which contains or may contain contaminated water, sewage or other waste, or liquid of unknown or unsafe quality which may be capable of imparting contamination to the public water supply as the result of backflow. By-pass arrangements, jumper connections, removable sections, swivel or changeable devices, and other temporary or permanent devices through which or because of which backflow could occur are considered to be cross-connections.

(19) "CT" is the product of "residual disinfectant concentration" (C) in milligrams per liter determined before or at taps providing water for human consumption, and the corresponding "disinfectant contact time" (T) in minutes.

(20) "DEPARTMENT" means the Department of Environmental Protection (DEP) and the Approved County Public Health Units, and, where the context is appropriate, their employees.

(21) "DIATOMACEOUS EARTH FILTRATION" means a process resulting in substantial particulate removal in which a precoat cake of diatomaceous earth filter media is deposited on a support membrane (septum); and, while the water is filtered by passing through the cake on the septum, additional filter media known as body feed is continuously added to the feed water to maintain the permeability of the filter cake.

(22) "DIRECT FILTRATION" means a series of processes including coagulation and filtration but excluding sedimentation resulting in substantial particulate removal.

(23) "DISINFECTANT" means any oxidant, including but not limited to chlorine, chlorine dioxide, chloramines, and ozone added to water in any part of the treatment or distribution process, that is intended to kill or inactivate pathogenic microorganisms.

(24) "DISINFECTANT CONTACT TIME" ("T" in CT calculations) means the time in minutes that it takes for water to move from the point of disinfectant application or the previous point of disinfectant residual measurement to a point before or at the point where residual disinfectant concentration ("C") is measured.

(25) "DISINFECTION" means a process which inactivates pathogenic organisms in water by chemical oxidants or equivalent agents.

(26) "DOMESTIC OR OTHER NON-DISTRIBUTION SYSTEM PLUMBING PROBLEM" means a coliform contamination problem in a public water system with more than one service connection that is limited to the specific service connection from which the coliform-positive sample was taken.

(27) "DOSE EQUIVALENT" means the product of the absorbed dose from ionizing radiation and such factors as account for differences in biological effectiveness due to the type of radiation and its distribution in the body, specified by the International Commission on Radiological Units and Measurements (ICRU).

(28 "EFFECTIVE CORROSION INHIBITOR RESIDUAL," for the purpose of 40 C.F.R. subpart I (1995) only, means a concentration sufficient to form a passivating film on the interior walls of a pipe.

(29) "EXEMPTION" means approval from the Department affording a public water system, existing as of the effective date of these rules, an extended time for compliance with a maximum contaminant level or treatment technique contained in a drinking water standard. An exemption pertains to non-compliance with a maximum contaminant level for reasons other than that instance when application of a generally available treatment method fails to adequately treat the raw water source.

(30) "FILTRATION" means a process for removing particulate matter from water by passage through porous media.

(31) "FIRST DRAW SAMPLE" means a one-liter sample of tap water, collected in accordance with 40 C.F.R. part 141.86(b)(2) (1995), that has been standing in plumbing pipes at least 6 hours and is collected without flushing the tap.

(32) "FLOCCULATION" means a process to enhance agglomeration or collection of smaller floc particles into larger, more easily settleable particles through gentle stirring by hydraulic or mechanical means.

(33) "GROSS ALPHA PARTICLE ACTIVITY" means the total radioactivity due to alpha particle emission as inferred from measurements on a dry sample.

(34) "GROSS BETA PARTICLE ACTIVITY" means the total radioactivity due to beta particle emission as inferred from measurements on a dry sample.

(35) "GROUND WATER UNDER THE DIRECT INFLUENCE OF SURFACE WATER" means any water beneath the surface of the ground with:

(a) significant occurrence of insects or other macroorganisms, algae, or large-diameter pathogens such as Giardia lamblia or Cryptosporidium, or

(b) significant and relatively rapid shifts in water characteristics such as turbidity, temperature, conductivity, or pH which closely correlate to climatological or surface water conditions.

(36) "HALOGEN" as used in the present context of this rule means one of the chemical elements chlorine or bromine.

(37) "HEALTH HAZARDS" means any conditions, devices, or practices in a water supply system or its operation which create or may create an imminent and substantial danger to the health and well-being of the water consumer.

(38) "HETEROTROPHIC PLATE COUNT," formerly known as the standard plate count, is a procedure for estimating the number of live heterotrophic bacteria in water. Unless stated otherwise, heterotrophic plate count refers to Method (9215A), the pour plate method, as set forth in Standard Methods for Examination of Water and Wastewater, American Public Health Association, 17th Edition, 1989, pp. 9-58 to 9-60.

(39) "HUMAN CONSUMPTION" means water which is ingested, or absorbed into the body by dermal contact or through inhalation, except water which is used solely for fire or chemical emergencies.

(40) "INITIAL COMPLIANCE PERIOD" means the first full three-year compliance period that begins January 1, 1993.

(41) "LARGE SYSTEM," for the purpose of 40 C.F.R. subpart I (1995) only, means a water system that serves more than 50,000 people.

(42) "LEAD SERVICE LINE" means a service line made of lead which connects the water main to the building inlet and any lead pigtail, gooseneck or other fitting which is connected to such a lead line.

(43) LEGIONELLA means a genus of bacteria some species of which have caused a type of pneumonia called Legionnaires Disease.

(44) "LINER" means the tubular material used to seal off caving materials which may be encountered below the bottom end of the well casing. A liner shall not be allowed to overlap or telescope into any portion of the well casing.

(45) "MAN-MADE BETA PARTICLE AND PHOTON EMITTERS" means all radionuclides emitting beta particles or photons listed in "Maximum Permissible Body Burdens and Maximum Permissible Concentration of Radionuclides in Air or Water for Occupational Exposure," NBS Handbook 69, except the daughter products of thorium-232, uranium-235, and uranium-238.

(46) "MAXIMUM CONTAMINANT LEVEL" (MCL) means the maximum permissible level of a contaminant in water which is delivered to any user of a public water system.

(47) "MAXIMUM TOTAL TRIHALOMETHANE POTENTIAL" (MTP) means the maximum concentration of total trihalomethanes produced in a given water containing a disinfectant residual after 7 days at a temperature of 25°C or above.

(48) "MEDIUM SYSTEM," for the purpose of 40 C.F.R. subpart I (1995) only, means a water system that serves greater than 3,300 and less than or equal to 50,000 people.

(49) "NEAR THE FIRST SERVICE CONNECTION" means at one of the 20 percent of all service connections in the entire system that are nearest the water supply treatment facility, as measured by water transport time within the distribution system.

(50) "NON-COMMUNITY WATER SYSTEM" means a public water system which provides piped water for human consumption to at least 15 service connections or which serves at least 25 individuals at least 60 days out of the year but which is not a community water system. NOTE: The difference between community water systems and non-community water systems is that the former serves inhabitants whereas the latter serves transients or non-residents who otherwise do not inhabit the building served by the system. Other public water systems are addressed in Chapter 10D-4, F.A.C.

(51) "NON-TRANSIENT NON-COMMUNITY WATER SYSTEM" means a public water system that is not a community water system and that regularly serves at least 25 of the same persons over 6 months per year.

(52) "OPTIMAL CORROSION CONTROL TREATMENT," for the purpose of 40 C.F.R. subpart I (1995) only, means the corrosion control treatment that minimizes the lead and copper concentrations at users' taps while ensuring that the treatment does not cause the system to violate any national primary drinking water regulations.

(53) "PERSON" means an individual, public or private corporation, company, association, partnership, municipality, agency of the state, district, Federal agency, or any other legal entity, or its legal representative, agent, or assigns.

(54) "PICOCURIE (pCi)" means that quantity of radioactive material producing 2.22 nuclear transformations per minute.

(55) "POINT OF DISINFECTANT APPLICATION" is the point where the disinfectant is applied and water downstream of the point is not subject to recontamination by surface water runoff.

(56) "POINT-OF-ENTRY TREATMENT DEVICE" is a treatment device applied to the drinking water entering a house or building in order to reduce contaminants in the drinking water distributed throughout the house or building.

(57) "POINT-OF-USE TREATMENT DEVICE" is a treatment device applied to a single tap used in order to reduce contaminants in drinking water at that location.

(58) "PUBLIC WATER SYSTEM" means a system that provides piped water to the public for human consumption, if it has at least fifteen service connections or regularly serves at least twenty-five individuals daily at least 60 days out of the year. Such terms include: 1) any collection, treatment, storage and distribution facilities

under control of the operator of such system and used primarily in connection with such system; and 2) any collection or pretreatment storage facilities not under such control which are used primarily in connection with such system. A public water system is a "community water system," a "non-community water system," or a "non-transient non-community water system."

(59) "RECLAIMED WATER" means water that has received at least secondary treatment and is reused after flowing out of a wastewater treatment facility.

(60) "REM" means the unit of dose equivalent from ionizing radiation to the total body or any internal organ or organ system. A "millirem" (mrem) is 1/1000 of a rem.

(61) "REPEAT COMPLIANCE PERIOD" means any subsequent compliance period after the initial compliance period.

(62) "RESIDUAL DISINFECTANT CONCENTRATION" ("C" in CT calculations) means the concentration of disinfectant measured in milligrams per liter in a representative sample of water.

(63) "SANITARY HAZARD" means a physical condition which involves or affects any part of a drinking water system or the raw water source, and that creates an imminent or potentially serious risk to the health of any person who consumes water from that system.

(64) "SANITARY SURVEY" means an on-site review of the water source, facilities, equipment, operation, and maintenance of a public water system to evaluate the adequacy of such source, facilities, equipment, operation, and maintenance for producing and distributing safe drinking water.

(65) "SEDIMENTATION" means a process for removal of solids before filtration by gravity or separation.

(66) "SERVICE LINE SAMPLE" means a one-liter sample of water collected in accordance with 40 C.F.R. part 141.86(b)(3), (1995), that has been standing for at least 6 hours in a service line.

(67) "SINGLE FAMILY STRUCTURE," for the purpose of 40 C.F.R. subpart I only, means a building constructed as a single-family residence that is currently used as either a residence or a place of business.

(68) "SLOW SAND FILTRATION" means a process involving passage of raw water through a bed of sand at low velocity (generally less than 0.4 meters per hour) resulting in substantial particulate removal by physical and biological mechanisms.

(69) "SMALL SYSTEM," for the purpose of 40 C.F.R. subpart I (1995) only, means a water system that serves 3,300 people or less.

(70) "SOURCE WATER SAMPLE" for the purpose of 40 C.F.R. subpart I (1995) only, means a sample that is collected at an entry point to the distribution system and is representative of a source of supply after treatment.

(71) "STANDARD BACTERIA SAMPLE" means the aliquot of raw or finished drinking water that is examined for the presence of coliform bacteria, and shall consist of: a. For the bacteriological fermentation tube test, five (5) standard portions of either:

1. Ten milliliters (10 ml); 2. or one hundred milliliters (100 ml); b. For the membrane filter technique, not less than one hundred milliliters (100 ml).

(72) "SUPPLIER OF WATER" means any person who owns or operates a public water system.

(73) "SURFACE WATER" means water upon the surface of the earth, whether contained in bounds created naturally or artificially or diffused. Water from natural springs shall be classified as surface water when it exits from the spring onto the earth's surface.

(74) "SYSTEM WITH A SINGLE SERVICE CONNECTION" means a system which supplies drinking water to consumers via a single service line.

(75) "TOO NUMEROUS TO COUNT" means that the total number of bacterial colonies exceed 200 on a 47-millimeter diameter membrane filter used for coliform detection.

(76) "TOTAL TRIHALOMETHANES" (TTHM) means the sum of the concentration in milligrams per liter of the trihalomethane compounds: trichloromethane (chloroform), dibromochloromethane, bromodichloromethane, tribromomethane (bromoform), rounded to two significant figures.

(77) "TREATMENT TECHNIQUE" means the technology, when installed in a public water system, which leads to the reduction of contaminant levels.

(78) "TRIHALOMETHANE" (THM) means one of the family of organic compounds named as derivatives of methane, wherein three of the four hydrogen atoms in methane are each substituted by a halogen atom in the molecular structure.

(79) "VARIANCE" means approval from the Department affording a public water system an extended time for compliance with a maximum contaminant level or treatment technique contained in a drinking water standard. A variance pertains to non-compliance with a maximum
contaminant level due to the inability to meet the maximum contaminant level even when a treatment method has been applied to the raw water source. The non-compliance is due to the quality of the raw water.

(80) "VIRUS" means a virus of fecal origin which is infectious to humans by waterborne transmission.

(81) "WAIVER" means approval from the Department for reduction of chlorination, elimination of certified water plant operator requirements for non-community or non-transient non-community water systems, or the reduction of monitoring requirements for organic contaminants listed in Rules 62-550.310(2)(b) and (c), F.A.C.

(82) "WATERBORNE DISEASE OUTBREAK" means the occurrence of acute infectious illness, epidemiologically associated with the ingestion of water from a public water system which is deficient in treatment, as determined by the Department.

(83) "WELL" means any excavation that is drilled, cored, bored, washed, driven, dug, jetted, or otherwise constructed when the intended use of such excavation is to

conduct ground water from a source bed to the surface, by pumping or natural flow, when ground water from such excavation is used or is to be used for a public water supply system.
Specific Authority 403.861(9), FS.
Law Implemented 403.853, 403.862, FS.
History -- New 11-9-7, Amended 1-13-81, 11-19-87, Formerly 17-22.103, Amended 1-18-89, 5-7-90, 1-3-91, 1-1-93, Formerly 17-550.200, Amended 9-7-94, Amended 12-9-96.

PART III
QUALITY STANDARDS

62-550.300 Application of Quality Standards to Public Water Systems. The ultimate concern of a public drinking water program is the quality of piped water for human consumption when the water reaches the consumers. The following rules establish the maximum contaminant levels for the water within public water systems. Public water systems shall not exceed the maximum contaminant levels established herein unless granted a variance or exemption pursuant to Rules 62-560.510 or 62-560.520, F.A.C., or identified as excluded from the standards by this Chapter. Public water systems shall take necessary corrective action approved by the Department to meet all applicable standards. Treatment techniques in lieu of maximum contaminant levels for surface water systems or ground water systems under the direct influence of surface water are referenced in Rule 62-555.600, F.A.C., Scope of Additional Requirements For Surface Water Systems.
Specific Authority 403.861(9), FS.
Law Implemented 403.852(12), (13), 403.853(1), FS.
History -- New 11-9-77, Amended 1-13-81, 3-30-82, 5-23-84, 11-19-87, Formerly 17-22.200, Amended 1-18-89, 1-3-91, Formerly 17-550.300.

62-550.310 Primary Drinking Water Standards Maximum Contaminant Levels. (These standards may also apply as ground water quality standards as referenced in Chapter 62-520, F.A.C.)

(1) INORGANICS - Except for nitrate and nitrite, which apply to all public water systems, this subsection applies to community water systems and non-transient non-community water systems only.

(a) The maximum contaminant levels for the inorganic contaminants are listed in Table 1, which is incorporated herein and appears at the end of this Chapter.

(b) The maximum contaminant level for nitrate (as N) applicable to non-community water systems is 10 milligrams per liter. The Department or Approved County Public Health Unit shall allow a contaminant level for nitrate (as N) of up to 20

milligrams per liter upon a showing by the supplier of water that the following conditions are met:

1. The water distributed by the water system is not available to children under 6 months of age or to lactating mothers, and

2. There is continuous public notification of what the nitrate level (as N) is and the potential health effects of such exposure are.

3. The Department shall require monitoring every 3 months as long as the maximum contaminant level is exceeded. Should adverse health effects occur, the Department shall require immediate compliance with the maximum contaminant level for nitrate (as N).

(2) ORGANICS - Paragraphs (a) below applies only to community water systems serving more than 10,000 people. Paragraphs (b) and (c) apply to community and non-transient non-community water systems. Paragraph (d) applies to all public water systems that use acrylamide or epichlorohydrin in their water systems.

(a) Total trihalomethanes (the sum of the concentrations of bromodichloromethane, dibromochloromethane, tribromomethane (bromoform) and trichloromethane (chloroform)). The maximum contaminant level is 0.10 milligrams per liter (mg/L).

(b) The maximum contaminant levels for the volatile organic compounds are listed in Table 2 which is incorporated herein and appears at the end of this Chapter.

(c) The maximum contaminant levels for the pesticides and polychlorinated biphenyls (PCBs) are listed in Table 3 which is incorporated herein and appears at the end of this Chapter.

(d) There are no maximum contaminant levels for the water treatment chemicals acrylamide and epichlorohydrin. However, treatment techniques pursuant to Rule 62-550.325, F.A.C., shall apply.

(3) MICROBIOLOGICAL - This subsection applies to all public water systems. Monitoring requirements to demonstrate compliance with this subsection are defined in Rule 62-550.518, F.A.C.

(a) The maximum contaminant level is based on the presence or absence of total coliforms in a sample, rather than coliform density. For the purpose of the public notice requirements in Rule 62-560.410, F.A.C., a violation of the standards in this paragraph poses a non-acute risk to health.

1. For a system which collects at least 40 samples per month, if no more than 5.0 percent of the samples collected during a month are total coliform-positive, the system is in compliance with the maximum contaminant level for total coliforms.

2. For a system which collects fewer than 40 samples per month, if no more than one sample collected during a month is total coliform-positive, the system is in compliance with the maximum contaminant level for total coliforms.

(b) Any fecal coliform-positive repeat sample or E.coli-positive repeat sample, or any total coliform-positive repeat sample following a fecal coliform-positive or E.coli-

positive routine sample is a violation of the maximum contaminant level for total coliforms. For the purposes of the public notification requirements in Rule 62-560.410, F.A.C., this is a violation that poses an acute risk to health.

(c) A public water system shall determine compliance with the maximum contaminant level for total coliforms in paragraphs (a) and (b) or this subsection for each month (or quarter for non-community water systems which serve 1,000 or fewer persons) in which it is required to monitor for total coliforms.

(4) RADIONUCLIDES - This subsection applies only to community water systems and non-transient non-community water systems. The following are maximum contaminant levels for:

(a) Naturally occurring radionuclides:

Contaminant Level,	picocuries per liter
Combined radium-226 and radium-228	5
Gross alpha particle activity including radium-226 but excluding radon and uranium	15

(b) Man-made radionuclides:

1. The average annual concentration of beta particle and photon radioactivity from man-made radionuclides in drinking water shall not produce a total annual exposure greater than 4 millirem/year.

2. Except for those radionuclides listed below, the concentration of radionuclides in subparagraph 1. shall be calculated on the basis of a 2 liter per day drinking water intake using the 168-hour data listed in "Maximum Permissible Body Burdens and Maximum Permissible Concentration of Radionuclides in Air or Water for Occupational Exposure," NBS Handbook 69 as amended August 1963, U.S. Department of Commerce.

Average Annual Concentration Assumed to Produce an Exposure of 4 millirem/year:	
Tritium in the total body -	20,000pCi/1
Strontium-90 in the bone marrow -	8pCi/1

Specific Authority 403.861(9), FS.
Law Implemented 403.852(12), 403.853(1), FS.
History -- New 11-19-87, Formerly 17-22.210, Amended 1-18-89, 5-7-90, 1-3-91, 1-1-93, 1-26-93. 7-4-93, Formerly 17-550.310, Amended 9-7-94.

62-550.320 Secondary Drinking Water Standards. This section applies only to community water systems. (These standards may also apply as ground water quality standards as referenced in Chapter 62-520, F.A.C.).

(1) The secondary maximum contaminant levels are listed in Table 4 which is incorporated herein and appears at the end of this Chapter.

(2) Failure to meet the fluoride secondary standard requires public notification pursuant to Rule 62-560.430, F.A.C.

Specific Authority 403.861(9), FS.
Law Implemented 403.852(13), 403.853(1), FS.
History -- New 11-19-87, Formerly 17-22.220, Amended 1-18-89, 1-1-93, 7-4-93, Formerly 17-550.320, Amended 9-7-94.

62-550.325 Treatment Techniques. This section establishes treatment techniques that may be used by suppliers of water in lieu of complying with maximum contaminant levels for specified contaminants.

(1) The following treatment technique for acrylamide and epichlorohydrin shall be used in lieu of maximum contaminant levels:

(a) Each public water system shall certify annually in writing to the Department (using third party or manufacturer's certification) that when acrylamide and epichlorohydrin are used, the combination of dose and monomer level does not exceed the levels specified as follows:

1. Acrylamide 0.05% dosed at 1 ppm (or equivalent).
2. Epichlorohydrin 0.01% dosed at 20 ppm (or equivalent).

(b) Certifications may rely on manufacturers or third parties, as approved by the Department.

(2) Iron and Manganese.

(a) Suppliers of water may use sequestering agents in lieu of meeting the maximum contaminant level for iron and manganese when the maximum iron and manganese concentration does not exceed 1.0 milligrams per liter in water.

(b) Such agents or additives and their proposed dosage rate shall be approved for potable water use pursuant to Rule 62-555.320(3), F.A.C.

(c) Suppliers of water shall report the dosage rate and water concentration level of the sequestering agent in treated water to the Department annually in writing.

Specific Authority 403.861(6), (9), FS.
Law Implemented 403.853(1), (3), 403.854(1), 403.861(16), (17), FS.
History -- New 1-1-93, Amended 7-4-93, Formerly 17-550.325.

62-550.330 Other Contaminants Without a Standard. No contaminant which creates or has the potential to create an imminent and substantial danger to the public shall be introduced into a public water system.

Specific Authority 403.861(9), FS.

Law Implemented 403.852(12), (13), 403.853(1), FS.
History -- New 11-19-87, Formerly 17-22.230, Formerly 17-550.330.

62-550.335 Relationship Among Rules 62-550.300-.690, F.A.C
Specific Authority 403.861(9), FS.
Law Implemented 403.852(12), (13), 403.853(1), FS.
History -- New 11-19-87, Formerly 17-22.235, Amended 1-18-89, 1-3-91, Formerly 17-550.335, Repealed 12-9-96.

PART IV
UNREGULATED CONTAMINANTS

62-550.400 General Requirements for Unregulated Contaminants. All community and non-transient non-community water systems shall monitor for the contaminants listed in Rules 62-550.405 and 62-550.410 F.A.C.
Specific Authority 403.861(9), (16), (17), FS.
Law Implemented 403.853(1), (3), FS.
History -- New 1-18-89, Amended 5-7-90, 1-1-93, Formerly 17-550.400.

62-550.405 Group I Unregulated Organic Contaminants. The Group I unregulated organic contaminants are listed in Table 5 which is incorporated herein and appears at the end of this Chapter.
Specific Authority 403.861(9), FS.
Law Implemented 403.853(1), (3), 403.861(16), (17), FS.
History -- New 1-1-93, Amended 1-26-93, Formerly 17-550.405, Amended 9-7-94.

62-550.410 Group II Unregulated Organic Contaminants. The Group II unregulated organic contaminants are listed in Table 6 which is incorporated herein and appears at the end of this Chapter.
Specific Authority 403.861(9), FS.
Law Implemented 403.853(1), (3), 403.861(16), (17), FS.
History -- Formerly 17-550.310(8), Amended 1-1-93, 1-26-93, 7-4-93, Formerly 17-550.410, Amended 9-7-94.

62-550.415 Group III Unregulated Organic Contaminants.. The Group III unregulated organic contaminants are listed in Table 7 which is incorporated herein and appears at the end of this Chapter.
Specific Authority 403.861(9), FS.
Law Implemented 403.853(1), (3), 403.861(16), (17), FS.
History -- New 9-7-94.

PART V
MONITORING REQUIREMENTS

62-550.500 General Monitoring Requirements for Contaminants.
These general requirements shall apply unless other monitoring is required for a specific contaminant as specified in Rules 62-550.510 through 62-550.540, F.A.C.

(1) The Monitoring Framework. Monitoring by public water systems shall be accomplished within a standardized monitoring framework developed to address the issues of complexity, coordination between various rules, and coordination of monitoring schedules. A compliance cycle is a nine-year period during which all public water systems must monitor. The first two compliance cycles begin January 1, 1993 and January 1, 2002. Each compliance cycle is broken down into three three-year compliance periods. The first three compliance periods that make up the first compliance cycle begin January 1, 1993, January 1, 1996, and January 1, 1999.

(2) Monitoring Frequencies. Table 8 summarizes the monitoring frequencies for each group of contaminants.

(3) Monitoring Schedule. Each public water system shall monitor at the time designated by this part during each compliance cycle and compliance period. Table 9 summarizes when each public water system shall perform its monitoring.

(a) Systems that monitor for a contaminant quarterly may do so any time during the quarter, except that samples taken in consecutive quarters shall be taken at least 30 days apart.

(b) Systems that monitor for a contaminant annually may do so any time during the year, except that samples taken in consecutive years shall be taken at least 90 days apart.

(c) Systems that monitor for a contaminant every three years shall adhere to the following schedule:

1. Community water systems which serve more than 3,300 persons shall monitor during the first year of each compliance period.

2. Community water systems which serve 3,300 or fewer persons shall monitor during the second year of each compliance period.

3. Non-transient non-community water systems shall monitor during the third year of each compliance period.

(d) Systems that monitor for a contaminant every nine years shall monitor during the first three-year compliance period of each nine-year compliance cycle following the same schedule as in paragraph (c) above.

(e) In the event the population of a small community system increases to more than 3,300 persons, the system shall continue to monitor on the schedule originally prescribed in paragraphs (c) and (d) above for the remainder of the nine-year compliance cycle. At the beginning of the next nine-year compliance cycle, the system

shall begin monitoring in the prescribed year according to its then current size or classification.

(f) Upon request, small community systems and non-transient non-community systems shall be approved to monitor during earlier compliance periods than required by Table 9.

(4) Increased Monitoring. When specified by the State Health Officer, the Department shall require more frequent monitoring than specified in this section and shall require confirmation samples results as needed to protect public health.

(5) Monitoring Locations.

(a) Ground water and surface water systems shall take a minimum of one sample at every entry point to the distribution system that is representative of each source after treatment (hereafter called a sampling point). The system shall take each sample at the same sampling point unless conditions make another sampling point more representative of each source or treatment plant.

(b) For purposes of this chapter, surface water systems also include systems with a combination of surface and ground sources, and ground water systems which use ground water under the direct influence of surface water.

(c) If a system draws water from more than one source and the sources are combined before distribution, the system must sample at an entry point to the distribution system during periods of typical operating conditions (e.g., when water is representative of the sources being used).

(6) Confirmation Samples. The system shall take confirmation samples whenever a sample exceeds the maximum contaminant level for nitrate or nitrite, or whenever an unregulated contaminant listed in Rule 62-550.405, 62-550.410, or 62-550.415, F.A.C., is detected. However, a system may take confirmation samples for other contaminants. If confirmation samples are taken, the results shall be averaged with the first sampling results and the average used for the compliance determination as specified by subsection (9) below. Confirmation samples shall be collected at the same sampling point as soon as possible after the initial sample was taken, but not to exceed two weeks. The Department shall delete results of obvious sampling errors from this calculation.

(7) Measurement of Compliance. Compliance with Rule 62-550.310, F.A.C., shall be determined based on the analytical results obtained at each sampling point.

(a) For systems that are taking more than one sample per year, compliance is determined by a running annual average of all samples taken at each sampling point. If the running annual average of any sampling point is greater than the maximum contaminant level, then the system is out of compliance. If the initial sample or a subsequent sample would cause the running annual average to be exceeded, then the system is immediately out of compliance. Any samples which are below the detection limit shall be calculated as zero for purposes of determining the running annual average.

(b) If monitoring is conducted annually, or less frequently, the system is out of compliance if the level of a contaminant at any sampling point is greater than the maximum contaminant level. If confirmation samples are taken, the determination of compliance shall be based on the average of the original and confirmation samples.

(8) Exceeding a maximum contaminant level. A system that exceeds a maximum contaminant level as determined in Rule 62-550.310, F.A.C., shall notify the Department within 48 hours of receiving the results (except for microbiological and nitrate), begin monitoring quarterly in the next quarter after the violation occurred, and notify the public pursuant to Rule 62-560.410, F.A.C. The supplier of water shall take corrective action approved by the Department to meet the applicable standard.

(9) Waivers from Monitoring. Systems may request to receive a waiver from the requirement to monitor for organic contaminants pursuant to Rule 62-560.545, F.A.C.

(10) Reporting the results of analyses. All public water systems shall forward the results of analyses to the Department pursuant to Rule 62-550.730, F.A.C.

Specific Authority 403.861(9), FS.

Law Implemented 403.853(1), (3), 403.859(1), 403.861(16), (17), FS.

History -- New 11-19-87, Formerly 17-22.300, Amended 1-18-89, 5-7-90, 1-1-93, 1-26-93, 7-4-93, Formerly 17-550.500, Amended 9-7-94.

62-550.511 Asbestos Monitoring Requirements. All community and non-transient non-community systems that are susceptible to asbestos contamination (e.g. source water contaminated by asbestos or use of asbestos-cement pipe within the distribution system) shall monitor to determine compliance with the maximum contaminant level for asbestos specified in Rule 62-550.310(1)(a), F.A.C., according to the following:

(1) Each community and non-transient non-community water system that is susceptible to asbestos contamination (e.g., source water contaminated by asbestos or use of asbestos-cement pipe within the distribution system) shall monitor for asbestos during the year prescribed by Rule 62-550.500(3)(d), F.A.C. Source waters in Florida are not considered to be susceptible to asbestos contamination. The water system shall monitor source waters when notified in writing by the Department that the system is susceptible to asbestos contamination.

(a) A system susceptible to asbestos contamination due solely to corrosion of asbestos-cement pipe shall take one sample at a tap served by asbestos-cement pipe and under conditions where asbestos contamination is most likely to occur.

(b) A system susceptible to asbestos contamination due solely to source water shall monitor in accordance with the provision of Rule 62-550.500(5)(a), F.A.C.

(c) A system susceptible to contamination due both to its source water supply and corrosion of asbestos-cement pipe shall take one sample at a tap served by

asbestos-cement pipe and under conditions where asbestos contamination is most likely to occur.

(2) Reports of the result of asbestos sampling shall describe the location where the sample was taken and the reason why that location was chosen.

(3) During the year the system is scheduled to monitor, the system shall send the Department an asbestos sampling plan, using Form 62-555.900(10) detailing the location and the conditions under which the sample is to be taken.

(4) A system without asbestos-containing components shall certify to the Department in writing, using Form 62-555.900(10), that it is asbestos free. Certification shall satisfy the requirements of subsections (1), (2), and (3) above, and shall be submitted each nine-year compliance cycle during the specified year the system is required to monitor

(5) The Department shall reduce the monitoring frequency to annually, for systems that exceeded the maximum contaminant level for asbestos and are required to monitor quarterly as prescribed by Rule 62-550.500(8), F.A.C., if the running annual average is below the maximum contaminant level. The Department shall reduce the monitoring frequency as provided in Rule 62-550.500(3)(d), F.A.C., when the average of three consecutive years of monitoring results is less than 50% of the maximum contaminant level and no sample exceeds the maximum contaminant level.

(6) If the initial monitoring for asbestos was completed between January 1, 1990 and December 31, 1992, and the results did not exceed the maximum contaminant level specified in Rule 62-550.310(1)(a), F.A.C., the system may submit those results to the Department in lieu of monitoring during the first compliance cycle.

(7) Compositing of samples is allowed as provided in Rule 62-550.550(2), F.A.C.

Specific Authority 403.853(3), 403.861(9), FS.
Law Implemented 403.853(1), (3), (7), 403.861(16), (17),FS.
History -- New 1-1-93; Amended 7-4-93, Formerly 17-550.511, Amended 9-7-94, 2-7-95, 12-9-96.

62-550.512 Nitrate and Nitrite Monitoring Requirements. All public water systems shall monitor to determine compliance with the maximum contaminant levels for nitrate and nitrite specified in Rule 62-550.310(1)(a), F.A.C.

(1) Community and non-transient non-community water systems served by ground water systems shall monitor annually. Those systems served by surface water shall monitor quarterly.

(a) The repeat monitoring frequency for ground water systems shall be quarterly for at least one year following any one sample in which the concentration is greater than or equal to 50 percent of the maximum contaminant level. A ground water system may reduce the sampling frequency to annually after the running annual average is less than 50 percent of the maximum contaminant level.

(b) A surface water system may reduce the sampling frequency to annually if each analytical result from the four most recent consecutive quarters is less than 50 percent of the maximum contaminant level. A surface water system shall return to quarterly monitoring if any one sample is greater than or equal to 50 percent of the maximum contaminant level.

(c) After the initial round of quarterly sampling is completed, each system that monitors annually shall take subsequent samples during the quarter that previously resulted in the highest analytical result.

(2) Each non-community water system shall monitor annually. The monitoring frequency for any non-community water system shall be quarterly for at least one year following any one sample in which the concentration of nitrite is greater than or equal to 50 percent of the maximum contaminant level as specified in Table 1, and which requirement is set out in Table 8. Both tables are incorporated herein and appear at the end of this chapter. The system may return to annual monitoring when the running annual average is less than the maximum contaminant level.

(3) A system that exceeds the maximum contaminant level for nitrate or nitrite as specified in Rule 62-550.310(1)(a), F.A.C., shall comply with the following:

(a) Compliance with the maximum contaminant levels for nitrate and nitrite is determined based on one sample if the levels of these contaminants are below the maximum contaminant levels. If the levels of nitrate or nitrite exceed the maximum contaminant levels in the initial sample, a confirmation sample is required to be taken within 24 hours of notification of the analytical results of the first sample. Systems unable to comply with the requirement to take a confirmation sample within 24 hours shall immediately notify the public in accordance with Rule 62-560.410(1), F.A.C. Systems exercising this option shall take and analyze a confirmation sample within two weeks of notification of the analytical results of the first sample. Compliance shall be determined based on the average of the initial and confirmation samples.

(b) If the average of the initial and confirmation samples, or the initial sample if no confirmation is taken, exceeds the maximum contaminant level, the system shall immediately notify the public pursuant to Rule 62-560.410, F.A.C.

(c) Systems shall notify the Department within 24 hours of determining that the maximum contaminant level has been exceeded.

(4) Compositing of samples is allowed as provided in Rule 62-550.550(2), F.A.C.

Specific Authority 403.853(3), 403.861(9), FS.
Law Implemented 403.853(1), (3), (7), 403.861(16), (17), FS.
History -- New 1-1-93; Amended 7-4-93, Formerly 17-550.512, Amended 9-7-94, 2-7-95.

62-550.513 Inorganic Contaminants Monitoring Requirements.

Community and non-transient non-community water systems shall monitor to determine

compliance with the maximum contaminant levels of all the contaminants listed in Rule 62-550.310(1)(a), F.A.C., (except asbestos, nitrate, and nitrite) as follows:

(1) Ground water systems shall take one sample at each sampling point during each compliance period. Surface water systems shall take one sample annually.

(2) Systems that exceed the maximum contaminant level shall monitor quarterly. The system may decrease the quarterly monitoring requirement of this rule to the frequencies specified in subsection (1) above when the running annual average is below the maximum contaminant level.

(3) Conditions which require more frequent monitoring for lead than specified in subsections (1) and (2) above are found in Chapter 62-551, F.A.C.

(4) Compositing of samples is allowed as provided in Rule 62-550.550(2), F.A.C.

Specific Authority 403.853(3), 403.861(9), FS.
Law Implemented 403.853(1), (3), (7), 403.861(16), (17), FS.
History -- New 1-1-93, Formerly 17-550.513; Amended 2-7-95.

62-550.514 Total Trihalomethane Monitoring Requirements.

(1) When monitoring for total trihalomethanes, distribution samples that are representative of the finished water from each plant, shall be taken. The minimum number of samples required to be taken by the system shall be based on the number of treatment plants used by the system, except that multiple plants with wells drawing raw water from a single aquifer shall be considered one treatment plant. All samples shall be collected within a 24 hour period. Free or combined chlorine residual shall be taken and recorded concurrently with all trihalomethane samples.

(2) All community water systems that serve at least 10,000 individuals shall monitor for total trihalomethanes quarterly. At least four water distribution system samples shall be taken for each treatment plant used by the system. One-fourth of the required samples shall be taken at a point within the distribution system which reflects the maximum residence time of the water in the system. The remainder of the samples shall be taken at locations in the distribution system representative of the areas of maximum water usage, the different sources of water, and the different treatment methods employed.

(3) Methods to reduce the monitoring frequency for trihalomethanes.

(a) Total trihalomethane concentration may be used by a community water system to reduce monitoring frequency required by subsection (2) upon written request to the Department and the Department's approval. Approved reduced monitoring frequency shall never be less than one sample quarterly. The Department shall review the data from at least four quarters of monitoring in accordance with this paragraph and the local conditions affecting the system to determine that trihalomethane concentrations will be consistently below the maximum contaminant level in order to approve this reduction in monitoring.

(b) Total trihalomethane potential may be used by a community water system that uses only ground water sources to reduce the monitoring frequency required by this paragraph upon written request to the Department and the Department's approval. Approved reduced monitoring frequency for total trihalomethane potential shall never be less than one sample per year. For the monitoring frequency to be reduced, the system shall submit to the Department the results of at least one sample analyzed for maximum total trihalomethanes potential for each treatment plant used by the system. Monitoring frequency shall be reduced if the Department finds that the results have a maximum total trihalomethanes potential of less than 0.10 milligrams per liter and that, based upon an assessment of the system and local conditions affecting it, the system is not likely to exceed 50 percent of the maximum contaminant level for total trihalomethanes.

(c) If at any time during which the reduced monitoring described in paragraph (a) or (b) of this subsection applies, the results from any analysis taken by the system for total trihalomethanes or maximum total trihalomethanes potential are equal to or greater than 0.10 milligrams per liter, such results shall be confirmed by at least one check sample taken promptly after the results are received. If the check sample confirms that the total trihalomethane or maximum trihalomethanes potential is greater than or equal to 0.10 milligrams per liter, the system shall immediately begin monitoring in accordance with the requirements of subsection (2) of this section, and such monitoring shall continue for at least four consecutive quarters before the frequency may be reduced again.

(d) In the event of any significant change to the system's raw water or treatment program, the system shall immediately analyze an additional sample for total trihalomethanes or total trihalomethanes potential. If the data submitted by the water system indicate that the levels of total trihalomethanes within the distribution system are subject to significant variations, the Department shall require more frequent monitoring.

(e) All samples required by paragraphs (a), (b), (c), and (d) of this subsection shall be taken at a point within the distribution system that reflects the maximum residence time of the water in the system.

(4) Compliance with Rule 62-550.310(2)(a), F.A.C., shall be determined by the Department based on a running annual average of samples collected by the system as described in subsection (2) or paragraph (3) of this section. If the average of sample results covering any four consecutive quarterly periods exceeds the maximum contaminant level, the supplier of water shall comply with Rule 62-550.500(8), F.A.C. The temporary monitoring frequency established by the Department pursuant to Rule 62-550.500(4), F.A.C., shall continue until the maximum contaminant level has not been exceeded in the average of successive samples for 12 months.

Specific Authority 403.853(3), 403.861(9), FS.
Law Implemented 403.853(1), (3), (7), 403.861(16, (1), FS.

History -- New 1-1-93, Amended 7-4-93, Formerly 17-550.514; Amended 2-7-95.

62-550.515 Volatile Organic Contaminants Monitoring Requirements. Monitoring for the volatile organic contaminants listed in Rule 62-550.310(2)(b), F.A.C., shall be conducted to determine compliance with the maximum contaminant levels.

(1) Monitoring frequency.

(a) Initial base point monitoring. Each community and non-transient non-community water system shall take four consecutive quarterly samples for each contaminant listed in Rule 62-550.310(2)(b), F.A.C., during the first compliance period.

(b) If the public water system does not detect any of the contaminants listed in Rule 62-550.310(2)(b), F.A.C., it shall sample annually beginning with the next compliance period.

(c) If the initial monitoring for contaminants listed in Rule 62-550.310(2)(b), F.A.C., as required in subsection (1) of this section, has been completed between January 1, 1988 and December 31, 1992, and the system did not detect any contaminant listed in Rule 62-550.310(2)(b), F.A.C., then each ground and surface water system may take one sample annually beginning January 1, 1993.

(d) After a minimum of three years of annual sampling, ground water systems with no previous detection of any contaminant listed in Rule 62-550.310(2)(b), F.A.C., may take one sample during each compliance period.

(e) Surface water and ground water systems may apply to the Department for a monitoring waiver as specified in Rule 62-560.545, F.A.C.

(2) Sampling location. During the first quarter of the initial base point monitoring, ground water systems shall take a minimum of one sample that is specifically representative of each well. It may be collected as a raw or treated sample. Subsequent samples shall be taken as required by Rule 62-550.500(5), F.A.C.

(3) Monitoring frequency after a contaminant is detected. If a contaminant listed in Rule 62-550.310(2)(b), F.A.C., is detected at a level exceeding 0.0005 milligrams per liter in any sample:

(a) The system shall notify the Department within seven days of receiving the laboratory results and shall monitor quarterly for that contaminant at each sampling point that resulted in a detection.

(b) The Department shall decrease the quarterly monitoring requirement of this section to annually if the running annual average is below the maximum contaminant level. After three years of annual sampling with no detection of the contaminant, a ground water system may decrease the annual monitoring requirement to one sample each compliance period.

(c) Systems that monitor annually shall monitor during the quarter that previously yielded the highest analytical result for that particular contaminant.

(4) A system that exceeds the maximum contaminant level as specified in Rule 62-550.310(2)(b), F.A.C., shall notify the public pursuant to Rule 62-560.410, F.A.C., begin quarterly monitoring, and take corrective action as approved by the Department.

(5) The use of monitoring data collected between January 1, 1988 and January 1, 1993, shall be allowed for purposes of monitoring compliance. A single sample, rather than four quarterly samples, shall satisfy the initial base point monitoring requirement. Systems which have taken such samples and did not detect any contaminant listed in Rule 62-550.310(2)(b), F.A.C., shall begin monitoring annually.

(6) Compositing of samples is allowed as provided in Rule 17-550.550(2), F.A.C.

Specific Authority 403.853(3), 403.861(9), FS.
Law Implemented 403.853(1), (3), (7), 403.861(16), (17), FS.
History New 1-1-93, Amended 1-26-93, 7-4-93, Formerly 17-550.515, Amended 9-7-94, 2-7-95.

62-550.516 Pesticides and Polychlorinated Biphenyls Monitoring Requirements. Monitoring for the organic pesticide and polychlorinated biphenyl contaminants listed in Rule 62-550.310(2)(c), F.A.C., shall be conducted as follows:

(1) Monitoring frequency.

(a) Each community and non-transient non-community water system shall take four consecutive quarterly samples for each contaminant listed in Rule 62-550.310(2)(c), F.A.C., during each compliance period.

(b) Systems which serve more than 3,300 persons that do not detect a contaminant in the initial compliance period may reduce the sampling frequency to two quarterly samples,
taken at least 60 days apart, in one year during each repeat compliance period.

(c) Systems which serve less than or equal to 3,300 persons that do not detect a contaminant in the initial compliance period may reduce the sampling frequency to one sample during each repeat compliance period.

(d) Systems may apply to the Department for a monitoring waiver as specified in Rule 62-560.545, F.A.C.

(2) Sampling location. During the first quarter of the initial base point monitoring, ground water systems shall take a minimum of one sample that is representative of each well. The sample may be collected as a raw or treated sample. Subsequent samples shall be taken as directed by Rule 62-550.500(5), F.A.C.

(3) Monitoring requirements after a contaminant is detected. If an organic contaminant listed in Rule 62-550.310(2)(c), F.A.C., is detected in any sample:

(a) The system shall notify the Department within seven days after receiving the laboratory results and shall monitor quarterly at each sampling point where a contaminant was detected.

Part IV of Chapter 62-560, F.A.C. When compliance is achieved, the measures taken shall be reported to that office.

(f) The supplier of water is not required to report analytical results to the Department in cases where a Department of Health and Rehabilitative Services laboratory performs the analysis and reports the results to the Department.

(g) Copies of any written reports, summaries, or communications relating to sanitary surveys of the system conducted by the system itself, by a private consultant, or by any local or Federal agency, shall be submitted to the appropriate Department District Office or the appropriate Approved County Public Health Unit within 15 days of receipt by the supplier of water of the information.

(h) The supplier of water, within ten days of completion of each public notification requirement pursuant to Part IV of Chapter 62-560, F.A.C., shall submit to the Department a representative copy of each type of notice distributed, published, posted, and made available to the persons served by the system and the media.

(i) Upon request, the supplier of water shall submit to the Department within the time stated in the request, copies of any records required to be maintained under Rule 62-550.720, F.A.C. or copies of any document which the Department is entitled to inspect.

(2) Certified laboratories.

(a) A certified laboratory shall report the following information, at a minimum, to the Department or Approved County Public Health Unit in the appropriate Department approved format. Format specifications may be obtained by writing to the Department's Drinking Water Section, 2600 Blair Stone Road, Tallahassee, Florida 32399-2400. If lab analysis forms are not submitted using the approved format, the forms will be rejected. The information submitted by the certified laboratory for water analysis includes, at a minimum:

1. Laboratory name - The complete, unabbreviated laboratory name is required. If the analytical work was subcontracted out to another certified laboratory, the subcontracting laboratory name shall also be included.

2. Laboratory certification number - The correct, five digit lab certification number, assigned by HRS, shall be clearly identified for the services provided. Any subcontracting laboratory certification numbers shall also be identified for the services provided. The proper certification number for the services provided shall be included, such as when a laboratory that performs radiological analyses has a different certification number from a laboratory that performs other analyses, and both laboratories have the same owner and address.

3. Date and time of the beginning of the analysis - A complete date (month, day, and year) and time of the beginning of the analysis (including a.m. or p.m.) shall be included in order to calculate sample holding time. Results from samples exceeding the appropriate holding time for the contaminant before analysis (for example, thirty

the Department's determination, the system shall have six months in which to commission and complete an independent analysis of the system. Upon receipt of independent analysis, the Department will reconsider its determination and notify the system of its decision and include the notice of rights to an administrative hearing as provided in Rule 62-103.155, F.A.C.
Specific Authority 403.853(3), 403.861(9), FS.
Law Implemented 403.853(1), (3), (7), 403.861(16), (17), FS.
History -- New 1-1-93, Amended 7-4-93, Formerly 17-550.517, Amended 9-7-94.

62-550.518 Microbiological Monitoring Requirements.

(1) All public water systems shall analyze for coliform bacteria to determine compliance with Rule 62-550.310(3), F.A.C. Public water systems shall collect total coliform samples at sites that are representative of water throughout the distribution system and in accordance with a written sampling plan that addresses location, timing, frequency and rotation period. These plans shall be available for review and possible revision on the occasion of a sanitary survey conducted by the Department. Descriptions of sampling locations shall be specific, i.e. numbered street addresses or lot numbers. Pressure tank and plant tap samples are not acceptable for determining compliance.

(2) Total coliform samples shall be taken at regular intervals and in numbers proportionate to the population served by the system. Community water systems, non-transient non-community water systems, non-community water systems that use surface water, and non-community water systems that serve more than 1,000 persons per day during any one month shall take monthly samples. In addition, a minimum of one representative raw water sample per month shall be taken. In no event shall the number of distribution samples be less than as set forth below:

INSERT TABLE

(3) A non-community water system that serves 1,000 or fewer persons shall monitor at the rate of two samples in each calendar quarter during which the system provides water to the public. In addition, a minimum of one raw sample shall be collected per quarter.

(4) The supplier of water shall maintain a minimum free chlorine residual of 0.2 milligrams per liter or its equivalent throughout the distribution system at all times. If the supplier of water fails to maintain this level of free chlorine residual, or its equivalent, the supplier of water shall take necessary corrective action as approved by

the Department. When using chlorine in combination with ammonia, a minimum combined chlorine residual of 0.6 milligrams per liter shall be maintained.

(5) The public water system shall collect samples at regular intervals throughout the month, except that a system that uses ground water (except ground water under the direct influence of surface water), and that serves 4,900 persons or fewer, may collect all required samples on a single day if the samples are taken from different sites.

(6) A public water system that uses surface water or ground water under the direct influence of surface water and that does not practice filtration in compliance with Rule 62-555.610, F.A.C., shall collect at least one sample near the first service connection each day the turbidity level of the source water exceeds one NTU, measured as specified in Rule 62-550.560(3), F.A.C. This sample shall be analyzed for the presence of total coliforms. When any turbidity measurement in any day exceeds one NTU, the system shall collect this coliform sample within 24 hours, unless the Department determines that the system, for logistical reasons outside the system's control, cannot have the sample analyzed within 30 hours of collection. In this case the Department shall specify how much time the system has to collect the sample. Sample results from this coliform monitoring shall be included in determining compliance with the maximum contaminant level for total coliforms in Rule 62-550.310(3), F.A.C.

(7) Special purpose samples, such as those taken to determine whether disinfection practices are sufficient following pipe placement, replacement, or repair, shall not be used to determine compliance with the maximum contaminant level for total coliforms in Rule 62-550.310(3), F.A.C. Repeat samples taken pursuant to subsection (8) of this section are not considered special purpose samples, and shall be used to determine compliance with the maximum contaminant level for total coliforms in Rule 62-550.310(3), F.A.C.

(8) Repeat monitoring.

(a) If a routine sample is total coliform-positive, the public water system shall collect a set of repeat samples within 24 hours of being notified of the positive result. The system shall collect all repeat samples on the same day. A system that collects monthly routine distribution samples shall collect no fewer than three repeat samples for each total coliform-positive sample found. A non-community water system that serves 1,000 or fewer persons shall collect no fewer than four repeat samples for each total coliform-positive sample found. The Department shall extend the 24-hour limit on a case-by-case basis if the system has a logistical problem that is beyond its control in collecting the repeat samples within 24 hours. If an extension is granted, the Department shall specify how much time the system has to collect the repeat samples.

(b) The system shall collect at least one repeat sample from the sampling tap where the original total coliform-positive sample was taken, at least one repeat sample at a tap within five service connections upstream of the original sampling site, and at least one repeat sample at a tap within five service connections downstream of the

original sampling site. If a total coliform-positive sample is at the end of the distribution system, or one away from the end of the distribution system, the system need not collect the one repeat sample upstream or downstream of the original sampling site, whichever is applicable.

(c) If any repeat sample in the set is total coliform-positive the public water system shall collect an additional set of repeat samples in the manner specified in paragraphs (8)(a) through (8)(c) of this section. The public water system shall collect the additional samples within 24 hours of being notified of the positive result, unless the Department extends the limit as provided in paragraph (8)(a) of this section. The system shall repeat this process until either total coliforms are not detected in one complete set of repeat samples or the system determines that the maximum contaminant level for total coliforms in Rule 62-550.310(3), F.A.C., has been exceeded and notifies the Department in accordance with subsections (11) and (12) below.

(d) Results of all routine and repeat samples not invalidated by the Department shall be included in determining compliance with the maximum contaminant level for total coliforms in Rule 62-550.310(3), F.A.C.

(9) If a system collecting fewer than five routine samples per month has one or more total coliform-positive samples and the Department does not invalidate the sample(s) under Rule 62-550.518(10)(a), F.A.C., it shall collect at least five routine samples during the next month the system provides water to the public.

(10) Invalidation of total coliform samples. A total coliform-positive sample invalidated under this subsection does not count toward meeting the minimum monitoring requirements of this section. Department invalidation of a total coliform-positive sample invalidates subsequent fecal coliform or E. coli positive results on the same sample.

(a) The Department shall invalidate a total coliform-positive sample only if any of the following conditions are met:

1. The laboratory establishes that improper sample analysis caused the total coliform-positive result.

2. The Department, on the basis of the results of the repeat samples collected as required by subsection (8) of this section, determines that the total coliform-positive sample resulted from a non-distribution system plumbing problem. The Department shall not invalidate a sample on the basis of repeat samples unless all repeat samples collected at the same tap as the original total coliform-positive sample are also total coliform-positive, and all repeat samples collected within five service connections of the original tap are total coliform-negative. The Department shall not invalidate a total coliform-positive sample on the basis of repeat samples if all the repeat samples are total coliform-negative, or if the public water system has only one service connection.

3. The Department has received in writing substantial grounds to conclude that a total coliform-positive result is due to a circumstance or condition that does not reflect water quality in the distribution system. In this case the system shall still collect

all repeat samples required under subsection (8) of this section, and use them to determine compliance with the maximum contaminant level for total coliforms in Rule 62-550.310(3), F.A.C. The written documentation shall describe the specific cause of the total coliform-positive sample, and what action the system has taken, or will take, to correct this problem. The Department shall not invalidate a total coliform-positive sample solely on the grounds that all repeat samples are total coliform-negative.

(b) Unless total coliforms are detected, a laboratory shall invalidate a total coliform sample if the sample produces a turbid culture in the absence of gas production using an analytical method where gas formation is examined (e.g., the Multiple-Tube Fermentation Technique); produces a turbid culture in the absence of an acid reaction in the Presence-Absence (P-A) Coliform Test; or, exhibits confluent growth or produces colonies too numerous to count with an analytical method using a membrane filter (e.g., Membrane Filter Technique). If a laboratory invalidates a sample because of such interference, the system shall report to the Department in accordance with Rule 62-550.730(1)(a), F.A.C., and collect another sample from the same location as the original sample within 24 hours of being notified of the interference problem. The system shall continue to resample every 24 hours and have the samples analyzed until it obtains a valid result. The Department shall expand the 24-hour requirement on a case-by-case basis if the system has a logistical problem that is beyond its control in collecting the repeat samples within 24 hours. If an extension is granted, the Department shall specify how much time the system has to collect the repeat samples.

(11) Fecal coliforms/Escherichia coli (E. coli) testing. If any raw water routine or repeat sample is total coliform-positive, the system shall analyze that total coliform-positive culture to determine if fecal coliforms are present, except that the system may test for E. coli in lieu of fecal coliforms. If fecal coliforms or E. coli are present in the routine or repeat sample, the system shall notify the Department by the end of the day when the system is notified of the test result, unless the system is notified of the result after the Department office is closed, in which case the system shall notify the Department before the end of the next business day.

(12) Response to violation.

(a) A public water system that has exceeded the maximum contaminant level for total coliforms in Rule 62-550.310(3), F.A.C., shall report the violation to the Department no later than the end of the next business day after it learns of the violation, and shall notify the public in accordance with Rule 62-560.410, F.A.C.

(b) A public water system that has failed to comply with a coliform monitoring requirement shall report the monitoring violation to the Department within 48 hours after the system discovers the violation, and shall notify the public in accordance with Rule 62-560.410, F.A.C.

Specific Authority 403.853(3), 403.861(9), FS.
Law Implemented 403.853(1), (3), (7), 403.861(16), (17), FS.

History -- New 1-1-93; Amended 7-4-93, Formerly 17-550.518, Amended 9-7-94; 2-7-95.

62-550.519 Radionuclides Monitoring Requirements.

(1) Monitoring requirements for naturally occurring radionuclides for community and non-transient non-community water systems.

(a) Suppliers of water shall monitor at least once every compliance period pursuant to Rule 62-550.500(3)(c), F.A.C., for radium-226 and radium-228. Compliance shall be based on the average of the analyses of four samples obtained at four consecutive quarterly intervals. Compositing of two consecutive samples is allowed.

(b) When an annual record taken in conformance with paragraph (a) above has established that the average annual concentration is less than half the maximum contaminant levels set forth in Rule 62-550.310(4), F.A.C., analysis of a single sample shall be substituted for the quarterly sampling procedure required by paragraph (a).

(c) A gross alpha particle activity screening measurement may be substituted for the required radium-226 and radium-228 analysis, provided that the measured gross alpha particle activity does not exceed five pCi/L.

(d) In areas where radium-228 is known to be present or may reasonably be expected to be present in drinking water, the system shall analyze for radium-226 or radium-228 when the gross alpha particle activity screening measurement exceeds two pCi/L.

(e) When the gross alpha particle activity screening measurement exceeds five pCi/L, the same or an equivalent sample shall be analyzed for radium-226. If the concentration of radium-226 exceeds three pCi/L, the same or an equivalent sample shall be analyzed for radium-228. The result for radium-226 and the result for radium-228 shall be added to determine if the combined radium-226 and radium-228 exceeds the maximum contaminant level.

(f) Suppliers of water shall conduct annual monitoring when the radium-226 concentration exceeds three pCi/L.

(g) The Department shall require more frequent monitoring in the event of possible contamination or when changes in the distribution system or treatment processes occur that may increase the concentration of radioactivity in the finished water.

(h) A supplier of water shall monitor in conformance with paragraph (a) of this subsection within 12 months of the introduction of a new water source.

(i) If a water system obtains water from two or more sources that have different concentrations of radioactivity, the supplier of water shall monitor the source water in addition to water from within the distribution system.

(j) If the average annual maximum contaminant level for gross alpha particle activity or combined radium-226 and radium-228 as set forth in Rule 62-550.310(5)(a),

F.A.C., is exceeded, the supplier of water shall comply with Rule 62-550.500, F.A.C. The temporary monitoring frequency established by the Department pursuant to Rule 62-550.500, F.A.C., shall continue for at least quarterly intervals until the annual average no longer exceeds the maximum contaminant level.

(2) Monitoring requirements for man-made radioactivity in community water systems using surface water and serving more than 100,000 persons, and public water systems vulnerable to man-made radioactive contamination as determined by the Department.

(a) Suppliers of water shall monitor at least once every three years pursuant to Rule 62-550.500(3)(c), F.A.C., for gross beta particle radioactivity. Compliance shall be based on the average of the results of the analysis obtained at four consecutive quarterly intervals. Compositing of two consecutive samples is allowed.

(b) The supplier of water will be in compliance with this section if the gross beta particle activity is less than 50 pCi/L and the average annual concentrations of tritium and strontium-90 are less than the levels listed in Rule 62-550.310(4)(b), F.A.C. If both radionuclides are present the sum of their annual dose equivalents to bone marrow shall not exceed 4 millirem/year.

(c) If the gross beta particle activity exceeds 50 pCi/L, an analysis of the sample shall be performed to identify the major radioactive constituents present, and the appropriate organ and total body doses shall be calculated to determine compliance with Rule 62-550.310(4)(b)2., F.A.C.

(d) The supplier of any public water system designated by the Department as using waters contaminated by nuclear facilities shall conduct quarterly monitoring for gross beta particle and iodine-131 radioactivity and shall conduct annual monitoring for strontium-90 and tritium.

1. Compliance with quarterly monitoring for gross beta particle activity standards shall be based on the average of the analyses of monthly samples taken for three consecutive months or the analysis of a composite of three monthly samples. The former monitoring procedure is recommended. If the gross beta particle activity in a sample exceeds 15 pCi/L, the same or an equivalent sample shall be analyzed for strontium-89 and cesium-134. If the gross beta particle activity exceeds 50 pCi/L, an analysis of the sample must be performed to identify the major radioactive constituents present and the appropriate organ and total body doses shall be calculated to determine compliance with Rule 62-550.310(4)(b), F.A.C.

2. For iodine-131, a composite of five consecutive daily samples shall be analyzed once each quarter. More frequent monitoring as specified by the Department shall be
conducted when iodine-131 is identified in the finished water.

3. Compliance with annual monitoring for strontium-90 and tritium shall be based on the analysis of a composite of four consecutive quarterly samples or the

average of the analyses of four consecutive quarterly samples. The latter monitoring procedure is recommended.

4. The Department shall allow the substitution of environmental surveillance data taken in conjunction with a nuclear facility for direct monitoring of man-made radioactivity by the supplier of water where the Department determines such data is applicable to a particular community water system.

(e) If the average annual maximum contaminant level for man-made radioactivity set forth in Rule 62-550.310(4)(b), F.A.C., is exceeded, the supplier of water shall take corrective action approved by the Department to meet the applicable standards. The supplier of water also shall give notice to the public served by the water system as required by Rule 62-560.410, F.A.C. The Department shall establish more stringent monitoring frequencies, if necessary, based on the maximum contaminant level exceeded, the potential health effects of that level, the estimated time needed to take corrective action, and any other known to the Department.

Specific Authority 403.853(3), 403.861(9), FS.
Law Implemented 403.853(1), (3), (7), 403.861(16), (17), FS.
History -- New 1-1-93; Amended 7-4-93, Formerly 17-550.519; Amended 2-7-95.

62-550.520 Secondary Contaminants Monitoring Requirements.

(1) Analysis to determine compliance with Rule 62-550.320, F.A.C., shall be conducted by all community water systems and shall be repeated once each compliance period. Monitoring for pH and corrosivity shall be conducted pursuant to Chapter 62-551, F.A.C, and is not required by this section.

(2) If the results of an analysis indicate that the level of fluoride exceeds the maximum contaminant level, the supplier of water shall notify the public pursuant to Rule 62-560.430, F.A.C., and take corrective action as approved by the Department pursuant to Rule 62-560.700, F.A.C.

Specific Authority 403.861(9), FS.
Law Implemented 403.853(1), (3), 403.861(16), (17), FS.
History -- New 11-19-87, Formerly 17-22.320, Amended 1-18-89, 5-7-90, 1-1-93, 7-4-93, Formerly 17-550.520.

62-550.521 Unregulated Contaminants Monitoring Requirements.

(1) Monitoring for the Group I Unregulated Organic Contaminants listed in Rule 62-550.405, F.A.C., shall be conducted by each community and non-transient non-community water system. Such systems shall take four consecutive quarterly samples at each sampling point and report the results to the Department. Samples shall be taken pursuant to Rule 62-550.500(3)(c), F.A.C., and Table 9. Repeat monitoring in future years is not required. Systems which have previously monitored for these contaminants may use those results to satisfy this requirement.

(2) Monitoring for the Group II Unregulated Organic Contaminants listed in Rule 62-550.410, F.A.C., shall be conducted by each community and non-transient non-community water system. Such systems shall take one sample during each compliance period at each sampling point for the listed contaminants and report the results to the Department. Samples shall be taken pursuant to Rule 62-550.500(3)(c), F.A.C., and Table 9.

(3) Monitoring for the Group III Unregulated Organic Contaminants listed in Rule 62-550.415, F.A.C., shall be conducted by each community and non-transient non-community water system. Such systems shall take one sample at each sampling point and report the results to the Department. Samples shall be taken pursuant to Rule 62-550.500(3)(c), F.A.C., and Table 9. Repeat monitoring in future years is not required. Systems which have previously monitored for these contaminants may use those results to satisfy this requirement.

(4) Instead of performing the monitoring required by this section, a community water system or non-transient non-community water system serving fewer than 150 service connections and fewer than 350 persons may send a letter to the Department stating that the system is available for sampling. This letter shall be sent to the Department by January 1, 1994 for community systems and by January 1, 1995 for non-transient non-community systems. Normally, these small systems will not be required to monitor for unregulated contaminants, and they shall not send such samples to the Department unless requested to do so by the Department.

(5) If a sample analysis shows the presence of an unregulated contaminant, the supplier of water shall take a confirmation sample in accordance with Rule 62-550.500(6), F.A.C., and notify the Department within seven days after the result of the confirmation sample is received. If the presence of the contaminant is determined by the State Health Officer and the Department to constitute an unreasonable risk to health, corrective action, including additional monitoring, shall be taken by the supplier of water as approved by the Department, pursuant to Rule 62-560.700, F.A.C., based on the potential health risks of the contaminant level, the estimated time needed to take corrective action, and any other data known to the Department.

Specific Authority 403.853(3), 403.861(9), FS.
Law Implemented 403.853(1), (3), 403.861(16), (17), FS.
History -- New 1-1-93; Amended 7-4-93, Formerly 17-550.521, Amended 9-7-94, 2-7-95.

62-550.540 Monitoring of Consecutive Public Systems. When one public water system receives all of its water from another public water system, the recipient public water system is the consecutive public water system. If a public water system receives only part of its water from another public water system, the recipient water system is not a consecutive public water system. The consecutive public water system shall provide microbiological and chlorine residual monitoring in a manner

complying with Rule 62-550.518, F.A.C. Additional monitoring of the contaminants listed in Part III shall be required for consecutive systems which have a potential threat of contamination within their distribution system that is not corrected by the treatment provided. Consecutive water systems shall comply with the provisions of Chapter 62-551, F.A.C., Control of Lead and Copper and Rule 62-550.511, F.A.C., Asbestos Monitoring Requirements.
Specific Authority 403.861(9), FS.
Law Implemented 403.853(1), (3), (7), 403.861(16), (17), FS.
History -- New 11-19-87; Formerly 17-22.340; Amended 1-18-89, 1-1-93, Formerly 17-550.540.

62-550.550 Approved Laboratories and Analytical Methods for Public Water Systems.

(1) To determine compliance with Rules 62-550.510 through 62-550.540, F.A.C., samples for compliance monitoring are acceptable only if they have been analyzed by a laboratory approved by the Department of Health and Rehabilitative Services in accordance with Chapter 10D-41, F.A.C. The use of an alternative analytical technique shall not decrease the monitoring frequency required in this Part. Use of an alternative analytical technique requires written permission from the Department of Health and Rehabilitative Services, pursuant to Chapter 10D-41, F.A.C.

(2) Measurements for residual disinfectant concentration, and field measurements of dissolved oxygen, conductivity, temperature, and pH may be performed by any supplier of water in accordance with the appropriate methodology in Standard Methods for the Examination of Water and Wastewater, 16th Edition, which is hereby incorporated by reference. The measurement for turbidity may be performed by any supplier of water in accordance with the Nephelometric Method in Standard Methods for the Examination of Water and Wastewater, 16th Edition. However, for surface water systems, measurements for pH, temperature, turbidity, and residual disinfectant concentrations shall be conducted under the supervision of a drinking water plant operator certified under Chapter 62-602, F.A.C. The State may take and analyze samples and use the results to determine compliance with the applicable requirements of this Chapter.

(3) Compositing of Samples.

(a) A public water system may reduce the total number of samples that must be analyzed pursuant to Rules 62-550.511, 62-550.512, 62-550.513, 62-550.515, 62-550.516, 62-550.519, and 62-550.521, F.A.C., by the use of compositing. No more than two samples shall be combined into one composite sample when analyzing for antimony or thallium which are listed in Table 1, or for any of the contaminants in the volatile organic compounds listed in Table 2, or for ethylene dibromide (EDB) which is listed in Table 3. No more than three samples shall be combined into one composite sample when analyzing for toxaphene which is listed in Table 3. No more than four

samples shall be combined into one composite sample when analyzing for cyanide which is listed in Table 1. No more than five samples shall be combined into one composite sample when analyzing for the other contaminants in the other groups.

(b) Compositing shall be done only by certified laboratories using methods approved pursuant to Chapter 10D-41, F.A.C. All samples, except those taken for radionuclides, shall be analyzed within 14 days of collection.

(c) If the population served by the system is greater than 3,300 persons, then compositing is only permitted at sampling points within a single system. For systems serving 3,300 or fewer persons, compositing among different systems is permitted provided the 5 sample limit is maintained.

(d) Resampling after a detection of a contaminant in a composite sample.

1. A follow-up sample shall be taken within 14 days from each source and sampling point included in the composite. Each of the samples shall be analyzed individually for the detected contaminant.

2. If duplicates of the original sample for volatile organics and pesticides are available, the system may use these duplicates instead of resampling. If a duplicate is used, it shall be analyzed for the detected contaminant within 14 days of collection.

(e) Compositing of no more than two samples from new wells for the purpose of obtaining clearance is allowed.

Specific Authority 403.853(3), 403.861(9), FS.
Law Implemented 403.853(1), (3), 403.861(16), (17), F.S.
History -- New 11-19-87, Formerly 17-22.350, Amended 1-18-89, 5-7-90, 1-3-91, 1-1-93, 1-26-93, Formerly 17-550.550, Amended 9-7-94, 2-7-95.

62-550.560 Monitoring Requirements for Surface Water Systems and Ground Water Systems Under the Direct Influence of Surface Water.

(1) Until June 29, 1993, surface water systems and ground water systems under the direct influence of surface water shall measure turbidity at a representative entry point(s) to the distribution system at least once per day to determine compliance with Rule 62-550.310(3), F.A.C. One sample per plant shall be collected.

(2) Interim Monitoring Requirements for Surface Water Systems Prior to Installation of Filtration. These requirements are set forth in 40 CFR 141.74(b)(1), (2), (5) and (6) as published on pages 27531 through 27535 of the June 29, 1989, Federal Register which are hereby adopted and incorporated by reference. The effective date of these requirements is six months from the date of written notification to the system by the Department that the system is using a surface water source as defined in Rules 62-550.200 and 62-555.600, F.A.C.

(3) Monitoring Requirements for Systems Using Filtration Treatment. A public water system that uses a surface water source and provides filtration treatment shall monitor in accordance with this subsection beginning June 29, 1993.

(a) Turbidity measurements as required by Rule 62-555.620, F.A.C., shall be performed on representative samples of the system's filtered water every four hours (or more frequently) that the system serves water to the public. A public water system may substitute continuous turbidity monitoring in lieu of grab sample monitoring if it validates the continuous measurement for accuracy on a regular basis using a Department approved protocol that includes:

1. Initial approval of the monitoring equipment.
2. Quarterly calibration of the equipment.
3. Retention of maintenance and calibration records for a period of not less than two years on the premises of the public water system or at a convenient location near the premises.

(b) For any systems that use slow sand filtration or filtration treatment other than conventional treatment, direct filtration, or diatomaceous earth filtration, the Department shall, at the request of the supplier of water, reduce the sampling frequency to once per day if, based on a showing by the supplier of water, less frequent monitoring is sufficient to indicate effective filtration performance. For systems that serve 500 or fewer persons, the Department shall, at the request of the supplier of water, reduce the turbidity sampling frequency to once per day, regardless of the type of filtration treatment used if, based on a showing by the supplier of water, less frequent monitoring is sufficient to indicate effective filtration performance.

(c) The residual disinfectant concentration of the water entering the distribution system shall be monitored continuously. The lowest value shall be recorded each day. If there is a failure in the continuous monitoring equipment, grab sampling every four hours may be conducted in lieu of continuous monitoring, but for no more than five working days following the failure of the equipment. Systems serving 3,300 or fewer persons may take grab samples at least one hour apart in lieu of providing continuous monitoring on an ongoing basis at the frequencies each day prescribed below:

System size population	Samples per day
<500	1
501 to 1,000	2
1,001 to 2,500	3
2,501 to 3,300	4

If at any time the residual disinfectant concentration falls below 0.2 milligrams per liter free chlorine or its equivalent in a system using grab sampling in lieu of continuous monitoring, the system shall immediately begin taking grab samples every four hours

until the residual disinfectant concentration is equal to or greater than 0.2 milligrams per liter or its equivalent.

(d) The residual disinfectant concentration shall be measured at least at the same points in the distribution system and at the same time as total coliforms are sampled, as specified in Rule 62-550.518, F.A.C., except that the Department shall allow a public water system which uses both a surface water source and a ground water source to take disinfectant residual samples at points other than the total coliform sampling points if the Department determines that such points are more representative of treated (disinfected) water quality within the distribution system. Heterotrophic bacteria, measured as heterotrophic plate count (HPC) as specified in Chapter 10D-41, F.A.C., may be measured in lieu of residual disinfectant concentration only for compliance with treatment technique requirements.

Specific Authority 403.853(3), 403.861(9), FS.
Law Implemented 403.853(1),(3), 403.861(16)(17), FS.
History -- New, 1-3-91, Amended 1-1-93, Formerly 17-550.560.

62-550.590 Public Water System Monitoring Information and Monitoring Schedule.

(1) Table 8 summarizes the base monitoring frequencies which apply to public water systems in determining compliance with the rules set forth in this Part.

(2) Table 9 contains the monitoring schedule that all public water systems shall follow.

Specific Authority 403.853(3), 403.861(9), FS.
Law Implemented 403.853(1), (3), 403.861(16), (17), FS.
History -- 1-18-89, Amended 1-3-91, 1-1-93, Formerly 17-550.590, Amended 9-7-94.

PART VII
SURVEILLANCE, RECORDKEEPING, AND REPORTING

62-550.700 General

Specific Authority 403.861, FS.
Law Implemented 403.852, 403.853, 403.855, 403.858, FS.
History -- New 1-18-89, Formerly 17-550.700, Repealed 12-9-96.

62-550.710 Surveillance.

Specific Authority 403.861(9), FS.
Law Implemented 403.852(12), 403.853(3), 403.855, 403.858, FS.
History -- New 11-19-87, Formerly 17-22.810, Amended 1-18-89, Formerly 17-550.710, Repealed 12-9-96.

62-550.720 Recordkeeping. All suppliers of water shall retain on the premises of the public water system treatment plant or at a convenient location near the premises, the following records:

(1) Records of bacteriological analyses made pursuant to this Chapter shall be kept for not less than 5 years. Records of chemical analyses made pursuant to this Chapter shall be kept for not less than 10 years. Actual laboratory reports may be kept, or data may be transferred to tabular summaries, provided that the information required in Rule 62-550.730(1), F.A.C., is included.

(2) Records of action taken by the system to correct a violation of primary drinking water regulations shall be kept for a period not less than 3 years after the last action taken with respect to the particular violation involved.

(3) Copies of any written reports, summaries, or communications relating to cross connection control programs or sanitary surveys of the system conducted by any local, State, or Federal agency, shall be kept for a period not less than 10 years after completion of the sanitary survey.

(4) Records concerning a variance or exemption granted to the system shall be kept for a period ending not less than 5 years following the expiration of the variance and exemption.

(5) Water plant operation reports shall be kept for a period of not less than 5 years.

(6) Any system subject to the requirements of Chapter 62-551, F.A.C., shall retain, for no fewer than 12 years, original records of all sampling data and analyses, reports, surveys, letters, evaluations, schedules, Department determinations, and any other information required by Chapter 62-551, F.A.C.

Specific Authority 403.861(9), FS.
Law Implemented 403.853(3), FS.
History -- New 11-19- 87, Formerly 17-22.820, Amended 1-18-89, 01-01-93, 7-4-93, Formerly 17-550.720.

62-550.730 Reporting Requirements for Public Water Systems. Suppliers of water and HRS certified laboratories shall report as follows:

(1) Suppliers of water.

(a) Except where a shorter reporting period is specified in this Chapter, the suppliers of water shall report to the appropriate District office of the Department or Approved County Public Health Unit the results of the test measurement or analysis required by this Chapter within the first ten days following the end of the required monitoring period as designated by the Department, or the first ten days following the month in which the sample results were received, whichever time is shortest.

(b) The supplier of water shall use the approved DEP computer format for reporting all water analysis results, available from the Department's Drinking Water Section, 2600 Blair Stone Road, Tallahassee, Florida 32399-2400. The supplier of

water shall completely fill out the analysis forms in non-erasable ink or on a typewriter, and shall include, at a minimum the following information:

1. Facility name and PWS I.D. number - The complete, unabbreviated facility name is required. The correct, seven digit PWS I.D. number assigned by DEP shall also be clearly written.

2. Address and county - The water system's legal address (plant location) shall be completely filled out along with the name of the county where the water system is located.

3. Collector's name and title - The collector's name and job title shall be included along with a business phone number.

4. Date and time of collection - A complete date (month, day, and year) and sampling time (including a.m. or p.m.) shall be included in order to calculate sample holding time. The results from samples exceeding the appropriate holding time for the contaminant before analysis (for example, thirty hours for bacteriological samples) shall be rejected by the Department as not reliable.

5. Type of water system. The sample form shall clearly show if the water system is a community, non community, non-transient non-community, or other public water system.

6. Raw or treated - The sample form shall indicate if the samples were collected from raw or treated water. If samples from both water types are included on the form, they shall be clearly labeled from which type of water each sample was taken.

7. Sample type - The sample form shall clearly show if the sample was taken for compliance, recheck, main clearance, well survey, inter-agency agreement, or other purposes. If "other" is marked, the purpose for taking the sample shall be stated (e.g., complaint, quality control, special, etc.).

8. Sample location - Samples shall be taken at valid sampling locations as described in Rule 62-550.500(5), F.A.C. Legal addresses, or the best descriptions possible, shall be given for each sampling point.

(c) Analysis results reported on forms that are not completely, clearly, and correctly filled out by the supplier of water shall be invalid. The Department District Office or Approved County Public Health Unit shall reject invalid analytical results and return the forms to the supplier of water within 7 days. The supplier of water shall then resubmit the analysis form with the corrected information within 5 days.

(d) The monthly operation reports for a public water system shall be submitted by the supplier of water or certified lead operator to the appropriate Department District Office or the appropriate Approved County Public Health Unit within 15 days after the month of operation.

(e) The supplier of water shall report to the appropriate District Office of the Department within 48 hours (unless otherwise specified by the chapter) the failure to comply with any drinking water rule contained in Parts III, IV, or V of this Chapter, or

Part IV of Chapter 62-560, F.A.C. When compliance is achieved, the measures taken shall be reported to that office.

(f) The supplier of water is not required to report analytical results to the Department in cases where a Department of Health and Rehabilitative Services laboratory performs the analysis and reports the results to the Department.

(g) Copies of any written reports, summaries, or communications relating to sanitary surveys of the system conducted by the system itself, by a private consultant, or by any local or Federal agency, shall be submitted to the appropriate Department District Office or the appropriate Approved County Public Health Unit within 15 days of receipt by the supplier of water of the information.

(h) The supplier of water, within ten days of completion of each public notification requirement pursuant to Part IV of Chapter 62-560, F.A.C., shall submit to the Department a representative copy of each type of notice distributed, published, posted, and made available to the persons served by the system and the media.

(i) Upon request, the supplier of water shall submit to the Department within the time stated in the request, copies of any records required to be maintained under Rule 62-550.720, F.A.C. or copies of any document which the Department is entitled to inspect.

(2) Certified laboratories.

(a) A certified laboratory shall report the following information, at a minimum, to the Department or Approved County Public Health Unit in the appropriate Department approved format. Format specifications may be obtained by writing to the Department's Drinking Water Section, 2600 Blair Stone Road, Tallahassee, Florida 32399-2400. If lab analysis forms are not submitted using the approved format, the forms will be rejected. The information submitted by the certified laboratory for water analysis includes, at a minimum:

1. Laboratory name - The complete, unabbreviated laboratory name is required. If the analytical work was subcontracted out to another certified laboratory, the subcontracting laboratory name shall also be included.

2. Laboratory certification number - The correct, five digit lab certification number, assigned by HRS, shall be clearly identified for the services provided. Any subcontracting laboratory certification numbers shall also be identified for the services provided. The proper certification number for the services provided shall be included, such as when a laboratory that performs radiological analyses has a different certification number from a laboratory that performs other analyses, and both laboratories have the same owner and address.

3. Date and time of the beginning of the analysis - A complete date (month, day, and year) and time of the beginning of the analysis (including a.m. or p.m.) shall be included in order to calculate sample holding time. Results from samples exceeding the appropriate holding time for the contaminant before analysis (for example, thirty

hours for bacteriological samples) shall not be accepted as reliable and shall be rejected by the Department.

4. Name, title, and business phone number of the laboratory contact person.

5. Detection limits and analytical methods - The actual detection limits and analytical methods for each parameter shall be included.

6. True value of the detected contaminant - Any value detected above the certification method detection limit shall be reported as a real number. Only reporting that a value is below the maximum contaminant level is insufficient.

7. Analysis error - The analysis error for each radiological analysis shall be included to determine compliance with the standards in this Chapter.

(b) All certified laboratories shall report the chemical analysis results by using the name of the contaminant as given in Parts III or IV of the Chapter. Different isomers of a contaminant shall be reported separately. If a laboratory reports a result for a contaminant not listed in Parts III or IV of this Chapter, the name of the contaminant and its isomers shall be given using I.U.P.A.C. (International Union of Pure and Applied Chemistry) nomenclature.

(c) Analytical results reported on forms that are not completely, clearly, and correctly filled out by the certified laboratory as described in (a) and (b), are invalid. The Department or Approved County Public Health Unit shall reject all invalid analytical results and return the forms to the supplier of water within 7 days of receipt. The supplier of water shall then resubmit the analysis form with the corrected information within 5 days.

(d) The Department shall not be responsible for any costs incurred when requiring a supplier of water to resample for invalid analytical results.

(3) A public water system that uses a surface water source and provides filtration treatment shall report monthly to the office specified by the Department the information in this subsection beginning June 29, 1993, or when filtration is installed, whichever is later. This information shall be provided in the format specified by and available from the Department of Environmental Protection, Drinking Water Section, 2600 Blair Stone Road, Tallahassee, Florida 32399-2400.

(a) Turbidity measurements required by Rule 62-550.560, F.A.C., shall be reported within 10 days after the end of each month the system serves water to the public. Required information includes:

1. The total number of filtered water turbidity measurements taken during the month.

2. The number and percentage of filtered water turbidity measurements taken during the month which are less than or equal to the turbidity limits specified in Rule 62-555.620, F.A.C., for the filtration technology being used.

3. The date and value of any turbidity measurements taken during the month which exceed five NTU.

4. A turbidity reading representative of each 24 hour period.

5. The average turbidity reading for the month based on the daily readings reported in Rule 62-550.730(3)(a)4., F.A.C.

(b) Disinfection information specified in Rule 62-555.630, F.A.C., shall be reported to the Department within 10 days after the end of each month the system serves water to the public. Required information includes:

1. For each day, the lowest measurement of residual disinfectant concentration in milligrams per liter in water entering the distribution system.

2. The date and duration of each period when the residual disinfectant concentration in water entering the distribution system fell below 0.2 milligrams per liter free chlorine or its equivalent and the date the Department was notified.

3. The residual disinfection information on the samples taken in the distribution system in conjunction with total coliform monitoring pursuant to Rules 62-550.510(6) and 62-555.630(3)(c), F.A.C., for the current and previous month the system serves water to the public. The required value of "V" shall be calculated from the formula found in Rule 62-555.630, F.A.C.

(4) A public water system that uses a surface water source or ground water under the direct influence of surface water and that does not provide filtration treatment shall report monthly to the office specified by the Department beginning December 31, 1990, or six months from the time the Department notifies the system that its ground water source is under the direct influence of surface water. The required information is specified in 40 CFR 141.75(a) as published on pages 27535 through 27537 of the June 29, 1989, Federal Register, hereby adopted and incorporated by reference. This information shall be provided in the format specified by and is available from the Department's Drinking Water Section, 2600 Blair Stone Road, Tallahassee, Florida 32399-2400.

(5) Reporting Formats for the Control of Lead and Copper. Analytical results for samples taken pursuant to this chapter shall be reported in a format which includes all of the required information described below. If laboratory analysis reports are submitted without all of the required information, as set forth below, the submittal will be rejected.

(a) Lead and copper tap samples. The information submitted by the certified laboratory for the analysis of lead and copper tap samples shall include, at a minimum:

1. System name.

2. Public water system identification number.

3. Laboratory name. The complete unabbreviated laboratory name is required. If the analytical work was subcontracted out to another certified laboratory, the subcontracting laboratory name shall also be included.

4. Laboratory certification number. The correct five digit laboratory certification number as assigned by the Department of Health and Rehabilitative Services shall be clearly identified for the services provided. Any subcontracting laboratory's certification number shall also be submitted for the services provided.

TABLE 9: MONITORING SCHEDULE
REFERENCE RULE 62-550.500(4)
Each public water system shall take required samples during the time period specified below

CONTAMINANT GROUP		COMMUNITY SYSTEMS SERVING MORE THAN 3,300 PEOPLE	COMMUNITY SYSTEMS SERVING 3,300 OR FEWER PEOPLE	NON-TRANSIENT NON-COMMUNITY SYSTEMS	NONCOMMUNITY SYSTEMS
ASBESTOS RULE 62-550.511		FIRST YEAR OF EACH NINE YEAR COMPLIANCE CYCLE	SECOND YEAR OF EACH NINE YEAR COMPLIANCE CYCLE	THIRD YEAR OF EACH NINE YEAR COMPLIANCE CYCLE	NOT REQUIRED
NITRATES AND NITRITES RULE 62-550.512	GROUND WATER	ANNUALLY	ANNUALLY	ANNUALLY	ANNUALLY
	SURFACE WATER	QUARTERLY	QUARTERLY	QUARTERLY	ANNUALLY
INORGANICS RULE 62-550.513	GROUND WATER	FIRST YEAR OF EACH THREE YEAR COMPLIANCE PERIOD	SECOND YEAR OF EACH THREE YEAR COMPLIANCE PERIOD	THIRD YEAR OF EACH THREE YEAR COMPLIANCE PERIOD	NOT REQUIRED
	SURFACE WATER	ANNUALLY	ANNUALLY	ANNUALLY	NOT REQUIRED
VOLATILE ORGANIC CONTAMINANTS RULE 62-550.515		FIRST YEAR OF EACH THREE YEAR COMPLIANCE PERIOD UNLESS ANNUAL MONITORING IS AUTHORIZED	SECOND YEAR OF EACH THREE YEAR COMPLIANCE PERIOD UNLESS ANNUAL MONITORING IS AUTHORIZED	THIRD YEAR OF EACH THREE YEAR COMPLIANCE PERIOD UNLESS ANNUAL MONITORING IS AUTHORIZED	NOT REQUIRED
PESTICIDES & PCBs RULE 62-550.516		FIRST YEAR OF EACH THREE YEAR COMPLIANCE PERIOD	SECOND YEAR OF EACH THREE YEAR COMPLIANCE PERIOD	THIRD YEAR OF EACH THREE YEAR COMPLIANCE PERIOD	NOT REQUIRED
RADIONUCLIDES RULE 62-550.519		FIRST YEAR OF EACH THREE YEAR COMPLIANCE PERIOD	SECOND YEAR OF EACH THREE YEAR COMPLIANCE PERIOD	THIRD YEAR OF EACH THREE YEAR COMPLIANCE PERIOD	NOT REQUIRED
SECONDARY CONTAMINANTS RULE 62-550.520		FIRST YEAR OF EACH THREE YEAR COMPLIANCE PERIOD	SECOND YEAR OF EACH THREE YEAR COMPLIANCE PERIOD	NOT REQUIRED	NOT REQUIRED
GROUP I AND III UNREGULATED ORGANICS RULE 62-550.521(1)AND (3)		FIRST YEAR OF THE FIRST THREE YEAR COMPLIANCE PERIOD BEGINNING JANUARY 1, 1993	SECOND YEAR OF THE FIRST THREE YEAR COMPLIANCE PERIOD BEGINNING JANUARY 1, 1993	THIRD YEAR OF THE FIRST THREE YEAR COMPLIANCE PERIOD BEGINNING JANUARY 1, 1993	NOT REQUIRED
GROUP II UNREGULATED ORGANICS RULE 62-550.521(2)		FIRST YEAR OF EACH THREE YEAR COMPLIANCE PERIOD	SECOND YEAR OF EACH THREE YEAR COMPLIANCE PERIOD	THIRD YEAR OF EACH THREE YEAR COMPLIANCE PERIOD	NOT REQUIRED

Note: Monitoring for microbiological contamination is covered by Rule 62-550.518, F.A.C., and monitoring for turbidity by surface water systems is covered by Rule 62-550.560, F.A.C.

j. The number of sites reported.

2. Format table.

a. Each sampling site location identification number corresponding to the identification number reported in Part VI of DEP Form 62-555.900(12), F.A.C.

b. The sampling date for each reported sample.

c. The measured value of the water quality parameters and dosage rates required to be analyzed under 40 C.F.R. part 141.87 (1995).

Specific Authority 403.853(3), 403.861(9), FS.
Law Implemented 403.852(12), (13), 403.853(3), 403.861(16), (17), FS.
History -- New 11-19-87, Formerly 17-22.830, Amended 1-18-89, 1-3-91, 1-1-93, Formerly 17-550.730, Amended 9-7-94, 2-7-95, Amended 12-9-96.

62-550.740 Location of Records.
Specific Authority 403.861(9), (16), (17), FS.
Law Implemented 403.101, 403.853(3), (4), FS.
History -- New 11-19-87, Formerly 17-22.835, Amended 1-18-89, Formerly 17-550.740, Repealed 12-9-96.

PART VIII
CONTROL OF LEAD AND COPPER

62-550.800 Control of Lead and Copper. In addition to the requirements of this chapter, the standards and criteria contained in the Code of Federal Regulations (C.F.R.), title 40, part 141, sections 80 through 91, (1995), are adopted by reference and enforceable under this rule.
Specific Authority 403.861(9) FS.
Law Implemented 403.853 FS.
History--New 12-9-96

TABLE 1
MAXIMUM CONTAMINANT LEVELS FOR INORGANIC COMPOUNDS

FEDERAL CONTAMINANT ID NUMBER	CONTAMINANT	MCL (mg/L)
1074	Antimony	0.006
1005	Arsenic	0.05
1094	Asbestos	7 MFL
1010	Barium	2
1075	Beryllium	0.004
1015	Cadmium	0.005
1020	Chromium	0.1
1024	Cyanide	0.2
1025	Fluoride	4
1030	Lead	0.015
1035	Mercury	0.002
1036	Nickel	0.1
1040	Nitrate	10 (as N)
1041	Nitrite	1 (as N)
1045	Selenium	0.05
1052	Sodium	160
1085	Thallium	0.002

Abbreviations used: MCL = maximum contaminant level
MFL = million fibers per liter greater than 10 micrometers.
mg/L = milligrams per liter

TABLE 2
MAXIMUM CONTAMINANT LIMITS FOR VOLATILE ORGANIC COMPOUNDS

FEDERAL CONTAMINANT ID NUMBER	CONTAMINANT & (CAS NUMBER)	MCL (mg/L)
2977	1,1-Dichloroethylene (75-35-4)	0.007
2981	1,1,1-Trichloroethane (71-55-6)	0.2
2985	1,1,2-Tricholoroethane (79-00-5)	0.005
2980	1,2-Dichloroethane (107-06-2)	0.003
2983	1,2-Dichloropropane (78-87-5)	0.005
2378	1,2,4-Tricholorobenzene (120-82-1)	0.07
2990	Benzene (71-43-2)	0.001
2982	Carbon tetrachloride (56-23-5)	0.003
2380	cis-1,2-Dichloroethylene (156-59-2)	0.07
2964	Dichloromethane (75-09-2)	0.005
2992	Ethylbenzene (100-41-4)	0.7
2989	Monochlorobenzene (108-90-7)	0.1
2968	o-Dichlorobenzene (95-50-1)	0.6
2969	para-Dichlorobenzene (106-46-7)	0.075
2996	Styrene (100-42-5)	0.1
2987	Tetrachloroethylene (127-18-4)	0.003
2991	Toluene (108-88-3)	1
2979	trans-1,2-Dichloroethylene (156-60-5)	0.1
2984	Trichloroethylene (79-01-6)	0.003
2976	Vinyl chloride (75-01-4)	0.001
2955	Xylenes (total) (1330-20-7)	10

Abbreviations used: MCL = maximum contaminant level
mg/L = milligrams per liter
CAS Number = Chemical Abstract System Number

TABLE 3
MAXIMUM CONTAMINANT LIMITS FOR PESTICIDES AND PCBs

CONTAMINANT ID NUMBER	CONTAMINANT & CAS NUMBER	MCL (mg/L)
2063	2,3,7,8-TCDD (Dioxin) (1746-01-6)	3×10^{-8}
2105	2,4-D (94-75-7)	0.07
2110	2,4,5-TP (Silvex) (93-72-1)	0.05
2051	Alachlor (15972-60-8)	0.002
2050	Atrazine (1912-24-9)	0.003
2306	Benzo(a)pyrene (50-32-8)	0.0002
2046	Carbofuran (1563-66-2)	0.04
2959	Chlordane (57-74-9)	0.002
2031	Dalapon (75-99-0)	0.2
2035	Di(2-ethylhexyl)adipate (103-23-1)	0.4
2039	Di(2-ethylhexyl)phthalate (117-81-7)	0.006
2931	Dibromochloropropane(DBCP) (96-12-8)	0.0002
2041	Dinoseb (88-85-7)	0.007
2032	Diquat (85-00-7)	0.02
2033	Endothall (145-73-3)	0.1
2005	Endrin (72-20-8)	0.002
2946	Ethylene dibromide (EDB) (106-93-4)	0.00002
2034	Glyphosate (1071-83-6)	0.7
2065	Heptachlor (76-44-8)	0.0004
2067	Heptachlor epoxide (1024-57-3)	0.0002
2274	Hexachlorobenzene (118-74-1)	0.001
2042	Hexachlorocyclopentadiene (77-47-4)	0.05
2010	Lindane (58-89-9)	0.0002
2015	Methoxychlor (72-43-5)	0.04
2036	Oxamyl (vydate) (23135-22-0)	0.2
2326	Pentachlorophenol (87-86-5)	0.001
2040	Picloram (1918-02-1)	0.5

2383	Polychlorinated biphenyl (PCB) (1336-36-3)	0.0005
2037	Simazine (122-34-9)	0.004
2020	Toxaphene (8001-35-2)	0.003

Abbreviations used: MCL = maximum contaminant level
mg/L = milligrams per liter
CAS Number = Chemical Abstract System Number

TABLE 4
SECONDARY DRINKING WATER STANDARDS

FEDERAL CONTAMINANT ID NUMBER	CONTAMINANT	LEVELS (mg/L)*
1002	Aluminum	0.2
1017	Chloride	250
1022	Copper	1
1025	Fluoride	2.0
1028	Iron	0.3
1032	Manganese	0.05
1050	Silver	0.1
1055	Sulfate	250
1095	Zinc	5
1905	Color	15 color units
1920	Odor**	3 (threshold odor number)
1925	pH	6.5 - 8.5
1930	Total Dissolved Solids	500 (may be greater if no other maximum contaminant level is exceeded)
2905	Foaming agents	0.5

*except color, odor, corrosivity, and pH
** For purpose of compliance with ground water quality secondary standards, as referenced in Chapter 62-520, F.A.C., levels of ethylbenzene exceeding 30 micrograms per liter, toluene exceeding 40 micrograms per liter, or xylenes exceeding 20 micrograms per liter shall be considered equivalent to exceeding the drinking water secondary standard for odor.

TABLE 5
GROUP I UNREGULATED ORGANIC CONTAMINANTS

FEDERAL CONTAMINANT ID NUMBER	CONTAMINANT & CAS NUMBER*
2066	3-Hydroxycarbofuran (16655-82-6)
2047	Aldicarb (116-06-3)
2044	Aldicarb sulfone (1646-88-4)
2043	Aldicarb sulfoxide (1646-87-3)
2356	Aldrin (309-00-2)
2076	Butachlor (23184-66-9)
2021	Carbaryl (63-25-2)
2440	Dicamba (1918-00-9)
2364	Dieldrin (60-57-1)
2022	Methomyl (16752-77-5)
2045	Metolachlor (51218-45-2)
2595	Metribuzin (21087-69-9)
2077	Propachlor (1918-16-7)

* CAS NUMBER = Chemical Abstract System Number

TABLE 6
GROUP II UNREGULATED ORGANIC CONTAMINANTS

FEDERAL CONTAMINANT ID NUMBER	CONTAMINANT & CAS NUMBER*
2410	1,1-dichloropropylene (563-58-6)
2978	1,1-dichloroethane (75-34-3)
2986	1,1,1,2-tetrachloroethane (630-20-6)
2988	1,1,2,2-tetrachloroethane (79-34-6)
2414	1,2,3-trichloropropane (96-18-4)
2412	1,3-dichloropropane (142-28-9)
2413	1,3-dichloropropene (542-75-6)
2416	2,2-dichloropropane (594-20-7)
2993	Bromobenzene (108-86-1)
2943	Bromodichloromethane (75-27-4)
2942	Bromoform (75-25-2)
2214	Bromomethane (74-83-9)
2216	Chloroethane (75-00-3)
2941	Chloroform (67-66-3)
2210	Chloromethane (74-87-3)
2944	Dibromochloromethane (124-48-1)
2408	Dibromomethane (74-95-3)
2212	Dichlorodifluoromethane (75-71-8)
2967	m-dichlorobenzene (541-73-1)
2251	Methyl tert-butyl-ether (MTBE) (1634-04-4)
2965	o-chlorotoluene (95-49-8)
2966	p-chlorotoluene (106-43-4)
2218	Trichlorofluoromethane (75-69-4)

* CAS NUMBER = Chemical Abstract System Number

TABLE 7
GROUP III UNREGULATED ORGANIC CONTAMINANTS

FEDERAL CONTAMINANT ID NUMBER	CONTAMINANT & CAS NUMBER*
9112	2-methyl-4,6-dinitrophenol (534-52-1)
9108	2-chlorophenol (95-57-8)
2270	2-4-dinitrotoluene (121-14-2)
9116	2,4,6-trichlorophenol (88-06-2)
2294	Butyl benzyl phthalate (85-68-7)
2290	Di-n-butylphthalate (84-74-2)
2284	Diethylphthalate (84-66-2)
2282	Dimethylphthalate (131-11-3)
9089	Dioctylphthalate (117-84-0)
2262	Isophorone (78-59-1)
9115	Phenol (108-95-2)

* CAS NUMBER = Chemical Abstract System Number

TABLE 8: MONITORING FREQUENCIES

CONTAMINANT GROUP	APPLICABILITY	SAMPLES REQUIRED		FREQUENCY		TRIGGER THAT INCREASES MONITORING	INCREASED FREQUENCY	TRIGGER THAT DECREASES MONITORING	DECREASED FREQUENCY	SAMPLING LOCATIONS
		G.W.	S.W.	G.W.	S.W.					
ASBESTOS RULE 62-550.310(1)(a) RULE 62-550.511	C, NTNC	1	1	9 YEARS	9 YEARS	≥ MCL	QUARTERLY	NOT VULNERABLE	NONE REQUIRED	NOTE 1
NITRATE AND NITRITE RULE 62-550.310(1)(a) RULE 62-550.512	C, NTNC	1	1	ANNUALLY	QUARTERLY	≥ 50% OF MCL	QUARTERLY	--	--	NOTE 2
	NC	1	1	ANNUALLY	ANNUALLY	≥ MCL				
INORGANICS RULE 62-550.310(1)(a) RULE 62-550.513	C, NTNC	1	1	3 YEARS	ANNUALLY	≥ MCL	QUARTERLY	--	--	NOTE 2
TOTAL TRIHALOMETHANES RULE 62-550.310(2)(a) RULE 62-550.514	C ≥ 10,000 PERSONS	4	4	QUARTERLY	QUARTERLY	--	--	--	--	NOTE 3
VOLATILE ORGANICS RULE 62-550.310(2)(b) RULE 62-550.515	C, NTNC	1	1	NOTE 5	NOTE 5	DETECTION	QUARTERLY	NO DETECTION	ANNUALLY	NOTE 2
PESTICIDES & PCB RULE 62-550.310(2)(c) RULE 62-550.516	C, NTNC	4 CONSEC-UTIVE QUARTERLY	4 CONSEC-UTIVE QUARTERLY	3 YEARS	3 YEARS	DETECTION	QUARTERLY	NO DETECTION	NOTE 6	NOTE 2
ACRYLAMIDE & EPICHLOROHYDRIN RULE 62-550.310(2)(d) RULE 62-550.325	C, NTNC, NC	NOTE 7	NOTE 7	--	--	--	--	--	--	NOTE 2
TURBIDITY-SURFACE WATER RULE 62-550.310(3) RULE 62-550.560	C, NTNC, NC	--	NOTE 8	--	NOTE 8	SEE RULE 62-555.620			--	NOTE 2
MICROBIOLOGICAL RULE 62-550.310(4) RULE 62-550.518	C, NTNC, NC > 1,000 PERSONS	RULE 62-550.518	RULE 62-550.518	MONTHLY	MONTHLY	POSITIVE TEST	RULE 62-550.518(8)	--	--	RULE 62-550.518
	NC ≤ 1,000 PERSONS	2	2	QUARTERLY	QUARTERLY					

TABLE 8--CONTINUED

CONTAMINANT GROUP	APPLICABILITY	SAMPLES REQUIRED		FREQUENCY		TRIGGER THAT INCREASE MONITORING	INCREASED FREQUENCY	TRIGGER THAT DECREASES MONITORING	DECREASED FREQUENCY	SAMPLING LOCATION
		G.W.	S.W.	G.W.	S.W.					
NATURALLY OCCURRING RADIONUCLIDES RULE 62-550.310(5)(a) RULE 62-550.519	C, NTNC	NOTE 9	NOTE 9	3 YEARS	3 YEARS	≥ MCL	RULE 62-550.519(1)	--	--	NOTE 2
MAN-MADE RADIONUCLIDES RULE 62-550.310(5)(b) RULE 62-550.519	C ≥ 100,000 PERSONS	NONE	NOTE 9	--	3 YEARS	≥ MCL	RULE 62-550.519(2)	--	--	NOTE 2
SECONDARY CONTAMINANTS RULE 62-550.320 RULE 62-550.520	C	1	1	3 YEARS	3 YEARS	--	--	--	--	NOTE 2
GROUP I UNREGULATED ORGANICS RULE 62-550.405 RULE 62-550.521(10)	C, NTNC	4 CONSEC-UTIVE QUARTERLY	4 CONSEC-UTIVE QUARTERLY	NONE	NONE	--	--	--	--	NOTE 2
	C, NTNC < 150 Connections	NOTE 10	NOTE 10	--	--					
GROUP II UNREGULATED ORGANICS RULE 62-550.410 RULE 62-550.521(2)	C, NTNC	1	1	3 YEARS	3 YEARS	--	--	--	--	NOTE 2
	C, NTNC < 150 Connections	NOTE 10	NOTE 10	--	--					
GROUP III UNREGULATED ORGANICS RULE 62-550.415 RULE 62-550.521(10)	C, NTNC	1	1	NONE	NONE	--	--	--	--	NOTE 2
	C, NTNC < 150 Connections	NOTE 10	NOTE 10	--	--					

Abbreviations used: C = community systems; NTNC = non-transient non-community systems;
NC = non-community systems;
SW = surface water sources; GW = ground water sources;
MCL = maximum contamination level

NOTE 1: See Rule 62-550.511, F.A.C. A system vulnerable to asbestos contamination due solely to corrosion of asbestos-cement pipe shall take one sample at a tap served by asbestos-cement pipe and under conditions where asbestos contamination is most likely to occur. A system vulnerable to asbestos contamination due solely to source water shall monitor at every entry point to the distribution system which is representative of each well or source after treatment. Systems vulnerable to contamination from both sources shall take one sample at a tap served by asbestos cement pipe and under conditions where asbestos contamination is most likely to occur.

NOTE 2: See Rule 62-550.500(6), F.A.C. Each system shall sample at every entry point to the distribution system which is representative of each source after treatment. If the system draws water from more than one source and the sources are combined before distribution, the system must sample at an entry point to the distribution system during periods of normal operating conditions (i.e., when water representative of all sources is being used). Each sample must be taken at the same sampling point unless conditions make another sampling point more representative of each source, treatment plant or distribution system.

NOTE 3: See Rule 62-550.514, F.A.C. Take at least 4 samples each quarter which are representative of each treatment plant from within the distribution system. At least one-fourth of the required samples shall be taken at a point within the distribution system which reflects the maximum residence time of the water in the system. The remainder of the samples shall be taken at representative locations in the distribution system, taking into account the areas of maximum water usage, the different sources of water, and the different treatment methods employed.

NOTE 4: See Rule 62-550.515(2), F.A.C. Surface water systems shall sample as directed in Note 2 above. Ground water systems shall take a minimum of one sample, during the first quarter of the initial base point monitoring, representative of each well exclusively. It may be a raw or treated sample. Subsequent samples shall be taken as in Note 2 above.

NOTE 5: See Rule 62-550.515(1), F.A.C. Each system shall take four consecutive quarterly samples during its assigned year of the first compliance period. If no contaminant is detected, the system will monitor annually during the next three year compliance period. If still no contaminants are detected, ground water systems shall take one sample during each subsequent three year compliance period. Surface water systems will continue to monitor annually. If the initial monitoring for contaminants listed in Rule 62-550.310(2)(b), F.A.C., has been completed by December 31, 1992, and the system did not detect any contaminants, then each ground and surface water system shall take one sample annually beginning January 1, 1993.

NOTE 6: See Rule 62-550.516(1), F.A.C. Systems serving more than 3,300 persons which do not detect a contaminant in the initial compliance period may reduce the sampling frequency to a minimum of two quarterly samples in one year during each repeat compliance period. Systems serving less than or equal to 3,300 persons which do not detect a contaminant in the initial compliance period may reduce the sampling frequency to a minimum of one sample during each repeat compliance period.

NOTE 7: See Rule 62-550.325, F.A.C. Each public water system must certify annually in writing to the Department (using third party or manufacturer's certification) that when acrylamide or epichlorohydrin are used in drinking water systems, the combination (or product) of dose and monomer level does not exceed the levels specified as follows:

Acrylamide 0.05% dosed at 1 part per million (or equivalent)

Epichlorohydrin 0.01% dosed at 20 part per million (or equivalent)

NOTE 8: Community, non-community, and non-transient non-community systems using surface water or ground water under the direct influence of surface water are required to monitor for turbidity. Until June 29, 1993, Rule 62-550.517, F.A.C., governs. After that date, the provisions of Rules 62-550.560 and 62-555.620, F.A.C., apply.

NOTE 9: See Rule 62-550.519, F.A.C. Compliance shall be based on the average of the analysis of four quarterly samples obtained at quarterly intervals. A maximum of two quarterly samples may be composited.

NOTE 10: See Rule 62-550.521(3), F.A.C. C and NTNC systems with less than 150 service connections, and serving fewer than 350 people, should notify the Department that their system is available for testing. Do not send samples to the Department. If the Department determines that the system must take samples for unregulated contaminants, it will notify the owner. The samples will be taken at the system's expense. Reference Rule 62-550.410, F.A.C.

TABLE 9: MONITORING SCHEDULE
REFERENCE RULE 62-550.500(4)
Each public water system shall take required samples during the time period specified below

CONTAMINANT GROUP		COMMUNITY SYSTEMS SERVING MORE THAN 3,300 PEOPLE	COMMUNITY SYSTEMS SERVING 3,300 OR FEWER PEOPLE	NON-TRANSIENT NON-COMMUNITY SYSTEMS	NONCOMMUNITY SYSTEMS
ASBESTOS RULE 62-550.511		FIRST YEAR OF EACH NINE YEAR COMPLIANCE CYCLE	SECOND YEAR OF EACH NINE YEAR COMPLIANCE CYCLE	THIRD YEAR OF EACH NINE YEAR COMPLIANCE CYCLE	NOT REQUIRED
NITRATES AND NITRITES RULE 62-550.512	GROUND WATER	ANNUALLY	ANNUALLY	ANNUALLY	ANNUALLY
	SURFACE WATER	QUARTERLY	QUARTERLY	QUARTERLY	ANNUALLY
INORGANICS RULE 62-550.513	GROUND WATER	FIRST YEAR OF EACH THREE YEAR COMPLIANCE PERIOD	SECOND YEAR OF EACH THREE YEAR COMPLIANCE PERIOD	THIRD YEAR OF EACH THREE YEAR COMPLIANCE PERIOD	NOT REQUIRED
	SURFACE WATER	ANNUALLY	ANNUALLY	ANNUALLY	NOT REQUIRED
VOLATILE ORGANIC CONTAMINANTS RULE 62-550.515		FIRST YEAR OF EACH THREE YEAR COMPLIANCE PERIOD UNLESS ANNUAL MONITORING IS AUTHORIZED	SECOND YEAR OF EACH THREE YEAR COMPLIANCE PERIOD UNLESS ANNUAL MONITORING IS AUTHORIZED	THIRD YEAR OF EACH THREE YEAR COMPLIANCE PERIOD UNLESS ANNUAL MONITORING IS AUTHORIZED	NOT REQUIRED
PESTICIDES & PCBs RULE 62-550.516		FIRST YEAR OF EACH THREE YEAR COMPLIANCE PERIOD	SECOND YEAR OF EACH THREE YEAR COMPLIANCE PERIOD	THIRD YEAR OF EACH THREE YEAR COMPLIANCE PERIOD	NOT REQUIRED
RADIONUCLIDES RULE 62-550.519		FIRST YEAR OF EACH THREE YEAR COMPLIANCE PERIOD	SECOND YEAR OF EACH THREE YEAR COMPLIANCE PERIOD	THIRD YEAR OF EACH THREE YEAR COMPLIANCE PERIOD	NOT REQUIRED
SECONDARY CONTAMINANTS RULE 62-550.520		FIRST YEAR OF EACH THREE YEAR COMPLIANCE PERIOD	SECOND YEAR OF EACH THREE YEAR COMPLIANCE PERIOD	NOT REQUIRED	NOT REQUIRED
GROUP I AND III UNREGULATED ORGANICS RULE 62-550.521(1)AND (3)		FIRST YEAR OF THE FIRST THREE YEAR COMPLIANCE PERIOD BEGINNING JANUARY 1, 1993	SECOND YEAR OF THE FIRST THREE YEAR COMPLIANCE PERIOD BEGINNING JANUARY 1, 1993	THIRD YEAR OF THE FIRST THREE YEAR COMPLIANCE PERIOD BEGINNING JANUARY 1, 1993	NOT REQUIRED
GROUP II UNREGULATED ORGANICS RULE 62-550.521(2)		FIRST YEAR OF EACH THREE YEAR COMPLIANCE PERIOD	SECOND YEAR OF EACH THREE YEAR COMPLIANCE PERIOD	THIRD YEAR OF EACH THREE YEAR COMPLIANCE PERIOD	NOT REQUIRED

Note: Monitoring for microbiological contamination is covered by Rule 62-550.518, F.A.C., and monitoring for turbidity by surface water systems is covered by Rule 62-550.560, F.A.C.

Appendix B
Water Treatment Technology Reference Data

Ion Exchange and Reverse Osmosis Expert Opinion Letters

HARN R/O SYSTEMS, INC.
REVERSE OSMOSIS WATER TREATMENT SYSTEMS

May 16, 1997

Mr. David W. Porter EP
David W. Porter E.P.
1857 Wells Rd
Suite 226
Orange Park, Fl. 32073

RE: Aloha Utilities

Dear Mr. Porter:

It was a pleasure talking with you about your potential need for a reverse osmosis water treatment system. As you are aware reverse osmosis membrane systems are designed to remove dissolved solids. Its use for removal of hydrogen sulfide would not be cost effective or technically correct. Hydrogen sulfide gas is easily removed after the R/O system using forced draft degasification. Any effort to remove it prior to an R/O system would produce elemental sulfur which cannot be removed in sufficient quantities prior to an R/O system to keep it from becoming an irreversible foulant.

Reverse osmosis is an excellent treatment process for removing dissolved salts from water. The majority of the systems that we have provided use well water with several systems using the Floridan Aquifer. We would be glad to show you systems that have been operating on well waters for several years with excellent performance. I have included a P&I diagram of a typical well water R/O system along with a few pictures of systems that we have designed, constructed and installed. If you should have any further questions please feel free to call me. I will look forward to working with you in the future.

Sincerely,

James A. Harn

JAH/amc
attachments

205 SEABOARD AVENUE • VENICE, FLORIDA 34292 • (941) 488-9671 • FAX (941) 488-9400
POST OFFICE BOX 879 • NOKOMIS, FLORIDA 34274-0879 • E-MAIL: harnro@aol.com

FAX: (813) 621-4085

A.E.S., INC. OF CALIFORNIA
5912-F Breckenridge Pkwy. / Tampa, Florida 33610 / (813) 621-3932

May 12, 1997

Mr. Dave W. Porter., P.E. C.O.
1857 Wells Road, Suite 226
Orange Park, FL 32073

Via Fax (904) 269-3667
No. of Pages: 1

Subject: **R/O - H2S removal application**

Dear Mr. Porter:

A.E.S., Inc. of California is a Tampa based water purification and wastewater treatment company specializing in membrane treatment applications. Based on the information provided in your fax dated May 8, 1997 regarding the above subject, please be advised as follow:

1.- Reverse Osmosis (R/O) Membrane Treatment is not suitable for reduction/removal of Hydrogen Sulfide (H2S).

2.- One method of removing H2S and other gases such as Carbon Dioxide (CO2) is thru the use of a degassifier system.

If you have any questions regarding the above, please do not hesitate to call me. We look forward to being of service on your future requirements.

Sincerely,

Carlos Camero
Sales Engineer



ADVANCED SEPARATION
TECHNOLOGIES INCORPORATED™
A CALGON CARBON CORPORATION
5315 GREAT OAK DRIVE, LAKELAND, FL 33815

FACSIMILE MESSAGE

DATE: **May 16, 1997**

TO:	**David Porter**	FROM:	**JOHN McLEAN**
TEL No:	(904) 269-6773	TELEPHONE No:	(941) 687-4460
FAX No:	**(904) 2693667**	FAX No:	(941) 687-9362

PAGES 1 (including this cover sheet)

SUBJECT: **Aloha Utilities H_2S Removal**

Dear Mr. Porter:

Thank you for your request for information and pricing for the removal of H_2S from the Silver Springs Water System.

Advanced Separation Technologies, Inc. uses a patented continuous contactor, the ISEP® (Ionic separator) which can efficiently use ion exchange resin to the remove impurities from water.

Although our unique technology allows us to operate in many applications not economical with conventional ion exchange systems, the removal of H_2S can not be economically done using ion exchange resin. We would suggest you investigate gas stripping systems for this application.

Once again, thank for your interest in Advanced Separation Technologies, Inc.. If you have any questions or would like any further information, please contact us at your convenience.

Yours sincerely,

John C. McLean

General Water Treatment Technology References

a new caustic soda (sodium hydroxide) storage and feed facility for distribution system corrosion control pH adjustment.

4.2.1 Hydrogen Sulfide Removal Considerations

A forced draft packed column aeration tower is capable of stripping many different compounds from a flow stream by providing the necessary surface area and turbulence along with countercurrent air flow. Packed tower aerators (PTA), otherwise known as air strippers, are currently being used at the WRWTP to reduce the sulfide concentration within the raw water by removing hydrogen sulfide. New PTAs will be added for the 1997 expansion of the WRWTP and a more detailed description of this system and its equipment is presented in a later section of this chapter. The following discussion presented in this section presents some of the issues involved with hydrogen sulfide removal by aeration.

The advantages of early removal of hydrogen sulfide from the raw water include the following:

- Reduces chlorine demand during disinfection.
- Reduces the potential of elemental sulfur forming within the raw water stream as it passes through the treatment process, thereby increasing turbidity.
- Reduces the potential growth of sulfide oxidizing bacteria within the ground storage tanks.
- Reduces the potential of the finished water having poor odor and taste.

The chemical relationship of hydrogen sulfide (H_2S) in water can be represented as follows:

$$(1) \qquad H_2S \;\text{<==>}\; H^+ + HS^-$$

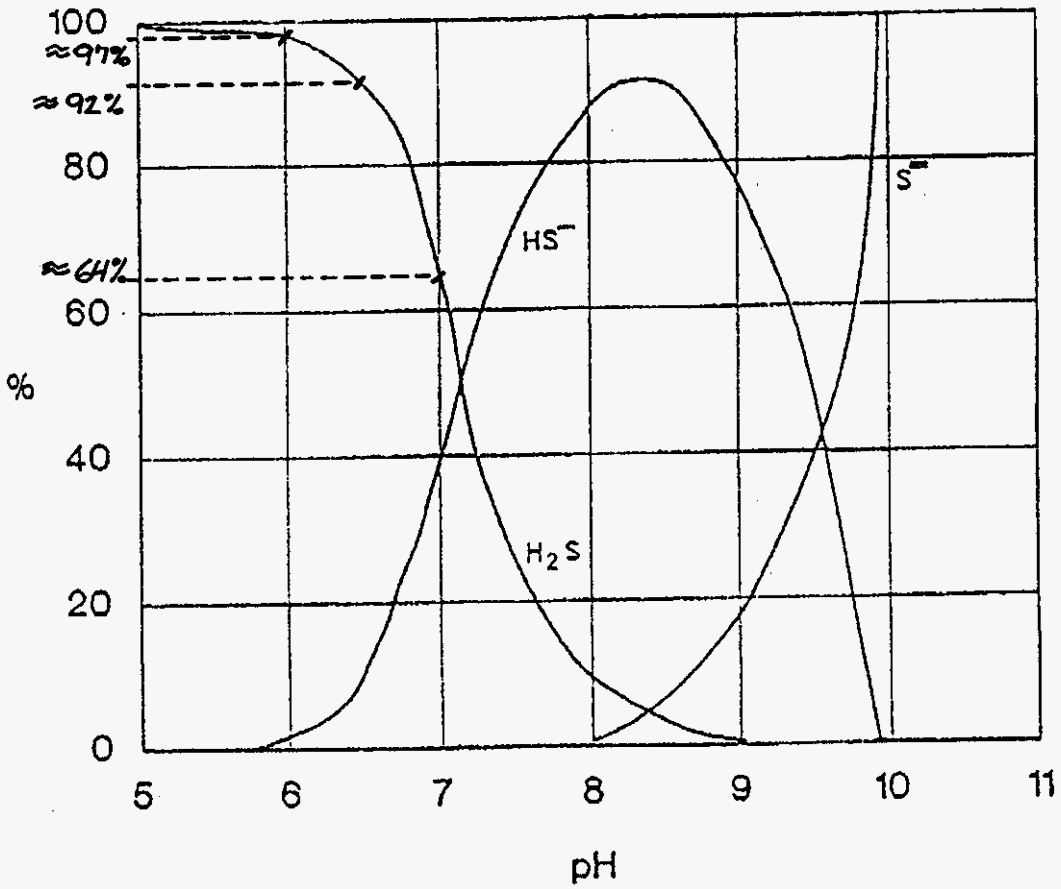
$$(2) \qquad HS^- \;\text{<==>}\; H^+ + S^=$$

Equation (1) represents hydrogen sulfide (H_2S) in the dissolved gas form while equation (2) represents the bisulfide form (HS^-). The ionic specie of sulfide is highly pH dependent as shown in Figure 4-3 which presents the hydrogen sulfide-sulfide equilibrium. At the low pH range of 5 to 6, H_2S is the dominant specie in solution. As the pH increases in the range of 7 to 9, the bisulfide form becomes the dominant specie. The H_2S gas is the only one of these species that is volatile and can be released from solution. As a result, typical aeration processes are not efficient for H_2S removal without pH adjustment to less than about 6.5. The result of an inefficient aeration process is the production of high turbidities in the finished water from an incomplete oxidation of H_2S to elemental sulfur (S°) which can occur in the storage tanks by dissolved oxygen imparted to the water by aeration, or by the application of chlorine before of after the storage tanks. The main reactions involved are:

$$2H_2S + 2O_2 \text{ --> } H_2SO_4 + S^\circ, \text{ and}$$

$$H_2S + Cl_2 \;\text{<==>}\; 2HCl + S^\circ,$$

where S° is elemental sulfur, a solid particle.



EFFECT OF pH ON HYDROGEN SULFIDE EQUILIBRIUM

Total sulfide concentrations at the WRWTP have been identified in the Orange County Water Quality Master Plan - Western Regional System, August 1992, as 0.5 to 1.5 mg/l. At the existing raw water pH at WRWTP of 7.5 to 7.9, approximately 20 percent of the total sulfides in solution exist as hydrogen sulfide as shown in Figure 4-3. Therefore, pH adjustment will be provided in the 1997 plant expansion to allow more efficient removal of the hydrogen sulfide present in the raw water. As the pH is adjusted to below 6.5, removal efficiencies will increase because a greater percentage of the total sulfides will exist as the hydrogen sulfide specie.

It is important to understand that all sulfides that remain in the water stream at any stage of treatment exist proportionally in the hydrogen sulfide or bisulfide forms as graphically represented on Figure 4-3. At a pH of 7.5 this translates to 22 percent of the remaining total sulfides existing as hydrogen sulfide and available for conversion into elemental sulfur, sulfate and other oxidized sulfur compounds at any time. A side effect of pH adjustment and increased hydrogen sulfide removal is an increase in the hydrogen sulfide concentration discharged to atmosphere. Odor control of the off-gas becomes an issue and is discussed later in this chapter.

4.3 Wells

The June 1989 Western Regional Water System Preliminary Engineering Design report prepared by Post, Buckley, Shuh & Jernigan, Inc. identifies 28 possible well locations on the site. The potential well sites were selected to provide adequate distance between the wells and sanitary hazards, sewage disposal systems, and property boundaries as required by FDEP regulations. Aquifer tests performed at the site indicate that each well can produce 3,000 gpm without experiencing excessive drawdown. At this withdrawal rate, a radius of 500 ft should be maintained to minimize interference between adjacent wells.

The existing WRWTP includes two 4.3 mgd wells. Each well consists of a constant speed vertical turbine pump and includes a flowmeter on the discharge piping. As the capacity of the plant increases, additional wells will have to be provided. Each new well will consist of a 4.3 mgd constant speed vertical turbine pump, a check valve, butterfly valve, air release valve, and flowmeter to match the existing wells. The wells will be designed to meet the maximum day demand with the largest well out of service. This will require a well capacity of 24.0 mgd for the 1997 expansion. Therefore, seven wells will be provided for a capacity of 25.8 mgd with one well out of service. These wells are shown on the site plan and are indicated as wells No. 1 through No. 7, with wells No. 1 and No. 2 representing the two existing facilities. The locations shown provide a 500 ft radius between the wells to minimize interference. Production well design data for the 1997 expansion is listed below.

Well Pumps	
Number	5
Type	Vertical turbine
Size, in	14
Motor horsepower, hp	150
Rated capacity of each pump, mgd	4.3
Rated head, ft	155
Number of stages	2
Drive type	Constant speed

Number of stages	1
Air Flow per Scrubber	
Maximum, 3 PTAs operating, cfm	52,500
Velocity across vessel, fpm	464
Minimum, 1 PTAs operating, cfm	17,500
Velocity across vessel, fpm	154

A recirculation pump will be provided to recirculate the scrubbate from the odor control vessel sump back through the system. The fan on the PTA will be sufficiently sized to provide enough pressure to deliver the air flow across the PTA and through the scrubber. A discharge stack will be provided to discharge the treated air to atmosphere.

4.5.5.1 Off-Gas Packed Tower Scrubber Chemical Feed Evaluation. The standard approach for operating a packed tower scrubber is to add sodium hydroxide to raise pH and sodium hypochlorite to oxidize the H_2S. The use of these chemicals may present a problem at the WRWTP if the local wastewater treatment facility, the Northwest Regional Reclamation Facility (NRRF), is to accept the scrubbate blowdown. The reason for this is that the NRRF supplies reuse water to the citrus industry. The County's contract with this industry limits the sodium and chloride levels in the delivered reuse water. Because of this condition, the County has imposed a sodium limit of 300 mg/L on all dischargers. A set chloride limit has not been established at this time, but each application will be evaluated by the County to determine if a limit will be imposed.

If the blowdown from the WRWTP odor control scrubbers is to be discharged to the NRRF, it will have to meet the defined limits. If the commonly used chemicals, NaOH, NaOCl and Cl_2, are employed then sodium and chloride by-products will exist in the blowdown. For this reason alternative chemicals, that can be used in place of NaOH, NaOCl and Cl_2, are considered for use at the WRWTP and are evaluated below in a side by side comparison with NaOH, NaOCl and Cl_2. These alternative chemicals are potassium hydroxide (KOH) for pH adjustment and hydrogen peroxide (H_2O_2) as an oxidizing agent. Other alternative chemicals, such as calcium hydroxide (CaOH) and calcium hypochlorite (CaOCl) were not considered due to the potential for scaling that would occur under elevated pH conditions. Another alternative chemical, potassium permanganate, was not considered as an alternative oxidant based on its ineffectiveness.

The chemical equations used to develop the stoichiometric relationships between the evaluated chemicals and hydrogen sulfide are as follows:

pH Adjustment

Option 1 - Sodium Hydroxide

$$H_2S + 2NaOH \rightarrow Na_2S + 2H_2O$$

Option 2 - Potassium Hydroxide

$$H_2S + 2KOH \rightarrow K_2S + 2H_2O$$

Oxidizing Agents

Option A - Sodium Hypochlorite

$HS^- + 4NaOCl \rightarrow SO_4^{2-} + 4NaCl + H^+$

Option B - Chlorine

$HS^- + 4Cl_2 + 4H_2O + 8NaOH \rightarrow SO_4^{2-} + 8NaCl + 8H_2O + H^+$

Option C - Hydrogen Peroxide

$Na_2S + 4H_2O_2 \rightarrow Na_2SO_4 + 4H_2O + H^+$

Table B-1 in the Appendix B provides the chemical requirements for treating the hydrogen sulfide within the scrubbers. The pure chemical load in pounds per day is calculated by using the stoichiometric relationships derived from the equations above and are summarized as follows:

	0.5mg/L sulfides		1.5mg/L sulfides	
CHEMICAL (LBS/DAY)	Ann. Avg.	Max. Mo.	Ann. Avg.	Max. Mo.
Hydrogen Sulfide Removed	44	87	131	261
- ppm	4.5	6.0	13.5	18.0
pH adjustment				
Option 1 - NaOH	~~102~~	~~205~~	~~307~~	615
Option 2 - KOH	287	574	860	1721
Oxidizing Agent				
Option A - NaOCl	382	763	1145	2289
Option B - Cl_2	364	728	1092	2183
- NaOH	410	819	1229	2458
Option C - H_2O_2	174	348	522	1045

UPDATED

Table B-2 in the Appendix B indicates the sodium and chloride loads that would be part of the blowdown pumped to the Northwest Regional Reclamation Facility. This table also shows the amount of dilution water that will be required to maintain a sodium concentration below 300 mg/l leaving the water plant. The sodium and chloride loads in pounds per day and dilution water requirements for different chemical combinations are summarized as follows:

	0.5mg/L sulfides		1.5mg/L sulfides	
CHEMICAL (LBS/DAY)	Ann. Avg.	Max. Mo.	Ann. Avg.	Max.Mo.
pH Adjustment Only				
Option 1 - NaOH				
Sodium, Na	59	118	177	354
Chloride, Cl	0	0	0	0
Dilution, gpm	20	35	55	105
Option 2 - KOH				
Sodium, Na	0	0	0	0
Chloride, Cl	0	0	0	0

Dilution, gpm	0	0	0	0
pH Adjustment & Oxidation				
Option 1/A - NaOH & NaOCl				
Sodium, Na	177	354	530	1061
Chloride, Cl	182	364	546	1091
Dilution, gpm	55	105	155	310
Option 1/B - NaOH & Cl_2				
Sodium, Na	295	589	884	1768
Chloride, Cl	364	727	1091	2182
Dilution, gpm	85	170	255	505
Option 1/C - NaOH & H_2O_2				
Sodium, Na	59	118	177	354
Chloride, Cl	0	0	0	0
Dilution, gpm	20	35	55	105
Option 2/C - KOH & H_2O_2				
Sodium, Na	0	0	0	0
Chloride, Cl	0	0	0	0
Dilution, gpm	0	0	0	0

The chemical combinations depicted in the summary table above distinguish between two levels of treatment; pH adjustment only and pH adjustment with oxidation. Hydrogen sulfide can be effectively stripped from the PTA off-gas and transferred into the aqueous state with pH adjustment only. This will limit the amount of chemical required for odor control and also allow for reasonable dilution water requirements for reducing the sodium concentration. However, without an oxidizing agent, the hydrogen sulfide present will transform into bisulfide. In the bisulfide form, the hydrogen sulfide can easily convert back into the H_2S form as the pH lowers. Under this condition there is a potential for the hydrogen sulfide within the blowdown to come out of solution and release into the atmosphere at the water plant lift station or at the wastewater plant influent structure. The ramification of not adding an oxidizing agent is uncertain and would require full scale testing to determine if this limited treatment of off-gas is acceptable to the County.

By oxidizing the aqueous hydrogen sulfide it is converted to sulfate which prevents the revolatilization of H_2S. But, chemical consumption is increased substantially which results in an increase in sodium and chloride in the blowdown. The dilution quantities for pH adjustment and oxidation using the standard chemicals (option 1/A & 1/B) are reasonable if the total sulfide concentration in the raw water remains at 0.5 mg/L. However, if the sulfide level increases to 1.5 mg/L, dilution water in the range of 0.45 mgd for option 1/A and 0.73 mgd for option 1/B could be required. These dilution quantities are unreasonable and would add a substantial load to the Northwest Regional Reclamation Facility considering its capacity is 3.5 mgd and it currently operates at 3.0 mgd.

4.5.5.2 Packed Tower Scrubber Chemical Cost Comparison. An annual cost comparison of the different chemical alternatives is shown in Table B-3 in

Appendix B. The table reflects calculated chemical costs for a year's supply at current market prices for annual average conditions at a raw water sulfide concentration of 0.5 mg/L. A summary of the table is as follows:

TREATMENT ALTERNATIVE	$ / Year
pH Adjustment Only	
Option 1 - NaOH	$ 15,700
Option 2 - KOH	$ 39,600
pH Adjustment & Oxidation	
Option 1/A - NaOH & NaOCl	$ 82,500
Option 1/B - NaOH & Cl_2	$105,000
Option 1/C - NaOH & H_2O_2	$ 64,000
Option 2/C - KOH & H_2O_2	$ 87,900

updated

4.5.5.3 Packed Tower Scrubber Chemical Feed Recommendation. The established sodium and potential chloride limits imposed on all dischargers to the NRRF eliminate conventional chemical use as an option due to the unreasonable dilution water requirements. Also, because of the unpredictable results of caustic scrubbing only, this approach is not recommended as the only off-gas treatment to be provided under the 1997 expansion. This option would require full scale pilot testing to be performed at the WRWTP if it were ever considered. Another option is to install odor control facilities equipped to fully oxidize the hydrogen sulfide but to test its performance using caustic only. This provides the capability of adding the oxidizing agent under conditions that caustic conditioning alone does not provide adequate treatment.

Therefore, **the recommended chemical off-gas treatment for the 1997 expansion is option 2/C; alternative chemical treatment using potassium hydroxide and hydrogen peroxide.** This option eliminates the need to monitor sodium and chloride levels within the blowdown and also eliminates the need to provide dilution water to maintain a sodium and/or chloride concentration within the lift station wet well. In addition, the KOH storage tank does not require heat tracing due to a much lower freezing point than that of NaOH. Currently, KOH is more readily available in Florida due to the demand and lack of supply of NaOH. The H_2O_2 storage tank will need to be only 15 percent of the size of the comparable storage quantity of NaOCl. The cost of providing these alternative chemicals, based on the above comparison, is similar to using NaOH and NaOCl, and cheaper than using NaOH and Cl_2.

4.5.6 Off-Gas Packed Tower Scrubber Location

The two off-gas packed tower scrubbers proposed for the 1997 expansion will be placed between the PTAs, on top of the original detention basin roof slab. One scrubber will serve the three PTA's east of the basin while the second will serve those on the west. If an alternative treatment method is considered, or the basin top slab cannot handle the required loads, relocation of the odor control system will be evaluated during final design.

4.5.7 Off-Gas Packed Tower Scrubber Control

The control of the off-gas packed tower scrubbers consists of recirculation pump control, chemical feed pump control, and make-up water control. The pH

APPENDIX A

pH ADJUSTMENT CHEMICAL COMPARISON
SULFURIC ACID (H_2SO_4) vs. CARBON DIOXIDE (CO_2)

Performance testing performed on the two recently installed PTAs at WRWTP indicated removal rates of total sulfides as follows:

- 60 percent at an adjusted pH of 7.5
- 87 percent at an adjusted pH of 6.5
- 97 percent at an adjusted pH of 5.5

The results of this performance testing confirm the need to adjust the pH of the raw water prior to entering the PTAs in order to optimize hydrogen sulfide removal.

Sulfuric acid (H_2SO_4) is commonly used to provide pH adjustment prior to aeration. The effect of using sulfuric acid is the resultant destruction of alkalinity, which makes the treated water more corrosive. The alkalinity must be restored following aeration to stabilize the water and this requires an additional chemical facility to be placed on-site. Recent tests have been performed using carbon dioxide (CO_2) in place of sulfuric acid. Adjustment of pH using carbon dioxide does not destroy alkalinity, eliminating the need for any additional chemical or storage facility.

When sulfuric acid is added to raw water, the bicarbonate ion (HCO_3^-) converts to carbonic acid (H_2CO_3). As the pH lowers, carbon dioxide in the dissolved form is stripped from the bicarbonate ion within the PTA. This results in an increase in the pH through the PTA and a net loss of bicarbonate alkalinity. Conversely, carbon dioxide added to water forms aqueous carbonic acid which lowers pH. Since no bicarbonate ion is destroyed, alkalinity remains intact while carbon dioxide is stripped and pH increases as water flows through the PTA.

1. Pilot Test Results. At this time there is no full scale carbon dioxide pH adjustment system in use prior to aeration towers within the state of Florida. However, pilot testing was conducted in August, 1993 at Orange County's ECON Water Treatment Plant by Boyle Engineering. The pilot test used both sulfuric acid and carbon dioxide to lower the pH of the raw water from 7.9 to 6.0, at different water and air loading rates. The results were that each compound, used for pH adjustment, provided equivalent sulfide removal efficiencies. The other significant finding was that the carbon dioxide did not reduce the alkalinity of the raw water, whereas the sulfuric acid reduced the alkalinity substantially.

Additional comparison testing of sulfuric acid and carbon dioxided was performed at the Orlando Utilities Commission's Lake Highland WTP. These results were similar to those at the ECON WTP and concluded that both sulfuric acid and carbon dioxide produce similar sulfide removal efficiencies for adjusted pH levels within the range of 7.7 to 5.7. The significant finding in these tests were the larger amounts of carbon dioxide required, compared to sulfuric acid, to provide pH levels below

6.5. Above a pH of 6.5 similar amounts of carbon dioxide and sulfuric acid were required to adjust the pH of the raw water. However, below a pH of 6.5 the consumption of carbon dioxide increased substantially in comparison to the sulfuric acid required. The test results of the concentrations of chemical required for adjusting the pH were as follows:

pH	H_2SO_4 (mg/l)	CO_2 (mg/l)
7.5	10	10
7.0	25	25
6.5	65	75
6.3	80	130
6.1	90	200
5.9	100	300
5.7	110	530

The determination of which chemical is best suited for the WRWTP expansion is dependent on the total sulfide concentration within the raw water. If total sulfide concentration is high, it may be prudent to use sulfuric acid in order to obtain a pH of 5.5 and removal rates is excess of 97 percent. However, if total sulfide concentration is low, a pH of 6.5 and 87 percent removal may be sufficient considering that the use of CO_2 eliminates the need for additional chemical storage and feed equipment for alkalinity adjustment.

Regardless of which chemical is used to reduce the pH of the raw water entering the aeration towers, the pH will increase steadily as the water flows through the tower. Results from the Lake Highland test document that the pH increased from 6.5 to above 8.0 through the aeration tower due to the available carbon dioxide being stripped in the process, independent of the chemical used.

The effects on total hardness, ammonia, turbidity, and conductivity following air stripping were also tested at Lake Highland. Total hardness, ammonia and turbidity levels were not significantly affected by the stripping. Conductivity increased 10 percent for those tests that used sulfuric acid. Conductivity is usually an indication of total dissolved solids within the flow stream, but it was found that the total dissolved solids only increased slightly. The conductivity increase can be attributed to the increase in sulfate levels that occur due to alkalinity destruction.

2. Chemical Consumption and Cost at WRWTP. For the performance test conducted at the WRWTP, sulfuric acid was injected into the raw water at a rate of 6.16 gallons per hour to adjust the pH down to 5.5 at a flow rate of 5.0 mgd. The sulfuric acid used for the test was a 93 percent raw solution. Following injection of the acid, no mixing was performed to thoroughly blend the acid into the raw water stream. A correlation can be made between sulfuric acid use and potential carbon dioxide use that is accurate in clean water applications. Based on the Lake Highland WTP pilot test data, a chemical consumption correlation can be made for the WRWTP. The projected consumption of sulfuric acid and carbon dioxide for the 1997 WRWTP expansion would be as follows:

	Sulfuric Acid		Carbon Dioxide
	5.5 pH	6.5 pH	6.5 pH
Raw Water Flow Projected Demand Year 2002 ,mgd			
Average Annual	12.0	<--	<--
Maximum Day	24.0	<--	<--
Peak Hour	42.0	<--	<--
Well Capacity Yr. 2002, mgd	25.8	<--	<--
Chemical Information			
Specific Gravity	1.841		1.016
Concentration, %	93		99
Flow rate, gph/mgd	1.233	0.721	1.508
, gph (a)	31.8	18.6	38.9
, gpm	0.53	0.31	0.65
Bulk Consumption (b)			
per month, gal.	11,000	6,500	13,500
, lbs.	169,000	100,000	115,000
per day, lbs.	5,600	3,300	3,800
Storage, tons (c)	90	50	60

(a) Flow rates based on maximum well production
(b) Bulk consumption based on average annual flows
(c) Storage based on average annual monthly requirement

The comparative annual cost of pH adjustment using sulfuric acid and carbon dioxide is as follows:

	Sulfuric Acid		Carbon Dioxide
	5.5 pH	6.5 pH	6.5 pH
Chemical, $/Ton	$90		$120
Delivery Fee	$200		included
Tanker Capacity, lbs.	46,000		40,000
, Tons	23		20
Cost/Delivery	$2270		$2400
Chemical Consumption/Year, Tons	1014	600	690
Deliveries/Year	44.1	26.1	34.5
Chemical Cost/Year	$100,100	$59,300	$82,800

(a) Sulfuric acid cost quote received from Florida Chemical Supply ((813)988-4890) on 9/8/94.
(b) The carbon dioxide quote received from ARCO representative John Burt ((615)641-2000) on 9/9/94

Based on the cost quotes received and the quantities of chemical required, carbon dioxide will be more expensive than sulfuric acid to attain a pH of 6.5. The ARCO representative explained that the costs of carbon dioxide fluctuate due to availability and demand, and that the cost of CO_2 per ton has been less than sulfuric acid in the past. In addition, if sulfuric is used, alkalinity adjustment is necessary and additional chemical storage and handling facilities would be required. As a result, using carbon dioxide will be more cost effective than using sulfuric acid.

3. Conclusions and Recommendation. Based on pilot test results, the maximum cost effective, total sulfide removal efficiencies for the two chemicals being considered are 97 percent for sulfuric acid and 87 percent for carbon dioxide. The projected sulfide concentrations following treatment are as follows:

	WRWTP raw water adjustment	
	6.5 pH	5.5 pH
Total Sulfide Removal Rate Projected	87%	97%
Hydrogen Sulfide Removed at projected raw water conditions, mg/l		
Min. 0.5 mg/l sulfide	0.435	0.485
Max. 1.5 mg/l sulfide	1.305	1.455
Total Sulfide Remaining in Discharge, mg/l		
Min. 0.5 mg/l sulfide	0.065	0.015
Max. 1.5 mg/l sulfide	0.195	0.045
H2S Available in Discharge @ pH of 8.0+, mg/l		
Min. 0.5 mg/l sulfide	0.0065	0.0015
Max. 1.5 mg/l sulfide	0.0195	0.0045

Sulfuric acid addition results in an approximate 80 percent destruction of alkalinity at an adjusted pH of 5.5. This will require alkalinity supplement since low alkalinity can result in increased corrosion within the distribution piping. Increased sulfate concentrations will also be experienced when sulfuric acid is used, resulting in the potential for increased copper corrosion. In addition, growth of sulfate reducing bacteria within the distribution piping can occur which may lead to sulfate converting back to sulfide when water temperature is increased (hot water heaters) resulting in taste and odor problems.

Another concern with using sulfuric acid is that it is a reportable substance that requires records to be kept in compliance with the governing regulations. Carbon dioxide is much safer to handle than sulfuric acid and also results in less problems with pumps and piping due to the corrosive nature of sulfuric acid.

Due to the low total sulfide concentration that exists within the raw water at the WRWTP, pH adjustment down to 6.5 will provide adequate

removal of total sulfide. Based on the cost of using the two chemicals and the adverse side effects and potential for problems to occur when sulfuric acid is used, carbon dioxide is recommended for pH adjustment at the WRWTP.

WATER
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Typical Claus process.

Odor Prevention

Controlling Hydrogen Sulfide Emissions

by Gary J. Nagl

PICTURES

- Typical Claus process

Few gases are as potent as hydrogen sulfide (H2S) at assaulting the human olfactory senses. The human nose can detect the obnoxious rotten egg odor of H2S at a level of only 0.4 parts per billion (ppb). Few compounds can be detected at such a low level. Hydrogen sulfide is also quite toxic and can cause permanent physical harm and even death. While the ppb levels of odor detection are not hazardous, prolong exposure to levels in the hundreds of parts per million range can be harmful. The maximum allowable exposure for prolong periods is 10 ppm, the maximum concentration for one hour exposure is 300 ppm and exposure to concentrations greater than 600 ppm for 30 minutes is fatal. In addition, hydrogen sulfide desensitizes the human olfactory senses to the point where even high concentrations of H2S are no longer odorous, thus people exposed to high levels of H2S are not aware that they are in danger.

Hydrogen sulfide is produced naturally by the anaerobic decomposition of any type of organic or inorganic matter that contains sulfur (e.g., rotting eggs, wallboard decomposition in landfills, the formation of natural gas from decomposing plant life, sulfate decomposition in sewers, etc.). Hydrogen sulfide is also produced synthetically in hydrogenation and hydrodesulfurization processes and in anaerobic, thermal treating processes such as coke ovens. However, whether present in nature, produced by nature, or produced by human activity, hydrogen sulfide presents severe health and corrosion hazards as well as being an odor nuisance. This article describes the major processes available for removing hydrogen sulfide from various types of gas streams.

The Claus Process

An important element of most oil and natural gas refining and processing facilities, the Claus process converts H2S to elemental sulfur by the following reactions;

1. H2S + 3/2 O2 --> SO2 + H2O
2. 2H2S + SO2 --> 3S0 + H2O
3. OVERALL H2S + 1/2 O2 --> S0 + H2O

In this process (Figure 1), one third of the H2S is first oxidized to SO2 in a furnace (Eq. 1). The SO2 and the remaining H2S then reacts in the furnace and in a series of reactors to produce elemental sulfur in accordance with Eq. 2. The overall removal efficiency of a Claus unit is dependent on the number of catalytic reactors as follows;

REACTORS/EFFICIENCY

2/95%

3/97%

4/98%

To achieve H2S removal efficiencies in excess of 98 percent, it is necessary to add a Tail Gas Unit to treat the effluent gas from the last sulfur condenser. Although there is a variety of different types of Tail Gas Units, most of them rely on the reduction of SO2 to H2S (eq. 4) or the hydrolysis of the reduced sulfur compounds to H2S (eq. 5 & 6) followed by either separation of the H2S and recycling it to the Claus unit or selective catalytic oxidation of the H2S to sulfur (Eq. 3). The Tail Gas Units can generally increase the H2S removal efficiency to greater than 99 percent.

4. SO2 + 3H2 --> H2S + 2H20

5. COS + H20 --> H2S + CO2

6. CS2 + 2H20 --> 2H2S + CO2

As illustrated in Eq. 1, Claus units require precise control of the 02 to H2S ratio with 1.5:1 being desirable. Too much 02 results in high SO2 emissions, while too little 02 results in low H2S removal efficiency. This is one of the reasons why Claus units are suitable for treating large, consistent, acid gas streams (CO2 and H2S), and why air streams and streams containing combustible components such as fuel gas streams cannot be treated in Claus units. Claus units also have turndown limitations on both sulfur loading and H2S concentration. However, they are very economical and reliable for processing large acid gas streams (50+ Long tons per day (LTPD) and producing high purity sulfur.

Chemical Oxidants

Odor control in wastewater treatment plants (WWTPs) is generally accomplished by

capturing the malodorous compounds in a ventilation stream and then either chemically oxidizing them to innocuous, odorless compounds and/or adsorbing them onto activated carbon. Since WWTPs have an abundance of organic, sulfur containing material and anaerobic environments readily available, H2S is the predominant odor precursor. However, there are many other odor compounds present. Consequently, odor control systems in WWTPs generally are designed to remove all of the odor precursors not just H2S. For this reason, nonselective chemical oxidation systems are very popular.

Although there are a variety of chemical oxidants available (chlorine, ozone, permanganate, etc.), the most popular is a combination of sodium hydroxide (NaOH) and sodium hypochlorite (NaOCl). This popularity stems from their relatively low cost, availability and excellent oxidizing capabilities. The actual oxidation reactions are quite complex. They can be best represented by the following:

7. H2S + 2NaOH <--> Na2S + 2H20

8. Na2S + 4NaOCl --> Na2S04 + 4NaCl

As shown in the above reactions, oxidants are continually consumed in the process and consequently, must be replaced. This represents an operating cost that is directly proportional to the amount of H2S being removed. Therefore, chemical oxidation systems are usually only economical for applications where the H2S loading is relatively low (approximately 100 pounds per day or less).

Although there is nothing proprietary about the chemicals used in oxidation systems, there is an abundance of different types of scrubbers utilized in this field. In the process, all of the reactions occur in the aqueous phase in which the chemical oxidants are dissolved. Consequently, the gaseous, odorous compounds must be contacted with the aqueous liquid in a way that the odor compounds will dissolve. This process is called absorption and is carried out in a vessel called a scrubber or an absorber. Although countercurrent, packed columns are the most common type of scrubbers. Spray chambers, mist scrubbers, and venturis are also used.

The products of the chemical oxidation reactions (Eq. 8) are water soluble and will accumulate in the scrubber solution until the solution becomes saturated and salt precipitation occurs. A small portion of the circulating solution is purged from the unit either continuously or batchwise to prevent this from occurring.

Caustic Scrubbers

Caustic scrubbing systems are often grouped with chemical oxidation systems. However, there is one very distinct and important difference between them: the caustic scrubbing reaction is equilibrium limited, whereas the chemical oxidation reactions are not. The importance of this difference is illustrated in Eq. 7. The reaction illustrated in Eq. 7 is driven to the right as the pH of the solution increases (more caustic is added) and to the left as the pH is decreased. In a caustic scrubber, the scrubbing solution is maintained at a high pH to enhance the absorption of the

H2S. However to control the salt content of the scrubbing solution, a portion of the solution inventory is purged from the system, and if the pH of this spent solution is allowed to decrease by mixing it with other waste streams, Eq. 7 will be driven to the left, and H2S will be released to the atmosphere. At the least, this scenario may create an odor problem. Taken to its maximum, it may create a hazardous condition. This is the reason that spent caustic is considered a hazardous substance.

Adsorption

Adsorption is the process in which a gas or a liquid adheres to the surface of a solid (an adsorbent). In the process, a fluid contacted with the adsorbent and (depending on the type of adsorbent employed) certain components from the fluid will be attracted to the solid surface. The process can be continued until the surface of the adsorbent is totally covered with adsorbed molecules. At this point, adsorbed material must be either desorbed from the solid surface or the adsorbent must be replaced with fresh material. Consequently, for an adsorption process to be economical, the adsorbent must possess a large surface-to-volume ratio and an affinity with the particular compound to be removed. For removing H2S from gas streams, activated carbon is the preferred adsorbent due to its high retentivity for H2S. Activated carbon can be made from just about any type of carbonaceous material; however, bituminous coal and coconut shell are the two most often used. In the manufacturing process, the carbonaceous base material is treated at elevated temperatures to remove the volatile compounds. The material is then steamed at approximately 900° C that substantially increases the surface area. The retentivity of activated carbon for H2S can be increased substantially by impregnating the carbon with either KOH or NaOH. In addition, "Catalytic Carbons" have been recently introduced that also have a high rententivity for H2S.

Generally, activated carbon is only used for removing volatile organic and acidic compounds from air streams, since the activated carbon would probably non-selectively adsorb most of the compounds in an anaerobic stream. In addition, when processing H2S containing gas streams, the regeneration procedure for caustic impregnated activated carbon is difficult and time consuming. Consequently, these systems are sometimes preceded by a wet-type scrubbing system, Figure 2, to decrease the load to the activated carbon and thus increase the life of the carbon.

H2S Scavengers

The natural gas industry has adopted "H2S scavengers" for treating gas streams containing less than 100 lbs/day of H2S. These systems utilize materials that produce innocuous products when reacted with H2S. However, the systems are non-regenerable. The four most popular systems include Sulfa-Chek which uses a caustic/sodium nitrite solution, Gas Treat which uses a nonregenerable amine, Sulfa-Scrub which uses triazines, and Sulfa-Treat which is a modified, solid, iron sponge system. The liquid based scavengers use either sparged columns or are sprayed directly into gas pipelines.

Amine Absorption Units

Alkanolamines or "amines" have been used commercially since the 1930s for removing acid gases (primarily CO2 and H2S) from a variety of hydrocarbon-based gas streams including natural gas, refinery fuel gas, coke oven gas, etc. Many different amines having different absorption capacities and different selectivities are in use today. However, they all have at least one hydroxyl group, responsible for water solubility, and one amino group responsible for absorption of acid gases.

Amine units do not convert the H2S into innocuous products. They simply absorb the H2S and other acidic components out of a gas stream and into an aqueous amine stream that is then heated producing a concentrated stream of the acidic components (amine acid gas). The acid gas stream is then directed to a process such as a Claus unit or a liquid redox unit that converts the H2S to harmless products. Figure 3 illustrates a typical amine unit. Generally, amine units are limited to anaerobic gas streams since oxygen will oxidize the amines.

Liquid Phase Oxidation Systems

The disadvantages of the previously described processes, namely the inability to process gas streams containing low concentrations of H2S, containing low absolute quantities of H2S and containing variable concentrations and quantities of H2S, resulted in the development of liquid phase oxidation systems. In these systems, H2S is oxidized to elemental sulfur in the chemical sense (electron transfer), rather than in the physical sense of reacting with oxygen. Although numerous liquid phase oxidation systems have been developed, the three of any commercial importance use either vanadium or iron as the source of electron transfer (reagents).

The first major commercial liquid oxidation process was the Stretford process developed by the North Western Gas Board and the Clayton Aniline Company, Ltd. in England. The original process used an aqueous solution of sodium carbonate, sodium bicarbonate and anthraquinone disulfonic acid (ADA). However, to form sulfur, the process relied on dissolving oxygen in the aqueous solution. Consequently, the low solubility of oxygen in water mandated large circulation rates. In addition, the reaction rates were so slow that they required large reaction tanks.

To correct these limitations, alkali vanadates were added to the solution and the chemistry of the system changed to the following:

9. CO3-2 + H2S <--> IICO3-1 + HS-1

10. HS-1 + 2V+5 --> 2V+4 + H+1 + S0

11. 2V+4 + ADAOXID + 2H2O --> 2V+5 ADARED + 2OH-1

12. ADARED + 1/2 02 --> ADAOXID + H2O

Equation 9 represents the absorption of the H2S into the aqueous, alkali solution, while Eq. 10 represents the oxidation of sulfide ions to elemental sulfur and the

simultaneous reduction of the vanadium. This reaction is relatively slow and requires between 5 and 10 minutes to go to completion. The slowness of this reaction prevents the Stretford process from processing air streams since the formation of thiosulfate and sulfate ions are much faster than the formation of sulfur. Equations 11 and 12 represent the steps required to reoxidize the vanadium back to the active +5 valance state. In Eq 11, the oxidized ADA acts as an oxygen carrier while Eq. 12 illustrates the reoxidation of the ADA with dissolved 02.

Figure 4 shows a typical Stretford flow scheme. The sour gas enters an Absorber where it is contacted with regenerated Stretford solution and adsorption of the H2S occurs. The type of absorber utilized depends on the specific application; however, venturis and/or packed columns are very common. The sweet gas leaves the Absorber and the solution enters a Delay Tank that has a liquid residence time of between 5 and 10 minutes. The purpose of the Delay Tank is to ensure completion of the sulfide oxidation reaction prior to the introduction of air. The solution from the Delay Tank is then directed to the Oxidizer where the vanadium is reoxidized by the reduction of ADA, where air is injected for reoxidizing the ADA and where sulfur is separated by flotation. The oxidized solution is directed to a Balance Tank and then back to the Absorber, while the sulfur froth is directed to a Slurry Tank where the froth is broken and the resultant slurry is directed to further separation such as filtration, centrifugation and/or melting.

One of the main difficulties encountered with the Stretford process is the toxicity of vanadium. Although this toxicity has been disputed, the perception is that vanadium is toxic. Consequently, Stretford units must be designed to handle sulfur cake and blowdown solution that contains vanadium. Stretford sulfur cake generally requires washing prior to disposal and the blowdown solution is minimized by the addition of a crystallizing system.

Iron-based, liquid oxidation processes were developed to eliminate the problems encountered with the Stretford process. Iron has always been recognized as an excellent oxidation catalyst; however, its very low solubility in water prevents it from being an economical, liquid phase oxidation process. This problem is alleviated by using water soluble, organic chelating agents to increase the solubility of iron in water from approximately 4 ppm to approximately 5 wt%. Although many chelated iron processes have been developed, many commercial installations employ the ARI LO-CAT process that is licensed by Wheelabrator Clean Air Systems, Inc.

The LO-CAT process uses a non-toxic, chelated iron catalyst that accelerates the oxidation reaction (Eq. 13) between H2S and oxygen to produce elemental sulfur.

13. H2S + 1/2 02 --> S0 + H2O

(Fe)

Equation 13 is the same as the modified Claus reaction (Eq. 3). However, the route to this reaction is much different from a Claus plant. In the Claus unit, a precise mixture of air and H2S passes through a thermal reaction chamber followed by several alumina catalyst beds with all of the reactions occurring in the vapor phase. In the LO-CAT process, the reactions occur at approximately ambient temperature

and in the liquid phase as indicated below;

14. H2S(V) + H20(L) <--> H2S(L) + H20(L)

15. H2S(L) <--> 2H+ + S=

16. S= + 2Fe-3 --> S + 2Fe12

17. 1/2 02(V) + H2O(L) --> 1/202(L) + H2O(L)

18. 1/2 02(L) + 2FE+2 + H2O --> 2Fe+3 + 2OH-

The sum of Equations 14 through 18 is Eq. 13.

Equations 14 and 15 simply represent the absorption of H2S into water and its subsequent ionization, while Eq. 16 represents the oxidation of sulfide ions to elemental sulfur and the accompanying reduction of ferric iron to the ferrous state. Equations 17 and 18 represent the absorption of oxygen into water followed by the oxidation of the ferrous iron back to the ferric state.

One of the main differences between the vanadium and iron-based liquid oxidation systems is the rate of reaction of the sulfide ions to sulfur. In the vanadium based systems, the reaction time is between 5 and 10 minutes, while in the iron-based system it is a matter of a few seconds. Consequently, air streams can be economically treated in iron-based systems if the correct operating conditions are selected.

The more favorable reaction rates of the iron-based system also allows flexibility in the design of the units. Figure 5 illustrates an air stream process. In this configuration, all of the reactions (Eq. 14 through 18) occur simultaneously in the same vessel. Figure 6 represents an approach similar to that illustrated in Figure 4 for the Stretford process. In this scheme, the sour gas is usually combustible or is a product that cannot be contaminated with air.

Summary

In summary, hydrogen sulfide is produced in numerous synthetic and natural processes, and due to its toxicity, corrosiveness and obnoxious odor, a great deal of attention is given to recovering it in an innocuous form. Consequently, numerous processes exist for treating H2S containing gas streams, and the most applicable one for a specific application will depend on the type of gas stream being treated, the amount of gas and H2S to be treated, the concentration of H2S and the turndown required. As a reference, Table 1 can be used a rough selection mechanism for the proper process.

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About the Author:

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WATER
Engineering & Management

OVER A CENTURY OF SERVICE TO WATER/WASTWATER PROFESSIONALS

Water Quality Products
Oct. 1, 1996, page 17

Metals Removal with Ion Exchange Resins

by Carl Galletti

Many impurities in water and other liquids exist as dissolved ionic species that can be removed by ion exchange processes. Ions are either positively charged-cations-or negatively charged-anions. Ion exchange resins remove undesirable ions from solution by an exchange process in which impurities are removed or immobilized by the resin and desirable ions are released into solution. The water softening process is an example of this process: "hardness" made up of calcium and magnesium cations in the water is exchanged for the sodium cations on the resin.

The first ion exchange resins were developed to remove the naturally-occurring ions found in most city water supplies such as calcium, magnesium, sodium, sulfates, chlorides, bicarbonates, carbonates, and silica.

For impurities or contaminants to be removed by ion exchange, they must be

- ionized or charged,
- exchanged with ions of the same charge, and/or
- attracted to the resin more than the ion it is trying to exchange for.

As a result of growing industries such as electroplating, semiconductor, and printed circuit boards, there was a need to remove metal ions from wastewater. Examples of metals requiring removal from wastewater include cadmium, chromium, mercury, nickel, copper, gold, lead, silver, zinc, and cyanide complexes.

Today, ion exchange resins are being used to remove toxic and precious metals from industrial wastewater streams. Industries are removing metals from their wastewater because of new regulatory discharge limits on metals to the environment, the economic benefits derived by recovering the metals, and because water reuse reduces waste volumes.

Ion exchange is a viable method of removal when the metals in the solution are ionized, when the ionic strength of solution is not too high, and when volumes to be treated are large and the metals concentrations are low.

Metals exist as either cations or complexed anions, and are either monovalent or polyvalent. Therefore, a variety of ion exchange resins must be considered for each application. Ion exchange resins for metal removal generally fall into four categories. The categories are determined by the resin's functional group.

Ion Exchange Resins for Metals Removal General Categories

1. 1. Strongly acidic cation exchange resins have sulfonic acid groups.
2. 2. Weakly acidic cation exchange resins have carboxylic acid groups.
3. 3. Strongly basic anion exchange resins have quaternary ammonium groups.
4. 4. Weakly basic anion exchange resins have polyamine groups.

There is also a specialized category of resins known as chelating resins. Chelating resins are more selective than standard resins due to their chelating functional groups. Examples of chelates are iminodiacetate, thiouronium and aminophosphonic.

Standard, strongly acidic cation resins remove heavy metals such as copper, nickel and zinc. However, they also remove common ions such as calcium, magnesium and sodium. If the calcium and magnesium concentrations are high compared to the heavy metals concentration, a problem occurs in removing the low concentrated heavy metals. There are a number of solutions to this problem. First, if the source of hardness is from the makeup water and not the process, then it can be removed upstream of the process with a simple water softener. The process water now will contain only the sodium ions from the softener and the metal ions introduced by the process. The sodium ions, being monovalent, will not interfere with the removal of most heavy metals by standard strongly acidic cation resins.

A second possible solution is to use a more specialized or selective resin to remove heavy metals from a high hardness background. SIR-300 is a macroporous cation resin with iminodiacetate functionality manufactured by ResinTech, Inc., of Cherry Hill, New Jersey. The iminodiacetate group forms chelates with heavy metals and other divalent metals. However, heavy metals form a stronger chelate than do calcium and magnesium. The heavy metals form stronger chelates with the iminodiacetate because of their shape, size and location of charge. In other words, chelating resins exchange ions based on charge and geometry of the ion. Also, monovalent ions such as sodium are held by weakly acidic groups are displaced easily by heavy metals. Therefore, a selectivity sequence is formed.

Weakly acidic cation resins used in the sodium form have a higher affinity for heavy metals over non-heavy metals except hydrogen. The difference in selectivity for heavy metals over calcium and magnesium on weak acid resin is greater than on strong acid cation resins. Greater selectivity, along with the relative ease of regenerating the resin, often makes weak acid cation resins a better choice for heavy metal removal than strong acid cation exchangers. However, the fact that weak acid cation resins have such a high affinity for hydrogen decreases their capacity for

metals at lower pHs. Also, since weak acid cation resins are used in the sodium form, they are not the proper choice for resins where deionizing and recycling is of interest. Selective resins are generally chosen over weakly acidic cation resins when removal or recovery of a single species is the goal or when the pH is low.

Some metals form complexes and exist as anions. Examples of some common metals that exist as anions are cyanide complexes, gold, silver, mercury, iron, and chromium. When these metals exist as anions, they must be removed by either anion resins or specialty resin. Strongly basic and weakly basic resins both exhibit generally the same selectivity. However, weakly basic resins sometimes display greater selectivities for multivalent anions than do strongly basic ones. Weakly basic anion resins (WBAR) are not run in the typical "free-base" form for metals removal. Rather, they must be in the protonated or acid form for exchange to take place.

Specialty or chelating resins are used to recover mercury and other noble metals when standard resins are not effective and when removal of other anions is not desired. The company's SIR-400 utilizes a thiouronium functional group as a chelate. The chelate formed with noble metal is very strong and run lengths are long. As a result, these resins are typically not regenerated and are used on a sacrificial basis.

In summary, ion exchange is a viable method to remove and recover toxic and precious metals. However, this process only concentrates metals and requires the incorporation of other disposal and recovery methods.

Designing an ion exchange process for removing or recovering metals from a waste stream involves the consideration of a number of critical factors. First, and probably most important, is a clear understanding of the wastewater chemistry, requiring more than just simply identifying the metals of concern and their concentrations. At a minimum, designers need to know solution pH, conductivity or TDS, hardness, inlet concentrations of metals, and effluent concentration to which metals must be reduced. This information allows designers to identify the ionic state of the metal and determine the probable effect of background ions. The second consideration is solution volume and flow rate requirements. These factors are critical because the limiting condition may be hydraulics or the kinetics of the resin. Finally, designers must be informed of the reason for implementing an ion exchange system. As this may sound elementary, designers cannot engineer a system unless they know whether the purpose is to recycle the water; meet regulated discharge limits; recover precious metals; remove a metal to a specific concentration; or attain some other goal.

Although there are many other considerations not discussed in this article, those factors can be properly considered only after consultation with a qualified ion exchange specialist. However, with a growing number of resins available, and with proper equipment design, ion exchange is a progressive means of removing metals from industrial wastewaters.

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WATER
Engineering & Management

OVER A CENTURY OF SERVICE TO WATER/WASTWATER PROFESSIONALS

Water Quality Products
Nov. 1, 1995, page 10

Ozone for Water Treatment Gains Acceptance

by Carl Schleicher

Dealers of water enhancement products are increasing ozone sales rapidly, while finding sales of chemical-oriented products are less attractive to their clients. The advantages of ozonated water are becoming better understood and easier to sell. As consumers demand a better water supply, the use of chemicals will continue to diminish while the use of ozone increases.

Dependant on the application and the contaminants present, ozonation can either eliminate or substantially reduce the chemicals required for water treatment, and provide a better quality water than conventional water treatment.

It is possible for dealers of water enhancement products to increase sales and profits by providing accurate information that differentiates between the myths and the truths concerning water supply contamination and viable solutions. Ozonation can play a major role in many of these solutions.

Ozone vs. Chlorine

Ozone is recognized among the strongest, fastest, commercially-available disinfectants and oxidants for water treatment. In addition, chlorine can not treat all water-borne pathogens, while ozone can. Cryptosporidium is only one of the many known but unregulated pathogens that chlorine alone cannot treat (assuming practical, safe doses are used, and remembering that chlorine is a poison at high doses). Further, chlorine generates trihalomethanes (THMs), which are disinfection by-products known to be carcinogenic, according to the American Journal of Public Health. THMs, including chloroform, occur due to a reaction with organics in the water, and are regulated by the USEPA.

It was planned that THMs were to be more stringently regulated; however, budget limitations have prevented the needed efforts to effect a limit lower than the 100 ppb (parts per billion) USEPA Interim (I) standard now in effect.

An approach for municipal water treatment, used in many large cities, and public

water supplies, is to use ozonation for pretreatment and a reduced amount of chlorine for post treatment. This method takes advantage of the best of chlorine and ozone characteristics as reported by the Electric Power Research Institute in 1993. If there is any unused ozone, it reverts back pure to oxygen. The decreased amount of chlorine used for post treatment provides protection for miles of distribution. Chlorine residual lasts for a longer time than ozone, and provides a measure of protection for the water.

This method of using ozone for pretreatment in a public water supply decreases the amount of chlorine used in comparison to traditional chlorination, all while providing a quality product water. The decreased amount of chlorine used results in reduced THMs and other disinfection byproducts that are caused by chlorination.

The reduction in chlorine also has the benefit of reducing or eliminating the taste and odor complaints municipalities receive. Conventional full strength chlorination in municipalities is well-known for chlorine taste and odor problems.

When dealing with public water supply water, disinfectants should be used at the POU to further protect the consumer against possible contamination that could be introduced in distribution pipes, filters and other sources such as an unintentional cross coupling or backflow. There are small undersink ozonators, for example, that do a quality job of protecting the water at the POU.

Ozone and POE Well Water Applications

The use of ozone has continued to expand rapidly in POE well water applications for whole-house residential use. Ozone treatment is directed toward specific aesthetic- and health-related contaminants. The sidebar shows an abbreviated list of problems ozone is used to treat.

Many associations and publications list ozone as a disinfectant, but do not include it as an oxidant. This is probably due to its popularity for bottled water disinfection. The FDA recognizes ozone as GRAS (generally recognized as safe). Most bottled water is ozonated. The International Bottled Water Association (IBWA) recommends that an ozone dose be applied to all bottled water. The ozone residual disinfects the water, the bottle and the bottle cap.

Ozonation treats the "troublesome trio"-iron, manganese and hydrogen sulfide. Many ground water supplies contain sufficient amounts of at least one component of this trio to cause objectionable taste, odor, slime, stain or color problems. Each can also be associated with bacteriological problems such as iron bacteria or sulphur bacteria. These bacteria do not generally present a health concern, but they are objectionable to live with.

Ozone and POU Water Applications

There is a large market for ozone water treatment of public-supplied water. The primary requirement is for POU drinking water. Consumers are concerned that the public water supply, although fine for drinking, is not of the quality they desire. This

is best demonstrated by observing the growing water bottling and vending sales. The concern is directed toward aesthetic-and health-related contaminants. It is becoming more commonly accepted that water-borne pathogens can exist in chlorinated water. It is also known that many water-borne pathogens are not regulated. Cryptosporidium, Cyclospora and Microsporidia, three examples of nonregulated pathogens, can exist in chlorinated water, and have been known for years to cause human disease.

There are ozonation devices that, when coupled with filtration devices, provide a major reduction in aesthetic and health-related contaminants. Benefits of these undersink type ozonation/filter devices include

- Providing water on tap that meets or exceeds the Safe Drinking Water Act specifications;
- Safely reducing bacteria, viruses, cysts (Cryptosporidium, Giardia), metals (lead, mercury), THMs, benzene, chlorine taste and odor;
- No handling or storing of chemicals. No storage tanks;
- Virtually maintenance free;
- No harmful residuals; <<p> LI>No wasted water. All the ozonated water is delivered to the consumer at the equipped faucet;
- Requires minimum under-the-sink space; no heavy bottles to lift, carry or store; and
- Low power requirements (40 watt) when in operation. Operation (power) is required only when water demand through the special faucet is present.

Ozone Water Treatment Applications

Ozone is being applied in a wide range of applications. Basically the reason ozone use is wide spread and growing rapidly is the need and desire to reduce or eliminate chemicals that would otherwise contaminate our water supplies and cause aesthetic, pollution and health problems. The many applications include swimming pools, spas, lakes, industrial, wastewater, process water, bottling, vending and cooling towers. There has been a 200 percent increase in U.S. drinking water plants since 1990.

Improve System Design with Tests

Before designing a system, define the problem. A comprehensive water test kit is essential. In home tests for iron, hydrogen sulphide, manganese, hardness and tannins should be included. Also look for iron bacteria or sulphur bacteria slime in the toilet. Special problems that require lab tests may be required. Emphasize your testing to the customers as part of your professional approach to gain their confidence in your water treatment abilities.

Ozonation with Other Treatment Equipment

Ozone is not a panacea; systems must provide a solution to the total water problem which may include other water treatment technologies including RO; anion exchange; cation exchange; filtration; ultraviolet; advanced oxidation and others.

Ozone Enhances Other System Components

Use ozone pretreatment to reduce or eliminate organic loading of softeners and RO to extend the life of softener resins, and RO membranes to ensure better long term RO and/or softener performance. Ozone can be combined with ultraviolet treatment to provide greater disinfection capabilities where ultraviolet alone does not treat Crypto and certain viruses.

The Future for Ozone

The future for ozonated water treatment is bright. There are many consumer-driven aesthetic and health pressures to improve water quality. Ozone is a viable technology that can replace or reduce the wide spread use of chemical water treatment and provide improved water quality.

What Ozone Will and Will Not Do

It is important that dealers recognize where ozonation helps water treatment and where ozone doesn't contribute.

Some common uses for ozone in water treatment are
Disinfection: Bacterial disinfection, viral inactivation, biofouling control

Oxidation of inorganics: Iron; manganese; organically-bound heavy metals; cyanides; sulfides; nitrites; arsenic

Oxidation of organics: Color; tastes and odors; detergents (some); phenols and some other organics; algae control; turbidity control; microflocculation (of soluble organics); pretreatment of organics for biological oxidation; and THM precursor control

Reduce or eliminate aesthetic problems: Rust or black colored water; stained cloths or fixtures; discolored, unpalatable food and beverages; slime in toilet tanks and sinks; fuzzy particles in water; odorous or cloudy water

Some common ozonation benefits:

- Reduces or eliminates major chemical use
- Improves turbidity
- Excellent flocculent and coagulant
- Provides good tasting water
- Virtually maintenance free

The contaminants and/or water problems that ozone will not treat include hardness; nitrates; chlorides; low pH; high TDS; sodium; corrosive water and others.

Components of a State-of-the-Art System

Quality parts for ozone generator longevity To date, ozone generators are not regulated. It is important for dealers to select a manufacturer that provides sales and service support. Ozone generators that provide outputs large enough to deal with problem water are usually of a corona discharge design. Corona discharge (CD) ozonation requires the use of rugged parts that will stand up to the high concentration ozone required for success. Parts should be constructed of a high grade of teflon, glass, stainless steel and other ozone-tolerant materials including certain proprietary materials such as KYNAR and special proprietary, high technology glass to provide long life under field conditions.

Air dryers for steady, greater ozone output The use of an air dryer provides more ozone output than a system using ambient air. In addition, ozone output won't vary with different humidity conditions. Without a dryer, the ozone generator output decreases when humidity increases and vice versa.
The lower the dew point, the less the water content in the feed gas for the ozone generator. Ozone generators must be operated at an extremely low dew point. Their longevity depends on dry air because moisture creates nitric acid, thus decreasing output and corroding equipment.

Compared to a system using ambient air, an ozone system using an air dryer operating at -p76 F dew point achieves more than three times the ozone output; feed gas moisture of less than one ten thousandth that of ambient air; negligible nitric acid production; a substantial increase in longevity; and a decrease in required maintenance.

Manufacturers have now developed a number of effective air dryer configurations which are available for different applications.

Efficient injection system minimizes system cost
There are many ozone injection options to maximize performance and minimize system cost with a given size ozonator and specific contaminant levels.

The efficiency achieved is a direct function of the size of the bubbles formed. Because ozone is only partially soluble in water, ozone bubbles must be as small as possible to increase bubble surface area and achieve maximum contact.

High efficiency venturi injectors form millimeter size bubbles. These injectors also cause vigorous mixing action which greatly increases the efficiency of mass transfer of the ozone gas into the water. High efficiency injectors provide up to 99 percent mass transfer.

Stone diffuser injection also creates small bubbles, but the limited life and the cost of the compressors handling high concentration ozone could be a disadvantage.

When required, inline and sidestream booster water pumps provide a low cost, effective, and longer life approach than compressors. Sidestream injection maintains all the flow and pressure available from the well pump.

Allow sufficient contact time

Most contactors used for residential applications are pressurized tanks using an appropriate in-pout closure and vent valve arrangement. This allows the contactor tank to function as an off-pgas tank and a contactor.

Contactor tanks provide the residence time for the ozone to do its work. Ozone contactor tanks are much smaller than chlorine tanks because ozone reacts 3,125 times faster than chlorine. Tank size should provide sufficient time to decomplex contaminants tied up with organics and to ensure disinfection. Tank size can require four to eight minutes of contact to disinfect microbials.

Ensure adequate filtration

Multimedia depth filters with automatic backwash are an important part of an ozone system. The wrong filters can plug, channel, increase pressure drops and become a maintenance nightmare. Longterm operation of an ozone system, particularly one handling higher levels of contaminants, requires skills in the design and maintenance of depth filters, which require backwashing every 24 hours. Depth filters are typically rated to provide a flow rate equal to one-half the backwash flow rate. For example, the flow capability for a typical 10-in. x 54 -in. depth filter is five gallons per minute (gpm) backwash and 2.7 gpm filter flow rate.

The performance possible with a well designed multi-pmedia 10-in. x 54 -in. depth filter is 5.5 gpm backwash and 10 gpm filter flow. These flow rates are greater than the typical flow rates and are essential to maximize ozone performance.

The 10-in. x 54 -in. tank size described will suffice for most residential, single family applications, but longterm operation depends completely on the selection of multi-media filtration. Selection of the multi-media must take into account pH, flow rates, contaminants and other factors.

For better water quality, follow the multi-pmedia depth filter with an automatic backwash granular activated carbon filter.

About the Author:

Carl L. Schleicher is president of Applied Ozone Technologies, Inc., Sarasota, Florida. He has been in the manufacturing industry for over 35 years and holds advanced technical degrees.

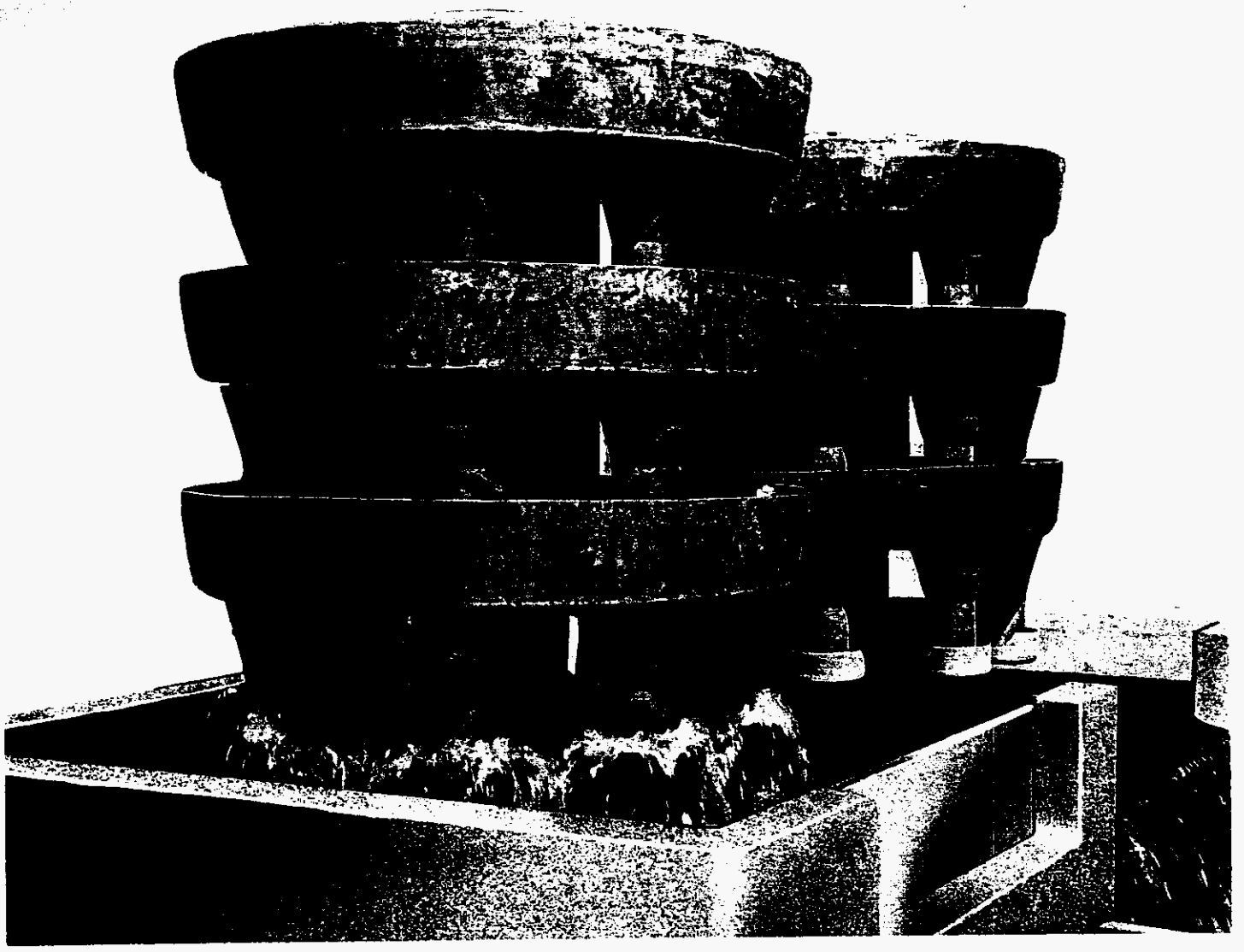
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Equipment Manufacturer's Data and Recommendations

Tray Aerator

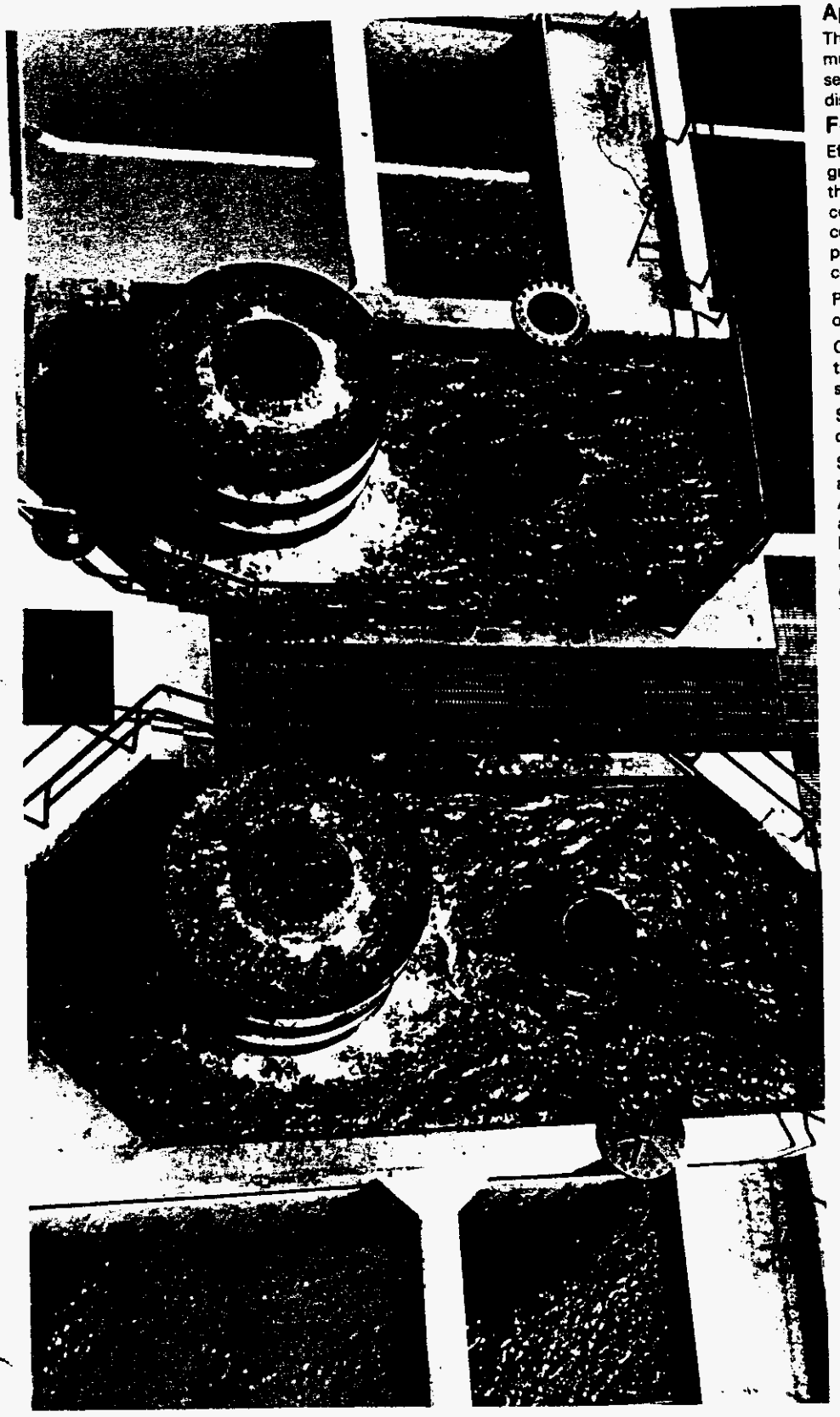
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Multicone Aerator



Infilco Degremont Inc

June 1977
Supersedes 8/72



Application

The Multicone Aerator is an aspirating multi-stage type aerator used in water and sewage treatment plants for the removal of dissolved gases or aeration of the water supply.

Features—Benefits

Efficient aeration depends upon establishing the greatest possible liquid and air interface. To do this, the primary, secondary and discharge cones are mounted one above the other concentrically upon a central inlet pipe which permits an excess of air to be brought into contact with the water.

Pumping costs are reduced because the operating head is low.

Capacity range is great because the head over the distribution orifice may be varied without substantially affecting performance.

Space requirements are small due to the compactness of the Multicone Aerator.

Strong aluminum construction assures long life and substantially reduced maintenance costs. All Multicone Aerators are constructed of cast aluminum and all sections are jointed together by aluminum spiders and tie rods.

Water will not freeze while the unit is in operation. On shutdown, water quickly drains through the distribution orifice and weep holes in the water seal bowls.

Installation

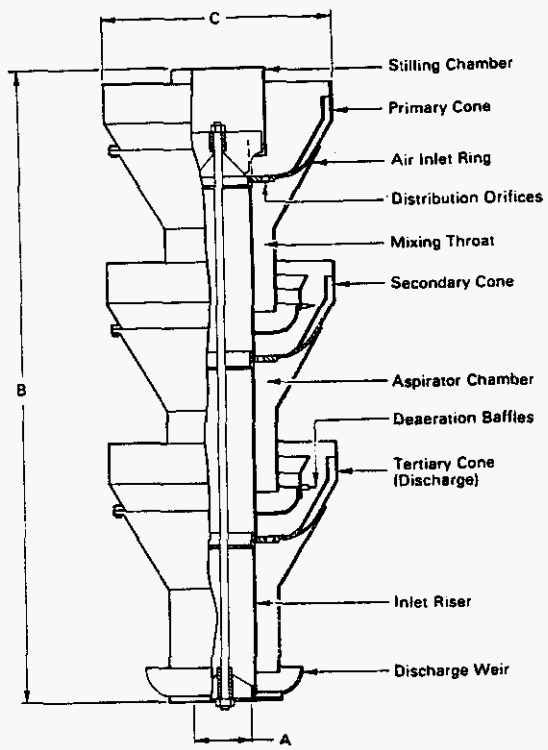
Normal installation may be made outdoors or indoors without sidewall enclosures because the water is confined within the discharge cone. There is no splashing if the operation is within the design capacity.

Installation is simplified since all units are shipped completely assembled. The lower end of the inlet riser is pipe flange faced and drilled in conformity with the 125 lb. American Standard. Installation consists of setting the aerator on the end of a flanged inlet pipe and bolting it into place.

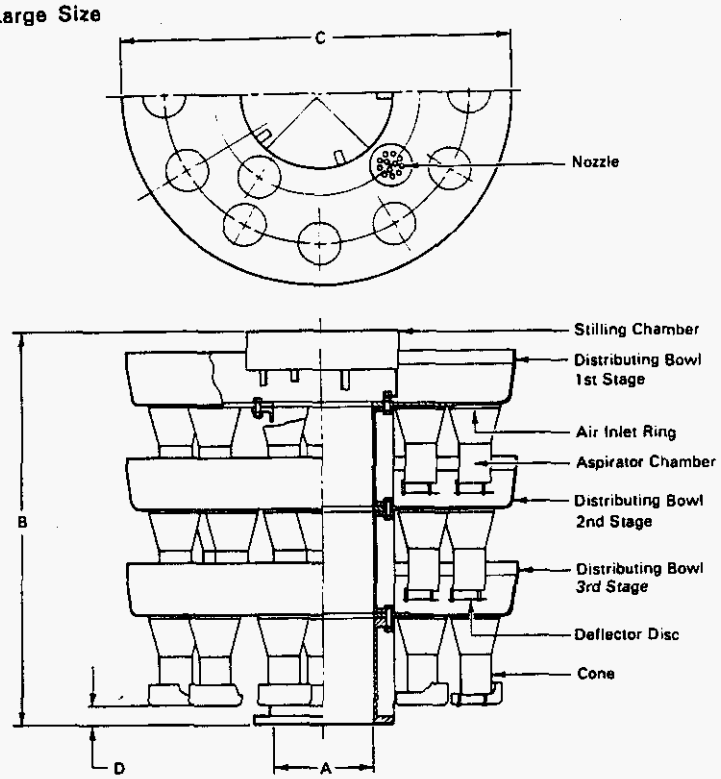
Availability

The Multicone Aerator is available in nine sizes and twenty-seven capacities. Variations in the sizes of the orifices and the number of orifice groups provide two capacities for size 52B and three for size 52A . Selection based upon flow requirements can be easily determined from the specifications chart. For example, for a 700 gpm requirement, size 52A, having a maximum capacity of 800 gpm, would be used. In large applications having small capacity variations, a single large unit is recommended. In applications having wide variations in flow, a number of smaller units provide greater flexibility.

Small Size



Large Size



Operation

Smaller Sizes—Capacities 100 to 400 gpm. Water flows through the central inlet riser into the inlet bowl of the primary cone and discharges into the primary aspirator chamber through multiple primary distribution orifices. The jet action of these many small streams of falling water, and the shaping of the aspirator chamber causes an excess of air to be sucked through the annular air inlet ring on the side of the primary cone.

Velocity is increased as water approaches the restricted mixing throat at the discharge of the aspirator chamber. Since the water is highly turbulent as it passes through this section, air is thoroughly whipped into it. The water seal acts also as an air release zone since the direction of flow is changed 180°. Entrained air and gases are swept out of the water, discharging upward and outward.

The efficient aeration provided by the primary cone is multiplied by repeating the entire process in all cones. Water leaving the air release zone below the secondary cone passes into the discharge cone and spills over the discharge weir in a waterfall effect into a basin or on to a collecting pan or slab.

Receiving bowls of all three cones are provided with overflow weirs to divert excess water into the aspirator chambers should the rated capacity of the aerator be temporarily exceeded.

Larger Sizes—Capacities 450 to 2800 gpm The general operation of the larger size aerators is similar to that already described. The differences in design are that there are three sections of riser pipe bowls placed between the flanges of adjacent risers, and in each stage the single cone is replaced by a multiple smaller cone within each bowl. For cleaning purposes, the second stage cones are offset from the first and the third stages. A third significant design feature is that a deflector disc replaces the water seal except in the discharge stage. There is no overflow provision since sufficient free-board is provided in the distributing bowl to handle momentary surges.

Specifications

Max. Capacities G.P.M.	Size	A	B	C	D	Shipping Wt. Lbs.
Small Size						
36-100	12	4"	63¾"	15¾"	—	350
120-250	22	6"	63¾"	22⅜"	—	600
280-400	32	8"	63¼"	33¾"	—	700
Large Size						
450	42A	12"	6'-0¼"	3'-9½"	2"	1400
600	42B	12"	6'-0¼"	3'-9½"	2"	1450
800, 1000, 1200	52A	16"	6'-4⅜"	5'-2½"	2½"	1650
1500, 1800	52B	16"	6'-4⅜"	5'-2½"	2½"	1750
2250	62A	20"	6'-4¾"	6'-4½"	2½"	2900
2800	62B	20"	6'-4¾"	6'-4½"	2½"	3100

U.S.A. Headquarters

Infilco Degrémont Inc.
Koger Executive Center,
Box K-7
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Telephone (804) 285-9961

Regional Sales Offices

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Baton Rouge, Louisiana

Boston, Massachusetts

Chicago, Illinois

Dallas, Texas

Detroit, Michigan

Houston, Texas

Kansas City, Kansas

Minneapolis, Minnesota

New York, New York

Pittsburgh, Pennsylvania

Philadelphia, Pennsylvania

Richmond, Virginia

San Francisco, California

Representatives in other major cities

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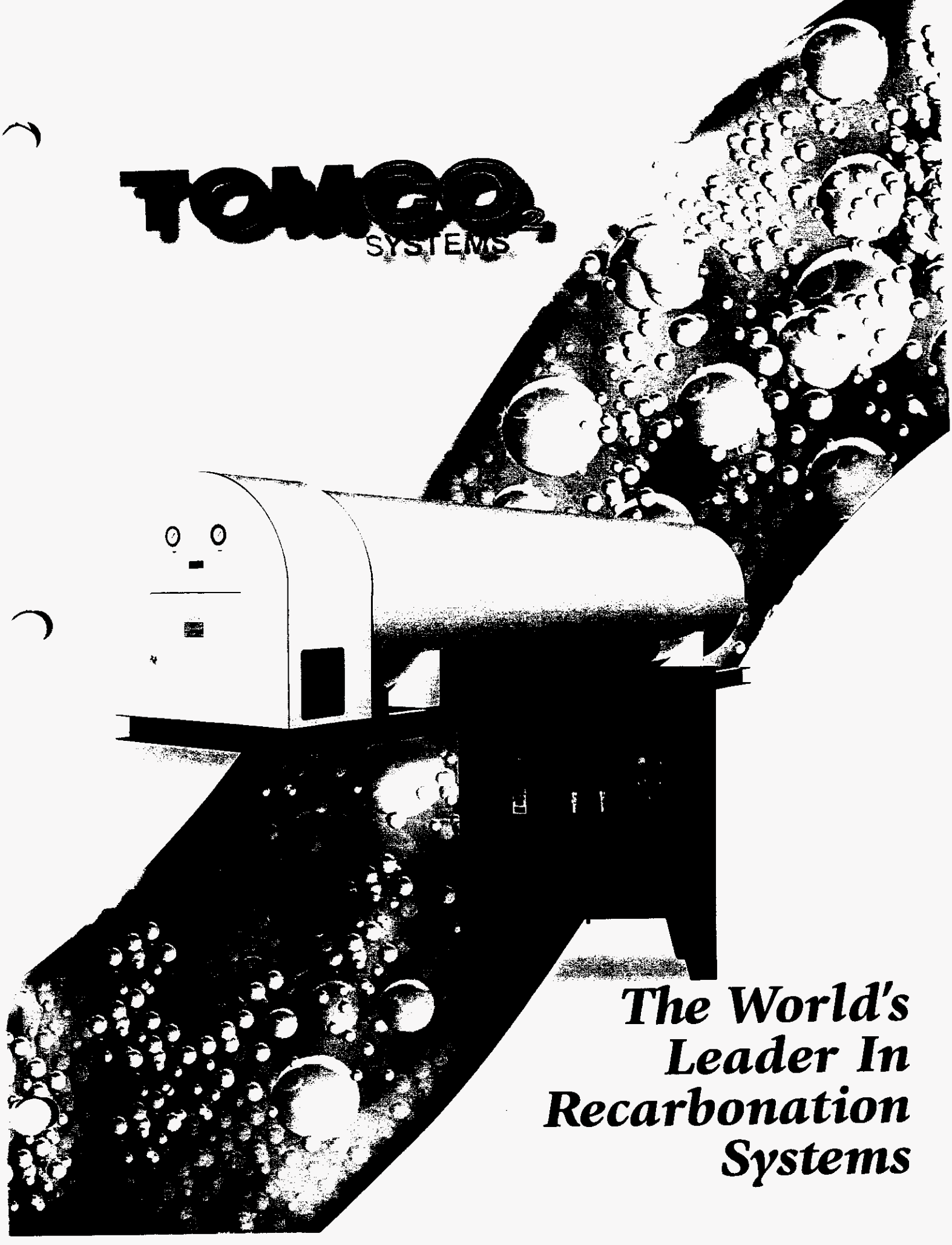
Italthai Industrial Co. Ltd.
Bangkok, Thailand

Infilco Degremont Inc

Printed in U.S.A.

Carbon Dioxide Storage and Feed Equipment

TOMCO2 SYSTEMS



The World's Leader In Recarbonation Systems

Liquid CO_2 Systems

In the treatment of potable water or wastewater, a means of lowering the pH may be required. $TOMCO_2$'s "LYCARBO" Liquid Carbon Dioxide Recarbonation System is the answer to this problem. Every "LYCARBO" system is designed for a specific application. $TOMCO_2$ will furnish all components of the liquid carbon dioxide recarbonation system. In addition, $TOMCO_2$ will assist the customer in determining the size of the system required and assume responsibility for the design, manufacture, check-out and start-up of the system.

$TOMCO_2$'s "Total Responsibility" concept will give the user of "LYCARBO" equipment only one company to call any time assistance is required.

Method of Operation

Liquid carbon dioxide is stored in an insulated storage unit. The storage unit is complete with the equipment necessary to maintain the liquid carbon dioxide around 0°F. A vaporizer is generally provided to change the liquid carbon dioxide to a vapor. Liquid carbon dioxide is drawn from the tank through the vaporizer and then returned to the tank as a vapor to maintain the storage pressure. Carbon dioxide vapor for process use is withdrawn from the tank and passed through regulators, metering equipment and other accessories depending on the type of feed equipment used.

Models Available

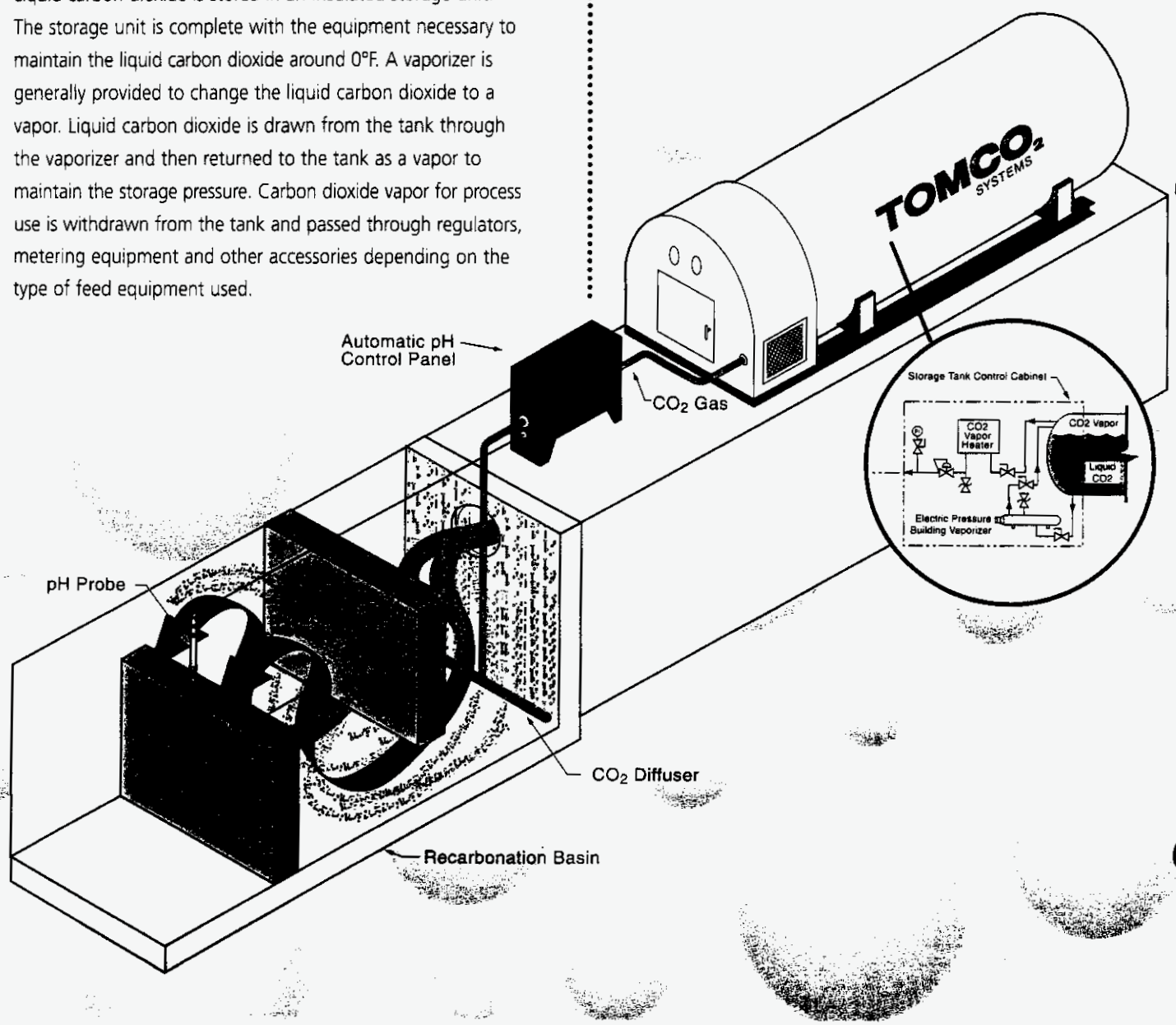
1. Direct CO_2 Gas Injection 2. Pressurized Solution Feed (PSF)

Direct CO_2 Gas Injection

The direct gas injection method of pH control is the traditional method for most water plants. The CO_2 gas is injected through a very fine bubble diffusion assembly which is located in a basin with a minimum water depth of 10 feet. Through a series of baffles in the basin, the CO_2 bubbles are kept in submergence as long as possible.

The use of a mechanical mixer located over a CO_2 diffusion system is another choice for the addition of CO_2 gas.

The recarbonation basin should be designed to allow for maximum CO_2 gas efficiency and accurate pH control.



The direct CO_2 gas feed pH control system is available in the following control configurations:

1. **Manual pH Control** — The CO_2 gas injection is controlled by a manual valve.
2. **Automatic pH Control** — The CO_2 gas injection is controlled by a backfeed pH signal.
3. **CO_2 Flow Paced Control** — The CO_2 gas injected based on a pre-determined CO_2 per gallon requirement.
4. **Water Flow Paced Control** — Not recommended.

Pressurized Solution Feed (PSF)
(Patent #5,487,835 and 5,514,264)

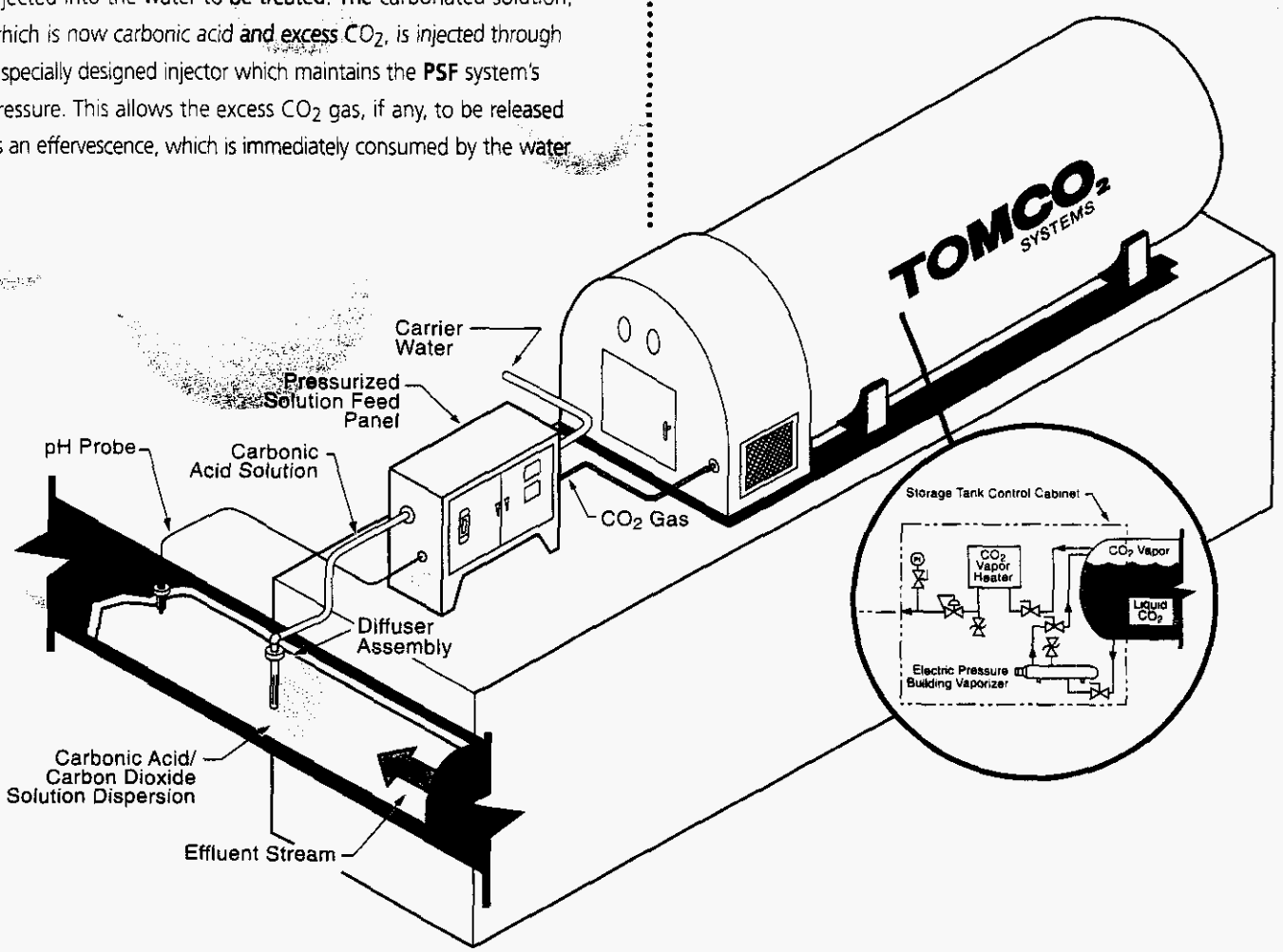
The ultimate CO_2 pH Control System. Where CO_2 efficiencies are important and precise pH control is required, **TOMCO$_2$'s PSF** system will fulfill these needs.

TOMCO$_2$'s PSF system is designed to utilize ninety-five percent of the CO_2 gas required to reduce the pH of most water. We can accomplish this by forcing the CO_2 gas into a solution under high pressure and forcing this gas to remain in solution until injected into the water to be treated. The carbonated solution, which is now carbonic acid and excess CO_2, is injected through a specially designed injector which maintains the **PSF** system's pressure. This allows the excess CO_2 gas, if any, to be released as an effervescence, which is immediately consumed by the water being treated. Because of this process, the chemical reaction time is much less, allowing pH probes to be placed closer to the injection point. With pH probes located 60-90 seconds from the **PSF** injection, extremely close control of the pH can be maintained.

By forcing the shortened chemical reaction times, the unique design of the **PSF** system allows recarbonation basins to be much smaller than previously required. With most municipal lime softened waters, 99.9% of the chemical reaction has taken place within three minutes of the carbonic acid injection. The pH is controlled and the water is stabilized within this three minute period.

TOMCO$_2$'s PSF can be installed into your plant where other CO_2 pH control systems will not perform properly. The **PSF** system can be installed into pipelines, troughs, tanks, basins or any location which has a minimal 18" submergence and 60-90 seconds retention time from **PSF** injection.

TOMCO$_2$'s PSF system can reduce construction and installation costs, then reduce chemical costs while providing the best possible pH control and water stability.



Series C General Specifications

Pressure Vessel: ASME coded for maximum working pressure of 350 psig.

Piping: Schedule 80 seamless stainless steel nozzles, Schedule 80 carbon steel pipe, 2000 pounds forged carbon steel fittings, stainless steel ball type valves.

Safeties: ASME approved direct spring loaded or pilot operated; size for unconfined outdoor installation.

Insulation: 6" polyurethane.

Outer Jacket: .063" aluminum.

Refrigeration Optional

Vaporizers Optional: *Steam, water or electric;* capacities to 10,000 lbs/hr.

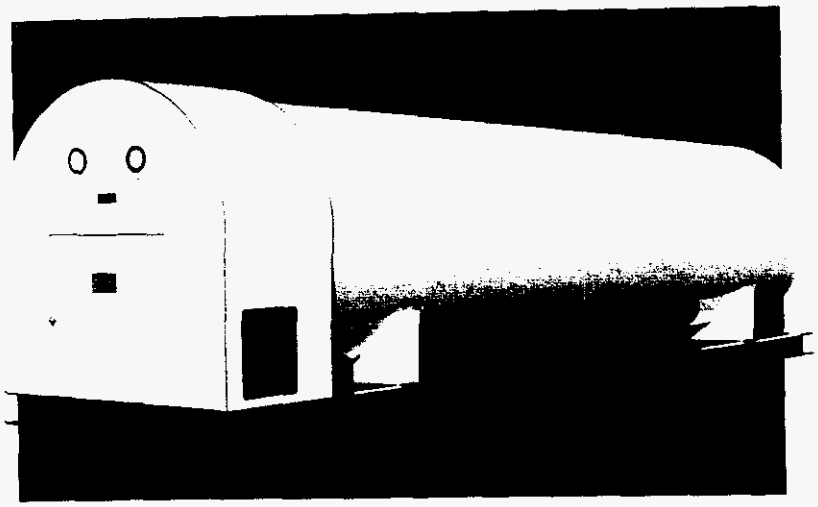
Liquid Level Gauge: *Differential pressure indicator type* with 6" dial

Electrical Characteristics: *208/220/230/380/460 volt*,* 60 Hz., 3 Phase.

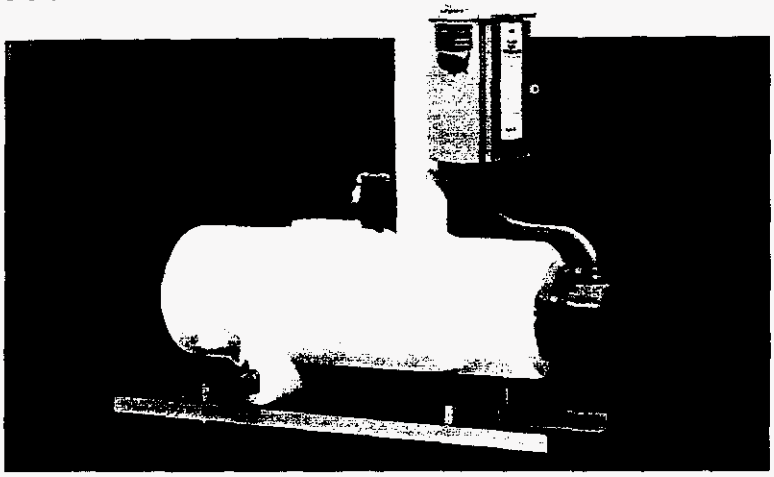
Control Cabinet: .040" prefinished aluminum with lockable access door.

• *Other electrical characteristics available upon request.*

Note: Vertical and economy storage series are also available in various sizes.



Model No.	Capacity	Height	Length	Width (6" Insul.)	Approx. Empty Wt.
WT-10C	10,000 lbs	6'10"	15'9"	7'6" (7'10")	12,750 lbs
WT-18C	36,000 lbs	8'10"	23'9"	7'6" (7'10")	18,500 lbs
WT-26C	52,000 lbs	8'10"	31'0"	7'6" (7'10")	25,000 lbs
WT-34C	68,000 lbs	8'10"	39'9"	7'6" (7'10")	31,900 lbs
WT-42C	84,000 lbs	8'10"	47'9"	7'6" (7'10")	38,500 lbs
WT-50C	100,000 lbs	8'10"	56'6"	7'6" (7'10")	45,000 lbs



Modular Electric Pressure Build Vaporizers for Liquid Carbon Dioxide

Features:

Designed to NEMA 3R standards

1" Carbon Dioxide blow down valve

Dual high temperature shutdown switches

350 psig ASME safety relief valve

Pressure control set for operation between 245 and 255 *psig* (May be field adjusted)

Model No.	Voltage	Capacity (lb/hr)	Wattage (kilowatts)	Dimensions	Approx. Weight
M-259	220 460	245 325	9 12	60" x 19" x 50" (152.4 cm x 48.3 cm x 127 cm)	231 lbs (105 kg)
M-418	220 460	490 650	18 24	60" x 19" x 50" (152.4 cm x 48.3 cm x 127 cm)	233 lbs (106 kg)
M-628	220 460	760 760	28 28	55" x 21" x 57" (139.7 cm x 53.3 cm x 144.8 cm)	386 lbs (175 lbs)
M-1256	220 460	1525 1525	56 56	101" x 21" x 57" (256.5 cm x 53.3 cm x 144.8 cm)	698 lbs (317 kg)

Electrical Characteristics:

230/460 volt*, 60 Hz., 3 Phase.

** Other electrical characteristics available upon request.*

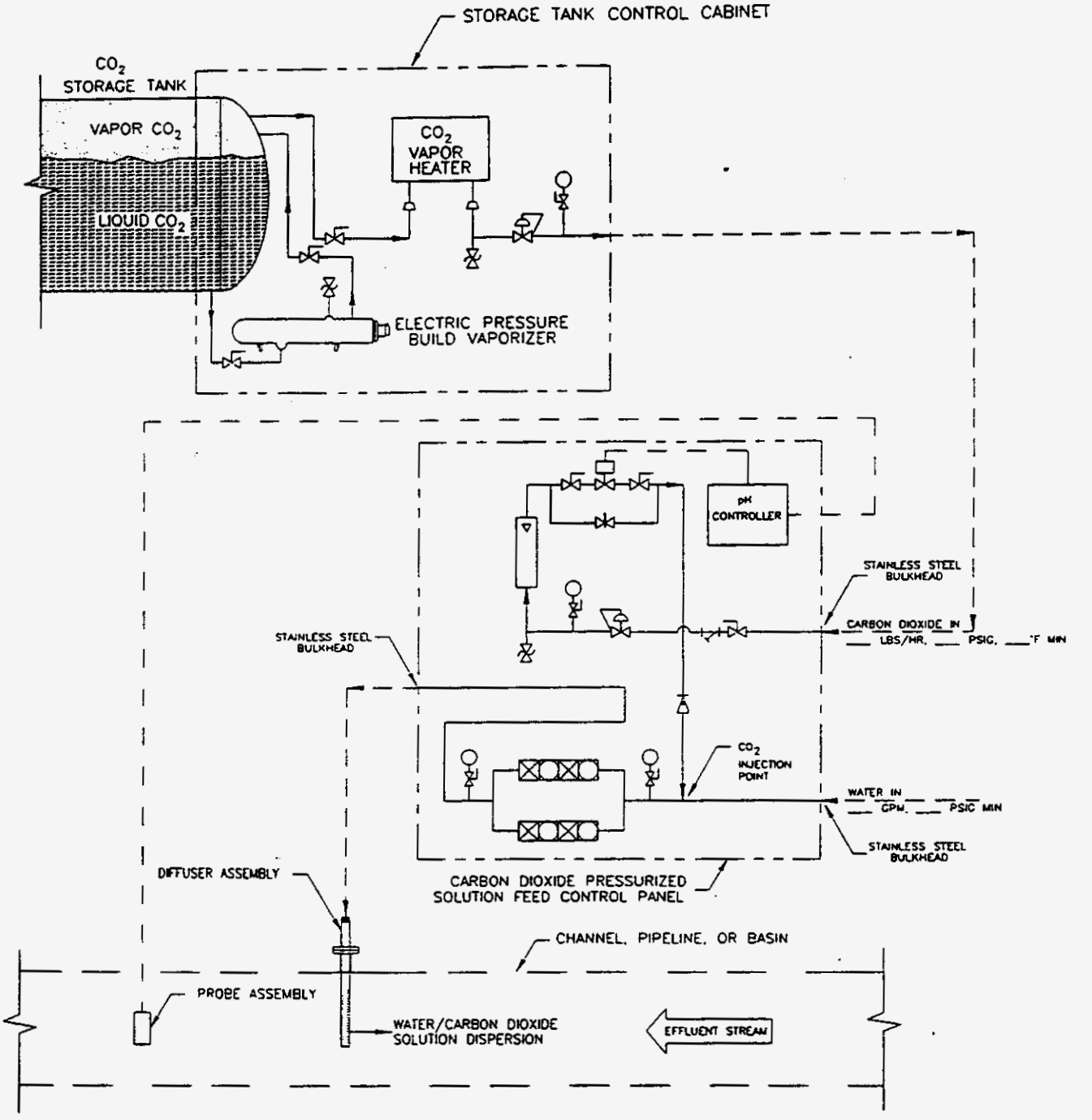
TOMCO$_2$ SYSTEMS

EQUIPMENT COMPANY

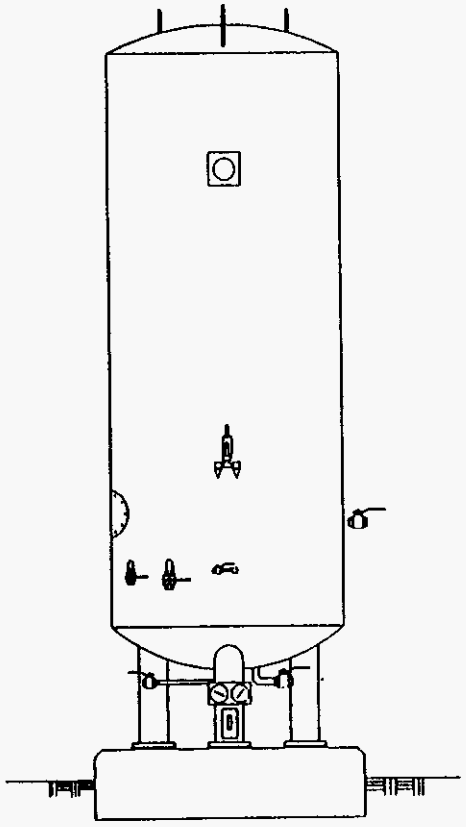
3340 Rosebud Road, Loganville, Georgia 30249

Phone: 770-979-8000 • 800-832-4262 • Fax: 770-978-5861 • e-mail: TOMCO@mindspring.com

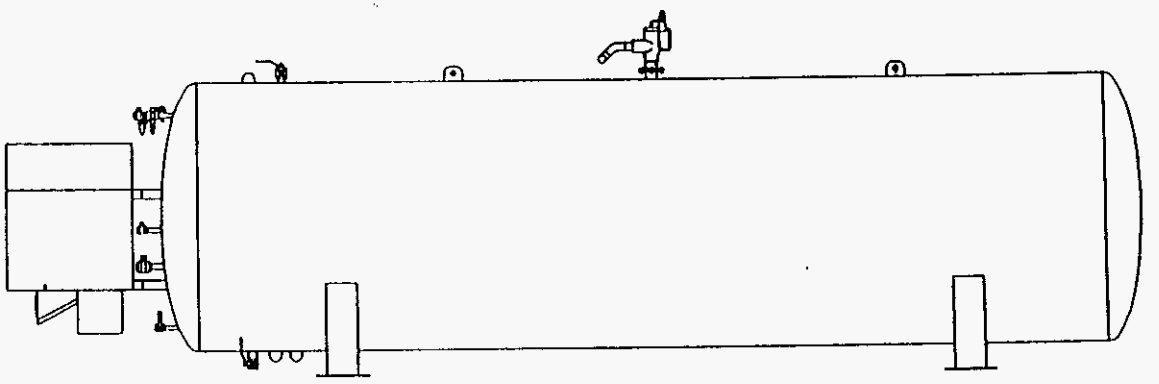
TOMCO'S GENERAL PIPING SCHEMATIC



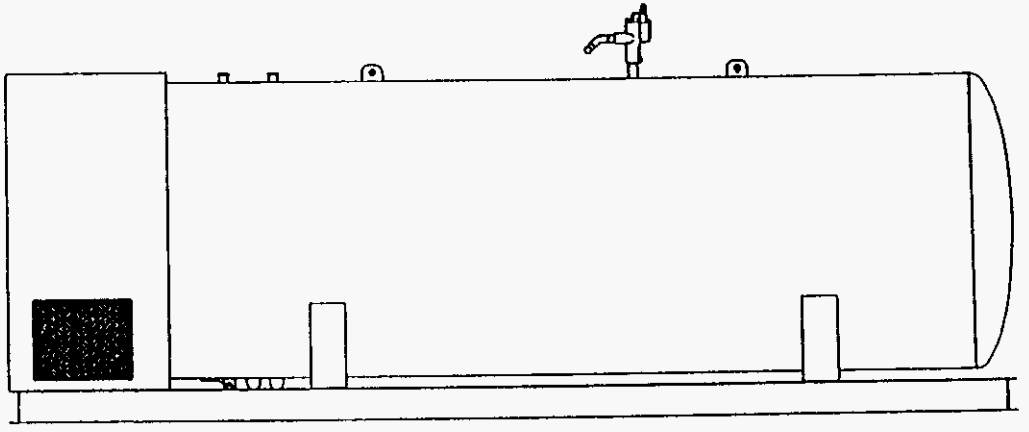
TOMCO'S STANDARD CARBON DIOXIDE STORAGE UNITS



VERTICAL TANK

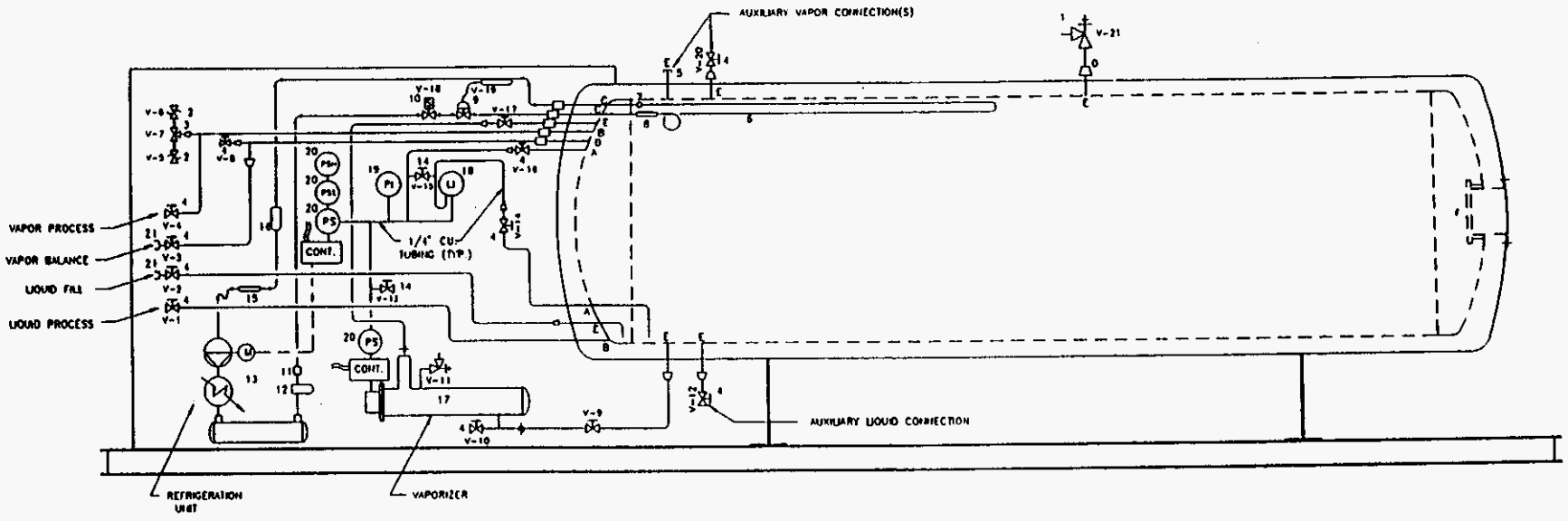


E-STYLE TANK



C-STYLE TANK

TOMCO'S GENERAL TANK SCHEMATIC



LEGEND

1. VESSEL SAFETY RELIEF VALVE (ASME APPRV'D). 350 PSIG SET PRESSURE. DISCHARGE PIPED TO WEATHER PROCTECTED TEE ARRANGEMENT.
2. BLEEDER VALVE - 330 PSIG SET PRESSURE.
3. THREE-WAY DIVERTER VALVE.
4. MANUAL BALL VALVE - DESIGNED FOR CO2 SERVICE WITH STANDARD PORT.
5. PIPE CAP, ANSI 3000#.
6. COPPER REFRIGERATION COIL. TYPE L (ACR).
7. REFRIGERATION MANIFOLD.
8. REFRIGERATION COIL DISTRIBUTOR.
9. EXPANSION VALVE.
10. SOLENOID VALVE.
11. SIGHT GLASS.
12. FILTER DRYER.
13. CONDENSING UNIT.
14. DIAPHRAGM VALVE.
15. VIBRATION ABSORBER.
16. SUCTION FILTER.
17. PRESSURE-BUILD VAPORIZER.
18. CONTENTS GAGE (DIFF'L PRESS. TYPE) - 6" DIAL, CALIBRATED IN LBS.
19. PRESSURE GAGE - 6" DIAL WITH 0 TO 600 PSIG RANGE.
20. PRESSURE SWITCH.
21. FIXED END CGA FITTING.

LINE/PENETRATION NOMINAL SIZE

A	1/2"
B	1"
C	1 1/4"
D	1 1/2"
E	2"
F	12"x16" (MANWAY)

VALVE NUMBER/SERVICE

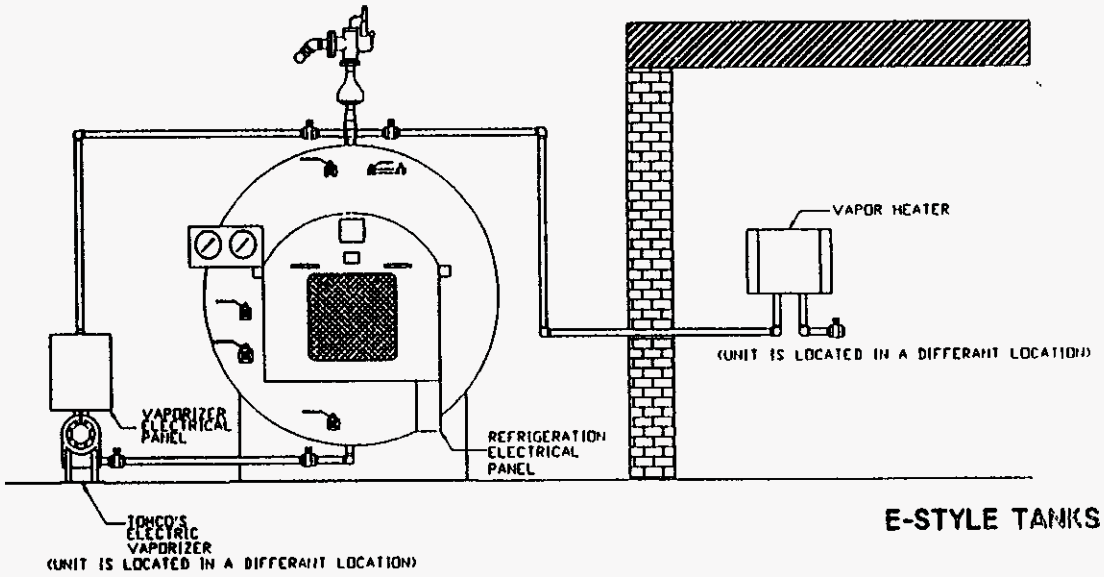
V-1	1" LIQUID PROCESS
V-2	1 1/2" LIQUID FILL
V-3	1" VAPOR BALANCE
V-4	1" VAPOR PROCESS
V-5	3/8" PRESSURE BLEED-OFF (330 PSIG SET PRESS.)
V-6	3/8" PRESSURE BLEED-OFF (330 PSIG SET PRESS.)
V-7	1/2" SWITCHING VALVE
V-8	1/2" AUXILIARY VAPOR PROCESS
V-9	1" OR 1 1/2" VAPORIZER ISOLATION
V-10	1" VAPORIZER BLOW-DOWN
V-11	1/2" VAPORIZER PRESSURE RELIEF
V-12	1 1/2" AUXILIARY LIQUID
V-13	1/4" INSTRUMENTATION BLOW-DOWN
V-14	1/2" INSTRUMENTATION ISOLATION
V-15	1/4" INSTRUMENTATION EQUALIZATION
V-16	1/2" INSTRUMENTATION ISOLATION
V-17	2" VAPORIZER ISOLATION
V-18	REFRIGERATION SOLENOID
V-19	REFRIGERATION EXPANSION
V-20	1 1/2" AUXILIARY VAPOR
V-21	1 1/2"x2" VESSEL SAFETY RELIEF

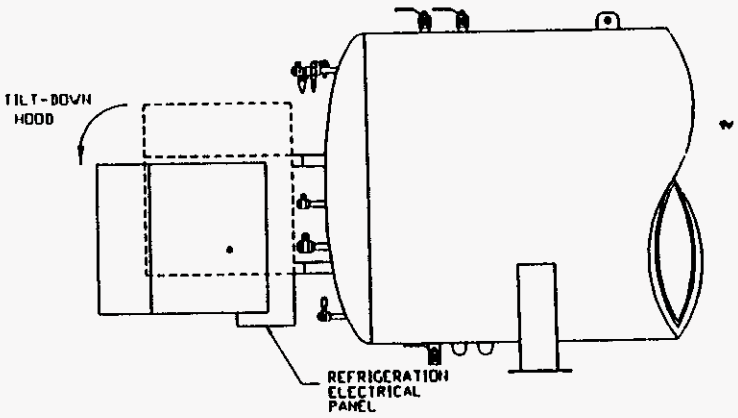
GENERAL NOTES:

1.) ALL PIPING SHALL BE SEAMLESS SCHEDULE 80 PIPE.

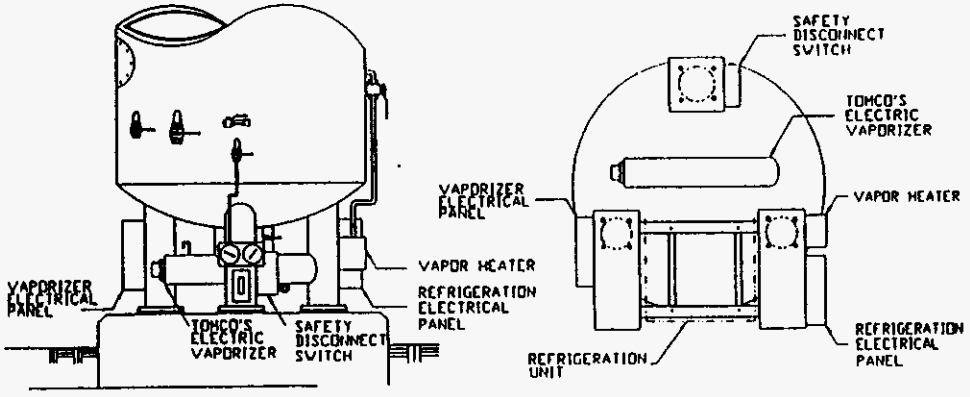
2.) ALL FORGED STEEL FITTINGS SHALL BE 2000# RATING OR HIGHER.

TOMCO'S GENERAL EQUIPMENT LAYOUT

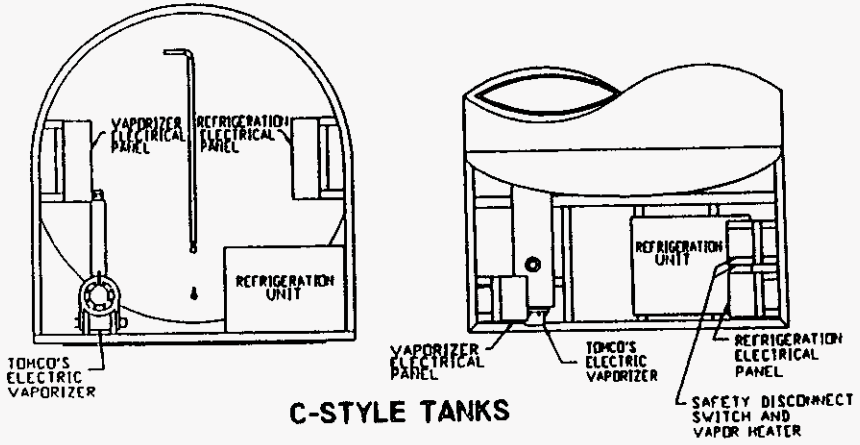




E-STYLE TANKS

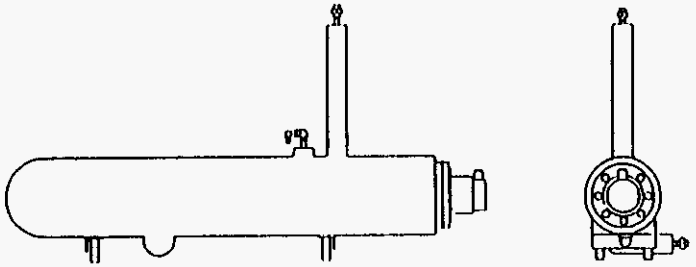


VERTICAL-STYLE TANKS

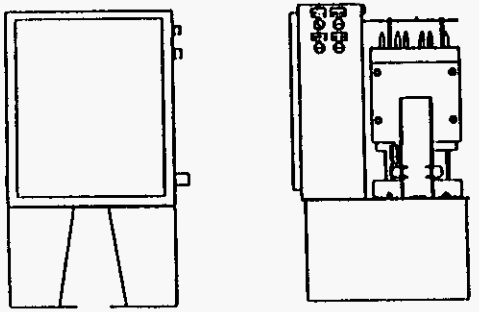


C-STYLE TANKS

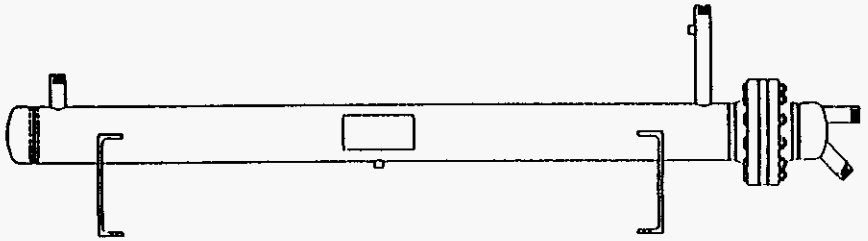
TOMCO'S CARBON DIOXIDE VAPORIZERS



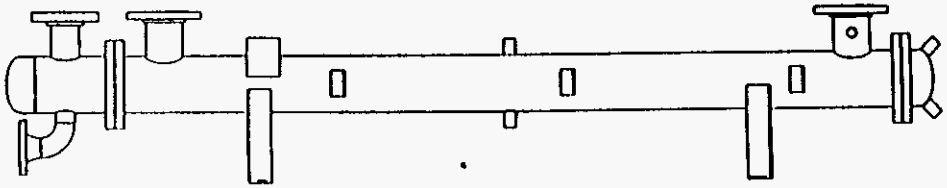
MODULAR ELECTRIC
PRESSURE BUILD



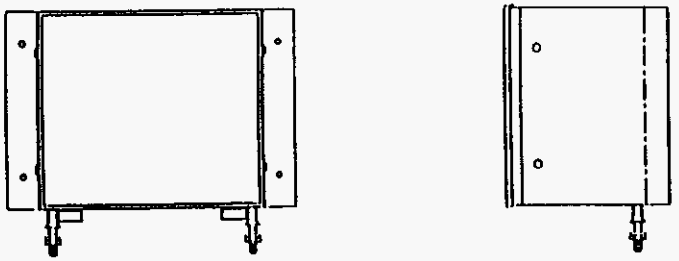
DIRECT TO PROCESS



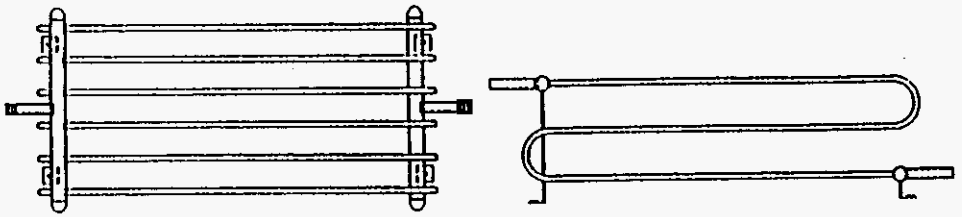
STEAM



WATER

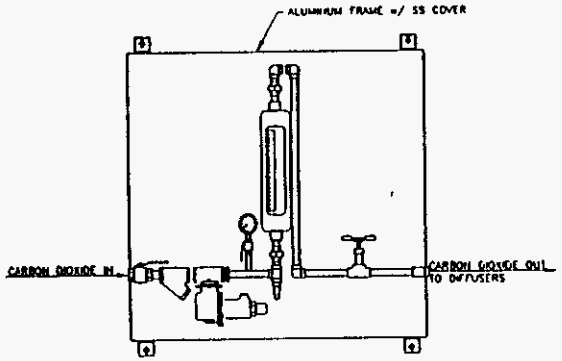


VAPOR HEATER

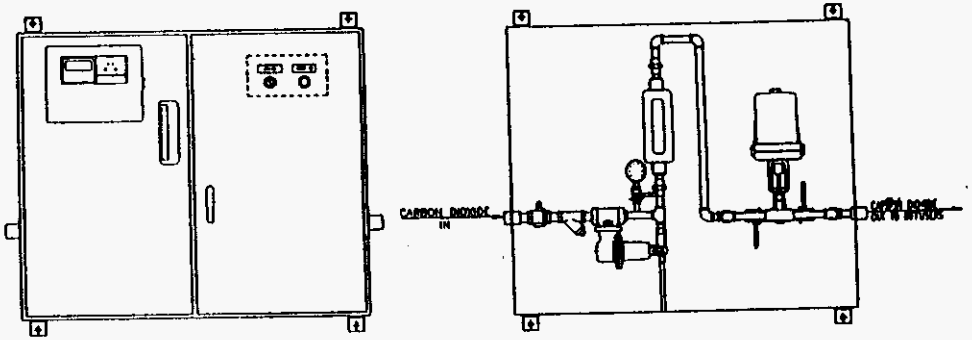


WATER BATH

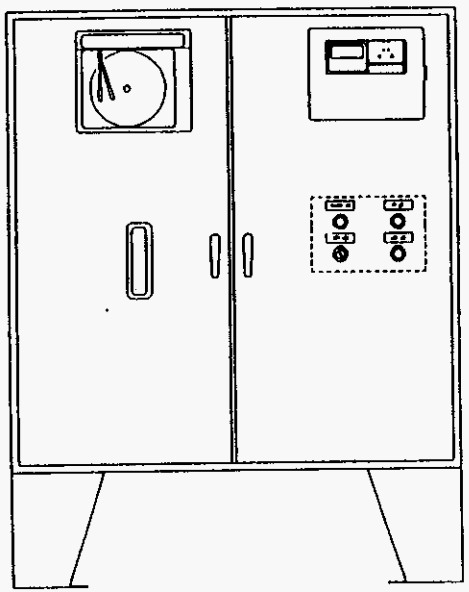
TOMCO'S CARBON DIOXIDE pH CONTROL PANELS

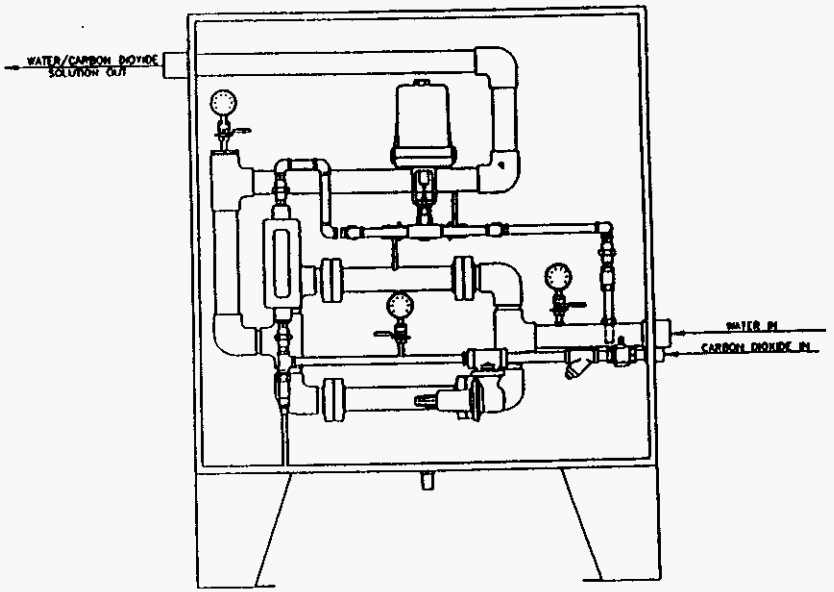


MANUAL



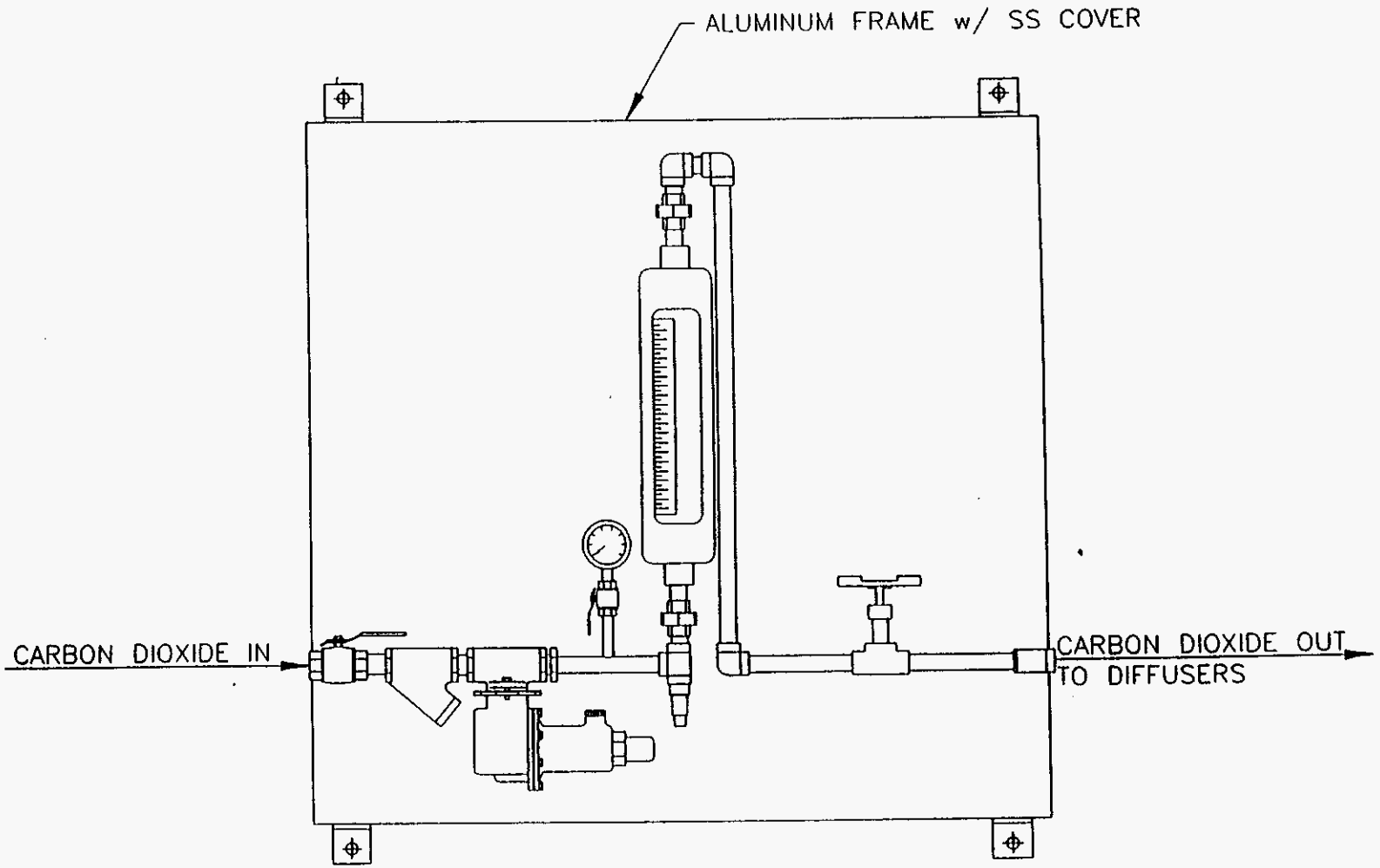
AUTOMATIC



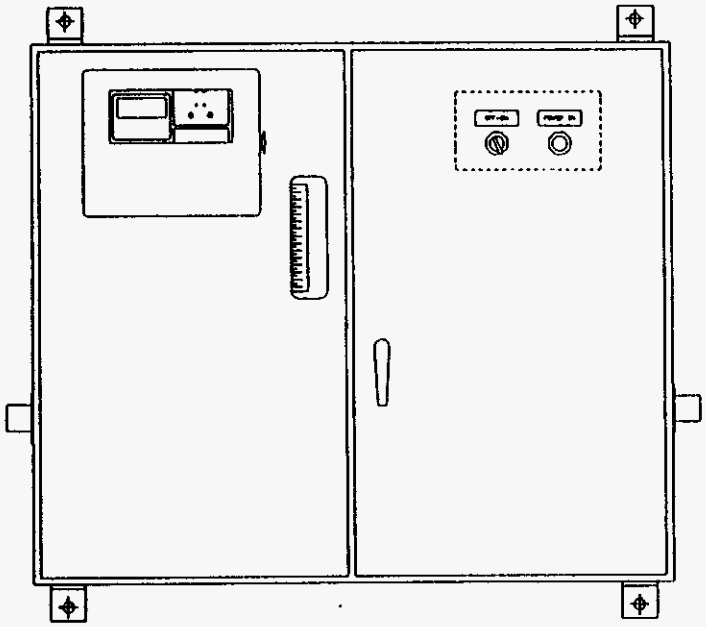


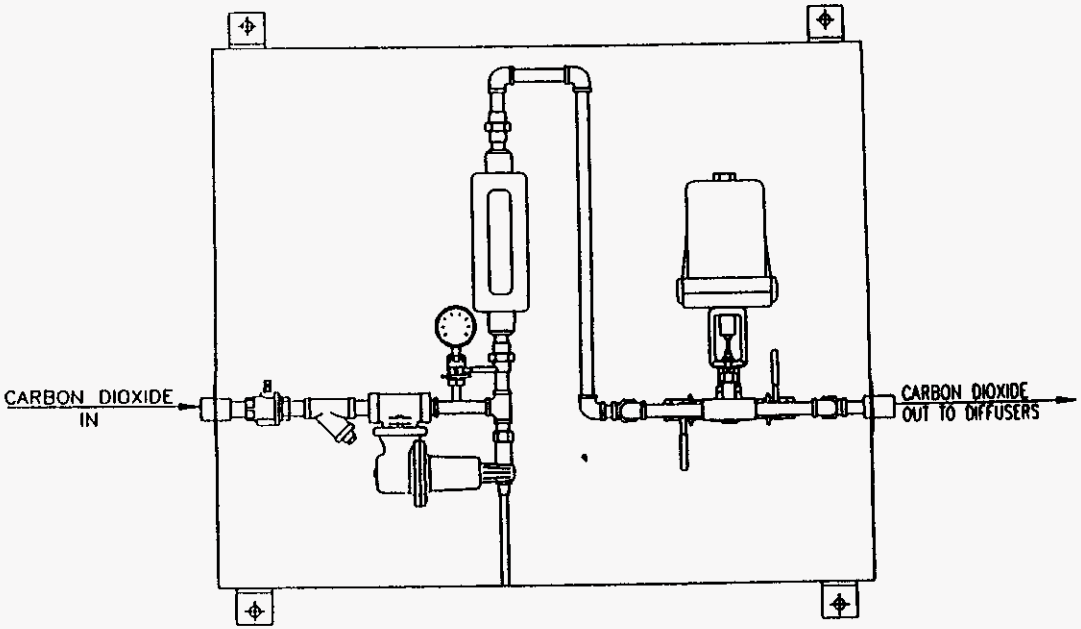
PRESSURIZED SOLUTION FEED

TOMCO'S CARBON DIOXIDE MANUAL PH CONTROL PANEL

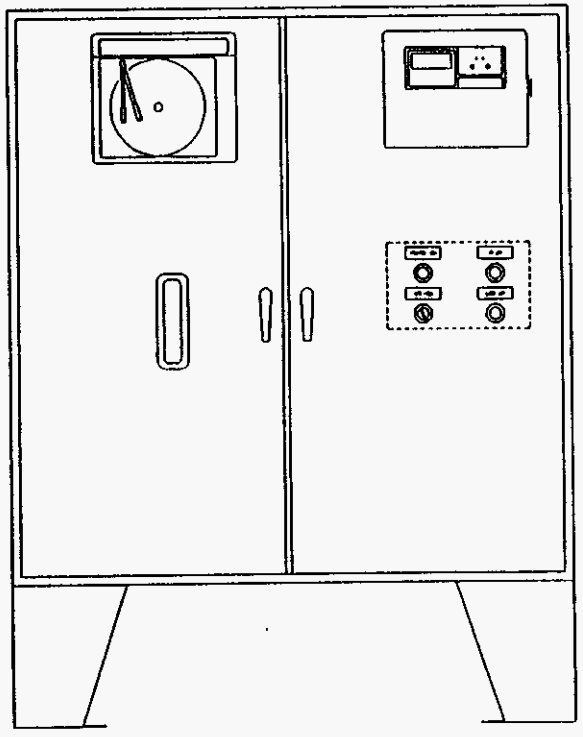


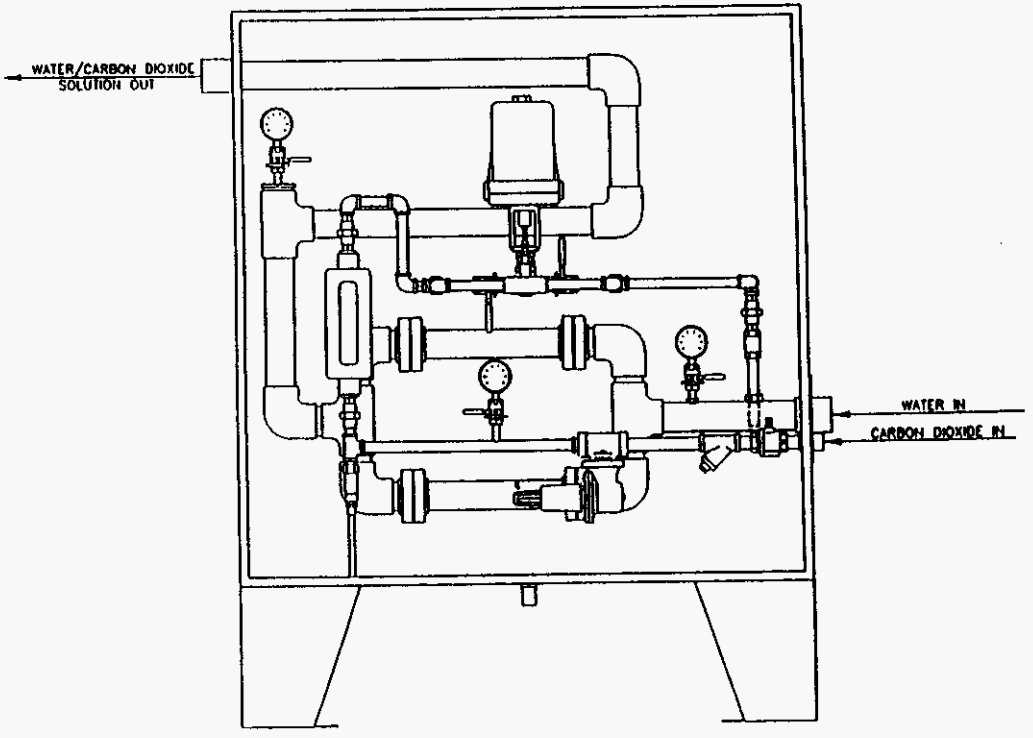
TOMCO'S CARBON DIOXIDE AUTOMATIC pH CONTROL PANEL



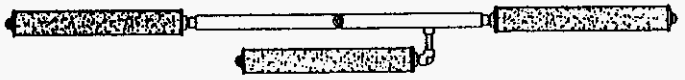


TOMCO'S CARBON DIOXIDE PRESSURIZED SOLUTION FEED pH CONTROL PANEL

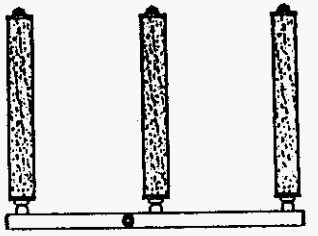




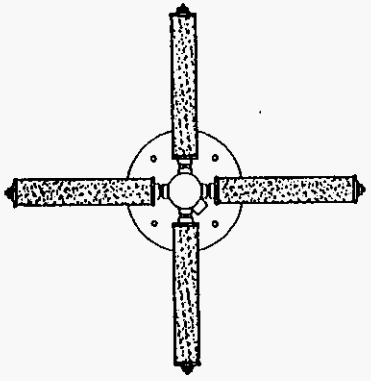
TOMCO'S DIFFUSERS



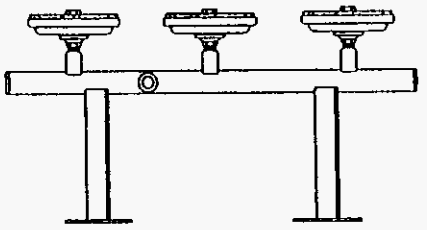
WIDE BASIN TYPE



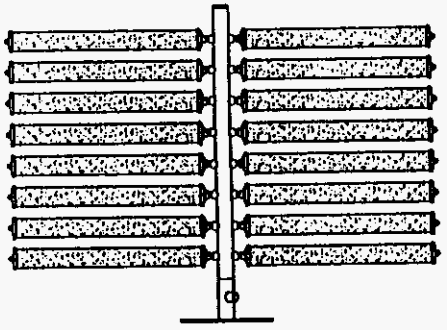
NARROW BASIN TYPE



WAGON WHEEL TYPE

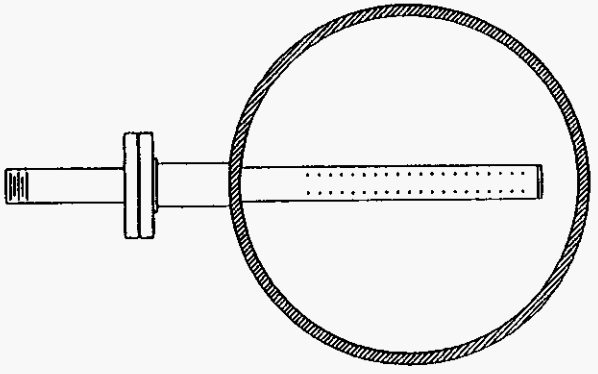


ROUND DISC TYPE
(LOW FLOW)



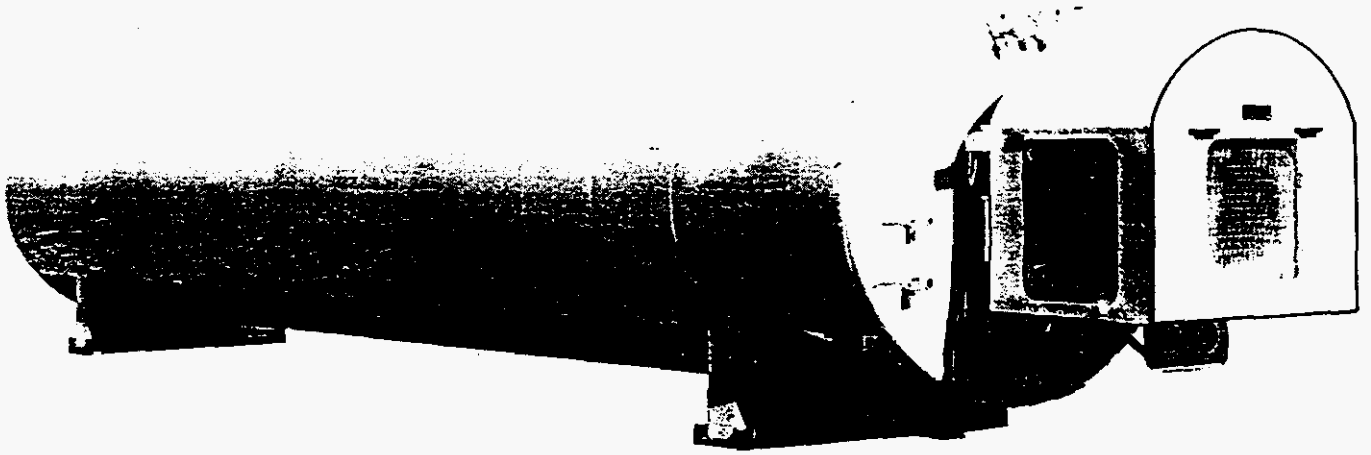
GRID TYPE

MANUAL AND AUTOMATIC PANELS



PRESSURIZED SOLUTION FEED

Carbon Dioxide Storage Unit



TOMCO$_2$ SYSTEMS

TOMCO$_2$ EQUIPMENT COMPANY
3340 Rosebud Road; Loganville, Georgia 30249
(404) 979-8000; 1-800-832-4262; FAX (404) 985-9179

Series E Carbon Dioxide Storage Units

Efficient CO_2 storage units from 7,500 to 240,000 pound capacity.

These long life units come in a variety of capacities, and are designed to operate efficiently even in environments of high heat and humidity.

Auxiliary outlets are available for additional liquid and vapor supply needs.

DIMENSIONS

MODEL NO.	CAPACITY	HEIGHT	LENGTH	WIDTH	APPROX. EMPTY WT.
3.7581EA	7,500 lbs.	7'11"	11'10"	5'10"	7,500 lbs.
681EA	12,000 lbs.	8'3"	15'10"	5'10"	9,000 lbs.
1481EA	28,000 lbs.	8'7"	19'6"	7'4"	14,000 lbs.
2681EA	52,000 lbs.	8'7"	33'0"	7'4"	23,500 lbs.
3081EA	60,000 lbs.	8'7"	37'0"	7'4"	26,500 lbs.
5081EA	100,000 lbs.	8'7"	57'0"	7'4"	40,000 lbs.
6081EA	120,000 lbs.	8'7"	67'0"	7'4"	45,000 lbs.
7081EA	140,000 lbs.	11'1"	43'11"	10'0"	53,000 lbs.
8081EA	160,000 lbs.	11'1"	49'3"	10'0"	60,500 lbs.
9081EA	180,000 lbs.	11'1"	54'7"	10'0"	68,000 lbs.
10081EA	200,000 lbs.	11'1"	59'11"	10'0"	72,500 lbs.
12081EA	240,000 lbs.	11'1"	71'1"	10'0"	85,000 lbs.

GENERAL SPECIFICATIONS

PRESSURE VESSEL: ASME Coded for maximum working pressure of 350 psig.

PIPING: Schedule 80 seamless pipe, 2,000 lb. forged steel fittings, ball type valves.

SAFETIES: ASME approved direct spring loaded or pilot operated, sized for unconfined outdoor installation.

INSULATION: 4" Polyurethane.

OUTER JACKET: .063" Aluminum.

VAPORIZERS OPTIONAL: Steam or electric, capacities to 6,000 lbs./hr.

LIQUID LEVEL GAUGE: Differential pressure indicator type with 6" dial.

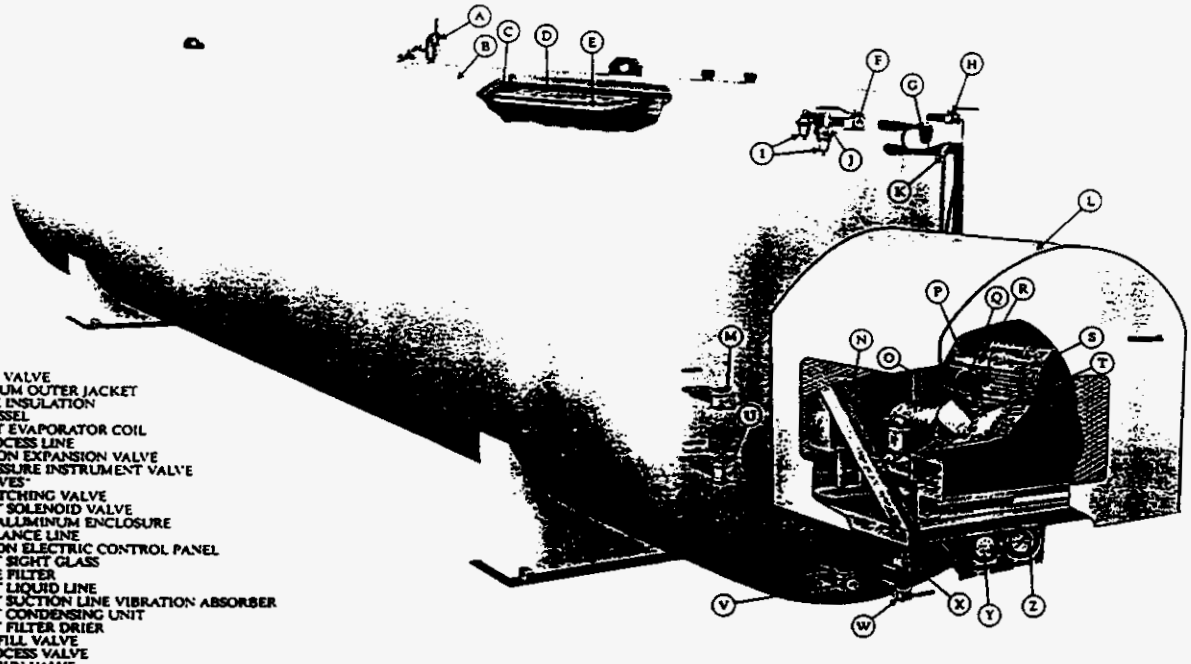
PRESSURE GAUGE: 0 to 600 psig with 6" dial.

ELECTRICAL CHARACTERISTICS: *Model 3.7581EA and 681EA use 208/220V, 60 Hz., 1 Ph. All other models use 208/220/230/460V, 60 Hz., 3 Ph.

CONTROL CABINET: .040" prefinished aluminum, complete cabinet folds down for total accessibility to refrigeration unit. (Add 4'0" to length shown for fold down clearance.)

*Other electrical characteristics available on request.

NOTE: Safety relief valve removed for shipment due to height requirements on 14 ton and larger units.



A • ASME SAFETY VALVE
B • .063" ALUMINUM OUTER JACKET
C • 4" URETHANE INSULATION
D • PRESSURE VESSEL
E • REFRIGERANT EVAPORATOR COIL
F • 1" VAPOR PROCESS LINE
G • REFRIGERATION EXPANSION VALVE
H • 1/2" LOW PRESSURE INSTRUMENT VALVE
I • BLEEDER VALVES*
J • BLEEDER SWITCHING VALVE
K • REFRIGERANT SOLENOID VALVE
L • FOLD DOWN ALUMINUM ENCLOSURE
M • 1" VAPOR BALANCE LINE
N • REFRIGERATION ELECTRIC CONTROL PANEL
O • REFRIGERANT SIGHT GLASS
P • SUCTION LINE FILTER
Q • REFRIGERANT LIQUID LINE
R • REFRIGERANT SUCTION LINE VIBRATION ABSORBER
S • REFRIGERANT CONDENSING UNIT
T • REFRIGERANT FILTER DRIER
U • 1-1/2" LIQUID FILL VALVE
V • 1" LIQUID PROCESS VALVE
W • 1/2" BLOW DOWN VALVE
X • 1/2" HIGH PRESSURE INSTRUMENT VALVE
Y • LIQUID LEVEL GAUGE
Z • PRESSURE GAUGE

*Bleeder Valve located on top of tank with Main Safety on 6 ton & smaller units.

Vertical Carbon Dioxide Storage Units

DIMENSIONS

MODEL NO.	CAPACITY	HEIGHT	LENGTH	WIDTH	APPROX. EMPTY WT.
681VA	12,000 lbs.	5'4"	16'1"	6'5"	10,000 lbs.
1481VA	28,000 lbs.	5'9"	20'4"	8'0"	15,500 lbs.
2681VA	52,000 lbs.	5'9"	31'10"	8'0"	25,000 lbs.
3081VA	60,000 lbs.	5'9"	35'10"	8'0"	30,000 lbs.
5081VA	100,000 lbs.	10'5"	39'6"	9'6"	40,000 lbs.

NOTE: The above are shipping dimensions with tank in a horizontal position. The length shown is the vertical height when storage unit is installed.

GENERAL SPECIFICATIONS

PRESSURE VESSEL: ASME Coded for maximum working pressure of 350 psig.

PIPING: Schedule 80 seamless pipe, 2,000 lb. forged steel fittings, ball type valves.

SAFETIES: ASME approved direct spring loaded or pilot operated, sized for unconfined outdoor installation.

INSULATION: 4" Polyurethane.

OUTER JACKET: .063" Aluminum.

VAPORIZERS OPTIONAL: Steam or electric, capacities to 6,000 lbs./hour.

LIQUID LEVEL GAUGE: Differential pressure indicator type with 6" dial.

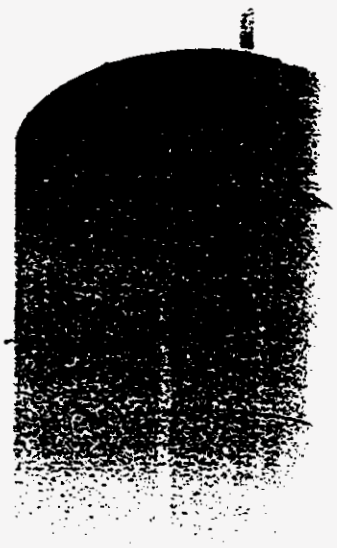
PRESSURE GAUGE: 0 to 600 psig with 6" dial.

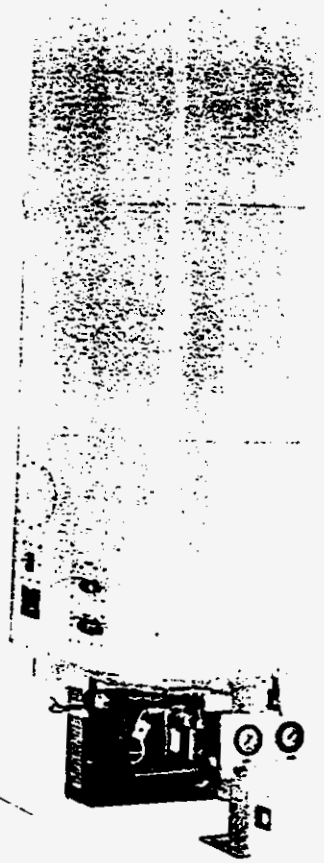
ELECTRICAL CHARACTERISTICS: *208/220/230/460 volt, 60 Hz., 3 Phase.

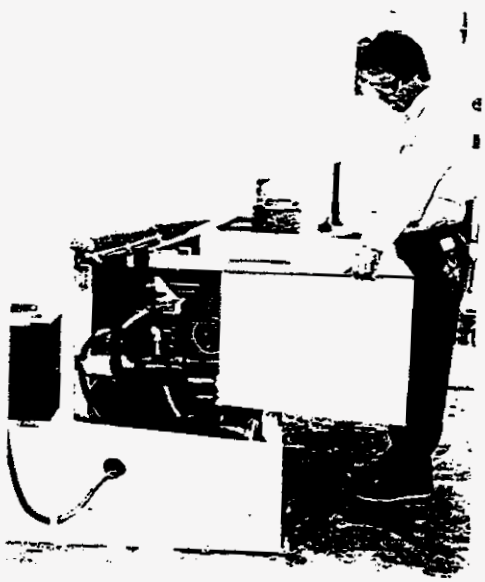
CONTROL CABINET: .040" prefinished aluminum, complete cabinet lifts off for total accessibility to refrigeration unit.

*Other electrical characteristics available on request.

NOTE: Safety relief valve removed for shipment.







Rise above it all with compact, CO_2 storage.

Now you can store up to 100,000 lbs. of CO_2 in a very limited amount of space with this sleek, low-maintenance, vertical aluminum skin storage unit.

Series C Carbon Dioxide Storage Unit

The CO_2 storage unit with wide flanged rectangular skids.

This Carbon Dioxide storage unit is designed for balanced weight distribution in areas where placement is a concern. As with all of our storage units, maximum efficiency of operation is our number one priority.

This low-maintenance storage unit has totally enclosed valves, electrical and refrigeration, and may be locked for safety and security. Vaporizing equipment is available.

A sleek aluminum factory finish conceals a 4" polyurethane insulation which allows for long life and maximum protection. Auxiliary outlets are available for additional liquid and vapor supply needs.

DIMENSIONS

MODEL NO.	CAPACITY	HEIGHT	LENGTH	WIDTH	APPROX. EMPTY WT.
3.75?5CA	7,500 lbs.	7'11"	11'0"	6'2"	8,000 lbs.
675CA	12,000 lbs.	8'3"	15'0"	6'2"	10,000 lbs.
1475CA	28,000 lbs.	8'10"	18'9"	7'8"	15,500 lbs.
2675CA	52,000 lbs.	9'0"	31'0"	7'8"	25,000 lbs.
3075CA	60,000 lbs.	9'0"	35'0"	7'6"	30,000 lbs.
5075CA	100,000 lbs.	9'0"	56'6"	7'6"	45,000 lbs.
6075CA	120,000 lbs.	9'0"	66'6"	7'6"	60,000 lbs.

GENERAL SPECIFICATIONS

PRESSURE VESSEL: ASME Coded for maximum working pressure of 350 psig.

PIPING: Schedule 80 seamless pipe, 2,000 lb. forged steel fittings, ball type valves.

SAFETIES: ASME approved direct spring loaded or pilot operated, sized for unconfined outdoor installation.

INSULATION: 4" Polyurethane.

OUTER JACKET: .063" Aluminum.

VAPORIZERS OPTIONAL: Steam or electric, capacities to 6,000 lbs./hour.

LIQUID LEVEL GAUGE: Differential pressure indicator type with 6" dial.

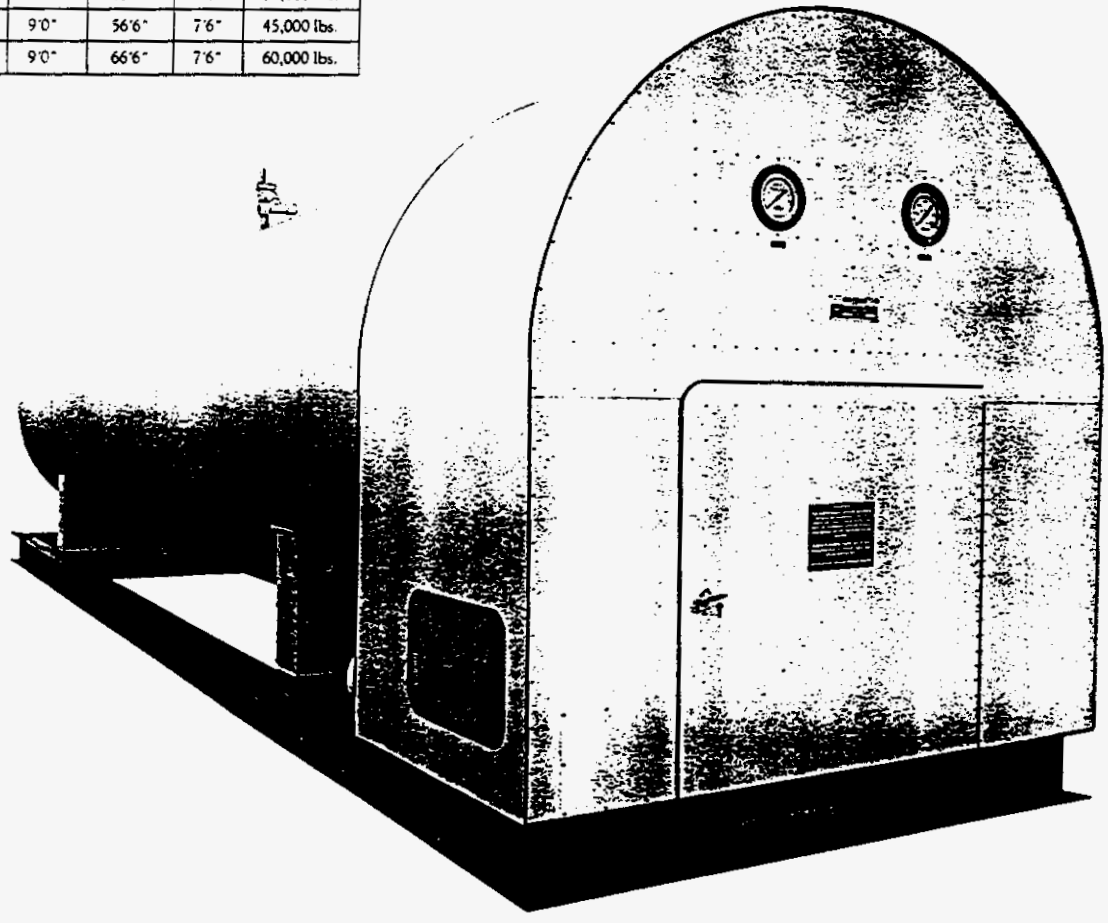
PRESSURE GAUGE: 0 to 600 psig with 6" dial.

ELECTRICAL CHARACTERISTICS: *208/220/230/460 volt, 60 Hz., 3 Phase.

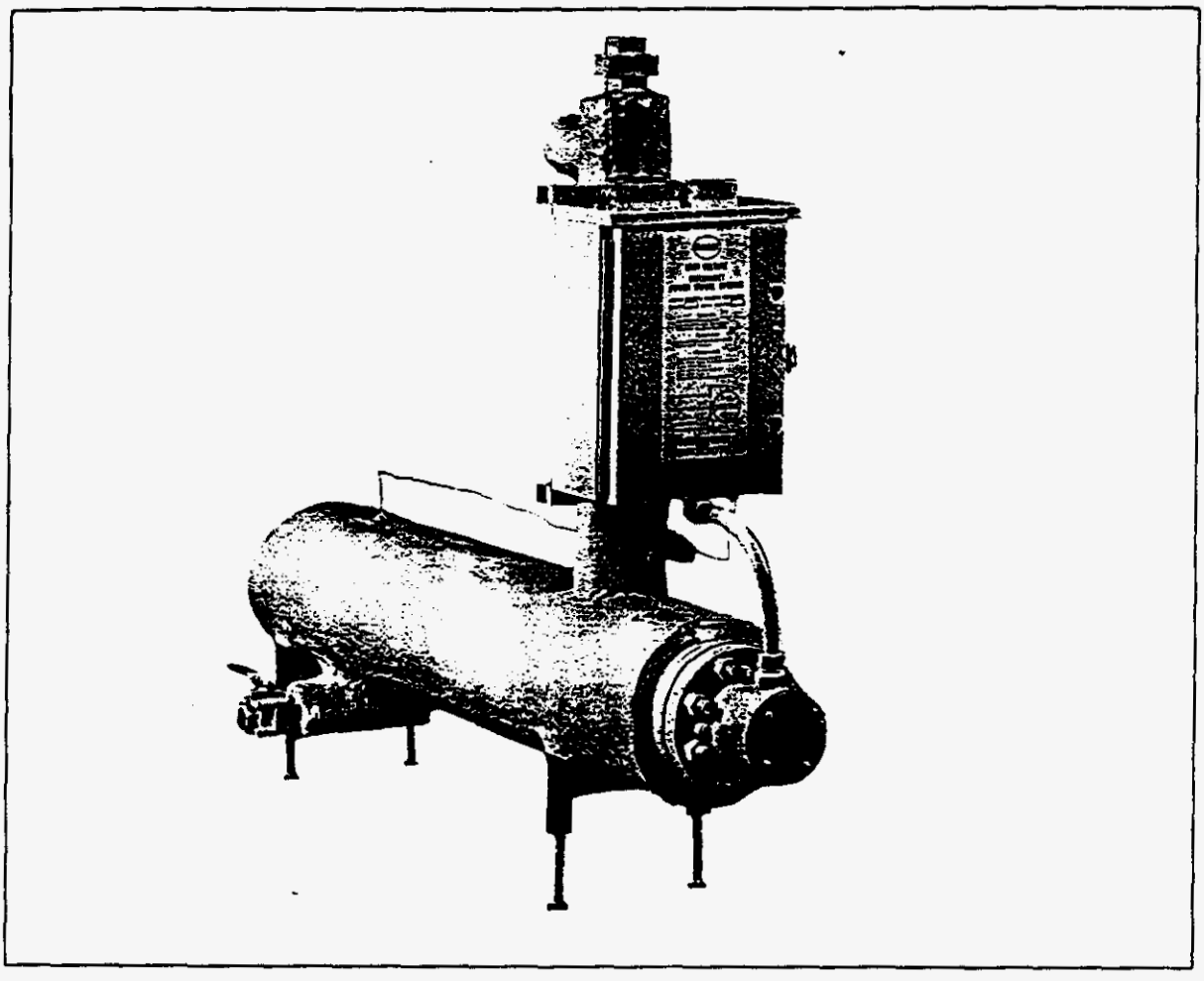
CONTROL CABINET: .040" prefinished aluminum with lockable access door.

*Other electrical characteristics available upon request.

NOTE: Safety relief valve removed for shipment due to height requirements on 14 ton and larger units.



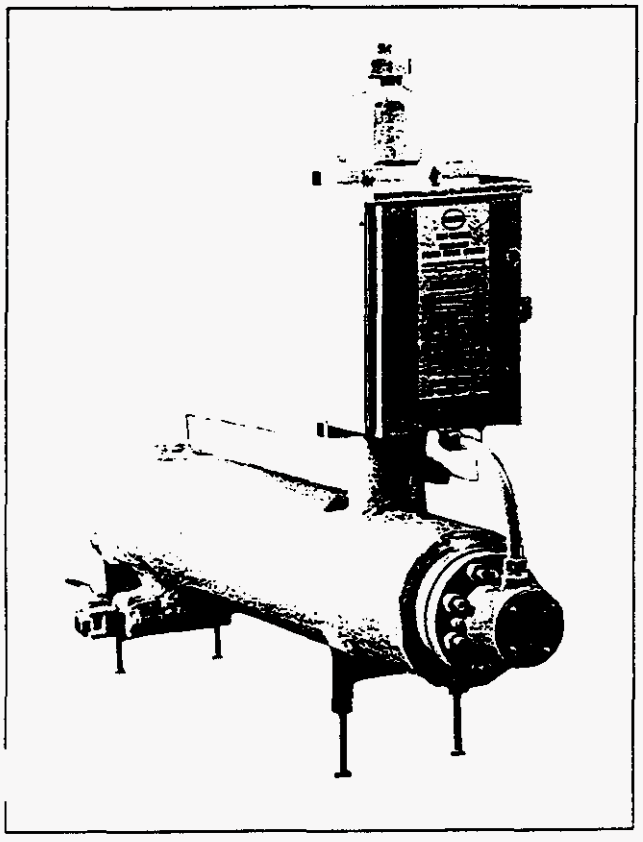
Carbon Dioxide Vaporizers



TOMCO$_2$ SYSTEMS

TOMCO$_2$ EQUIPMENT COMPANY
3340 Rosebud Road; Loganville, Georgia 30249
(404) 979-8000; 1-800-832-4262; FAX (404) 985-9179

Electric Vaporizers



MODULAR ELECTRIC PRESSURE BUILD VAPORIZERS FOR LIQUID CARBON DIOXIDE

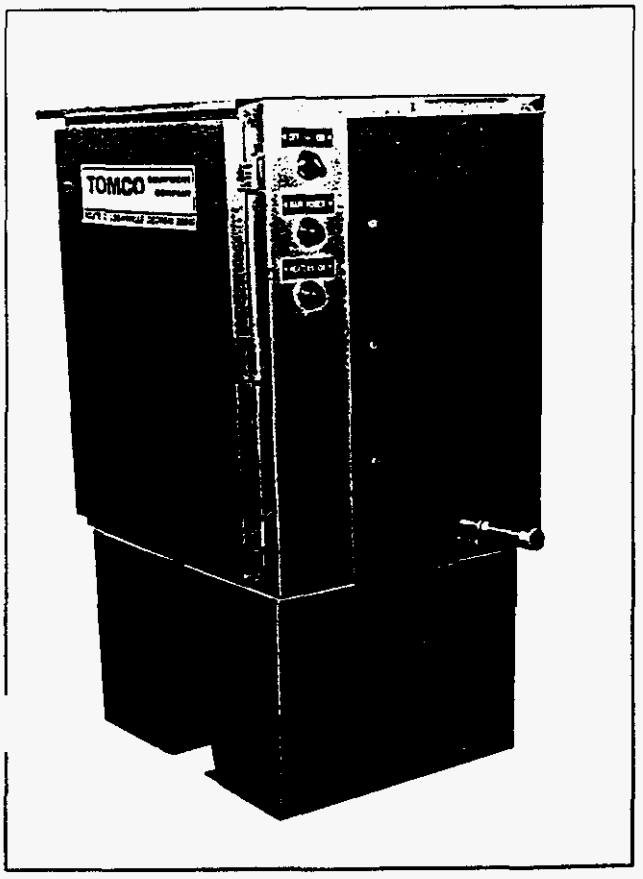
MODEL	CAPACITY	WATTAGE	DIMENSIONS	WEIGHT
M259	245 lbs/hr	9,000	60" x 19" x 50" high (152.4 cm x 48.3 cm x 127 cm)	231 lbs (105 kg)
M418	490 lbs/hr	18,000	60" x 19" x 50" high (152.4 cm x 48.3 cm x 127 cm)	233 lbs (106 kg)
M628	760 lbs/hr	28,000	55" x 21" x 57" high (139.7 cm x 53.3 cm x 144.8 cm)	386 lbs (175 kg)
M1256	1525 lbs/hr	56,000	101" x 21" x 57" high (256.5 cm x 53.3 cm x 144.8 cm)	698 lbs (317 kg)

FEATURES

(1) Designed to NEMA 3R standards
(2) 1" Carbon Dioxide blow down valve
(3) Dual high temperature shutdown switches
(4) 450 psig relief valve
(5) Pressure control set for operation between 245 psig and 255 psig (May be field adjusted)

ELECTRICAL CHARACTERISTICS:

230/460 volt, 60 Hz., 3 Phase



DIRECT TO PROCESS VAPORIZER FOR LIQUID CARBON DIOXIDE

MODEL	CAPACITY	WATTAGE	DIMENSIONS	WEIGHT
DTP 15	375 lbs/hr	15,000	22" x 23" x 37" high (55.9 cm x 58.4 cm x 94 cm)	265 lbs (120 kg)
DTP 30	750 lbs/hr	30,000	22" x 23" x 37" high (55.9 cm x 58.4 cm x 94 cm)	305 lbs (139 kg)
DTP 45	1125 lbs/hr	45,000	22" x 23" x 37" high (55.9 cm x 58.4 cm x 94 cm)	345 lbs (157 kg)
DTP 60	1500 lbs/hr	60,000	22" x 23" x 37" high (55.9 cm x 58.4 cm x 94 cm)	375 lbs (170 kg)

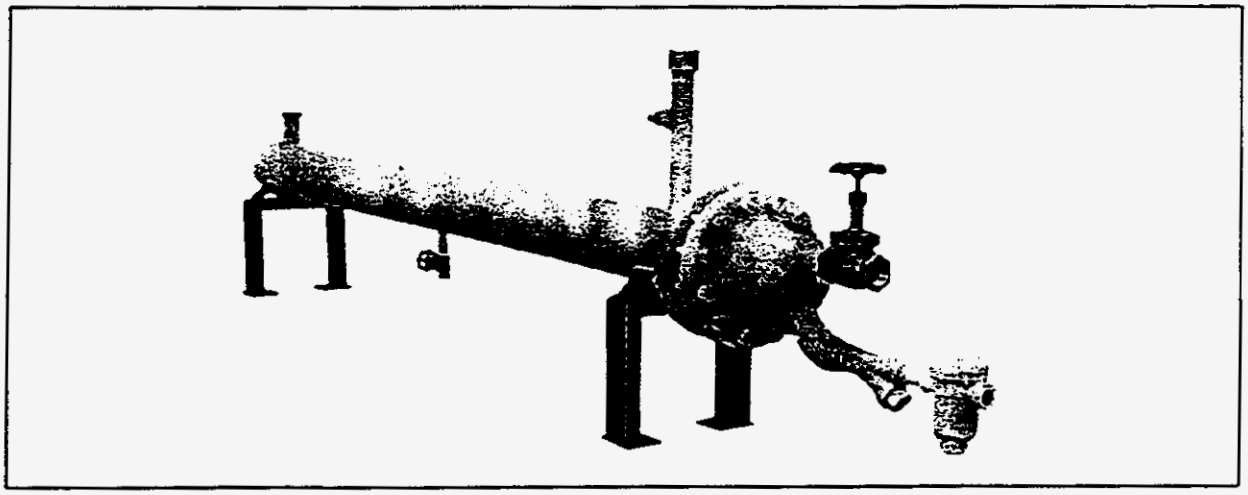
FEATURES

(1) Designed to NEMA 3R standards
(2) Replaceable heater platen
(3) Pilot light indicator for control power & heater cycle
(4) Low discharge temperature safety cut off
(5) Circuit breaker load protection

ELECTRICAL CHARACTERISTICS

230/460 volt, 60 Hz., 3-Phase

Steam and Water Vaporizers



CARBON DIOXIDE STEAM VAPORIZERS

MODEL	CAPACITY	DIMENSIONS	WEIGHT
SV-40	4000 lbs/hr	117" x 12" x 28" high (297.2 cm x 30.5 cm x 71.1 cm)	565 lbs (257 kg)
SV-60	6000 lbs/hr	160" x 12" x 28" high (406.4 cm x 30.5 cm x 71.1 cm)	605 lbs (275 kg)

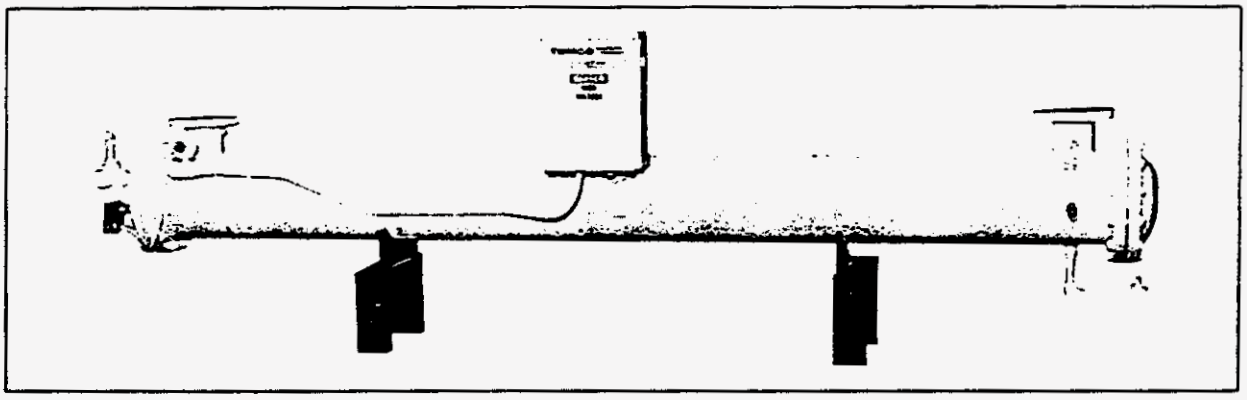
STEAM REQUIREMENTS

Output capacities based on 40 psig steam pressure.
All units have capability of operating between 15 and 250 psig steam pressure.

FEATURES

(1) 450 psig safety relief valve
(2) Steam service valve
(3) "Y" type strainer
(4) Inverted bucket steam trap
(5) CO_2 blow down valve
(6) 1½" MPT liquid inlet
(7) 1½" MPT vapor outlet
(8) 1½" FPT steam inlet
(9) 3/4" FPT condensate return

Larger units available upon request.



CARBON DIOXIDE WATER VAPORIZER

MODEL	CAPACITY	DIMENSIONS	WEIGHT
WV-40	4000 lbs/hr	137" x 24" x 32" high (348 cm x 61 cm x 81.3 cm)	1050 lbs (477 kg)
WV-60	6000 lbs/hr	139" x 26" x 32" high (353 cm x 66 cm x 81.3 cm)	1650 lbs (750 kg)

FEATURES

(1) CO_2 temperature rise from 0 to 50 degrees F at listed capacities, flow rates and water temperatures.
(2) ASME coded heat exchanger with a tube side working pressure of 400 psig and a shell side working pressure of 150 psig.
(3) Design temperature −20 to 150 degrees F.
(4) Low water supply protection
(5) Low discharge CO_2 temp. protection
(6) Pressure safety relief protection for CO_2 and water.
(7) 4" 150 lb. flanged water inlet & outlet.
(8) 1" FPT CO_2 inlet.
(9) 1½" FPT CO_2 outlet.

Vapor Heater



CARBON DIOXIDE VAPOR HEATER

MODEL	CAPACITY	WATTAGE	DIMENSIONS	WEIGHT
CVH-4	720 lbs/hr	4000	14" × 8.5" × 12" high (35.6 cm × 21.6 cm × 30.5 cm)	47 lbs (21 kg)

PURPOSE

To increase the temperature of carbon dioxide vapor from an average storage temperature of 0° to desired temperature level. Prevents such problems as regulator freeze-up and condensation on pipe lines.

FEATURES

(1) Heat transfer tube and heating elements pressure cast in common platen for maximum efficiency.
(2) Designed to NEMA 12 standards
(3) Overheat protection
(4) Adjustable temperature control
(5) Stainless steel mounting brackets

SPECIFICATIONS

½" MPT inlet and outlet connections
Allowable working pressure 1000 psig
Flow rate 720 lbs/hr @ 70 degrees F.

ELECTRICAL CHARACTERISTICS:

230/460 volt, 60 Hz., Single Phase

Packed Tower Stripper And Scrubber

ALTERNATE #1
***** NH FAN SPECIFICATIONS *****

NH FAN MANUFACTURED BY KCH SERVICES, INC.:
KCH Services Fans are selected for specific applications of volume, static pressure and service conditions. Fan selections are a balance of purchase price and operating cost. All KCH fans are equipped with standard efficiency motors, with premium efficiency motors being available as an option.

KCH NH fan housing are manufactured of Type II, Grade I high impact PVC. The fan inlet includes a close tolerance inlet cone, precisely fitted to insure efficient fan operation, and includes as standard, a flexible inlet coupling. The fan wheel is backward inclined, non-overloading, constructed and reinforced to industry standards. The wheel is steel construction, FRP coated and spark tested to assure coating integrity, with a 1045 carbon steel shaft with shaft seal. The shaft bearings are typically ball bearings, with grease fitting for relubrication. The shaft bearings are located outside the airstream which insures long bearing life. Fan balancing is done both static and electronically with an electronic vibration analyzer to insure smooth operation. A computer program is used to size the belts and drives. The drive is completely enclosed to conform to OSHA standards. Constant speed sheaves are standard and variable pitch drive sheaves are available as options. The fan base is fabricated from formed steel plate and angles, gusseted and reinforced for structural integrity. Base includes lifting lugs for rigging into place. The fan base is epoxy coated to resist the most extreme weather conditions The motor is a totally enclosed, fan cooled, ball bearing type, mounted on an adjustable base to allow for belt tensioning and alignment.

Standard features of the KCH NH fan are motor and drives, belt guard, shaft cover with lubrication holes, flexible inlet, flanged outlet, scroll drain and bolt-on gasketed inspection door, all stainless steel hardware.

NOTE: ESTIMATED EXTERNAL STATIC PRESSURE - The external static pressure for the proposed system has been estimated and may vary depending on actual field conditions. Associated cost for adjustment to fan RPM or horse power requirements due to static pressure increase or decrease shall be by others.

ALTERNATE #1 System #1 NH Fan Specification:

Ventilating

NH Fan Number - 18 1/4

Capacity - 4011 CFM

Static Pressure - 2" W.G.

Fan RPM - 1895

Required Brake Horsepower - 3.18

Arrangement - 9A

Discharge - UPBLAST

Wheel Class - II

Rotation - CW

Outlet Velocity - 2097 FPM

Motor Horsepower - 5

Motor RPM - 1750

Voltage - 230/460 V, 3 Phase, 60 Hertz

Full Load Amps - 15.20/7.60

Fan Motor & Drives Operating Weight 472 lbs.

Fan is shipped complete, less motor starter and safety disconnect.

ALTERNATE #1 Systems #2, 8, and 9 NH Fan Specification:

Ventilating

NH Fan Number - 12 1/4

Capacity - 2005 CFM

Static Pressure - 5.5" W.G.

Fan RPM - 3684

Required Brake Horsepower - 3.27

Arrangement - 9A

Discharge - UPBLAST

Wheel Class - II

Rotation - CW

Outlet Velocity - 2323 FPM

Motor Horsepower - 5

Motor RPM - 1750

Voltage - 230/460 V, 3 Phase, 60 Hertz

Full Load Amps - 15.20/7.60

Fan Motor & Drives Operating Weight 307 lbs.

Fan is shipped complete, less motor starter and safety disconnect.

ALTERNATE #1 Systems #6, and 7 NH Fan Specification:

Ventilating

NH Fan Number - 16 1/2

Capacity - 1955 CFM

Static Pressure - 2" W.G.

Fan RPM - 1558

Required Brake Horsepower - 1.10

Arrangement - 9A

Discharge - UPBLAST

Wheel Class - II

Rotation - CW

Outlet Velocity - 1252 FPM

Motor Horsepower - 1.5

Motor RPM - 1750

Voltage - 230/460 V, 3 Phase, 60 Hertz

Full Load Amps - 5.20/2.60

Fan Motor & Drives Operating Weight 390 lbs.

Fan is shipped complete, less motor starter and safety disconnect.

***** CI FAN SPECIFICATIONS *****

CI FAN MANUFACTURED BY KCH SERVICES, INC.:
KCH Services Fans are selected for specific applications of volume, static pressure and service conditions. Fan selections are a balance of purchase price and operating cost. All KCH fans are equipped with standard efficiency motors, with premium efficiency motors being available as an option.

KCH CI fan housing are manufactured of Type II, Grade I, vacuum formed high impact. The fan inlet includes a tapered inlet with slip coupling. The outlet is round, eliminating the need for a transition. The standard fan wheel is a six bladed, open paddle design with a cast steel spider for high speed and pressure. The wheel is steel construction,(FRP coated and spark tested to assure coating integrity), with a 1045 carbon steel shaft with shaft seals. The shaft bearings are typically ball bearings, with grease fitting for relubrication. The shaft bearings are located outside the airstream which insures long bearing life. Fan balancing is done both static and electronically with a vibration analyzer to insure smooth operation. A computer program is used to size the belts and drives. The drive is completely enclosed to conform to OSHA standards. Constant speed sheaves are standard and variable pitch drive sheaves are available as an option. The fan base is fabricated from formed steel plate and angles, gusseted and reinforced for structural integrity. Base includes lifting lugs for rigging into place. The fan base is epoxy coated to resist the most extreme weather conditions The motor is a totally enclosed, fan cooled, ball bearing type, mounted on an adjustable base to allow for belt tensioning and alignment.

Standard features of the KCH CI fan are motor and drives, belt guard, shaft cover, scroll drain and stainless steel hardware.

NOTE: ESTIMATED EXTERNAL STATIC PRESSURE - The external static pressure for the proposed system has been estimated and may vary depending on actual field conditions. Associated cost for adjustment to fan RPM or horse power requirements due to static pressure increase or decrease shall be by other.

ALTERNATE #1 System #3 and #4 CI Fan Specification:

Ventilating

CI Fan Number - 6

Capacity - 802 CFM

Static Pressure - 2.10" W.G.

Fan RPM - 2652

Required Brake Horsepower - .96

Arrangement - 9A

Rotation - CW

Discharge - UPBLAST

Wheel Type - Six Bladed, Spider Hub Design

Outlet Velocity - 3912 FPM

Motor Horsepower - 1.5

Motor RPM - 1750

Voltage - 230/460 V, 3 Phase, 60 Hertz

Full Load Amps - 5.20/2.60

Fan Motor & Drives Operating Weight - 178 lbs.

Fan is shipped complete, less motor starter and safety disconnect.

ALTERNATE #2
***** NH FAN SPECIFICATIONS *****

NH FAN MANUFACTURED BY KCH SERVICES, INC.:
KCH Services Fans are selected for specific applications of volume, static pressure and service conditions. Fan selections are a balance of purchase price and operating cost. All KCH fans are equipped with standard efficiency motors, with premium efficiency motors being available as an option.

KCH NH fan housing are manufactured of Type II, Grade I high impact PVC. The fan inlet includes a close tolerance inlet cone, precisely fitted to insure efficient fan operation, and includes as standard, a flexible inlet coupling. The fan wheel is backward inclined, non-overloading, constructed and reinforced to industry standards. The wheel is steel construction, FRP coated and spark tested to assure coating integrity, with a 1045 carbon steel shaft with shaft seal. The shaft bearings are typically ball bearings, with grease fitting for relubrication. The shaft bearings are located outside the airstream which insures long bearing life. Fan balancing is done both static and electronically with an electronic vibration analyzer to insure smooth operation. A computer program is used to size the belts and drives. The drive is completely enclosed to conform to OSHA standards. Constant speed sheaves are standard and variable pitch drive sheaves are available as options. The fan base is fabricated from formed steel plate and angles, gusseted and reinforced for structural integrity. Base includes lifting lugs for rigging into place. The fan base is epoxy coated to resist the most extreme weather conditions The motor is a totally enclosed, fan cooled, ball bearing type, mounted on an adjustable base to allow for belt tensioning and alignment.

tandard features of the KCH NH fan are motor and drives, belt guard, shaft cover with lubrication holes, flexible nlet, flanged outlet, scroll drain and bolt-on gasketed inspection door, all stainless steel hardware.

NOTE: ESTIMATED EXTERNAL STATIC PRESSURE - The external static pressure for the proposed system has been estimated and may vary depending on actual field conditions. Associated cost for adjustment to fan RPM or horse power requirements due to static pressure increase or decrease shall be by others.

ALTERNATE #2 System #1 NH Fan Specification:

Ventilating

NH Fan Number - 20

Capacity - 6016 CFM

Static Pressure - 5.5" W.G.

Fan RPM - 2406

Required Brake Horsepower - 10.53

Arrangement - 9A

Discharge - UPBLAST

Wheel Class - II

Rotation - CW

Outlet Velocity - 2615 FPM

Motor Horsepower - 15

Motor RPM - 1750

Voltage - 230/460 V, 3 Phase, 60 Hertz

Full Load Amps - 42/21

Fan Motor & Drives Operating Weight 670 lbs.

Fan is shipped complete, less motor starter and safety disconnect.

ALTERNATE #2 System #2 and 3 NH Fan Specification:

Ventilating

NH Fan Number - 24 1/2

Capacity - 9358 CFM

Static Pressure - 5.5" W.G.

Fan RPM - 1801

Required Brake Horsepower - 12.89

Arrangement - 9A

Discharge - UPBLAST

Wheel Class - II

Rotation - CW

Outlet Velocity - 2710 FPM

Motor Horsepower - 15

Motor RPM - 1750

Voltage - 230/460 V, 3 Phase, 60 Hertz

Full Load Amps - 42/21

Fan Motor & Drives Operating Weight 780 lbs.

Fan is shipped complete, less motor starter and safety disconnect.

***** SCRUBBERS AND STRIPPING MANUFACTURED BY KCH SERVICES, INC. *****

Phaser Series

KCH Services offers a low maintenance fume scrubber in vertical counter current design. These units are constructed of high impact, corrosion resistant Polypro.

KCH Services scrubbers are designed at velocities of 300 to 500 feet per minute, allowing thorough scrubbing and removal of contaminants as fumes pass through the unit. Open orifice, spray nozzles are polypropylene. Spray headers are easily removed for servicing if necessary. Strippers are designed for an air velocity of 80-95 FPM with liquid loadings of 4-10 GPM/ft^2.

The packing stage consists of non clogging 3.5" high efficiency packing media which offers mass transfer surface areas of 44 sq.ft. per cubic foot of packing. Packing depths vary to satisfy conditions and offer design flexibility to handle any water soluble contaminant at required removal efficiency.

Mist elimination is accomplished by the use of PVC chevron eliminator blades, providing (4) 30 degree directional changes in a 7" space. For higher efficiencies or fog control, polypropylene mesh pads can be used as an option. These pads are efficient down to 5 microns particle size.

KCH Services scrubber recirculation systems are available as part of the scrubber in a self-contained sump, or as a remote tank located below the unit where ever space permits. Heaters can be supplied for outdoor installation to prevent the solution in the sump from freezing. The recycle system uses a high efficiency CPVC vertical sump pump with a cantilever sleeved stainless steel shaft. This eliminates bearings and seals, and the pump can run dry for a short period of time without damage. This pump comes standard with a high efficiency chemical duty motor for continuous operation. Remote tanks are manufactured from reinforced PVC or polypropylene, and come complete with a flow meter and flow valve for supplying 1% to 5% of makeup water to the sump to maintain solution cleanliness and replenish evaporative losses. Both self-contained sumps and remote tanks are equipped with a high level overflow and a drain with a ball valve to facilitate installation and operation.

The steel scrubber base, (standard on all units), comes complete with eyes and hold down lifting lugs. An epoxy coating is applied to resist the most extreme weather conditions.

As with all our low maintenance products, quick opening access doors and view ports are standard. Stainless steel hardware is used throughout and PVC gasket material is used to seal flange fittings.

ALTERNATE #1
SYSTEM #1

The following is the design basis and recommendations for the Phaser/Stripper application:

1. Contaminants - H_2S
2. Capacity - 4011 CFM
3. Static Pressure - 2" W.G.
4. Vertical Unit
5. Liquid Flow Rate - 1000 GPM
6. Packing Height - 20 ft.
7. Packing Type -3.5" High Efficiency
8. Mist Elimination Type - Chevron Baffle
9. Material Type - Polypro
10. Overall Dimensions H-30' x 7' dia.
15. Estimated Operating Weight - 10000 lbs

NOTE: All units are shipped complete, less motor starters or local safety disconnects.

ALTERNATE #1
SYSTEM #2, 6, 7, 8, 9

The following is the design basis and recommendations for the Phaser/Stripper application:

1. Contaminants - H_2S
2. Capacity - 2000 CFM
3. Static Pressure - 2" W.G.
4. Vertical Unit
5. Liquid Flow Rate - 500 GPM
6. Packing Height - 20 ft.
7. Packing Type -3.5" High Efficiency
8. Mist Elimination Type - Chevron Baffle
9. Material Type - Polypro
10. Overall Dimensions H-30' x 5' dia.
15. Estimated Operating Weight - 8000 lbs

NOTE: All units are shipped complete, less motor starters or local safety disconnects.

ALTERNATE #1
SYSTEM #3 and 4

The following is the design basis and recommendations for the Phaser/Stripper application:

1. Contaminants - H_2S
2. Capacity - 802 CFM
3. Static Pressure - 2" W.G.
4. Vertical Unit
5. Liquid Flow Rate - 200 GPM
6. Packing Height - 20 ft.
7. Packing Type -3.5" High Efficiency
8. Mist Elimination Type - Chevron Baffle
9. Material Type - Polypro
10. Overall Dimensions H-30' x 3' dia.
15. Estimated Operating Weight - 7500 lbs

NOTE: All units are shipped complete, less motor starters or local safety disconnects.

ALTERNATE #2
SYSTEM #1

The following is the design basis and recommendations for the Phaser/Stripper application:

1. Contaminants - H_2S
2. Capacity - 6016 CFM
3. Static Pressure - 2" W.G.
4. Vertical Unit
5. Liquid Flow Rate - 1500 GPM
6. Packing Height - 22 ft.
7. Packing Type -3.5" High Efficiency
8. Mist Elimination Type - Chevron Baffle
9. Material Type - Polypro
10. Overall Dimensions H-32' x 9' dia.
15. Estimated Operating Weight - 13500 lbs

NOTE: All units are shipped complete, less motor starters or local safety disconnects.

ALTERNATE #2
SYSTEM #2 and 3

The following is the design basis and recommendations for the Phaser/Stripper application:

1. Contaminants - H_2S
2. Capacity - 9358 CFM
3. Static Pressure - 2" W.G.
4. Vertical Unit
5. Liquid Flow Rate - 2000 GPM
6. Packing Height - 22 ft.
7. Packing Type -3.5" High Efficiency
8. Mist Elimination Type - Chevron Baffle
9. Material Type - Polypro
10. Overall Dimensions H-32' x 10' dia.
15. Estimated Operating Weight - 15000 lbs

NOTE: All units are shipped complete, less motor starters or local safety disconnects.

ALTERNATE #1
SYSTEM #2, 8, and 9

The following is the design basis and recommendations for the Phaser Scrubber application:

1. Contaminants - H_2S
2. Capacity - 2005 CFM
3. Static Pressure - 3.5" W.G.
4. Vertical Unit
5. Self-Contained Recirculation
6. Liquid Flow Rate - 18 GPM
7. Make-Up Water Rate - .18-1 GPM
8. Packing Height - 5 ft.
9. Packing Type - 3.5" High Efficiency
10. Scrubber Liquor - H2O/ORP/pH
11. Mist Elimination Type - Chevron Baffle
12. Material Type - White PVC
13. Pump HP - 1

    Pump RPM - 3600

    Pump Voltage - 240/480

    Pump Full Load AMPS - 3.0/1.5
14. Overall Dimensions H-106" x 34" dia.
15. Estimated Operating Weight - 650 lbs

NOTE: All units are shipped complete, less motor starters or local safety disconnects.

ALTERNATE #1
SYSTEM #1

The following is the design basis and recommendations for the Phaser Scrubber application:

1. Contaminants - H_2S
2. Capacity - 6016 CFM
3. Static Pressure - 3.5" W.G.
4. Vertical Unit
5. Self-Contained Recirculation
6. Liquid Flow Rate - 36 GPM
7. Make-Up Water Rate - .36-1.8 GPM
8. Packing Height - 5 ft.
9. Packing Type - 3.5" High Efficiency
10. Scrubber Liquor - H2O/ORP/pH
11. Mist Elimination Type - Chevron Baffle
12. Material Type - White PVC
13. Pump HP - 2

    Pump RPM - 3600

    Pump Voltage - 240/480

    Pump Full Load AMPS -5.6/2.8
14. Overall Dimensions H-113" x 49" dia.
15. Estimated Operating Weight - 1600 lbs

NOTE: All units are shipped complete, less motor starters or local safety disconnects.

ALTERNATE #1
SYSTEM #2 and 3

The following is the design basis and recommendations for the Phaser Scrubber application:

1. Contaminants - H_2S
2. Capacity - 9358 CFM
3. Static Pressure - 3.5" W.G.
4. Vertical Unit
5. Self-Contained Recirculation
6. Liquid Flow Rate - 54 GPM
7. Make-Up Water Rate - .5-2.5 GPM
8. Packing Height - 5 ft.
9. Packing Type - 3.5" High Efficiency
10. Scrubber Liquor - H2O/ORP/pH
11. Mist Elimination Type - Chevron Baffle
12. Material Type - White PVC
13. Pump HP - 3

    Pump RPM - 3600

    Pump Voltage - 240/480

    Pump Full Load AMPS -8/4
14. Overall Dimensions H-114" x 64" dia.
15. Estimated Operating Weight - 2300 lbs

NOTE: All units are shipped complete, less motor starters or local safety disconnects.

***** pH CONTROL PACKAGE *****

KCH Services offers a pH control package to maintain the required pH of the scrubbing solution. pH control may be required as an integral component in the scrubbing process, or can be used to increase the scrubbing efficiency.

The KCH Services standard pH control package consists of a Great Lakes Model 671P analyzer with digital read-out, Great Lakes Model 6021PO probe, and Gorman-Rupp chemical Pump Model 14250-005. Analyzer and pump are mounted in a PVC enclosure, attached to the scrubber housing for a self- contained recirculation system, and attached to the recirculation tank for a remote recirculation system. The pH probe is mounted to the sump or the tank, and is prewired to the analyzer. The pump has pick-up tube attached, ready to drop into a chemical drum or customer supplied tank.

The analyzer is a two-channel system, with one channel being used to operate the chemical pump. The 2nd channel is available for a high or low alarm channel, with options available for both high and low pH conditions.

The pH equipment operates from 120 or 240 volt, 50/60 cycle power, and the analyzer can produce a 0-5 volt, 4-2(MA signal for attachment to a computer, recorder or other allied data gathering equipment.

*****ORP CONTROL PACKAGE*****

KCH Services offers an ORP control package to oxidize H_2S.

The KCH Services standard ORP system consists of a Great Lakes analog controller, probe, and Gorman-Ru chemical feed pump.

Analyzer and pump are mounted in a PVC enclosure, attached to the scrubber housing. The pump has a pick tube, attached, to drop into a chemical drum or customer supplied tank.

The analyzer is a 2-channel unit, with one channel devoted to operating the pump, the 2nd channel available f high or low alarm with a 4-20 ma or 0-5 voc output.

The recommended chemical additive is Sodium Hydochlorite at 1-5% maintained rate.

Carbon Contactor

CALGON

CALGON CARBON CORPORATION

EQUIPMENT BULLETIN

CALGON CARBON ODOR CONTROL UNITS

Calgon Carbon Corporation's Odor Control Units are pre-engineered granular activated carbon adsorption systems. Typical applications are found in many municipal and industrial wastewater treatment facilities where there is a need to control odors, control volatile organic compound emissions, remove toxic compounds, or minimize equipment corrosion. These modular units are designed to provide a cost effective odor removal solution with ease of installation and operation. These systems are ideal in situations when activated carbon can be regenerated in situ to restore H_2S capacity.

DESCRIPTION

Calgon Carbon Corporation Odor Control Units consist of fiberglass adsorbers, granular activated carbon, dampers, fan and motor assembly, and interconnecting fiberglass ductwork from the fan to the adsorber. They are available in ten standard sizes to handle air flows up to 17,000 cfm operating at ambient conditions. Other sizes and custom designs are also available. The adsorbers come in two varieties: single carbon bed units and dual carbon bed units. Dual carbon bed adsorbers can treat double the air flow of their single bed counterparts while minimizing the required floorspace. To handle larger flows, multiple units may be installed in parallel. The typical carbon bed depth is three feet.

The Calgon Carbon Corporation Odor Control Units are shipped ready for quick and easy installation. The items required for operation are electrical connections to fan motor, an appropriate foundation, and ductwork to deliver contaminated air to the fan inlet. During single bed adsorber operation, the contaminated air is driven upflow through the carbon bed. During dual bed adsorber operation, the contaminated air is driven upflow through the top carbon bed and down flow through the bottom carbon bed. The undesirable compounds are removed and the treated air is vented to the atmosphere. When the contaminant begins to appear in the treated airstream, spent carbon is removed and replaced with fresh carbon. For H_2S removal applications, the carbon can be regenerated in place with the appropriate solutions, in lieu of carbon replacement.

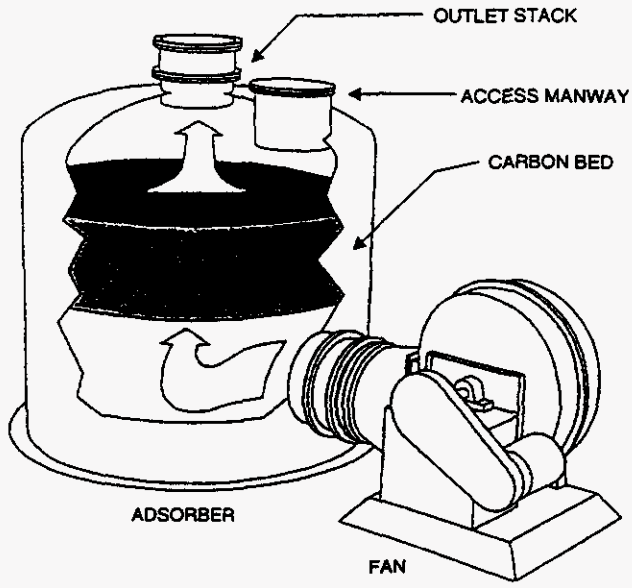
FEATURES AND BENEFITS

- Effective removal of contaminants
- Economical
- Pre-engineered
- Easy installation
- Low maintenance requirements
- Available in a wide range of sizes
- Built-in flow control provided with fan

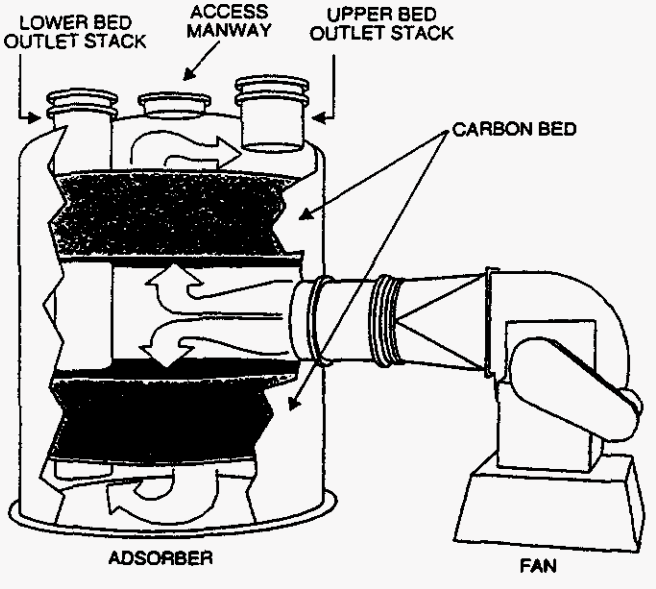
AVAILABLE OPTIONS

- Motorized dampers
- H_2S bed monitor
- Fire retardant fiberglass construction
- Explosion-proof fan and motor assembly
- Fiberglass exhaust stacks and weather caps
- Grease filters and mist eliminators

  In addition, Calgon Carbon Corporation can provide custom-designed supply ductwork.



SINGLE BED ARRANGEMENT



DUAL BED ARRANGEMENT

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LE-EGV-12/94

ODOR CONTROL UNITS

MODEL	OCU4S	OCU5S	OCU6S	OCU8S	OCU10S	OCU12S	OCU6D	OCU8D	OCU10D	OCU12D
DIAMETER	4 FT	5 FT	6 FT	8 FT	10 FT	12 FT	6 FT	8 FT	10 FT	12 FT
ARRANGMENT	SINGLE	SINGLE	SINGLE	SINGLE	SINGLE	SINGLE	DUAL	DUAL	DUAL	DUAL
MAX. CAP., CFM*	940	1470	2120	3770	5890	8475	4240	7540	11780	16960
BED AREA, FT2	12.53	19.63	28.27	50.27	78.54	113.10	56.54	100.54	157.08	226.20
FAN HP, NOMINAL	7.5	20	20	30	30	40	30	40	60	100
VESSEL HEIGHT, OVERALL	8'-3"	8'-0"	8'-2"	9'-0"	9'-10"	10'-2"	12'-11"	13'-3"	13'-7"	13'-11"
POUNDS GAC: BPL**	1200	1800	2600	4600	7200	10200	5200	9200	14200	20400
POUNDS GAC: CENTAUR HSV**	1350	2025	2925	5175	8100	11700	5850	10350	16200	23175
POUNDS GAC: IVP**	1350	2025	3150	5400	8550	12150	6075	10800	16875	24300

* BASED ON FACE VELOCITY OF 75 FT/MIN.
** NOMINAL, BASED ON 3 FEET BED DEPTH.

SAFETY MESSAGE

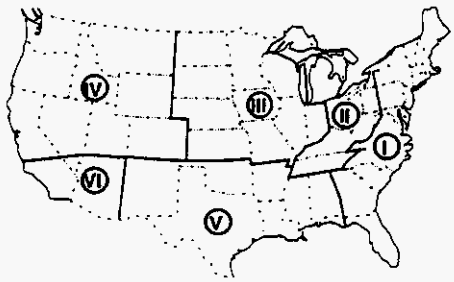
Wet activated carbon preferentially removes oxygen from air. In closed or partially closed containers and vessels, oxygen depletion may reach hazardous levels. If workers are to enter a vessel containing carbon, appropriate sampling and work procedures for potentially low-oxygen spaces should be followed, including all applicable Federal and State requirements. For additional details see Calgon Carbon Bulletin No. 198, Safety Considerations for Air Purification System.

For detailed information on the products described in this bulletin, please contact one of our Regional Sales Offices located nearest to you:

SALES OFFICES

Region I
Bridgewater, NJ
Tel (908) 526-4646
Fax (908) 526-2467

Region II
Pittsburgh, PA
Tel (412) 787-6700
800/4-CARBON
Fax (412) 787-6676



Region IV
San Mateo, CA
Tel (415) 572-9111
Fax (415) 574-4466

Region V
Houston, TX
Tel (713) 690-2000
Fax (713) 690-7909

Region III
Lisle, IL
Tel (708) 505-1919
Fax (708) 505-1936

Latin America/ Asia Pacific
Pittsburgh, PA
Tel (412) 787-4519
Fax (412) 787-4523

Canada
Calgon Carbon Canada, Inc.
Mississauga, Ontario
Tel (905) 673-7137
Fax (905) 673-8883

Europe
Chemviron Carbon
Brussels, Belgium
Tel 32 2 773 02 11
Fax 32 2 770 93 94

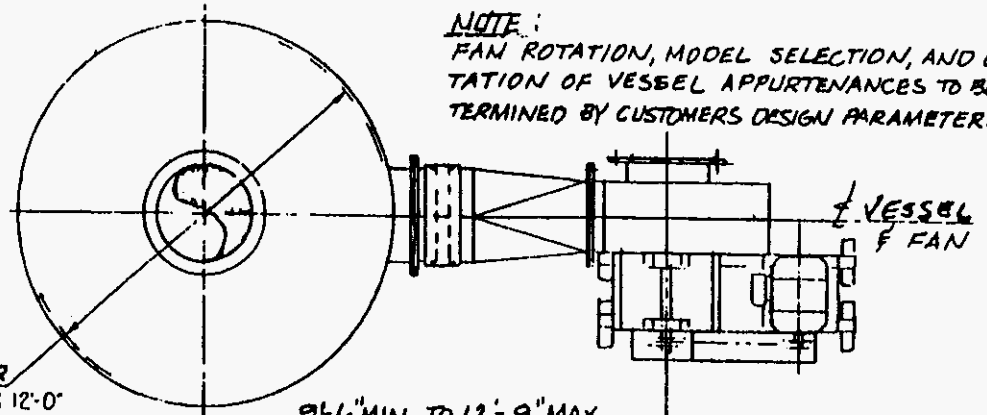
Region VI
Carlsbad, CA
Tel (619) 431-5550
Fax (619) 431-8169

If at any time our products or services do not meet your requirements or expectations, or if you would like to suggest any ideas for improvement, please call us at 1-800-548-1999. From outside the U.S. please call +1-412-787-6700.

CALGON

CALGON CARBON CORPORATION

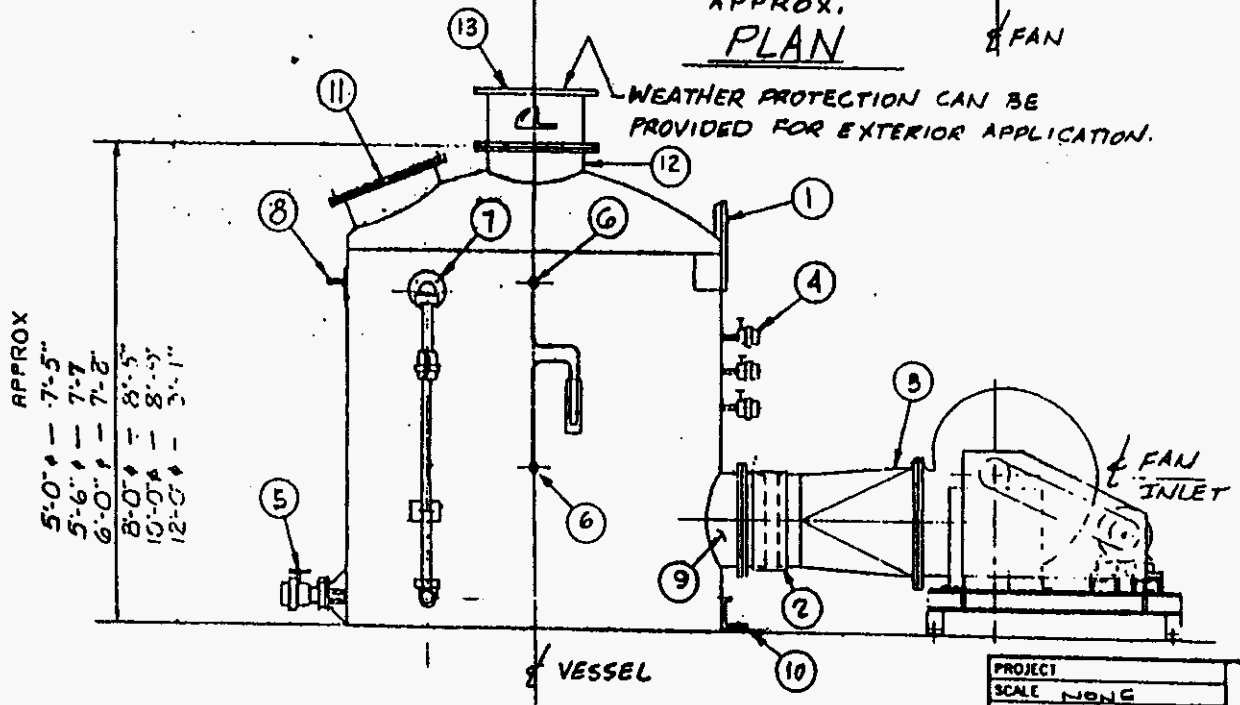
NOTE:
FAN ROTATION, MODEL SELECTION, AND ORIENTATION OF VESSEL APPURTENANCES TO BE DETERMINED BY CUSTOMERS DESIGN PARAMETERS.



VESSEL INSIDE DIAMETER
5'-0", 5'-6", 6'-0", 8'-0", 10'-0 OR 12'-0"

9'-6" MIN. TO 12'-9" MAX. APPROX.

PLAN



WEATHER PROTECTION CAN BE PROVIDED FOR EXTERIOR APPLICATION.

ELEVATION

LEGEND	
ITEM Nº	DESCRIPTION
1	LIFTING LUGS
2	FLEX CONNECTION
3	TRANSITION PIECE
4	CARBON SAMPLE PROBES
5	DRAIN
6	MANOMETER W/TAPS & TUBING
7	CARBON REGENERATION OVERFLOW PIPING ASSEMBLY
8	STN. STL. STATIC GROUNDING ROD
9	INLET NOZZLE
10	HOLD-DOWN BRACKETS
11	DOME MANWAY
12	OUTLET NOZZLE
13	[illegible] FAN DAMPER

GENERAL NOTES:

1. ALL VESSEL, FAN & DUCTWORK MATERIAL TO BE FIBERGLASS REINFORCED PLASTIC.
2. FABRICATION WILL BE AS PER A.S.T.M. SPECIFICATION D-3299 AND PS 15-69.
3. LIFTING LUGS AND HOLD DOWN BRACKETS WILL BE CADMIUM PLATED STEEL.
4. GASKETING MATERIAL AND FLEX-CONNECTION WILL BE NEOPRENE.
5. VESSEL PIPING APPURTENANCES WILL BE SCHEDULE 80 C.P.V.C.
6. BOLTING HARDWARE WILL BE STAINLESS STEEL

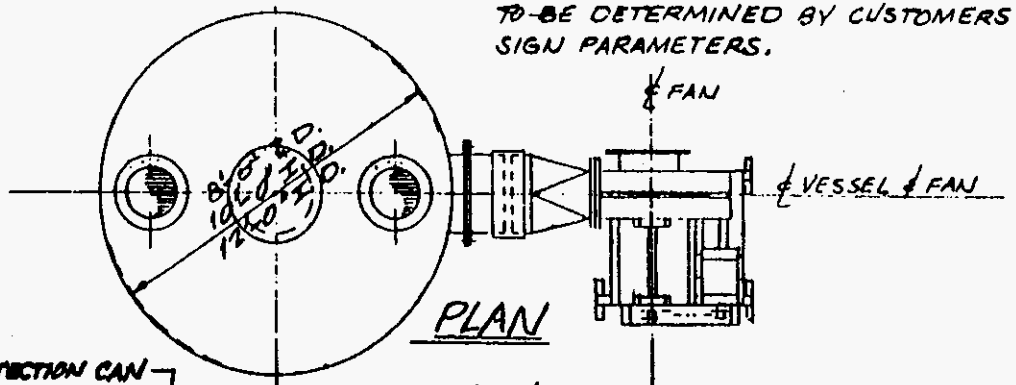
REV	DESCRIPTION
1	REV HT & PROBES 5-21-88

PROJECT
SCALE NONE
DRAWN JC
DATE 1-20-86
CHK'D
APPR'D

CALGON
CALGON CARBON CORPORATION
P.O. BOX [illegible] PITTSBURGH, PA 15230-0717

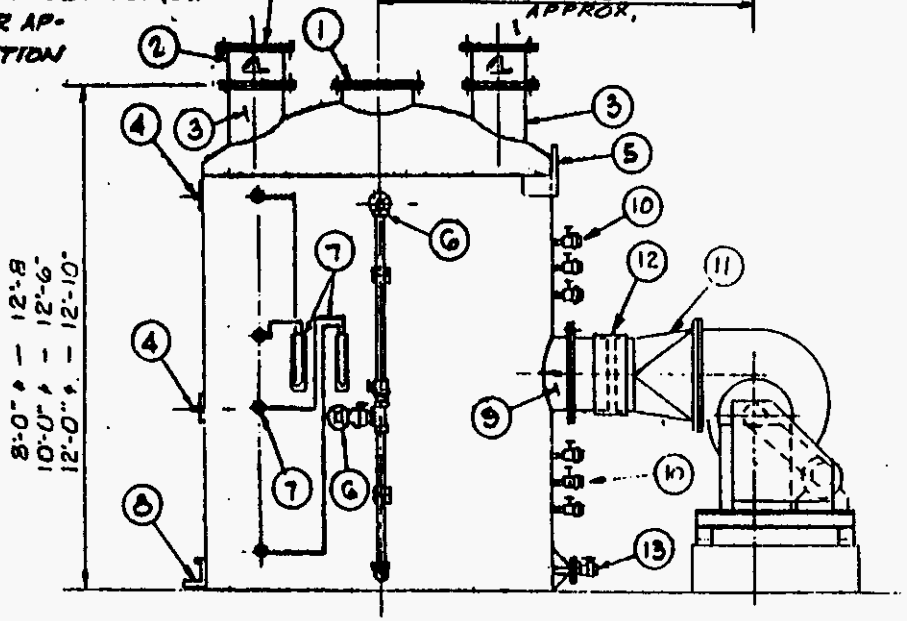
PLANT CUSTOMER GENERAL
TITLE ODOR CONTROL SYSTEM SINGLE BED ADSORBER
DWG. NO 90-30-0266
REV. 1

NOTE:
FAN ROTATION, MODEL SELECTION AND ORIENTATION OF VESSEL APPURTENANCES TO BE DETERMINED BY CUSTOMERS DESIGN PARAMETERS.



PLAN

WEATHER PROTECTION CAN BE PROVIDED FOR EXTERIOR APPLICATION



ELEVATION

LEGEND	
ITEM Nº	DESCRIPTION
1	DOME MANWAY
2	GASKETED SEAT DAMPER
3	OUTLET NOZZLES
4	STN. STL. GROUNDING RODS
5	LIFTING LUGS
6	CARBON REGENERATION OVER-FLOW ASSY.
7	MANOMETER w/TAPS & TUBING
8	HOLD-DOWN BRACKETS
9	INLET NOZZLE
10	CARBON SAMPLE PROBES
11	TRANSITION
12	FLEX CONNECTION
13	DRAIN

GENERAL NOTES:

1. ALL VESSEL, FAN AND DUCTWORK MATERIAL TO BE FIBERGLASS REINFORCED PLASTIC.
2. FABRICATION WILL BE AS PER A.S.T.M SPECIFICATION D-3299 AND PS 15-69.
3. LIFTING LUGS AND HOLD-DOWN BRACKETS WILL BE CADMIUM PLATED STEEL.
4. GASKETING MATERIAL AND FLEX-CONNECTION WILL BE NEOPRENE.
5. VESSEL PIPING APPURTENANCES WILL BE SCHEDULE 80 C.P.V.C.
6. BOLTING HARDWARE WILL BE STAINLESS STEEL

REV	DESCRIPTION
1	REV. PROBES & HT

PROJECT	
SCALE	NONE
DRAWN	BE
DATE	1-26-86
CHK'D.	MJS
APPR'D.	

CALGON

CALGON CARBON CORPORATION
P.O. BOX 717 PITTSBURGH, PA 15230-0717

PLANT CUSTOMER GENERAL

TITLE ODOR CONTROL SYSTEM
8', 10', 12' DUAL BED ADSORBER

DWG. NO. 30-30-0267

REV. 1

WATER ENVIRONMENT & TECHNOLOGY

CARBON CLEAN

A new version of activated carbon controls odors

Gary Van Stone, Daniel Brooks

Controlling odorous emissions has always been difficult for sewage treatment facilities, particularly for those near residential areas. But as nearby populations increase and pump stations transfer more wastewater solids to the plants, odor control is becoming a bigger challenge. Treatment facilities traditionally have used activated carbon adsorbers to clean the air. Now, a new type of activated carbon, catalytic/adsorptive carbon, controls odors better and costs less.

The principal sources of odor in wastewater operations are septic wastewater containing hydrogen sulfide (H_2S) and other odorous compounds in the plant's pipelines; industrial wastes discharged to the sewage collection system; unwashed grit; scum on primary settling tanks; organically overloaded biological treatment processes; solids thickening tanks; waste-gas burning operations in which lower than optimum temperatures are used; chemical mixing operations; solids incinerators; and digested solids in drying beds or solids holding basins.

Odors from these sources vary in degree and intensity depending on the amount of anaerobic decomposition present. Hydrogen sulfide, the most prevalent source of all odors, often is accompanied by mercaptans, indole, skatole, amines, fatty acids and other volatile organic compounds (VOCs). Odor-control systems typically focus on H_2S because of its low odor threshold (0.47 ppb), predominance as an odorous agent, and ease of analytical detection.

Activated Carbons

Wastewater treatment facilities use activated carbon for odor control because of its capacity for adsorbing H_2S and organics (odorous and volatile compounds), and its ease of regeneration or reactivation. Many facilities effectively control odors by directing air through a granular, activated carbon adsorber system. Activated carbons based on bituminous coal, coconut, impregnated bituminous coal and coconut products typically are used for this application, although each has inherent strengths and weaknesses.



At 10,000 × magnification, this image shows the surface characteristics of granular activated carbon.

The performance of coal- and coconut-based activated carbon is dictated by the classic adsorption theory, which states that all activated carbon structures are composed of randomly organized graphitic plates. It is the graphitic plates that produce the energy to adsorb volatile and odorous organic compounds and H_2S. The area between the graphitic plates, called the activated carbon pore, is where adsorption occurs. Activated carbons with more graphitic plates

usually have stronger adsorption energy and are better for adsorbing trace volatile and odorous organic compounds and H_2S.

Bituminous- and coconut-activated carbons readily adsorb volatile and odorous organic compounds, although their precise adsorption capacity depends on what compounds are present. The adsorption capacity for inorganic H_2S, however, is relatively low—typically in the range of 0.01-0.02 gm H_2S/cc carbon—and depends on physical adsorption capacity, although chemisorption and catalytic effects may influence total capacity. Bituminous- and coconut-activated carbons are not suited for applications in which H_2S is the predominant odorous compound or is present in high concentrations.

After exhausting the adsorption capacity of bituminous- or coconut-activated carbon, treatment facilities can reactivate it thermally, restoring it to near its original adsorption capacity. To do this, the plants remove the carbon from the system; ship it to a reactivation site; thermally reactivate it and return it to the system for reuse. Most facilities keep their systems on-line by "swapping out" exhausted carbon with a spare quantity stored onsite. Once a facility reactivates the original carbon, the material becomes the spare quantity so that fresh carbon is always available.

Activated carbon impregnated with sodium hydroxide (NaOH) or potassium hydroxide (KOH) is another carbon form used to treat odorous air (see Figure, *Impregnated Bituminous Coal Structure*). The impregnation promotes a chemical reaction with adsorbed H_2S, enhancing the carbon's capacity for removing sulfides. In addition to the impregnant's action, physical adsorption helps remove volatile and odorous organic compounds and H_2S from the air. However, the impregnant reduces the carbon's adsorption capacity for these compounds, because it takes up space on the activated carbon, blocking some of the adsorption pores. In the presence of oxygen, NaOH- or KOH-impregnated activated carbon undergoes an exothermic reaction ($C + O_2 \rightarrow CO_2$) that can heat the carbon to dangerously high temperatures, causing bed fires if there is insufficient air flow to dissipate the heat. This risk is increased by the low ignition temperatures of most impregnated carbons. Both NaOH-impregnated bituminous coal and KOH-impregnated coconut-activated carbons ignite somewhere between 200°C and 225°C. Non-impregnated activated carbons ignite between 380°C and 425°C.

As with standard activated carbon, facilities can regenerate impregnated carbons to restore their capacity for H_2S removal. To do this, carbon beds are soaked and washed with NaOH or KOH to remove the sulfur that is produced when H_2S reacts with the impregnant. This also removes a limited amount of adsorbed odorous organic compounds from the activated carbon.

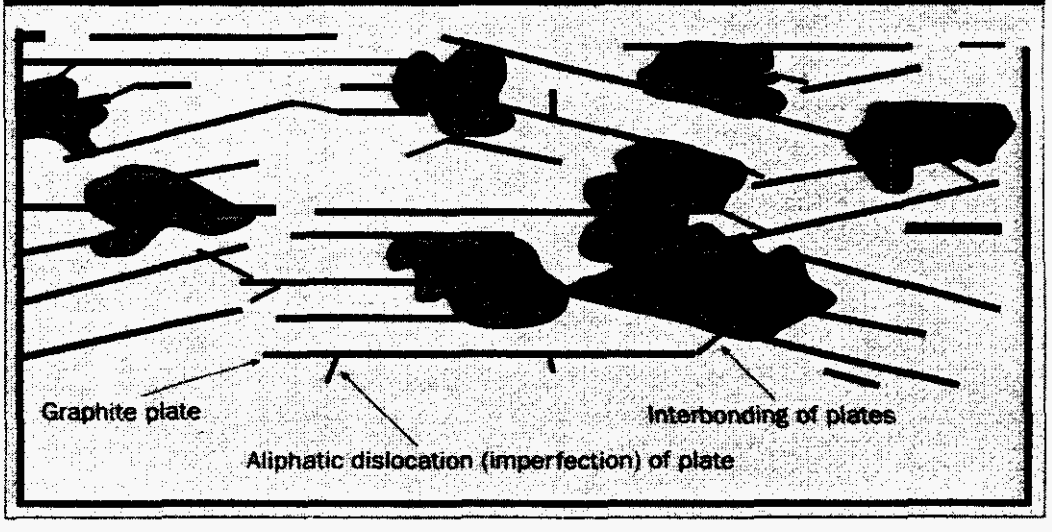
Impregnated carbons must be removed and replaced when they cease to adsorb odorous

Impregnated Carbons Compared to Catalytic Carbon

Typical properties	NaOH	KOH	Catalytic
Capacity (gm H_2S/cc carbon)*	0.14	0.12	0.09
Ignition temperature C	200-225	200-225	380-425
Regeneration chemical	NaOH	KOH	Water
Regeneration time	6-7 days	6-7 days	2 days
Disposal	Landfill	Landfill	Reactivation

*Based on TM-41 procedure

Impregnated Bituminous Coal Structure





The peroxide solution in these beakers illustrates the catalytic energy of an enhanced granular activated carbon (foreground) against a traditional type of carbon (background).

CALGON CARBON CORP.

compounds and can no longer be chemically regenerated. Unlike their non-impregnated counterparts, impregnated carbons cannot be thermally regenerated because the impregnant and the adsorbed sulfur interfere with the thermal reactivation process. The sulfur causes excess sulfur dioxide, a pollutant that violates air quality standards, and the sodium or potassium impregnant creates catalytic reactions that destroy the activated carbon. Regeneration with NaOH and KOH also is a problem because it requires large quantities of the hazardous chemicals. Exhausted impregnated carbons normally require landfill disposal.

Density the Key

Last year, Calgon Carbon Corp. introduced a new catalytic/adsorptive carbon for treating municipal wastewater odors. Centaur™ HSV is a bituminous, granular activated carbon with enhanced catalytic activity. In many ways similar to traditional bituminous activated carbons, this version's pores are finer (more of the graphitic plates are closer together), giving it a higher density.

Because it is not chemically impregnated, catalytic carbon can remove more volatile and odorous organic compounds. It adsorbs more H_2S because its catalytic sites promote a reaction between H_2S and oxygen from the odorous air stream. More than 90% of the H_2S reacts to form hydrogen sulfate. Only a small amount goes to elemental sulfur. These products remain on the catalytic carbon until it is exhausted and ready for regeneration.

These reactions increase the H_2S-removal capacity from approximately 0.02 gms H_2S/cc carbon to 0.09 gms H_2S/cc carbon or greater. Catalytic carbon approaches the H_2S-removal capacity of impregnated products, which is typically between 0.12 and 0.14 gms H_2S/cc carbon (see Table, *Impregnated Carbons Compared to Catalytic Carbon*).

Because catalytic/adsorptive carbon is not impregnated with NaOH or KOH, its ignition temperature is comparable to that of any bituminous activated carbon, 380°C to 425°C. Because there is no impregnant to cause an exothermic reaction, the product does not "heat up" like chemically impregnated carbons and is less likely to cause bed fires.

Once catalytic/adsorptive carbon has reached its capacity for H_2S adsorption, it is regenerated with water while in the adsorber column. The bed can be backwashed by filling the adsorber with water and allowing it to soak for approximately one hour. During this time, the water penetrates the pores of the activated carbon, dissolving the reaction products. More than 90% of the products of the H_2S-removal reaction on catalytic carbon are sulfuric acids and trace amounts of sulfurous acids, both of which are water soluble. After the water is drained, the procedure is repeated six to 12 times to complete the regeneration.

The solutions from the first two washes of water regeneration are acidic and require careful disposal. Normally, a facility can drain them back into untreated wastewater, providing this is done slowly enough to prevent changing the water's pH. After the first two washes, the solutions can be drained as rapidly as desired, because only trace amounts of acid remain. When regeneration is complete, the activated carbon is dried by blowing air through the carbon adsorber for approximately 12 hours, after which time the adsorber is reinstalled.

Catalytic/adsorptive carbon can be water regenerated until organic loading exhausts the carbon's adsorption capacity. The volatile and odorous organics—and to some degree the unreacted sulfur—slowly reduce access to the graphitic plates housing the catalytic sites.

When catalytic carbon loses its adsorption capacity, it must be removed from the adsorber and be thermally regenerated. Prior to thermal

Cost Comparison of Catalytic Carbon to Impregnated Products

Basis	Catalytic/ Adsorptive Carbon	Impregnated Carbon
Weight	16,200 lbs.	16,875 lbs.
Cost/lb	$2.25	$1.40
Self-sealing dampers	no	yes
Caustic resist fiberglass adsorber	not needed	yes
Cost of solution	$0.003/gal	$1.50/gal
Cost per regeneration	$1,400	$13,000
Number of regenerations	5	3
Total capital cost	$102,450	$100,625
Total regeneration cost	$7,000	$39,000
6-year cost	$109,450	$139,625

General conditions: 10 ft. diameter dual bed adsorber system (FRP adsorber, blower, duct, dampers and all necessary appurtenances); 8,500 cfm air flow, 6 year life.

regeneration, the facility must remove any sulfur compounds with water. The remaining volatile and odorous organic compounds typically do not interfere with thermal regeneration. The reactivation process for catalytic carbon is similar to that of non-impregnated carbons. When regeneration is complete, the original catalytic sites are restored and the catalytic carbon functions like a virgin product.

System Design

Because catalytic carbon can be regenerated repeatedly when used primarily for H_2S removal, many facilities are considering designs that use higher air flows and exhaust the carbon more frequently, requiring more frequent regeneration. Working with lower loadings of H_2S-reaction products may eliminate problems associated with regeneration. In effect, regeneration would be done on the basis of "working capacity for H_2S," which is similar to industrial applications of activated carbon regeneration, such as solvent recovery. Replacing impregnated carbons with catalytic carbons does not require physical changes to the system because the impregnated systems are designed for regeneration, which accommodates water washing.

Replacing impregnated carbons with catalytic carbons does not require physical changes to the system because the impregnated systems are designed for regeneration, which accommodates water washing.

It is critical that the air velocity of activated carbon systems stay within 50 feet per minute (fpm) to 100 fpm. Exceeding 100 fpm air flow fluidizes the activated carbon bed. All systems use 4 x 6 U.S.-sieve-series-sized activated carbon to minimize pressure drop, which lowers capital and operating costs.

Laboratory and field tests indicate that between 50 fpm and 100 fpm, the mass transfer zone to remove H_2S and volatile and odorous organic compounds is approximately 4-6 in. Beds as deep as 36 in. promote more efficient use of the activated carbon, because exiting odorous gases completely exhaust a higher percentage of the carbon bed. For example, a 12-in. bed will exhaust approximately 75% of the carbon at breakthrough, because 6 in. of the bed contains the transfer zone, which is only partially exhausted. A deeper, 36-in. bed would exhaust 92% of the carbon, a much more efficient use of the product. Hydrogen sulfide removal applications are most efficient when the relative humidity does not exceed 80%.

Larger, granular activated carbon systems used in municipal odor control typically are constructed of fiberglass, because of the corrosive nature of odorous emissions. Smaller package systems often are made of high-density polyethylene.

Because all activated carbon adsorption systems have similar adsorber designs, capital costs for catalytic and impregnated systems are approximately the same. However, impregnated carbon systems require self-sealing dampers that prevent air from passing through the carbon adsorber when the system is shut down. Failure to seal the air causes oxidation, which heats the carbon and can cause bed fires. Non-impregnated systems use a simple damper to control air flow. Although catalytic/adsorptive carbon initially costs more than its impregnated counterpart, the savings from eliminating self-sealing dampers and caustic resistant fiberglass offsets this capital difference. In the long run, catalytic systems are cheaper to operate, because they save time and labor, and require no chemicals.

Gary R. Van Stone *is a business director and* ***Daniel R. Brooks*** *is a market specialist with Calgon Carbon Corp. in Pittsburgh, Pa.*

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AR-M06- 03/96

CALGON

CALGON CARBON CORPORATION

PRODUCT BULLETIN

CENTAUR™ HSV

GRANULAR ACTIVATED CARBON

DESCRIPTION

CENTAUR™ HSV is a vapor phase virgin activated carbon that has been developed specifically for odor removal from sewage treatment operations. This bituminous coal based product is unique in that it provides high capacity for H_2S without chemical impregnants and adsorbs volatile organic compounds (VOCs) in an effective manner. CENTAUR™ HSV, by its catalytic functionality oxidizes H_2S and converts it to water soluble sulfur compounds. As a result, H_2S capacity can be restored simply by water washing the carbon, eliminating safety concerns typically encountered with alkali impregnated carbons. CENTAUR™ HSV is capable of being thermally reactivated which eliminates the disposal concerns associated with alkali impregnated carbons.

APPLICATIONS

CENTAUR™ HSV can be utilized for odor removal in sewage treatment applications. The product is ideal for use at pump stations and treatment plants where H_2S and organic odors are a problem. On-site regeneration as well as thermal reactivation are options for recycle or reuse of the product to minimize operating and disposal costs.

REGENERATION

When odor breakthrough due to H_2S occurs, the spent carbon can be regenerated in place. The H_2S capacity can be restored by water washing of the CENTAUR™ HSV carbon. Regeneration efficiency and the number of regeneration cycles depend on the loadings of H_2S and VOCs. For details on regeneration and cycle determination, please contact the Calgon Carbon Technical Sales Office in your area.

DESIGN CONSIDERATIONS

Effective removal of H_2S requires the gas stream to contain at least an equivalent amount of oxygen and relative humidity above 10%. Condensation of water on the carbon will reduce its performance, and devices to prevent free condensation are recommended. Additionally, if CENTAUR™ HSV is used to control VOCs it is recommended that the relative humidity be controlled to below 50% to maximize carbon utilization.

CENTAUR™ HSV can be utilized in a typical fixed bed mode with superficial velocities up to 125 ft/min. The bed depth can range from 12" to 36" depending on the on-stream time and water wash frequency desired. For assistance in the design of a carbon system, please contact the Calgon Carbon Technical Sales Office in your area.

PACKAGING

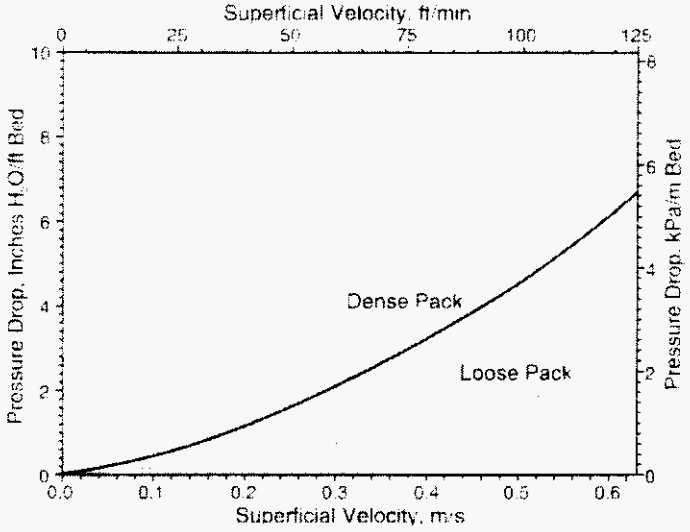
225 lb (102.3 kg) fiber drum

PROPERTIES

H_2S Capacity, g H_2S/cc carbon*:	0.09 min
Butane Activity, weight %:	15.8 min
Iodine No, mg/g:	800 min
Ash, weight %:	7 max
Moisture, weight %, as packed:	4 max
Apparent Density, g/cc:	0.56 min
Hardness No:	97 min
Mean Particle Diameter:	3.7 mm
U.S. Sieve Series:	
Percent on 4 mesh	15 max
Percent through 7 mesh	8 max

*As determined by Calgon Carbon test TM-41 in which a moist air stream containing 1% H_2S (total flow rate of 1,450 cc/min) is passed through a 0.725-inch diameter 9 inch long column of activated carbon and monitored to 50 ppm H_2S breakthrough.

PRESSURE DROP CURVE



MANUFACTURING

Catlettsburg, KY

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CALGON CARBON CORPORATION • P.O. BOX 717 • PITTSBURGH, PA 15230-0717 • PHONE 1-800-4CARBON

FEATURES	BENEFITS
• Not chemically impregnated	• Heat excursion potential caused by impregnants is eliminated thus making operations safer
	• Organic capacity is significantly higher than impregnated carbons thus reducing operating costs
• Metallurgical grade high purity coal	• Extreme hardness and abrasion resistance which reduces carbon attrition problems and pressure drop increase over time
• Catalytic Activity	• Centaur™ HSV has 70% of the H_2S capacity of alkali impregnated carbons and is capable of multiple regenerations to exceed the life of alkali impregnated carbons by 2-3 times
	• Since multiple water washes are possible, Centaur™ HSV is capable of treating higher odor concentrations typically handled by chemical wet scrubbers
• Pore volume not consumed by impregnant	• In contrast to impregnated carbons, Centaur™ HSV has equivalent or higher organic capacity as other virgin coal based carbons
• Enhanced adsorption pore volume	• Centaur™ HSV has been specifically designed to show enhanced organic capacity at low contaminant concentrations typically found in sewage treatment plants
• Ability to be water washed	• In H_2S service, Centaur™ HSV can be field regenerated by water washing multiple times, thus eliminating safety concerns experienced with alkali regeneration and chemical handling
• Ability to be thermally reactivated	• Centaur™ HSV can be thermally reactivated and reused in odor control applications, thus spent carbon disposal problems are eliminated

SAFETY MESSAGE

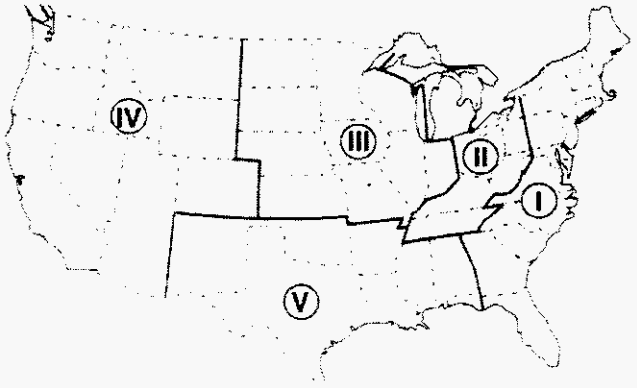
Wet activated carbon preferentially removes oxygen from air. In closed or partially closed containers and vessels, oxygen depletion may reach hazardous levels. If workers are to enter a vessel containing carbon, appropriate sampling and work procedures for potentially low oxygen spaces should be followed, including all applicable federal and state requirements.

1-800-4-CARBON

Domestic Sales Offices

Region I
Bridgewater, NJ
Tel (908) 526-4646
Fax (908) 526-2467

Region II
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1-800-4-CARBON
Fax (412) 787-6676



Region III
Lisle, IL
Tel (708) 505-1919
Fax (708) 505-1936

Region IV
Burlingame, CA
Tel (415) 548-2040
Fax (415) 344-2029

Region V
Houston, TX
Tel (713) 690-2000
Fax (713) 690-7909

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Tel (65) 221-3500
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Fax 32 2 770 93 94

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Fax (905) 673-8883

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Pittsburgh, PA
Tel (412) 787-4519
Fax (412) 787-4523

Calgon Carbon Corporation's activated carbon products are continuously being improved and changes may have taken place since this publication went to press.

CALGON
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Air Purification Systems from Calgon Carbon Corporation



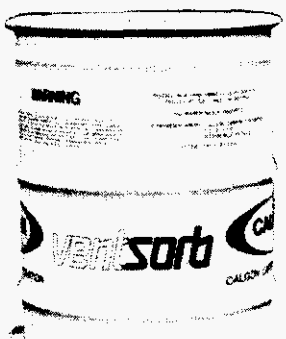
CALGON CARBON CORPORATION

Introduction

Calgon Carbon Corporation produces a wide variety of powder, granular and pelleted activated carbons made of wood, coal and coconut char, many of which are designed to meet specific air purification objectives. Applications typically include the removal of organic chemical contaminants from industrial air emissions, gas process streams, storage tank vents, internal work air environments, and soil remediation vents. However, having the right carbon product is just one component of a complete air purification program. To assure optimal performance of the carbon, Calgon Carbon has developed a complete line of standardized, pre-engineered adsorption systems—capable of treating air flows ranging from 1 standard cubic foot per minute (scfm) to thousands of scfm—which can be quickly delivered and easily installed at treatment sites. In addition, Vara International, a Division of Calgon Carbon, provides a wide variety of air purification systems for solvent recovery and control of volatile organic chemicals (VOCs).

The adsorption systems described in this bulletin are all designed for convenient and effective use of activated carbon products. Calgon Carbon can provide standard carbon products for air purification, and special grades for specific process requirements. In addition, economical carbon adsorption services are available which include safe handling, transport, storage and ultimate destruction of the adsorbed organic compounds through thermal reactivation. Such adsorption services may also include return or exchange of some of the adsorbers described. A Calgon Carbon Technical Sales Representative can provide assistance in selecting the proper activated carbon product, system, and/or service required for a total solution to meet most treatment requirements.

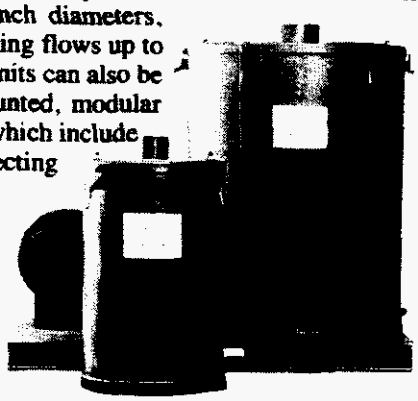
VentSorb® Systems



VentSorb units are modular, prefabricated steel canisters with an internal phenolic coating which contain 200 pounds of Calgon Carbon Type BPL or IVP granular activated carbon. These units are ideal for low flow air purification applications treating up to 100 scfm. These 55-gallon canisters contain all the elements found in a full-scale adsorption system — vessel, activated carbon, inlet connection and distributor, and an outlet connection for the purified air stream. Air is distributed across the carbon bed with a corrosion-resistant stainless steel septa. Most VentSorb units can be returned to Calgon Carbon after use, and adsorbed contaminants are destroyed in the carbon reactivation process. Return of VentSorb units is subject to Calgon Carbon's acceptance criteria.

High Flow VentSorb

Available in plastic or steel construction, High Flow VentSorb units are reusable, prefabricated canisters available in 28, 36, and 48-inch diameters, and capable of handling flows up to 1,100 scfm. These units can also be supplied as skid-mounted, modular adsorption systems which include a fan and interconnecting ductwork. When the carbon in the High Flow VentSorb becomes exhausted or spent, it can easily be emptied and replaced with fresh carbon.



Industrial Air Purification Systems



Calgon Carbon industrial air purification systems are pre-engineered units designed for permanent installation at the treatment site. Available in four sizes, these units are designed to treat air flows up to 10,000 scfm. The adsorbers are constructed of lined carbon steel, to provide corrosion-resistance protection in most applications. The granular activated carbon, which is supported by a grate and screen assembly, can be completely removed from the adsorber when the carbon's adsorptive capacity becomes exhausted and replaced with fresh carbon. If necessary, air movement can be achieved by adding an optional induced draft fan powered by a TEFC motor.

SweetStreet® Odor Control

The SweetStreet odor control unit is a compact, modular canister designed to remove unpleasant sulfide and methyl mercaptan odors venting from gravity sewer manholes. Standard canisters available for immediate shipment will fit existing round manholes in sizes ranging from 22-inch to 34-inch diameters. The SweetStreet odor control unit is supplied with 20 pounds of Calgon Carbon Type IVP carbon, which has more than twice the capacity for hydrogen sulfide as an equal quantity of standard vapor phase carbon.





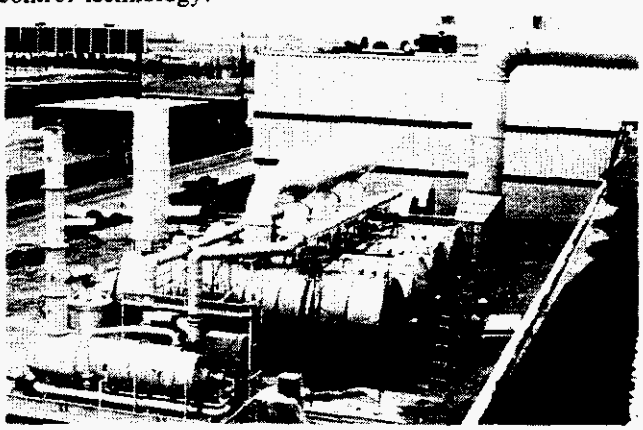
Odor Control Systems

Key features of Calgon Carbon's modular odor control systems include FRP construction, multiple access ports, a carbon bed support system, grounding rods and FRP blowers which are certified to meet Air Movement and Control Association (AMCA) specifications. Depending upon the application, these systems are designed as single bed or dual bed units capable of handling flows to 20,000 scfm. For higher flows, multiple units can be installed in a parallel mode. These units are also designed for the chemical regeneration of Type IVP* carbon in-place.

**U.S. Patent Number 4,558,022*

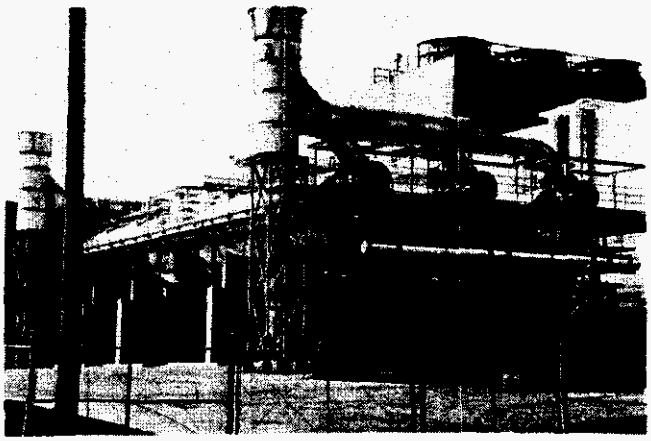
CADRE® For VOC Control

The CADRE VOC control system is a unique technological development which permits the user to economically remove and destroy volatile organic chemical compounds found in off-gases from air stripping operations, paint spray booths, chemical milling, etching or stripping operations, and large industrial air vents. Combining carbon adsorption, thermal regeneration and controlled oxidation, this on-site regenerable system is especially effective for treatment of air or gas streams that contain concentrations of VOCs which are not practically or economically recoverable. These units can be pre-assembled and skid-mounted to treat 1,000 to 50,000 scfm. Custom-designed systems can be built in sizes to handle up to one million scfm. CADRE offers the user a safe on-site VOC control system — often at the lowest total treatment cost — compared to any other individual control technology.



Solvent Recovery System

Vara solvent recovery systems are available in capacities and configurations to meet industrial requirements or space constraints. Packaged vertical or horizontal units can handle capacities of 1,000 to 20,000 scfm of solvent-laden air. Specially engineered and custom-designed systems handle air stream flows of 20,000 to 600,000 scfm. Although these systems are designed to handle the maximum expected air flow, in many more cases built-in flexibility allows them to be operated up to 15 percent above the rated capacity. The regeneration step can be effected with steam and the adsorbed solvent can be recovered for reuse or disposal, thus providing economic justification. Appropriate activated carbons can be selected specific to the solvent or service intended.



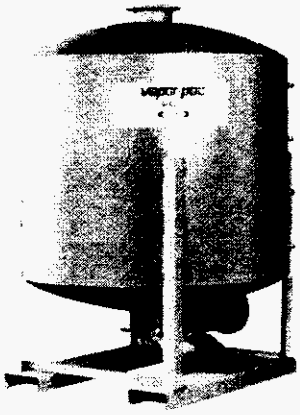
Air Purification Services

Calgon Carbon adsorption systems are also provided on a comprehensive service basis, thus eliminating the need for capital investment. Under terms of the service agreement, Calgon Carbon ships the appropriate adsorption system to the treatment site ready for quick and easy installation. Carbon handling is eliminated because the adsorption system serves both as a shipping container and as an adsorber which is easily transported and installed. This approach eliminates spent carbon disposal problems and handling of contaminated carbon, protecting employees from exposure to the spent material.

When the carbon's capacity becomes exhausted or spent, the unit is disconnected and returned to Calgon Carbon's reactivation facility, providing that the spent carbon meets reactivation acceptance criteria. At the reactivation site, the carbon is thermally reactivated, and the organic chemical contaminants are destroyed. The units can be refilled with either virgin or reactivated carbon. The service is provided for a monthly fee agreed upon in advance by the user and Calgon Carbon. Agreements can be made for short-term or ongoing treatment requirements.

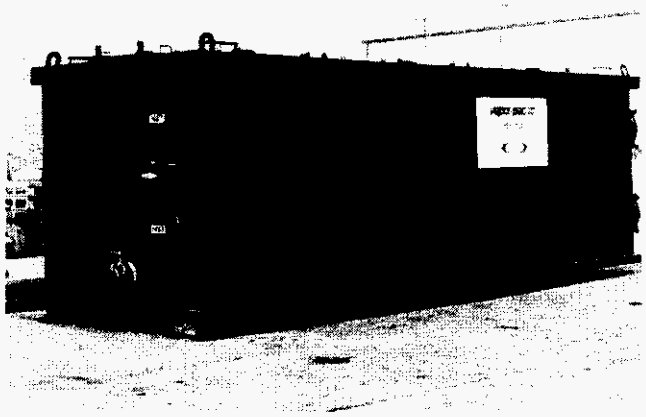
Vapor-Pac

The Vapor-Pac unit provided under a service agreement contains 1,800 pounds of activated carbon and is capable of handling flows up to 1,000 scfm. These units are available either in polyethylene or stainless steel construction, and can be arranged in parallel or series modes for specific site requirements. The Vapor-Pac unit is portable, can be moved by fork lift, and can be conveniently transported.



Vapor-Pac 10

The Vapor-Pac 10 unit is provided under a service agreement also. However, this unit contains 12,500 pounds of activated carbon and can treat flows up to 10,000 scfm. As an option, this unit has been designed to contain two separate beds to accommodate series operation, or to operate one bed while leaving the second bed in a standby position. Sample ports are provided to monitor breakthrough or exhaustion of the first-stage bed. The Vapor-Pac 10 design allows transport by special trucks which can load, transport and unload the unit without the use of a crane.



Reactivation Service

Calgon Carbon operates two granular activated carbon reactivation sites in the U.S.: one at Neville Island, Pennsylvania, and the other at Catlettsburg, Kentucky. These plants operate closed loop systems designed for maximum environmental safety and are the largest, most sophisticated facilities in the world dedicated to the reactivation of carbon. Regular reviews by Calgon Carbon's "Carbon Acceptance Committee" assure that its facilities are always operating in full compliance with laws and regulations applying to transport and reactivation of the spent carbon. Both the Neville Island and Catlettsburg reactivation facilities are fully permitted under RCRA Part B to accept manifested spent activated carbon, and each plant carries sudden and accidental pollution insurance as required by federal and state laws. In addition, the Company owns and operates a trailer fleet specifically designed for the transport of reactivated and spent carbon. Every driver in the private fleet is fully trained in changeout procedures. Transport trailers are licensed and insured up to $1 million in case of an accident.

For more information describing any of the air purification systems or services described in this bulletin, write or call Calgon Carbon Corporation, P.O. Box 717, Pittsburgh, PA 15230, (412) 787-6700. Bulletin 27-264, "Activated Carbon Products for Liquid and Vapor Phase Applications" is also available to assist in the selection of the appropriate activated carbon product for a specific application.

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Tel (412) 787-6700

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Tel (908) 526-4646

International
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Mississauga, Ontario
Tel (416) 673-7137

Houston TX
Tel (713) 690-2000

San Mateo CA
Tel (415) 572-9111

Carlsbad CA
Tel (619) 431-5550

Vara International
Division of
Calgon Carbon Corporation
Vero Beach, FL
Tel (407) 567-1320

Brussels, Belgium
Tel 32 2 773 02 11

CALGON

CALGON CARBON CORPORATION

Ozone

OZONIA®

Ozonia North America
178 Route 46 East
Post Office Box 330
Lodi, N.J. 07644
TEL: (201)778-2131
FAX: (201)778-2357

TELEFAX TRANSMITTAL FORM

To:	Moss Kelley	Fax:	407-774-7209
Att:	Brian Scheutte	Total Pages:	14
From:	Mary LaMarca	Date:	May 12, 1997
Re:	Ozone System Equipment for Potable Water Applications		

Gentlemen:

As requested, additional information regarding the oxygen-fed ozone systems follows. Each system price includes an OZAT ozone generator, PSA type oxygen generator, compressor, ozone destruct unit, dissolved and ambient ozone monitors.

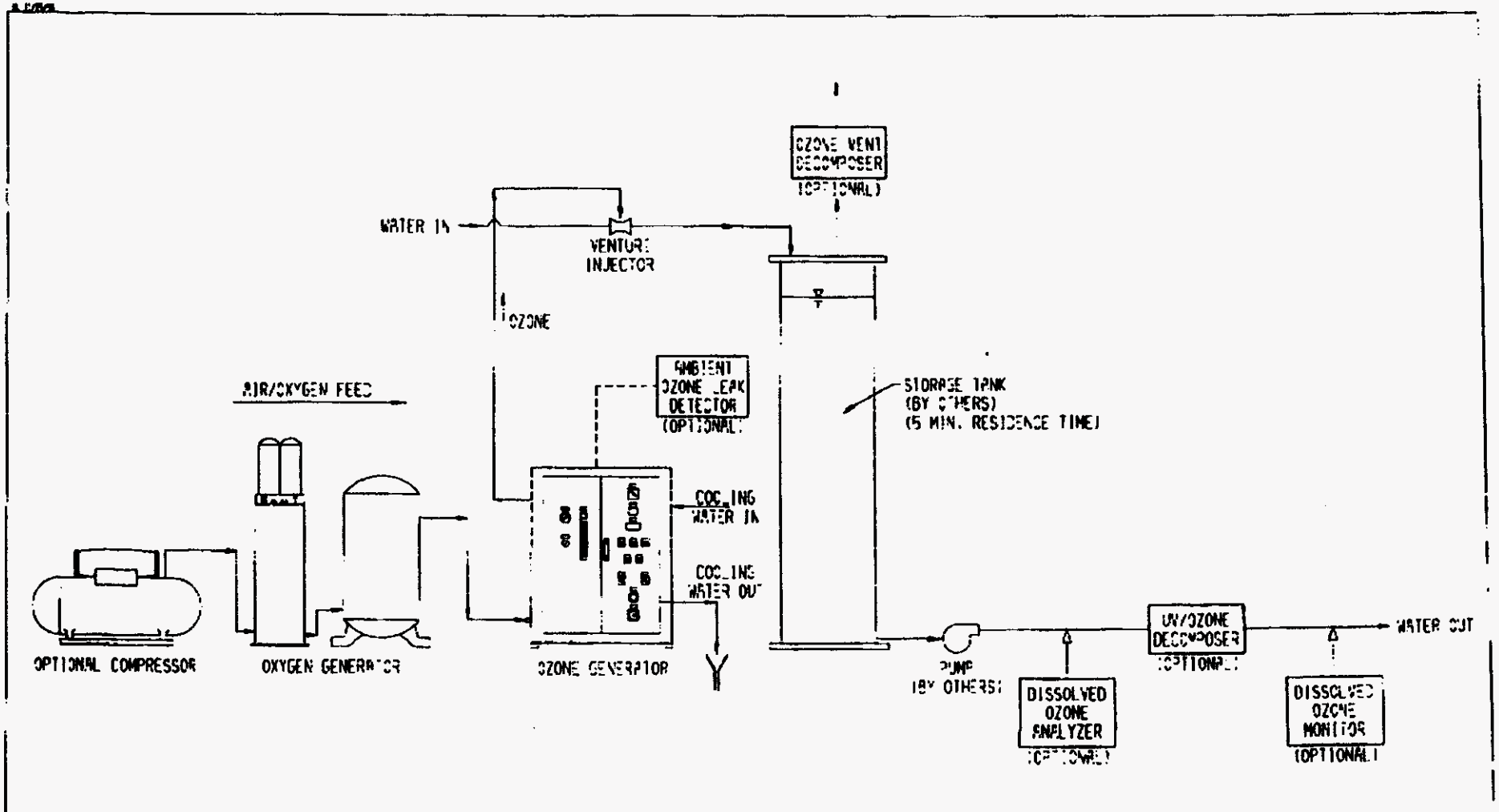
Capacity	Compressor HP	O2 Generator	Ozone Destruct
8.9 PPD @ 10%	7.5	OG-50	OD-10
18.0 PPD @ 9%	10	OG-100	OD-25
36.8 PPD @ 9%	15	OG-250	OD-50
50.0 PPD @ 12%	15	OG-250	OD-50
74.2 PPD @ 9%	20	OG-500	OD-100

Feel free to contact me if you have questions.

Very Truly Yours,

OZONIA NORTH AMERICA

Mary LaMarca
Applications Engineer


OZONE VENT DECOMPOSER
(OPTIONAL)
WATER IN
VENTURI INJECTOR
OZONE
AMBIENT OZONE LEAK DETECTOR
(OPTIONAL)
AIR/OXYGEN FEED
STORAGE TANK
(BY OTHERS)
(5 MIN. RESIDENCE TIME)
COOLING WATER IN
COOLING WATER OUT
OPTIONAL COMPRESSOR
OXYGEN GENERATOR
OZONE GENERATOR
PUMP
(BY OTHERS)
DISSOLVED OZONE ANALYZER
(OPTIONAL)
UV/OZONE DECOMPOSER
(OPTIONAL)
WATER OUT
DISSOLVED OZONE MONITOR
(OPTIONAL)

About Atlas Copco

The World Leader in Compressed Air

Atlas Copco has engineered and manufactured air compressors for the industrial and construction markets for more than 75 years. This experience, plus a dedicated program of research and development, has made Atlas Copco the largest manufacturer of compressed air systems in the world. Innovative advances in the GA5-7 Series have evolved from this technological leadership.

Support for Atlas Copco equipment is available through a comprehensive network of authorized distributors, strategically located throughout the United States. Their personnel are factory trained and certified to provide the application assistance, service and parts resources required to ensure maximum efficiency and reliability for your compressed air system.

Technical Specifications

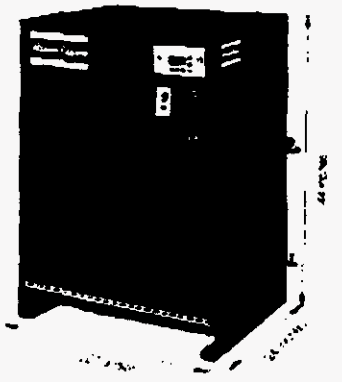
Model	Motor HP	Working Pressure PSIG	Capacity ACFM[1]	Sound Level dB(A)[2]	Weight Lbs Pack	Weight Lbs FF
GA5	7.5	125	25	69	460	530
		175	18			
GA7	10	125	38	71	480	550
		175	29			

[1] Unit performance measured according to Pneurop/Cagi PN2CPTC2

[2] Maximum noise level measured at a distance of 3 feet according to Pneurop/Cagi PNSNTC2 test code

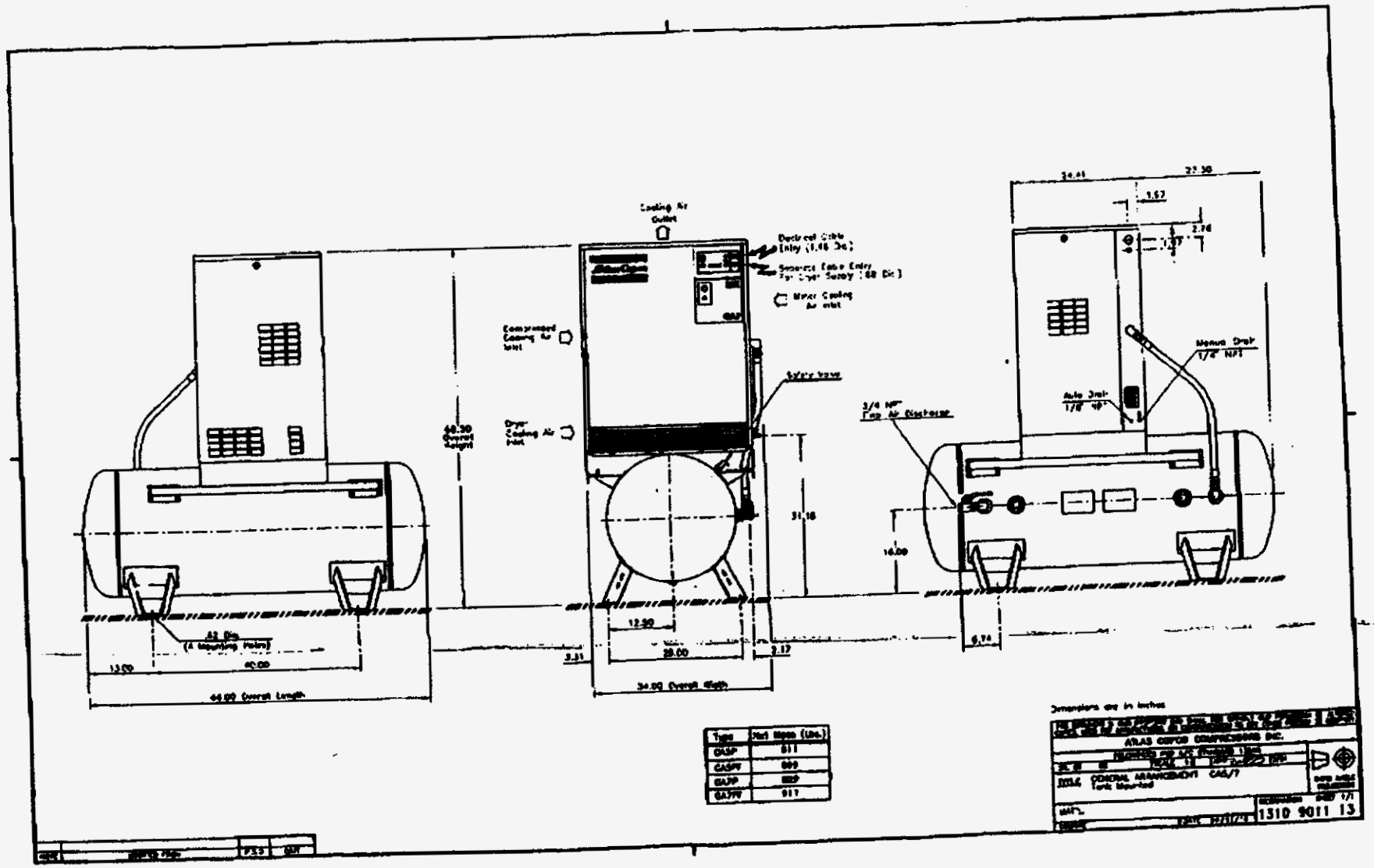
Danger: Compressed air should never be supplied as breathing air unless it is properly purified for breathing. Atlas Copco assumes no responsibility or liability related to the purchaser's/user's breathing air system.

Member:



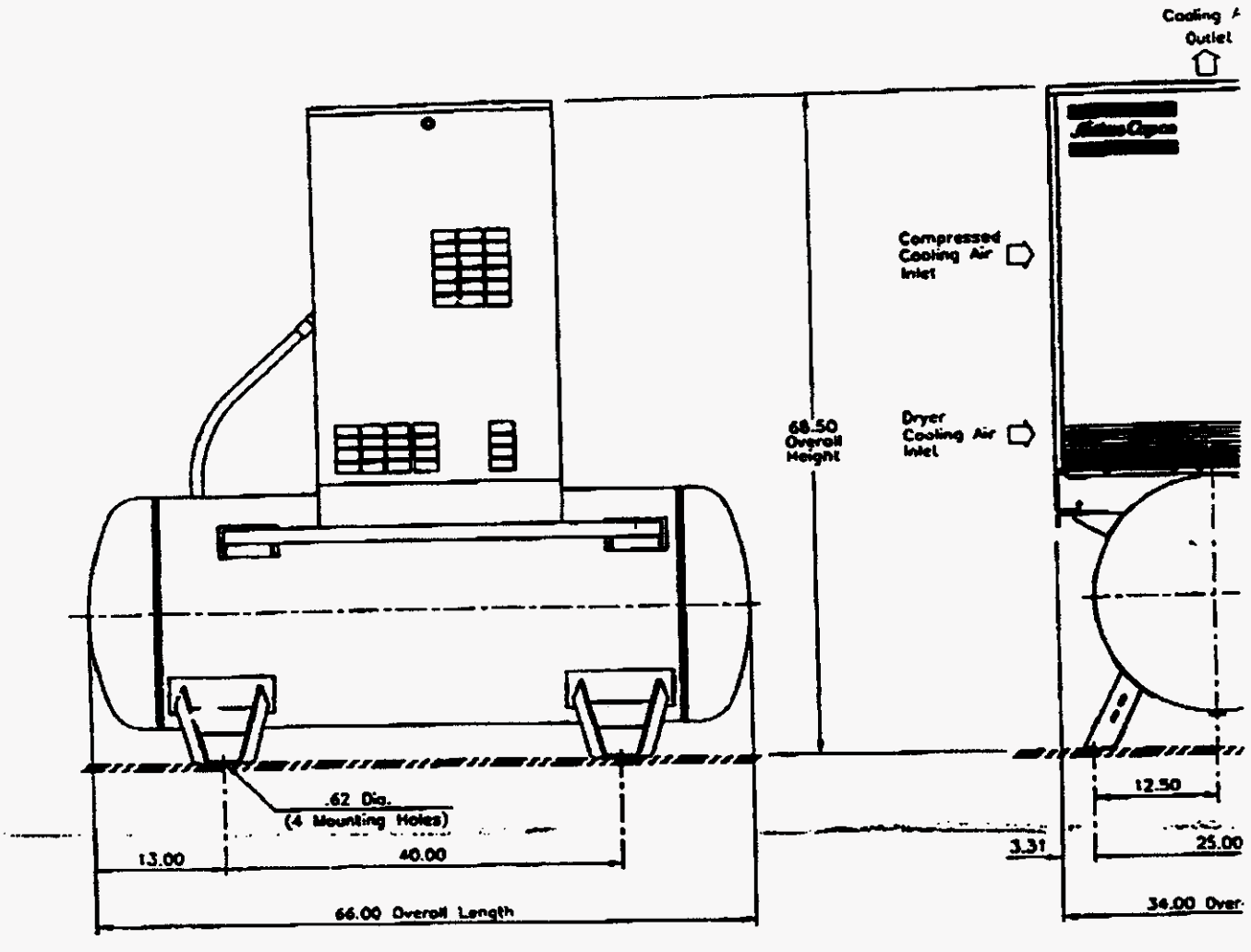
Atlas Copco Compressors Inc.
161 Lower Westfield Road
Holyoke, MA 01040
Tel: 413-536-0600 Fax: 413-536-0931

The information contained herein is general in nature and is not intended for specific construction, installation or application purposes.

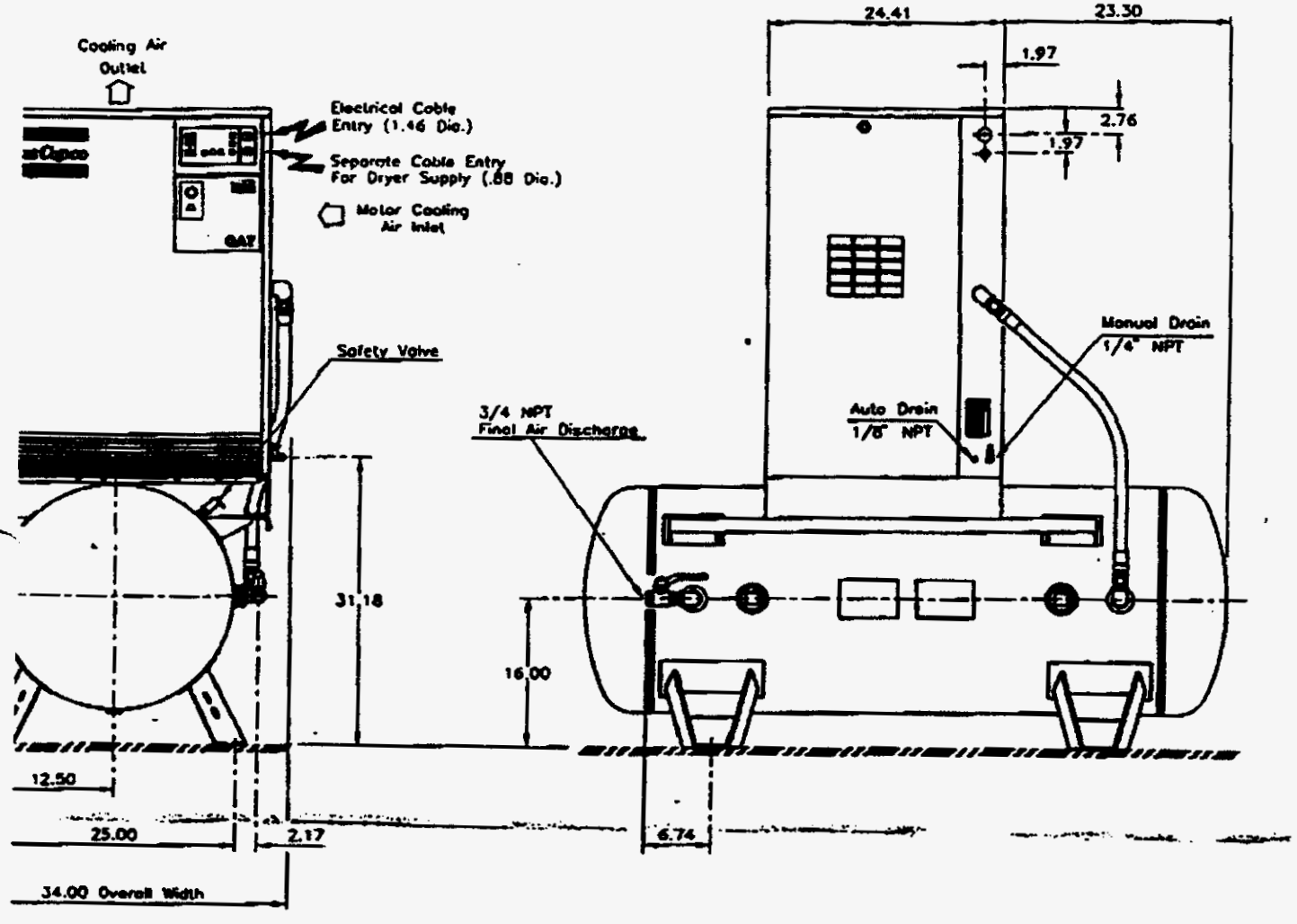


Type	Net Mass (Lbs.)
CASP	811
CASPY	869
CAJP	882
CAJPY	917

05/12 '97 15:55 [illegible]



NOTE	MODIFIED FROM	P.S.O.	DATE



Type	Net Mass (Lbs.)
GA5P	811
GA5FF	899
GA7P	829
GA7FF	917

Dimensions are in inches

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ATLAS COPCO COMPRESSORS INC.

TOLERANCES PER A/C STANDARD 13600

DR. BY RC SCALE 1:8 APP'D DATE

TITLE GENERAL ARRANGEMENT GA5/7
Tank Mounted

MAT'L

DRAWING DATE 94/11/18

DESIGNATION 1310 9011 1

About Atlas Copco

The world Leader in Compressed Air

Atlas Copco has engineered and manufactured air compressors for the industrial and construction markets for more than 75 years. This experience, plus a dedicated program of research and development, has made Atlas Copco the largest manufacturer of compressed air systems in the world. Innovative advances in the GA11 22 Series have evolved from this technological leadership.

Support from Atlas Copco equipment is available through a comprehensive network of authorized distributors strategically located throughout the United States. Their personnel are factory trained and certified to provide the application assistance, service and parts resources required to ensure maximum efficiency and reliability for your compressed air system.

Technical Specifications

Model	Motor HP	Working Pressure PSIG	Capacity ACFM[1]	Sound Level[2] dB(A) Open	Pack	Full Feature	Net Weight Lbs. Open	Pack	Full Feature
GA11	15	100	71	81	76	76	809	859	992
		125	64	81	76	76			
		150	57	81	76	76			
		175	52	81	76	76			
GA15	20	100	95	82	78	78	854	904	1058
		125	88	82	78	78			
		150	80	82	78	78			
		175	73	82	78	78			
GA18	25	100	111	83	79	79	920	970	1124
		125	108	83	79	79			
		150	97	83	79	79			
		175	89	82	79	79			
GA22	30	100	131	84	80	80	940	990	1146
		125	128	84	80	80			
		150	116	83	79	79			
		175	106	83	79	79			

(1) Unit performance measured according to CAGI Datasheet PNEUROP/CAGI

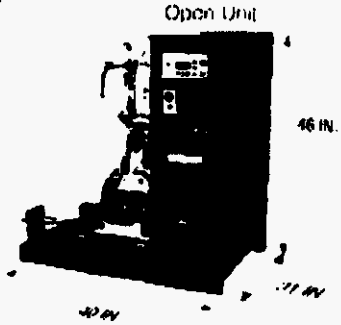
(2) Maximum noise level measured at a distance of 3 feet according to CAGI Datasheet PNEUROP test code

Danger: Compressed air should never be sampled as breathing air unless it is properly treated for breathing. Atlas Copco disclaims any responsibility or liability related to the purchaser's breathing air system.

Member:

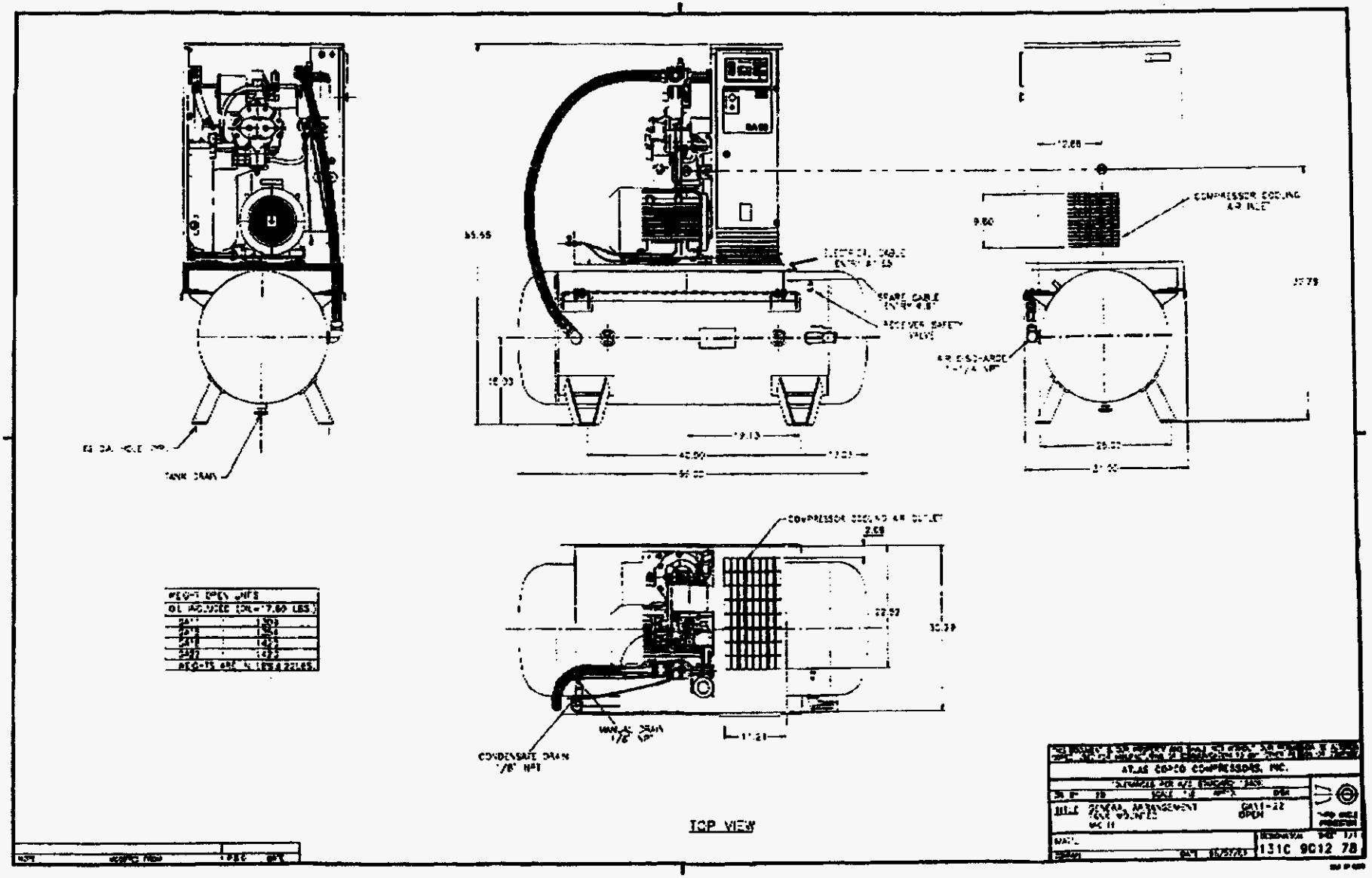


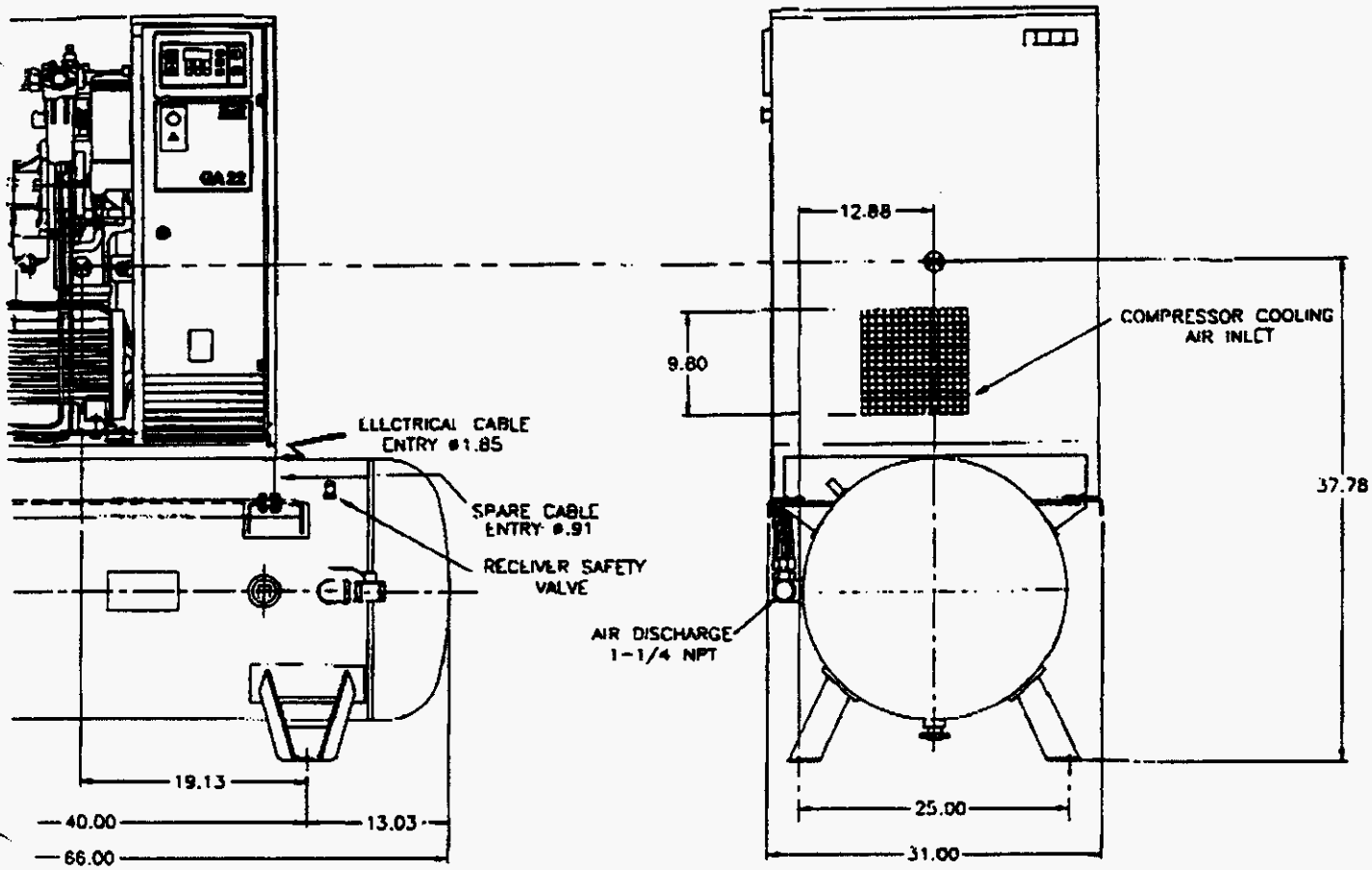
Open Unit

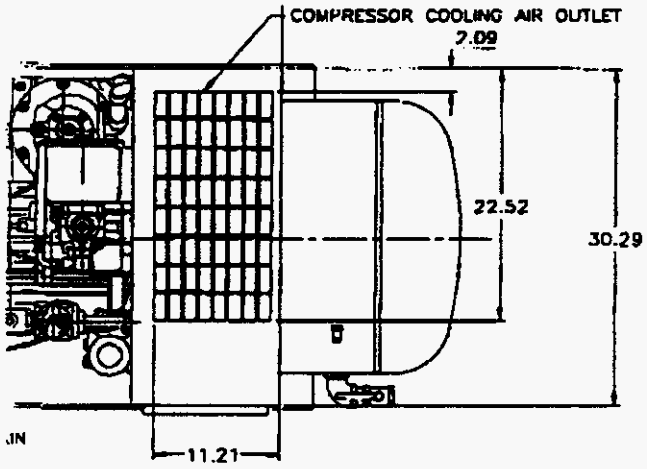


Atlas Copco Compressors Inc.
161 Lower Holyoke Road
Holyoke, MA 01040
Tel 413-536-0600 Fax. 413-536-0991

This information contained herein is general in nature and is not intended for specific construction, installation or application purposes.


COMPRESSOR COOLING AIR INLET
COMPRESSOR COOLING AIR OUTLET
CONDENSATE DRAIN
TANK DRAIN
TOP VIEW
ATLAS COPCO COMPRESSORS, INC.
131C 9012 78





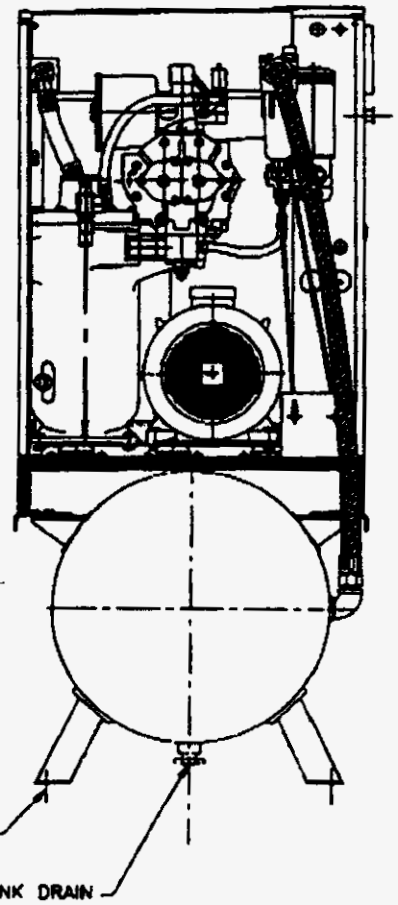
TOP VIEW

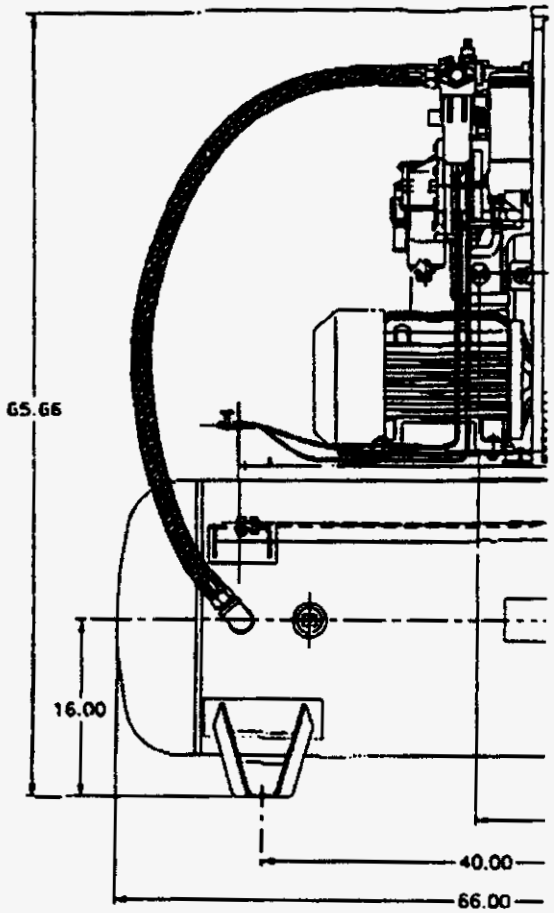
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ATLAS COPCO COMPRESSORS, INC.

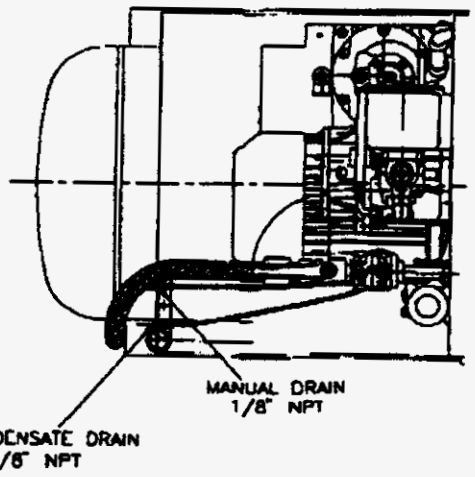
TOLERANCES PER A/C STANDARD 1350K

DR. BY SB	SCALE 1:8	APP'D.	DISK	
TITLE GENERAL ARRANGEMENT TANK MOUNTED MK III		GA11-22 OPEN		THIRD ANGLE PROJECTION
MAT'L.			DESIGNATION	SHEET 1/1
COMPARE	DATE 95/07/07		1310 9012 78	





WEIGHT OPEN UNITS	
OIL INCLUDED (OIL=17.60 LBS.)	
GA11	1309
GA15	1354
GA18	1420
GA22	1420
WEIGHTS ARE IN LBS ± 22LBS.	



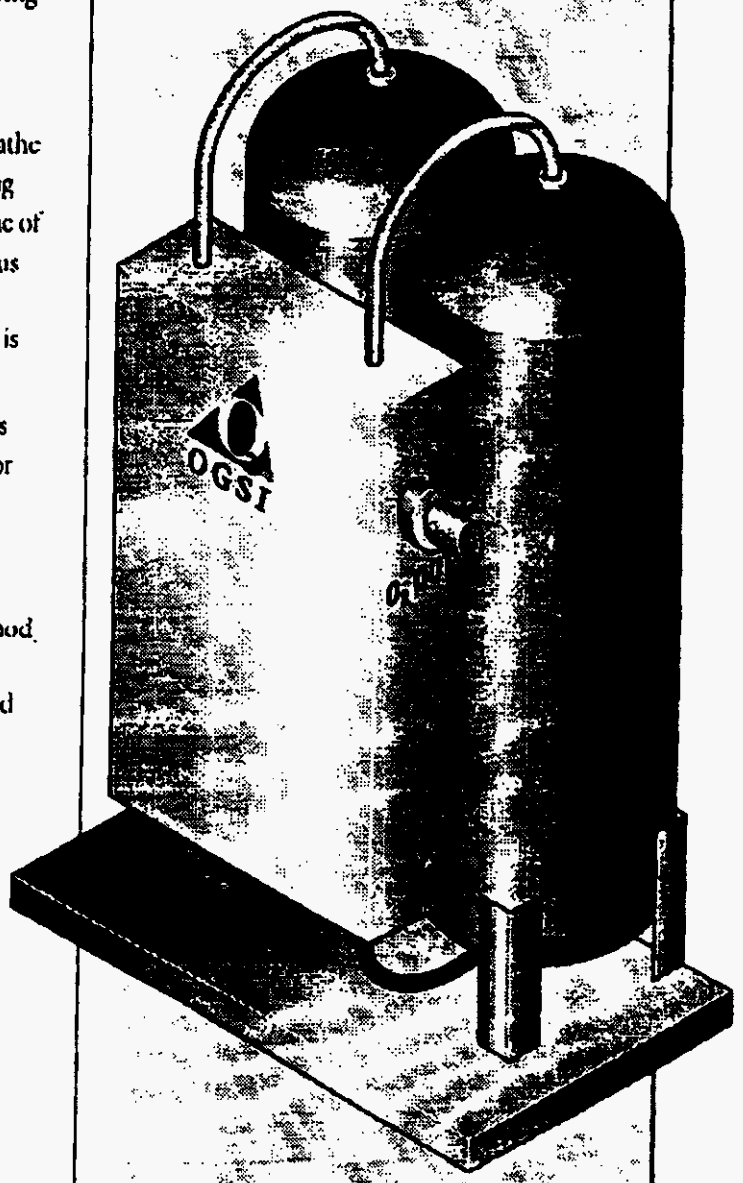
TOP

MODIFIED FROM	P.S.O.	DATE

OGSI

Oxygen Generating Systems, Inc.

If you are using one cylinder of oxygen per week, you can save money by switching to an *OGSI* oxygen generator.



For on-site production of Oxygen used in:

- ▲ Welding
- ▲ Water Treatment
- ▲ Pulp and Paper
- ▲ Ozone Systems
- ▲ Fish Farming
- ▲ Jewelry Manufacturing
- ▲ Battery Manufacturing
- ▲ Glass Industry

Features and Benefits:

Twenty-one percent (21%) of the air we breathe is composed of oxygen. Using Pressure Swing Adsorption (PSA) technology, the *OGSI* line of generators extract this oxygen in a continuous process. The costs and hazards of handling high pressure cylinders or oxygen reservoirs is eliminated.

OGSI micro-processor controlled generators can be attached to existing air compressors or shipped with a dedicated compressor. Every generator includes a storage tank for high demand periods.

PSA technology is a simple and reliable method of oxygen separation that requires no special training or maintenance. *OGSI* has developed 7 different models with capacities from 25 SCF/Hr to 1000 SCF/Hr.

To determine the right size and potential payback of an *OGSI*, a Windows™ based software program is available at no charge.

Options:

- ▲ NEMA 4X rating
- ▲ Self-diagnostic electronics
- ▲ Telemetric communications to the factory or service center

2221 Niagara Falls Boulevard ▲ Niagara Falls, New York 14304 ▲ Phone: 716/731-1455 ▲ Fax: 716/731-1458 ▲ http://www.ogsi.com

Generator Specifications

Model	Air Requirements				Oxygen Output				Size			
	Avg. Flow		Min. Pressure		Flow		Max. Pressure		Approximate H x W x D		Weight	
	SCFM	Nm³/min	psig	kPa	SCF/Hr	Nm³/Hr	psig	kPa	in	cm	lbs	kg
OG-25	6.5	0.17	90	620.7	25	0.7	45	310.3	13 x 14 x 57	33 x 36 x 145	150	68.0
OG-50	12.0	0.32	90	620.7	50	1.3	45	310.3	18 x 20 x 60	46 x 51 x 152	275	124.7
OG-100	22.0	0.58	90	620.7	100	2.6	45	310.3	18 x 22 x 66	46 x 56 x 168	450	204.1
OG-175	32.0	0.84	90	620.7	175	4.6	45	310.3	20 x 26 x 72	51 x 66 x 183	725	328.9
OG-250	45.0	1.18	90	620.7	250	6.6	45	310.3	24 x 36 x 72	61 x 91 x 183	995	451.3
OG-500	88.0	2.31	90	620.7	500	13.1	45	310.3	30 x 52 x 83	76 x 132 x 211	1700	771.1
OG-1000	175.0	4.59	90	620.7	1000	26.2	45	310.3	54 x 54 x 83	137 x 137 x 211	3200	1451.5

Specification Notes

1— Non-standard size generators are available on request.
2— All pressure vessels are designed to meet ASME code (Section VIII, Div. 1).
3— All models produce oxygen at up to 95% purity.
4 — 120 VAC @ 60 Hz or 220 VAC @ 50 Hz input power may be specified.
5— Each generator is shipped with an oxygen storage tank. (sizes shown at right)

Models	*Storage Tank Size*
OG-25	30 gallons
OG-50	60 gallons
OG-100	60 gallons
OG-175	80 gallons
OG-250	120 gallons
OG-500	120 gallons
OG-1000	200 gallons

Systems and Cylinder Filling Plants

In many applications where a customer does not have a compressor, or the one that they have is not suitable for the additional air requirements, *OGSI* has an oxygen system that will do the job. Each of our generators is available with a skid mounted compressor to make a complete system. All the necessary interconnections between the generator and storage tank are included.

As a further continuation of the product line, *OGSI* can provide cylinder filling plants (CFPs) for oxygen. These plants allow the customer to produce oxygen on demand and the capability to fill cylinders when portability is an issue. Additionally, these plants can also be used when oxygen cylinders are to be supplied to others. CFPs come complete with: a) a generator; b) an air compressor; c) both air and oxygen storage tanks; d) an oxygen compressor; and e) a cylinder filling rack complete with cylinders. These fully automated plants are designed for minimal maintenance and operator training. Please call or fax today for additional information on generator systems or CFPs.

Free Software

Even before you decide if you really need a generator or a system, ask us about our Model Selection and Payback Software. This free Windows™ based software can be mailed to you on a 3.5" disc or downloaded from our World Wide Web page. This program provides the following information:

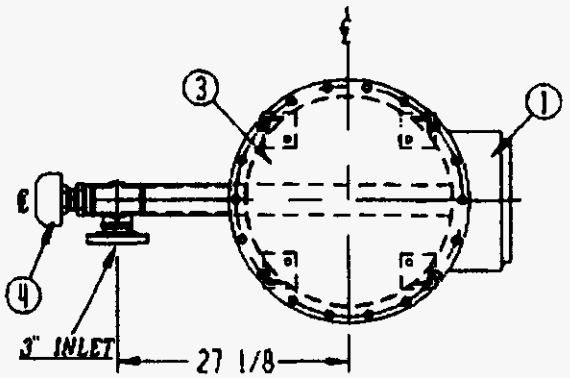
- *OGSI* Model Number
- Price of Generator or System
- Required CFM of Air
- Burden on Existing Compressor Capacity (%)
- Cost Pay Back Analysis (years 1 through 10)
- Graph of $ Savings Over Ten Years

The above results can be analyzed by varying the following inputs:

- Current Oxygen Usage
- Price of Oxygen
- Inflation Rate
- Cost of Electricity
- Hours and Days of Operation
- Compressor Efficiency

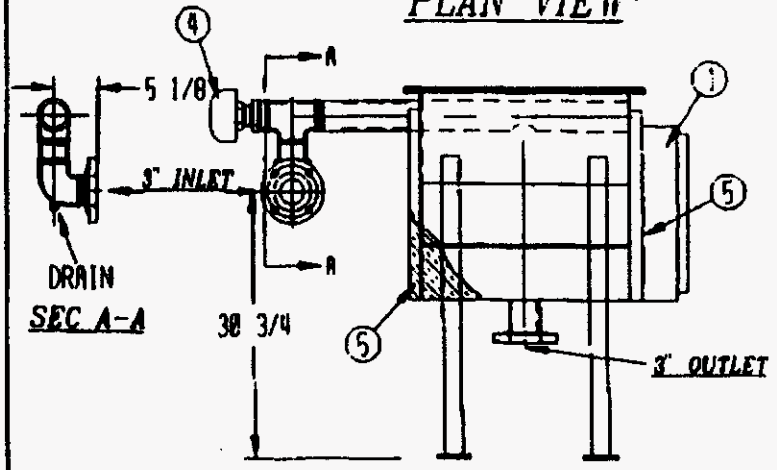
This information is accurate to the best of the manufacturer's knowledge, however, we reserve the right to change product specifications at any time. Please contact your sales representative for specific order inquiries.

2610R00001—11.95—5M

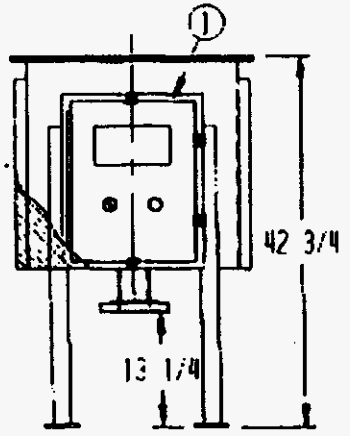


PLAN VIEW

OD-50
OD-100



FRONT ELEVATION



RIGHT ELEVATION

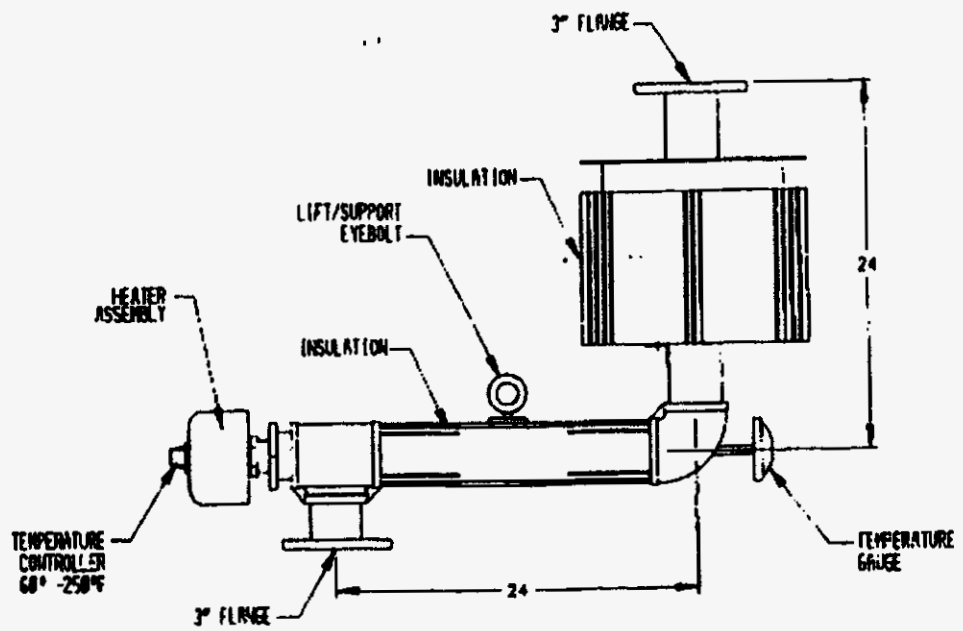
PARTS LIST

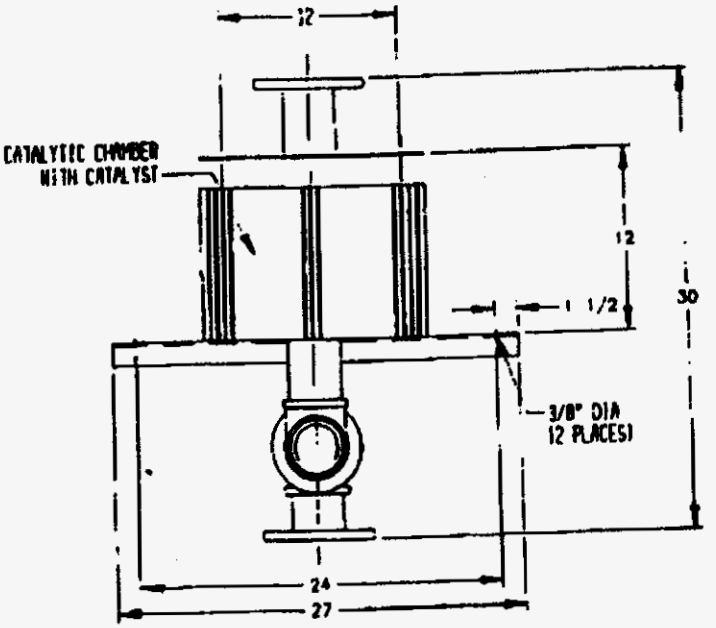
1. CONTROL BOX
2. CATALYST
3. CATALYST CHAMBER 22" DIA. x 29" HI
4. HEATER
5. INSULATION

		DRAWN: GA 1/12/95	SCALE: NONE	OZONE DESTRUCT UNIT
				OZONIA NORTH AMERICA
				SIZE: B — DWG NO: 05-01-S11A-R-001

05/12 '97 16:00 ID:OZONIA-LWI PAGE.002

OD-10
OD-25





	JSA 7/27/96	DZONE DESTRUCT UNIT	OZONIA Griffin Division NORTH AMERICA P.O. Box 330, 178 Route 46, Lodi, New Jersey 07644
			SCALE: 1 1/2"=1'-0" SIZE B DWG NO. 93-12-1000-0-014

OZONIA®

OZAT®

CFS

Compact Ozone Generators for Oxygen or Air Feed

Ozonia - technology
at its very best

OZAT® *CFS* Compact Ozone Generator Units

Once again Ozonia has taken a quantum step forward in the field of ozone generation. The *new range of CFS* units demonstrates Ozonia's unparalleled commitment to *technical research and* product improvement.

The first three units of this new series, are for the nominal production rates of 65, 130 and 195 gO_3/h at 6 wt% from oxygen or 30, 60 and 90 gO_3/h at 3 wt% from air.

The OZAT *CFS* will make high-grade *ozone generation* equipment available to all categories of users, requiring ozone for small applications, at very attractive prices.

The OZAT® *CFS* range of compact ozone generators represent the cutting edge of ozone generation technology encompassing all the major features of Ozonia's large customized ozonation plants.

With Ozonia's revolutionary "AT95" or "Advanced Technology 95" dielectric segments, the OZAT *CFS* range incorporates an optimised medium frequency power supply which takes advantage of the very latest semiconductor developments.

The resultant *CFS* is a low-cost industrial quality generator that is capable of producing ozone with concentrations up to 14 wt% from oxygen and 5 wt% from air. Technical features are exceptional:

- Very compact dimensions
- Integrated controls
- Single phase power supply
- Simple installation
- Oxygen or air feed gas
- High ozone concentrations
- Robust industrial quality
- High reliability and safety

The applications for the new *CFS* range are countless.

Small potable water plants
in hotels, on-board ships and rigs, isolated living quarters, housing complexes, etc... Proper ozone dosages can ensure disinfection and the removal of unwanted taste, color and odor.

Fish hatcheries
to protect valuable stocks of fry or fish against water borne micro-organisms or pollutants and, at the same time, to increase production rates and quality levels.

Water recirculation systems
for industrial applications, i.e.: CIP; USP water sterilization; high purity water treatment; rinse water recycling; etc... Ozone in conjunction with UV is an important means of reducing COD and TOC.

Bottled water
is easily disinfected by adding ozone immediately before filling the bottle or can. After a short storage time the ozone will decay leaving just disinfected water.

Influent water treatment
There are many applications where companies treat the incoming water from the municipal source to establish and maintain a consistent quality specification. Ozone, combined with UV or granular activated carbon, results in a perfect pretreatment step.

Cooling water treatment
Ozone is an excellent replacement for biocide in circulating cooling water systems.

Please contact your local Ozonia office, or Ozonia product distributor, for more specific information regarding application technology.

OZAT® is a trade name belonging to Ozonia

RATING DATA FOR THE *CFS* RANGE OF OZAT® UNITS

OZAT® Unit Type	Nominal Rating (gO_3/h)		Operating Pressure (psig)		Oxygen Feed (SCFH)	Air Feed (SCFH)	Cooling Water (GPH)	Electrical Rating (W)
	Oxygen	Air	Oxygen	Air				
CFS-1	65	30	15	30	28	28	30	690
CFS-2	130	60	15	30	56	56	60	1380
CFS-3	195	90	15	30	85	85	90	2070

1) Ozone produced at 6wt% from oxygen, 3wt% from air, with a cooling water inlet temperature of 55°F.
2) Cooling water inlet pressure: 30 to 90 psig.
3) Feedgas quantity at standard conditions for nominal production. Feedgas requirements will vary depending on production rate and ozone concentration.
4) Feedgas inlet pressure: 35 to 100 psig.
5) Feedgas dew-point: - 60°C

DIMENSIONS FOR THE *CFS* RANGE OF OZAT® UNITS

Model	Length (in.)	Width (in.)	Height (in.)	Weight (lb.)
CFS-1	34	15	19	122
CFS-2	34	15	19	133
CFS-3	34	15	19	144

1) Given weights are approximate service weights.

GENERAL DATA FOR THE *CFS* RANGE OF OZAT® UNITS

Site Conditions

- Design altitude (for service data at higher altitudes contact Ozonia) : 1000 m
- Ambient temp. : minimum 42°F, maximum 104°F, average (24 h) 95°F
- Humidity : <65% (yearly average)

Connection data

- Mains voltage : 1 x 230 VAC ± 10%
- Frequency : 48 to 63 Hz
- Power factor : 0.99
- Gas connections : ½" NPTF
- Cooling water : ½" NPTF

Control / Signals

- ON / OFF : Local / remote *(client)*
- Ozone output control : Local / remote
- Signal ON / OFF : Local / remote
- Alarm (collective) : Local / remote

Materials

- Enclosure : Mild steel
- In contact with O_3 : 316 stainless steel, PTFE, PVDF, viton
- In contact with water : PE, brass, 304/316 stainless steel

Protection class : IP 42

Color : RAL 5007 (blue)

Standards : EN / IEC / ISO

Conformity : CE

OZONIA®

Ozonia around the world



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Fax: +33(1)47 49 05 04



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Fax: +41(31)332 72 75



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Germany
Tel.: +49(421)80 46 75
Fax: +49(421)89 33 31



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c/o Degrémont Co., Ltd.
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Xianliezhong Road
Guangzhou 510095, PRC, China
Tel.: +86(20)8760 1669
Fax: +86(20)8760 1648

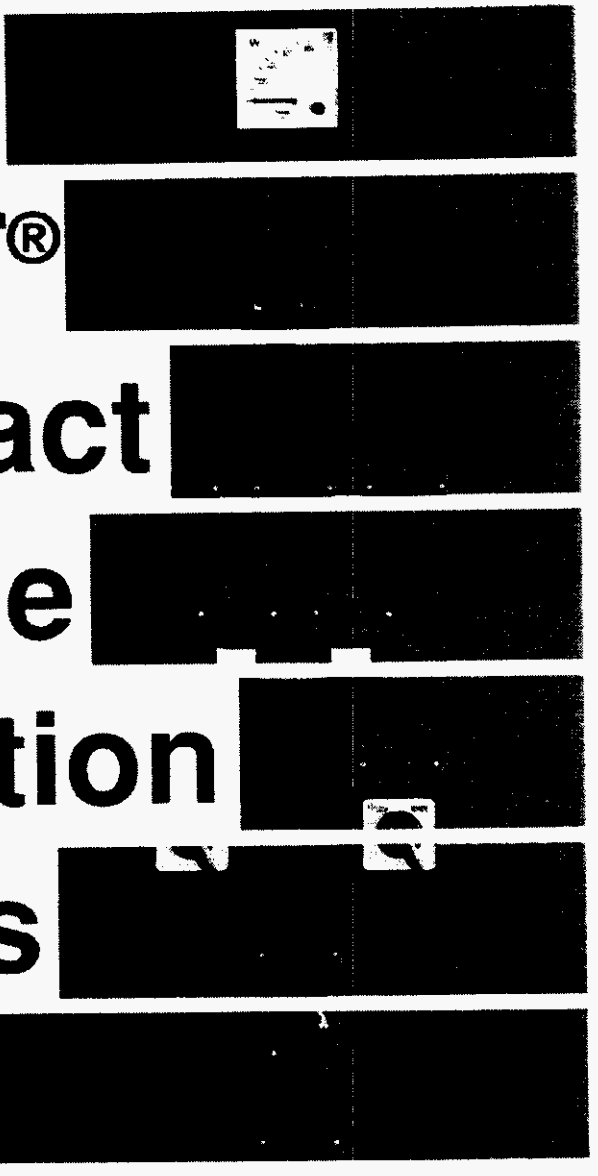


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623 00 Brno
Czech Republic
Tel.: +42(5)4321 20 45
Fax: +42(5)4321 20 45

Ozonia products are available in countries all over the world.
Please contact us to find out details of your local representative.

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The OZAT® Compact Ozone Generation Units



Ozonia – a way for a better world

In line with its quest for technical perfection that reflects the requirements of ozone users all over the world, Ozonia has now developed a completely new range of standardised compact ozone generator units.

This new product is intended for individuals, engineering companies and original equipment manufacturers who are confronted with either disinfection or oxidation problems and, to date, have considered ozone expensive.

The OZAT® product is unique because it takes advantage of the latest technological developments, including Ozonia's "Advanced Technology" (AT) dielectrics. Its modular construction results in a very compact unit capable of producing extremely high ozone concentrations and it offers clients inexpensive hi-tech equipment for the economic production of ozone.

These technical features, in conjunction with Ozonia's position to supply unparalleled expert advice regarding ozonation and integration of the associated equipment, results in another major step forward in solving some of the world's environmental problems.

OZAT® is a trade name belonging to Ozonia

INTRODUCTION

In the health conscious world of today more and more attention is being paid to our life styles and the things immediately influencing them. The greatest negative factor jeopardising future well-being is environmental pollution. This problem, although not new, is now reaching proportions that could have catastrophic consequences.

In an attempt to lighten, if not eliminate, the burden placed on natural resources, Ozonia has been doing its utmost to promote the use of ozone by operators who, up to now, have taken no measures whatsoever or have relied upon conventional chemicals to solve their immediate problems.

The success rate with large operators has been tremendous and, thanks to Ozonia's efforts, a large number of municipal drinking water works have changed their process so that the main oxidation is now done with ozone. Not only does this have a significant effect on the organoleptic qualities of the drinking water, it results in safer water free from trihalomethanes and other carcinogenic components. In addition to water treatment, great improvements are also being made in the pulp industry where previously, enormous amounts of chlorine were used to bleach the pulp white prior to it being turned into paper.

In order for small operators, and even individuals, to take advantage of Ozonia's State of the Art technology, a completely new range of ozone generators has been developed which include all of the technical advantages of the units used for large installations. This new line of generators, which is suitable for all types of applications, requires the minimum amount of expenditure and offers the maximum amount of safety and reliability.

OZONE

Ozone is a virtually colourless gas with an acrid odour and very strong oxidising properties. Figure 1 compares the Electrochemical

Oxidising Agent	EOP (volt)	EOP v Chlorine
Fluorine	3.06	2.25
Hydroxyl-radical	2.80	2.05
Oxygen (atomic)	2.42	1.78
OZONE	**2.08**	**1.52**
Hydrogen dioxide	1.78	1.30
Hyperchlorite	1.49	1.10
Chlorine	1.36	1.00
Chlorine dioxide	1.27	0.93
Oxygen (molecular)	1.23	0.90

Fig. 1: Comparison of ozone with other oxidising agents

other oxidising agents. Ozone is the triatomic form of oxygen that has been formed by recombining highly excited oxygen atoms or molecules with one another (see Fig. 2). Unlike other agents such as chlorine, oxidation with ozone leaves no toxic residues that have to be removed and disposed of because the process only yields "oxygenated" products and oxygen. In practice ozone is completely non-selective and immediately starts to oxidise everything it comes into contact with – this property makes it a very powerful bactericide and viricide as well as a strong bleaching agent. The ozone molecule is only moderately stable and, in the absence of oxidizable substances, will decay to form stable diatomic oxygen. The instability of ozone has the consequence that it can be neither stored nor transported over distances requiring long periods of time. This means it must be produced

which has the added environmental and safety advantages of not having to store or transport potentially dangerous chemicals in large quantities.

PRODUCING OZONE

The traditional way of producing ozone is by means of Dielectric Barrier Discharge or so called Silent Electrical Discharge. Dry feed gas (either oxygen or air) is passed through a gap formed by a high voltage electrode and an earth electrode. When high voltage at high frequency is applied to the high voltage electrode ozone is produced in the feed gas by the micro-discharges taking place in the discharge gap (see Fig. 3).

Although the discovery of how to produce synthetic ozone dates back over 130 years, it is only over the last 2 decades that any significant technical progress has been made

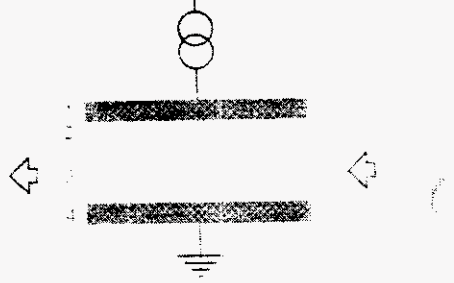


Fig. 3: Generating ozone

1 High voltage electrode
2 Dielectric
3 Discharge gap
4 Earth electrode

Key improvements highlighted by the OZAT® product are

- Ozone concentrations in excess of 10% can be produced from oxygen feed gas
- Ozone yield for a given electrode area has been improved dramatically
- The specific energy consumption of the "Advanced Technology" has been reduced by up to 60% for equal ozone concentrations (compared with Ozonia's conventional technology which is renowned for low consumption)
- High endurance, shock resistant "Advanced Technology" (AT) dielectrics with optimised properties and geometry

OZAT® OZONE GENERATORS

The OZAT® ozone generators have been specifically designed and manufactured with the smaller applications in mind. Up to recently, many potential ozone users had difficulties justifying the costs of producing ozone and either reverted to cheaper, less effective solutions or just lived with their problems. With Ozonia's new product line a completely new approach to ozone generation has been taken which makes the very same technology, as used for the large installations, available to small consumers for the very economic production of ozone.

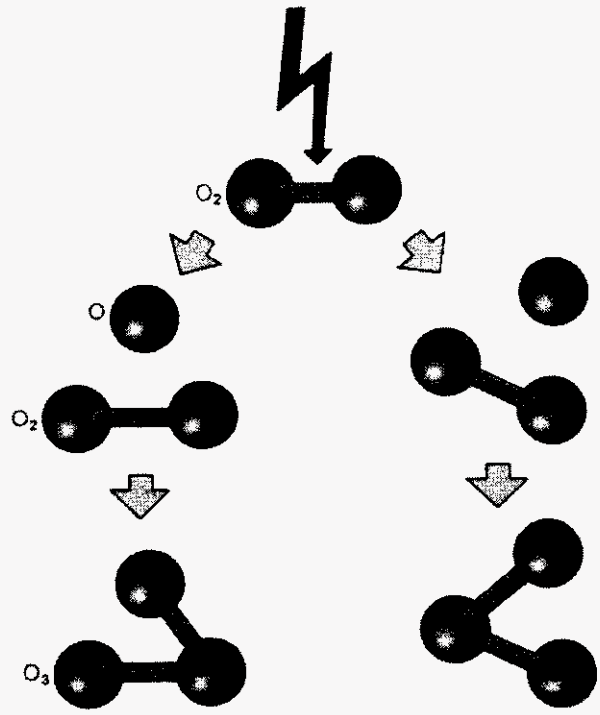


Fig. 2: Formation of ozone

in 6 unit sizes covering the ozone production range from 3 gO_3/h to 2500 gO_3/h (see Fig. 4).

Because the product is intended for general application and can cover uses from disinfection of private swimming pools to sophisticated production processes in organic chemistry, special attention has been given to design features ensuring that the product is:

- Absolutely reliable
- Easy to operate
- Requiring minimum maintenance and supervision

The OZAT® ozone generators are complete, fully factory assembled units that can be easily integrated into all types of systems, old or new, with the minimum amount of installation time and space requirement. The complete apparatus is contained in a very compact enclosure and, depending on the model in question, is either for wall / tabletop mounting or floor standing (see Fig. 6)

The enclosure, which is easily accessible through front openings, is divided into 2 compartments:

- *Mechanical compartment*

  Containing the permanently sealed ozone generator module(s) proper (see Fig. 7), the associated manifolds in the case of multiple ozone generator modules, all necessary pipework, fittings, valves, connections and relevant instrumentation for the safe working of the unit.

- *Electrical compartment*

  The electrical equipment is contained in a second compartment in the cubicle that completely separates and protects these components. The supply includes all equipment necessary for the safe and correct functioning of the generator unit plus a logic system that can be easily connected to an external PLC or remote control system.

Unit Type	Rating gO_3/h[1]	Pressure bar(g)	Feed kg/h[3]	Water Litre/h[3]	Rating kVA[3]
CF 1	70	1.0	1.17	90	0.90
CF 2	210	1.0	3.50	270	2.20
CF 3	410	1.0	6.84	540	4.20
CF 4	820	1.0	13.67	1080	8.10
CF 5	1650	1.0	27.50	2160	16.00
CF 6	2500	1.0	41.67	3240	20.00

1) Ozone produced at a concentration of 6wt% with a cooling water inlet temperature of 12°C
2) Ozone regulation range: 5 to 100%
3) Requirements to produce ozone at the nominal production rates
4) Other concentrations can be produced with different ozone outputs (see Fig. 5)
5) Oxygen feed gas mass based on ca. 97% oxygen

Fig. 4: Rating data of the individual OZAT® units

ANCILLARY EQUIPMENT

In addition to the OZAT® ozone generator unit a certain amount of ancillary equipment is required in order to form a functional system:

- Feed gas supply equipment
- Contacting equipment
- Vent ozone destructors
- Water chiller/ cooler unit

Feed gas preparation equipment

Because of the considerable savings to be made with the electrical energy consumption and the ever in-

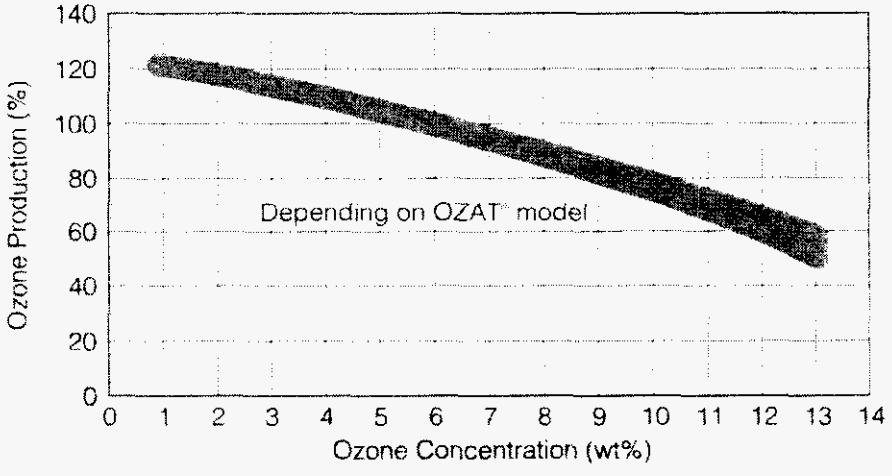
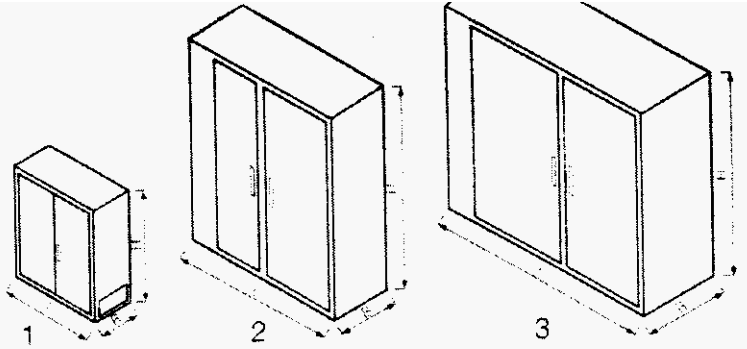


Fig. 5: Ozone yield at different concentrations



	CF1	CF2	CF3	CF4	CF5	CF6
L	900	900	1400	1400	1900	1900
B	400	400	600	600	900	900
H	1100	1100	2000	2000	2000	2000
kg	100	130	380	425	800	855
Model	1	1	2	2	3	3

1) All dimensions in mm. 2) Given weights are approximate service weights

Fig. 6: Dimensions of the OZAT® units

creasing demand for higher ozone concentrations, most State of the Art ozone generators use oxygen as the feed gas. There are several methods of obtaining or producing oxygen for this purpose:

- Liquid oxygen (LOX) can be purchased from gas companies who deliver the gas in special containers at regular intervals. This system has the advantages that the oxygen is of extremely high purity and very little equipment in the form of fittings, valves, etc. is required and, consequently, is very easy to maintain.

- Similarly, oxygen can be purchased from gas companies in high pressure containers, or banks of containers, at regular intervals. This system has the same advantages as LOX but requires that special attention be paid to gas quality especially the dew-point at generator service pressure.

- Oxygen gas of the desired quality can also be produced from atmospheric air with a pressure swing adsorption (PSA) oxygen production unit. These units compress air and then adsorb the nitrogen component with a special molecular sieve material.

Contacting system

After producing the ozone with the OZAT® system it is necessary to introduce the ozone to the process in question. This is done in a contacting system where the ozone-rich gas is mixed with the medium being medium contact area so that under specific conditions a high mass transfer is achieved. There are several methods of facilitating this transfer:

- Porous diffusers are probably the most popular method of introducing ozone. In the simplest case, the reactor is a vessel with porous diffusers mounted at the bottom through which the gas can be injected as small bubbles (see Fig. 8).

- Radial diffusers have been specially designed by Ozonia for use in restricted areas. A partial flow of the medium being treated is pumped into the radial diffuser head where it is mixed with the ozone gas. This mixture is then introduced to the main flow.

- In-line venturi type injectors offer ozone users a very simple and efficient means of introducing ozone to a medium. A high transfer efficiency is attained because of the under pressure environment it uses to introduce the ozone. Injectors are simple devices and there are countless ways of in-

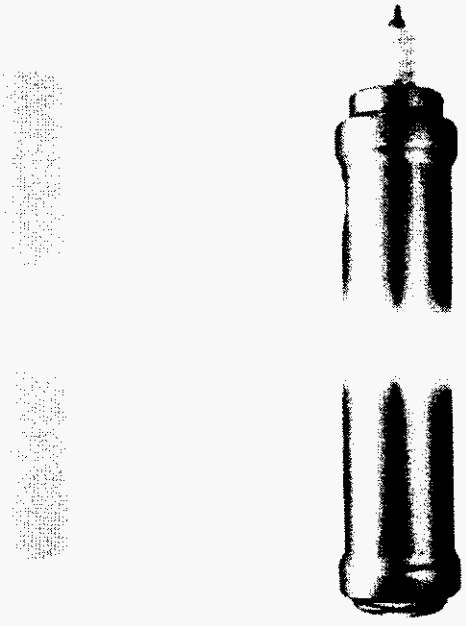


Fig 7: OZAT® generator module and AT dielectric

Fig. 9).

Vent ozone destructor

The exhaust gases from an ozone process normally contain small quantities of unused or unreacted ozone. Before these gases can be discharged to atmosphere it is necessary to decompose these traces of residual ozone. Basically, there are 3 methods of treating waste gas.

- With a catalytic ozone destructor unit. The gas entering the units is simply passed over a catalyst. Catalytic decomposition is the method preferred by Ozonia for small to medium sized applications and, consequently, market a line of units matched to the OZAT® generator range.
- Ozone can also be broken down thermally. With this method the waste gas is heated in excess of 300°C where ozone decomposes very rapidly. Thermal decomposition is particularly suitable for constant or large flows.
- The third method of decomposing ozone is over activated carbon in a similar way to the catalytic destruction unit. However, the use of activated carbon is not recommended, especially when oxygen is used as the feed gas, because the high exothermic reactions of the ozone decomposition and the oxidation of the activated carbon can give rise to extreme temperatures which could result in ignition of the material.

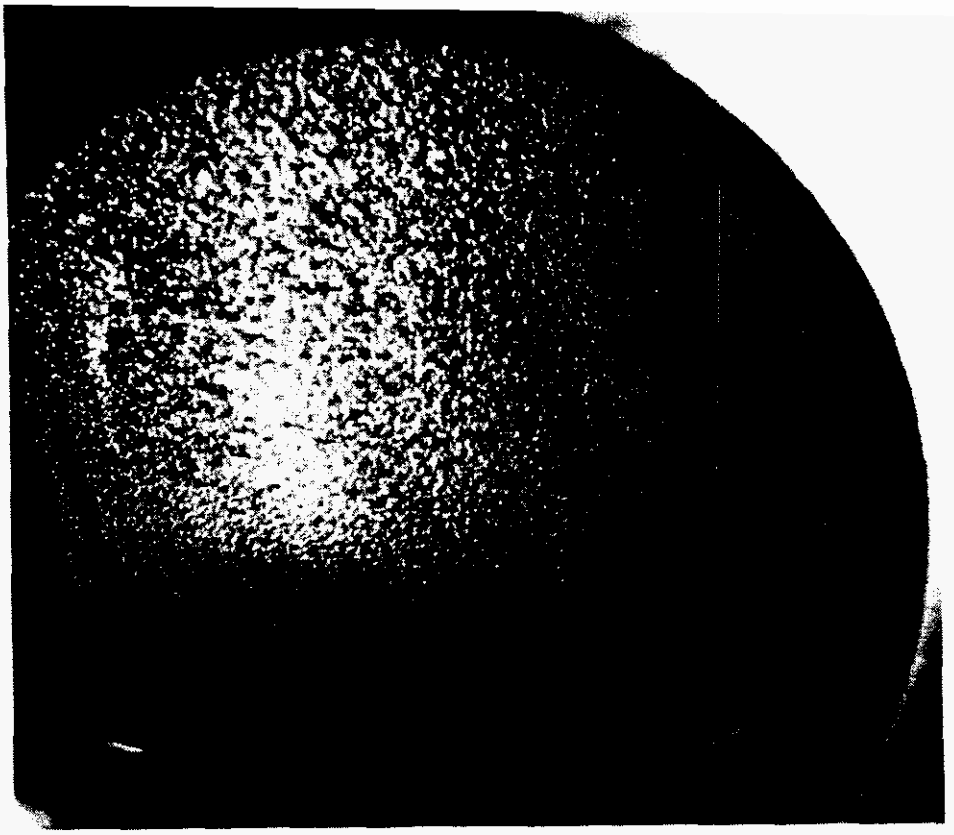


Fig. 8: Porous diffuser

Cooling water

The cooling water inlet temperature is a decisive parameter that has a direct effect on the ozone output of the generator unit (see Fig. 10). In order to ensure the most economical production, clients are advised to operate the generator units with the lowest possible cooling water temperature.

APPLICATIONS

The applications for ozone are numerous. Traditional applications are:

- Drinking water installations
- Waste treatment plants
- Swimming pools
- Aqua culture / aquariums

To date all of these applications had to have a certain dimension before the use of ozone became interesting. With the development of the OZAT® product, and consequently inexpensive ozone, the problems encountered with the smaller

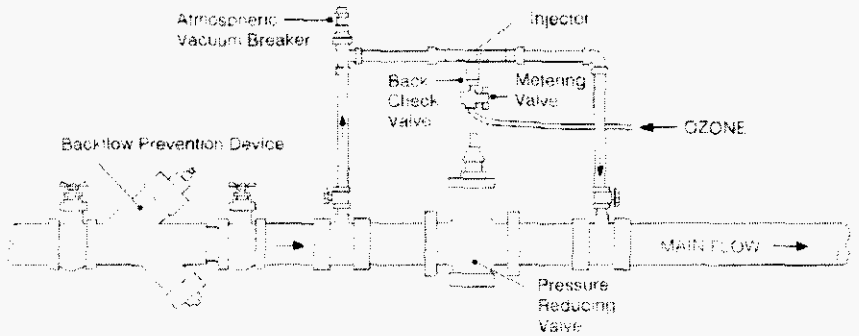


Fig. 9: In-line venturi injector

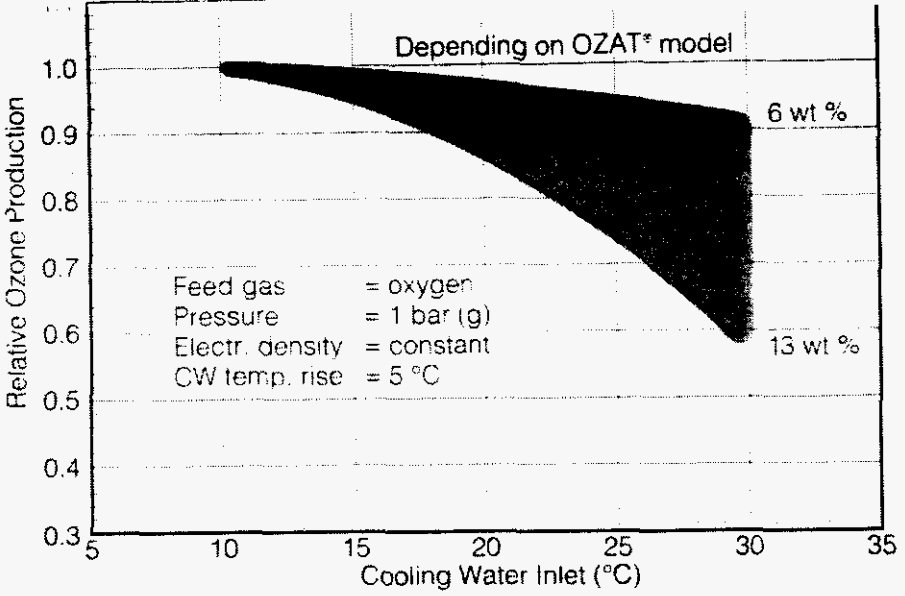


Fig. 10: Cooling water effect on ozone yield

installations in the same fields can also now be solved with ozone.

Drinking water

Ozone is ideally suited for the treatment of drinking water. One of the most important steps is disinfection, that, incidentally, was the first application of ozone as far back as the turn of the century. In order to disinfect water it is an accepted standard that a residual ozone concentration of 0.4 mg/l must be maintained for a period of 4 minutes resulting in a micro-organism kill-rate greater than 99.9%.

In many cases ground water contains excessive amounts of iron and manganese – these elements can readily be removed with ozone. The dissolved iron and manganese are converted into insoluble oxides which then precipitate and are removed by sedimentation and/or filtration.

Raw water also contains a multitude of organic compounds resulting from natural decay, decomposition processes, environmental pollution, industrial waste water, etc. Because some of these compounds cause water to discolour or to smell unpleasant and some of them are mutagenic, they must be eliminated or converted into harmless compounds. Ozone is excellently suited for such processes.

- Decolouration
  The colour of surface water used for drinking purposes is caused by conjugated double humic acid bonds. Ozone breaks down these bonds in to colourless saturated compounds – other compounds producing colour are also destroyed.

- Taste and odour
  Organic compounds that occur during anaerobic decomposition of ground and surface water under extreme oxygen deficiency usually impart an unpleasant taste and odour to the untreated water. Other sources of bad tastes and odours are phenols and chlorophenols, introduced to the water by pollution, and algae. Ozone is the perfect chemical for improving the organoleptic qualities of drinking water.

- Undesirable compounds
  In recent years a large number of mutagenic and carcinogenic compounds have been found in surface water and, consequently, in drinking water. There are 2 sources of mutagens in water: mutagenic that only form mutagenic compounds if they come into contact with chlorine. The former constitute a continuously growing danger proportional to environmental pollution. Precursors are for example humic acids which form trihalomethanes when they come in to contact with chlorine. In order to prevent the formation of THMs the precursors must be removed prior to chlorination. As already mentioned, such precursors can be easily oxidised with ozone.

- Residual protection
  A very important advantage of ozone treatment is because the oxidisable components have already been removed, only a small dose of conventional disinfection medium is required to achieve residual protection. These minor amounts do not have the same disadvantages as when the whole treatment process was carried out with the same conventional medium.

Waste treatment plants

The chemical oxidation with ozone is an innovative technology for the treatment of effluents that are contaminated with organic chemicals. Ozone alone, or in combination with hydroxyl-radicals, is effective against most organic compounds and the chemicals used in the process decompose to harmless and even beneficial by-products. The main objective of treating heavily polluted effluents is to reduce the COD and AOX load in particular the persistent portion that cannot be removed by biological pretreatment. When compared to alternatives, oxidation with ozone is a method that produces practically no residues requiring further specialised handling or treatment.

With the development of Advanced Technology ozone generators, such as OZAT®, and new findings in water treatment technology, these processes are becoming more cost

than expected.

Swimming pools

Swimming pools are basically a closed loop circulation system whereby the water that has been 'contaminated' by the swimmers in the pool, is circulated through a treatment stage in order to ensure that the actual water quality meets certain requirements in order to avoid the transmittal of diseases (conjunctivitis, enteritis, dermatitis, etc.) and infections.

The main objectives of disinfection is to keep the water clean in order to avoid health hazards and to prevent the growth of algae that would discolour the water.

Ozone is a particularly efficient disinfectant, which also breaks down certain amino acids, and turns the water an attractive blue colour. Special attention has to be given to the fact that there are no traces of ozone in the water being re-introduced into the swimming pool and all residual ozone must be destroyed in an activated carbon filter. As the pool water is susceptible to contamination without ozone, it is necessary to apply a low dose of chlorine, or one of its derivatives, to complete the disinfection process.

Aqua culture / aquariums

The application of ozone in fish hatcheries, fish farms, aquariums is becoming more and more popular. It is obvious that as soon the fish density per cubic metre is increased the risk of infection increases proportionally. In order to maintain the survival rate as high as possible it is of vital importance to ensure that there is no risk of water borne disease entering the system – this applies to circulating systems as well as once-through arrangements. As already mentioned in the section dealing with drinking water, ozone is an excellent disinfectant, however, special attention must be given to the fact that the residual ozone content in the water entering the fish tanks is below type of fish in question.

Further applications

With the advent of the OZAT® generators, potential users in the past who considered the use of ozone prohibitive because of cost, will reconsider. New applications will be discovered in many branches some of which have never taken advantage of ozone:

- Wafer etching in the semi-conductor industry
- Disinfection and treatment of cooling water circuits
- Disinfection and treatment of waste and recyclable material

The possibilities for product improvements by replacing conventional disinfectants with ozone, or just by introducing ozone, are enormous. For instance:

- In the beverage industry (bottled water, soft drinks, beer, etc., etc.) the water used must be treated and disinfected prior to use
- In canning and freezing factories products have to be carefully washed and vast quantities of clean water are required.

Other possible applications and uses are summarised here without any attempt at completeness:

- Disinfection purposes in slaughter houses
- Disinfection uses in zoos
- Air disinfection in cold storage facilities
- Wet disinfection of packing materials
- Disinfection of air conditioning systems
- Disinfection of patient washing water in hospitals
- Hygiene applications in operating theatres
- Advance oxidation processes (AOP)
- Etc.

continuing development is now concentrating on increasing profitability even further by reducing the client's initial investment costs and, at the same time raising the efficiency of the equipment.

POWER REQUIREMENTS

- Mains voltage:	CF1 - 1 x 230V plus earth CF2 to CF6 - 3 x 400V plus earth
- Frequency:	50 / 60 Hz

PROTECTION CLASS: IP 42

SITE CONDITIONS

- Maximum altitude:	1000 m
- Ambient temperature:	Minimum: 5 °C Maximum: 40 °C Average over 24 hours: 35 °C

MATERIALS

- Enclosure:	Mild steel
- Enclosure colour:	RAL 5007 (brilliant blue)
- In contact with O_2:	316, 316L, PTFE and viton
- Cooling water:	PE, nickle plated brass, 304/316L

CONNECTIONS

Electrical

Mains terminals:	CF1 plug & socket – (3 x 2.5 mm^2) CF2 plug & socket – (4 x 2.5 mm^2) CF3 terminals (supression filter) – 4 x 4 mm^2 CF4 terminals (supression filter) – 4 x 10 mm^2 CF5 terminals (supression filter) – 4 x 10 mm^2 CF6 terminals (supression filter) – 4 x 16 mm^2
- Remote control:	CF1 and CF2 – 14 x 1.0 mm^2 CF3 to CF6 – 26 x 1.0 mm^2

Mechanical

- Gas:	CF1 - SERTO 10 mm CF2 - SERTO 10 mm CF3 - Flange ND 15, NP 16 CF4 - Flange ND 15, NP 16 CF5 - Flange ND 20, NP 16 CF6 - Flange ND 25, NP 16
- Cooling water:	CF1 - SERTO 12 mm CF2 - SERTO 12 mm CF3 - Union ½" CF4 - Union ¾" CF5 - Union 1" CF6 - Union 1"

SPECIFICATIONS

The equipment has been designed and manufactured in accordance with Swiss and European standards.

Ozonia around the world













Ozonia products are available in all countries over the world.
Please contact us to find out details of your representative.

Representative Water Facility Water Quality Information

Water Quality

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Laboratory technicians, plant operators and distribution system technicians conduct tens of thousands of tests per year to ensure the quality of the City's water. The chart below compares the parameters set by the Safe Drinking Water Act with Melbourne's test results. Water analyses are in accordance with Safe Drinking Water Act standards.

Comparison to Primary Standards

Chemical Constituents	Max. Contamination Levels - mg/L (Milligrams per Liter)	Treated Water - mg/L (Milligrams per Liter)
Arsenic	0.05	0.0050
Barium	2.0	0.015
Cadmium	0.0050	0.0010
Chromium	0.10	0.0070
Cyanide	0.20	0.004
Fluoride	4.0	0.76
Lead	0.015	0.0010
Mercury	0.002	0.00010
Nickel	0.10	0.010
Nitrate	10	0.260
Nitrite	1.0	0.020
Selenium	0.0500	0.0020
Sodium	160	28
Antimony	0.0060	0.0030
Beryllium	0.00400	0.00030
Thallium	0.0020	0.0010
Asbestos	No Standards	None Detected

Comparison to Secondary Standards

Chemical Constituent	Max. Contamination Levels - mg/L (Milligrams per Liter)	Treated Water - mg/L (Milligrams per Liter)
Aluminum	0.20	Not Detected
Chloride	250.0	55.0
Copper	1.0	Not Detected
Fluoride	2.0	0.76
Iron	0.30	Not Detected
Manganese	0.05	Not Detected

Silver	0.10	Not Detected
Sulfate	250.0	43.0
Zinc	5.0	Not Detected
Color (PCU)	15 PCU	Not Detected
Odor (TON)		Not Detected
Lab pH	6.5-8.5	6.94
Total Dissolved Solids	500.0	186.0
Foaming Agents	0.50	0.05

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Send mail to watercon@iu.net with questions or comments about this web site.

Orlando Utilities Commission

Water Quality Analysis

The Floridan Aquifer provides an excellent source of high quality drinking water. The water provided by OUC meets and exceeds all standards established by the Safe Drinking Water Act.

This chart compares the parameters set by the Safe Drinking Water Act with OUC test results. Water analysis are in accordance with Safe Drinking Water Act standards.

Comparison to Primary Standards

Primary standards relate to health and are expressed as Maximum Contamination Levels (MCL). Results in milligrams per liter (Mg/L).

Inorganics	MCL	Raw[1] Water	Treated[2] Water
Arsenic	0.05	<0.002	<0.002
Barium	2.0	<0.10	<0.10
Cadmium	0.005	<0.001	<0.001
Chromium	0.100	<0.001	<0.001
Lead	0.015	<0.002	<0.002
Mercury	0.002	<0.0005	<0.0005
Selenium	0.050	<0.002	<0.002
Sodium	160	6.1	9.8
Nitrate	10.0	0.04	0.09
Nitrite	1.0	<0.010	<0.010
Fluoride	4.0	0.18	0.90
Turbidity in NTU	1.0	0.18	0.56
Antimony	0.006	<0.002	<0.002
Beryllium	0.004	<0.0001	<0.0001
Nickel	0.100	<0.001	0.001
Thallium	0.002	<0.001	<0.001
Molybdenum	0.040	<0.002	<0.002
Organics			
Endrin	0.002	<0.00008	<0.00008
Lindane	0.0002	<0.00003	<0.00003
Methoxychlor	0.040	<0.00028	<0.00028
Silvex	0.050	<0.00008	<0.00008
Toxaphene	0.003	<0.003	<0.003
Cyanide	<0.200	<0.010	<0.006
Antimony	0.004	<0.002	<0.002
Beryllium	0.100	<0.001	<0.001
Nickel	0.002	<0.002	<0.002
Thallium	0.070	<0.001	<0.001
2-4-D	0.100	<0.00011	<0.00011
THMS (Total)	0.100	<0.001	0.039
VOCs - 44 Total	(3)	BDL	BDL
SOCs - 48 Total	(4)	BDL	BDL
Rodionuclides			
Gross Alpha/pCi/L	5.0		2.0

Comparison to Secondary Standards

Secondary standards also have Maximum Contamination Levels, but are related to aesthetic qualities such as taste, odor, and color.

Secondary Standards	MCL	Raw Water	Treated Water
Chloride	250	9.7	24.8
Color in Pt-Co Units	15	2	1
Copper	1.3	<0.05	<0.05
Corrosivity	+0.2 to -0.2	- 0.09	- 0.49
Foaming Agents	0.500	<0.10	<0.10
Iron	0.3	0.029	0.031
Manganese	0.05	<0.02	<0.02
Odor Threshold # Units	3	30	2
pH Units	>6.5	7.9	7.3
Sulfate	250	9.1	9.4
Total Dissolved Solids	500	158	178
Silver	0.100	<0.001	<0.001
Zinc	5.0	<0.01	<0.01

Additional Testing (No Standards)		
Alkalinity $CaCO_3$	114	110
Calcium as Ca	41.4	42.0
Carbon Dioxide	3.7	9.1
Dissolved Oxygen	0.3	5.2
Hydrogen Sulfide	1.4	0.15
Magnesium as Mg	9.4	9.4
Phosphate as P	0.12	0.13
Potassium as K	0.9	0.9
Silica as SiO2	13.5	13.6
Total Hardness as $CaCO_3$	133	134

Abbreviations:

BDL Below Detectable Limits
< Less Than
> Greater Than
N/A Not Applicable
MCL Maximum Contamination Levels

1. **Notes:**
2. Average raw water for 37 of 37 wells based on 1994 & 1995 test results.
3. Average treated water for 11 plants based on 1994 & 1995 test results.
4. MCL varies with each parameter.

5. No standards.

For more information about OUC Water Quality, please call (407) 244-8779.

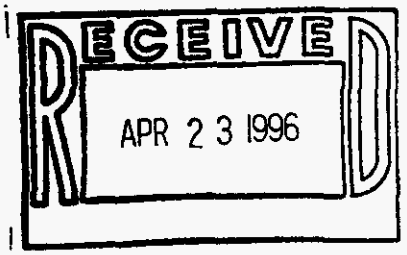
Revised 02/13/97

PUBLIC DRINKING WATER ANALYSIS REPORTING FORMAT

PUBLIC WATER SYSTEM INFORMATION (to be completed by system or lab)

System Name: ALOHA UTILITIES, INC. I.D.#: 6512214

Address: 2514 ALOHA PLACE HOLIDAY, FLORIDA 34691 Phone #: (813)937-4275
Type (check one): ( ) Community ( ) Nontransient Noncommunity ( ) Noncommunity



SAMPLE INFORMATION (to be completed by sampler)

Sample Date (MMDDYY) 02/29/96 Sample Time: 9:00 am

Sample Location (be specific): SEVEN SPRINGS WELL 1

Sampler's Signature: ALLAN CLARK Title: OPERATOR

Check Type(s): ( ) Distribution ( ) Recheck of MCL ( ) Resample of Lab Invalidated Sample
( ) Clearance ( ) Thm Max Res Time ( ) Plant Tap
( ) Distrib entry pt ( ) Raw ( ) Composite of Multiple Sites--Attach a format for each site

LABORATORY CERTIFICATION INFORMATION (to be completed by lab)

Lab Name: Tri-County Env. & Anal. Lab Inc. HRS#: 86140/E86070 Expiration Date: 6/30/96
Address: 2822 Land O' Lake Blvd., Land O' Lakes, FL 34639 Phone #: (813) 949-1069
Group Analyzed: INORGANIC CHEMICAL ANALYSIS

ANALYSIS INFORMATION (to be completed by lab)

Date Sample(s) Received: 02/29/96 Group(s) Analyzed & Results attached for compliance with 17-550, F.A.C.:

( ) Nitrate ( ) Nitrite ( ) Asbestos ( ) Turbidity

Inorganics--	Trihalomethanes --	Volatile Organics--	Secondaries --
(X) All 18 ( ) Partial	( ) All 4 ( ) Partial	( )All 21 ( ) Partial	( ) All 14 ( ) Partial

Pesticides & PCBs--	Group 1 Unregulateds--	Group 11 Unregulateds--	Radiochemicals--
( ) All 29 ( ) Partial	( ) All 13 ( ) Partial	( ) All 37 ( ) Partial	( ) Single Sample ( ) Qtrly Composite*

*Provide radiochemical sample dates & locations for each quarter

I, Tai Igbinosun, do HEARBY CERTIFY that all attached analytical data are correct.
Signature _____
Title Lab Manager Date 04/17/96

COMPLIANCE INFORMATION (to be completed by State)

Sample Collection Satisfactory:_____ Sample Analysis Satisfactory:_____
Resample Requested for:_____ Reason:_____
Person ndtified to resample:_____ Date Notified:_____
DER/ACPHU Reviewing Official:_____

TRI-COUNTY ENVIRONMENTAL & ANALYTICAL LAB INC.

2822 Land O' Lakes Blvd. / Land O' Lakes, FL 34639
Phone: (813) 949-1069 Fax (813) 949-4392
HRS#E84338 / 84420 / QA 9209 LD-048

REPORT NUMBER: 960229 / 0497-1

FOR: ALOHA UTILITIES
2514 ALOHA PLACE
HOLIDAY, FL. 34691

SAMPLE DATE :02/29/96
DATE RECEIVED :02/29/96
TIME SAMPLED : 9:00 am

PRIMARY INORGANIC ANALYSIS
62-550.310 (1)

SAMPLE MARKINGS: Annual Sampling

SITE: SEVEN SPRINGS WELL # 1

LABORATORY FINDINGS

PARAMETER ID	NAME	METHOD NUMBER	ANALYSIS RESULT (mg/l)	DETECTION LIMIT	DATE OF ANALYSIS
1005	Arsenic	SM3113B	<0.001	0.001	03/08/96
1010	Barium	208.2	<0.005	0.005	03/08/96
1015	Cadmium	213.2	<0.002	0.002	03/08/96
1020	Chromium	SM3113B	<0.005	0.005	03/08/96
1024	Cyanide	335.2	<0.002	0.002	03/08/96
1025	Fluoride	SM4500F C	0.09	0.01	03/05/96
1030	Lead	SM3113B	<0.001	0.001	03/08/96
1035	Mercury	245.1	<0.0002	0.0002	03/09/96
1036	Nickel	SM3111B	0.04	0.003	03/07/96
1040	Nitrate	353.2	0.07	0.01	03/07/96
1041	Nitrite	353.2	<0.01	0.01	03/07/96
otal	No2/No3	353.2	0.07	0.01	03/07/96
1045	Selenium	SM3113B	<0.001	0.001	03/09/96
1052	Sodium	SM3111B	42.6	0.002	03/09/96
1074	Antimony	204.2	<0.001	0.001	03/09/96
1075	Berylium	210.1	<0.002	0.002	03/09/96
1085	Thallium	279.2	<0.001	0.001	03/09/96

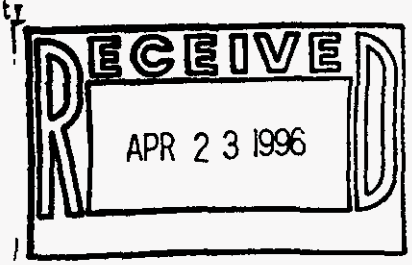
LAB MANAGER
TAI IGBINOSUN

PUBLIC DRINKING WATER ANALYSIS REPORTING FORMAT

PUBLIC WATER SYSTEM INFORMATION (to be completed by system or lab)

System Name: ALOHA UTILITIES, INC. I.D.#: 6512214

Address: 2514 ALOHA PLACE HOLIDAY, FLORIDA 34691 Phone #: (813)937-4275
Type (check one): ( ) Community ( ) Nontransient Noncommunity ( ) Noncommunity



SAMPLE INFORMATION (to be completed by sampler)

Sample Date (MMDDYY) 02/29/96 Sample Time: 9:16 am

Sample Location (be specific): SEVEN SPRINGS WELL 2

Sampler's Signature: ALLAN CLARK Title: OPERATOR

Check Type(s): ( ) Distribution ( ) Recheck of MCL ( ) Resample of Lab Invalidated Sample
( ) Clearance ( ) Thm Max Res Time ( ) Plant Tap
( ) Distrib entry pt ( ) Raw ( ) Composite of Multiple Sites--Attach a format for each site

LABORATORY CERTIFICATION INFORMATION (to be completed by lab)

Lab Name: Tri-County Env. & Anal. Lab Inc. HRS#: 86140/E86070 Expiration Date: 6/30/96
Address: 2822 Land O' Lake Blvd., Land O' Lakes, FL 34639 Phone #: (813) 949-1069
Group Analyzed: INORGANIC CHEMICAL ANALYSIS

ANALYSIS INFORMATION (to be completed by lab)

Date Sample(s) Received: 02/29/96 Group(s) Analyzed & Results attached for compliance with 17-550, F.A.C.:

( ) Nitrate ( ) Nitrite ( ) Asbestos ( ) Turbidity

Inorganics--	Trihalomethanes --	Volatile Organics--	Secondaries --
(X) All 18 ( ) Partial	( ) All 4 ( ) Partial	( )All 21 ( ) Partial	( ) All 14 ( ) Partial

Pesticides & PCBs--	Group 1 Unregulateds--	Group 11 Unregulateds--	Radiochemicals--
( ) All 29 ( ) Partial	( ) All 13 ( ) Partial	( ) All 37 ( ) Partial	( ) Single Sample
			( ) Qtrly Composite*

*Provide radiochemical sample dates & locations for each quarter

I, Tai Igbinosun, do HEREBY CERTIFY that all attached analytical data are correct.
Signature _____
Title Lab Manager Date 04/17/96

COMPLIANCE INFORMATION (to be completed by State)

Sample Collection Satisfactory:_____ Sample Analysis Satisfactory:_____
Resample Requested for:_____ Reason:_____
Person notified to resample:_____ Date Notified:_____
DER/ACPHU Reviewing Official:_____

TRI-COUNTY ENVIRONMENTAL & ANALYTICAL LAB INC.

2822 Land O' Lakes Blvd. / Land O' Lakes, FL 34639
Phone: (813) 949-1069 Fax (813) 949-4392
HRS#E84338 / 84420 / QA 9209 LD-048

REPORT NUMBER: 960229 / 0497-2

FOR: ALOHA UTILITIES
2514 ALOHA PLACE
HOLIDAY, FL. 34691

SAMPLE DATE :02/29/96
DATE RECEIVED :02/29/96
TIME SAMPLED : 9:16 am

PRIMARY INORGANIC ANALYSIS
62-550.310 (1)

SAMPLE MARKINGS: Annual Sampling

SITE: SEVEN SPRINGS WELL # 2

LABORATORY FINDINGS

PARAMETER ID	NAME	METHOD NUMBER	ANALYSIS RESULT (mg/l)	DETECTION LIMIT	DATE OF ANALYSIS
1005	Arsenic	SM3113B	<0.001	0.001	03/08/96
1010	Barium	208.2	<0.005	0.005	03/08/96
1015	Cadmium	213.2	<0.002	0.002	03/08/96
1020	Chromium	SM3113B	<0.005	0.005	03/08/96
1024	Cyanide	335.2	<0.002	0.002	03/08/96
1025	Fluoride	SM4500F C	0.04	0.01	03/05/96
1030	Lead	SM3113B	<0.001	0.001	03/08/96
1035	Mercury	245.1	<0.0002	0.0002	03/09/96
1036	Nickel	SM3111B	<0.003	0.003	03/07/96
1040	Nitrate	353.2	<0.01	0.01	03/07/96
1041	Nitrite	353.2	<0.01	0.01	03/07/96
otal	No2/No3	353.2	<0.01	0.01	03/07/96
1045	Selenium	SM3113B	<0.001	0.001	03/09/96
1052	Sodium	SM3111B	33.5	0.002	03/09/96
1074	Antimony	204.2	<0.001	0.001	03/09/96
1075	Berylium	210.1	<0.002	0.002	03/09/96
1085	Thallium	279.2	<0.001	0.001	03/09/96

LAB MANAGER
TAI IGBINOSUN

PUBLIC DRINKING WATER ANALYSIS REPORTING FORMAT

PUBLIC WATER SYSTEM INFORMATION (to be completed by system or lab)

System Name: ALOHA UTILITIES, INC. I.D.#: 6512214

Address: 2514 ALOHA PLACE HOLIDAY, FLORIDA 34691 Phone #: (813)937-4275
Type (check one): ( ) Community ( ) Nontransient Noncommunity ( ) Noncommunity

RECEIVED
APR 23 1996

SAMPLE INFORMATION (to be completed by sampler)

Sample Date (MMDDYY) 02/29/96 Sample Time: 8:20 am

Sample Location (be specific): SEVEN SPRINGS WELL 3

Sampler's Signature: ALLAN CLARK Title: OPERATOR

Check Type(s): ( ) Distribution ( ) Recheck of MCL ( ) Resample of Lab Invalidated Sample
( ) Clearance ( ) Thm Max Res Time ( ) Plant Tap
( ) Distrib entry pt ( ) Raw ( ) Composite of Multiple Sites--Attach a format for each site

LABORATORY CERTIFICATION INFORMATION (to be completed by lab)

Lab Name: Tri-County Env. & Anal. Lab Inc. HRS#: 86140/E86070 Expiration Date: 6/30/96
Address: 2822 Land O' Lake Blvd., Land O' Lakes, FL 34639 Phone #: (813) 949-1069
Group Analyzed: INORGANIC CHEMICAL ANALYSIS

ANALYSIS INFORMATION (to be completed by lab)

Date Sample(s) Received: 02/29/96 Group(s) Analyzed & Results attached for compliance with 17-550, F.A.C.:

( ) Nitrate ( ) Nitrite ( ) Asbestos ( ) Turbidity

Inorganics--	Trihalomethanes --	Volatile Organics--	Secondaries --
(X) All 18 ( ) Partial	( ) All 4 ( ) Partial	( )All 21 ( ) Partial	( ) All 14 ( ) Partial

Pesticides & PCBs--	Group 1 Unregulateds--	Group 11 Unregulateds--	Radiochemicals--
( ) All 29 ( ) Partial	( ) All 13 ( ) Partial	( ) All 37 ( ) Partial	( ) Single Sample
			( ) Qtrly Composite*

*Provide radiochemical sample dates & locations for each quarter

I, Tai Igbinosun, do HEARBY CERTIFY that all attached analytical data are correct.
Signature _____
Title Lab Manager Date 04/17/96

COMPLIANCE INFORMATION (to be completed by State)

Sample Collection Satisfactory:_____ Sample Analysis Satisfactory:_____
Resample Requested for:_____ Reason:_____
Person notified to resample:_____ Date Notified:_____
DER/ACPHU Reviewing Official:_____

TRI-COUNTY ENVIRONMENTAL & ANALYTICAL LAB INC.

2822 Land O' Lakes Blvd. / Land O' Lakes, FL 34639
Phone: (813) 949-1069 Fax (813) 949-4392
HRS#E84338 / 84420 / QA 9209 LD-048

REPORT NUMBER: 960229 / 0497-3

FOR: ALOHA UTILITIES
2514 ALOHA PLACE
HOLIDAY, FL. 34691

SAMPLE DATE :02/29/96
DATE RECEIVED :02/29/96
TIME SAMPLED : 8:20 am

PRIMARY INORGANIC ANALYSIS
62-550.310 (1)

SAMPLE MARKINGS: Annual Sampling

SITE: SEVEN SPRINGS WELL # 3

LABORATORY FINDINGS

PARAMETER ID	NAME	METHOD NUMBER	ANALYSIS RESULT (mg/l)	DETECTION LIMIT	DATE OF ANALYSIS
1005	Arsenic	SM3113B	<0.001	0.001	03/08/96
1010	Barium	208.2	<0.005	0.005	03/08/96
1015	Cadmium	213.2	<0.002	0.002	03/08/96
1020	Chromium	SM3113B	<0.005	0.005	03/08/96
1024	Cyanide	335.2	<0.002	0.002	03/08/96
1025	Fluoride	SM4500F C	0.06	0.01	03/05/96
1030	Lead	SM3113B	<0.001	0.001	03/08/96
1035	Mercury	245.1	<0.0002	0.0002	03/09/96
1036	Nickel	SM3111B	<0.003	0.003	03/07/96
1040	Nitrate	353.2	0.15	0.01	03/07/96
1041	Nitrite	353.2	<0.01	0.01	03/07/96
otal	No2/No3	353.2	0.15	0.01	03/07/96
1045	Selenium	SM3113B	<0.001	0.001	03/09/96
1052	Sodium	SM3111B	21.2	0.002	03/09/96
1074	Antimony	204.2	<0.001	0.001	03/09/96
1075	Berylium	210.1	<0.002	0.002	03/09/96
1085	Thallium	279.2	<0.001	0.001	03/09/96

LAB MANAGER
TAI IGBINOSUN

PUBLIC DRINKING WATER ANALYSIS REPORTING FORMAT

PUBLIC WATER SYSTEM INFORMATION (to be completed by system or lab)

System Name: ALOHA UTILITIES, INC. I.D.#: 6512214

Address: 2514 ALOHA PLACE HOLIDAY, FLORIDA 34691 Phone #: (813)937-4275
Type (check one): ( ) Community ( ) Nontransient Noncommunity ( ) Noncommunity

RECEIVED
APR 23 1996

SAMPLE INFORMATION (to be completed by sampler)

Sample Date (MMDDYY) 02/29/96 Sample Time: 8:00 am

Sample Location (be specific): SEVEN SPRINGS WELL 4

Sampler's Signature: ALLAN CLARK Title: OPERATOR

Check Type(s): ( ) Distribution ( ) Recheck of MCL ( ) Resample of Lab Invalidated Sample
( ) Clearance ( ) Thm Max Res Time ( ) Plant Tap
( ) Distrib entry pt ( ) Raw ( ) Composite of Multiple Sites--Attach a format for each site

LABORATORY CERTIFICATION INFORMATION (to be completed by lab)

Lab Name: Tri-County Env. & Anal. Lab Inc. HRS#: 86140/E86070 Expiration Date: 6/30/96
Address: 2822 Land O' Lake Blvd., Land O' Lakes, FL 34639 Phone #: (813) 949-1069
Group Analyzed: INORGANIC CHEMICAL ANALYSIS

ANALYSIS INFORMATION (to be completed by lab)

Date Sample(s) Received: 02/29/96 Group(s) Analyzed & Results attached for compliance with 17-550, F.A.C.:

( ) Nitrate ( ) Nitrite ( ) Asbestos ( ) Turbidity

Inorganics--	Trihalomethanes --	Volatile Organics--	Secondaries --
(X) All 18 ( ) Partial	( ) All 4 ( ) Partial	( )All 21 ( ) Partial	( ) All 14 ( ) Partial

Pesticides & PCBs--	Group 1 Unregulateds--	Group 11 Unregulateds--	Radiochemicals--
( ) All 29 ( ) Partial	( ) All 13 ( ) Partial	( ) All 37 ( ) Partial	( ) Single Sample
			( ) Qtrly Composite*

*Provide radiochemical sample dates & locations for each quarter

I, Tai Igbinosun, do HEARBY CERTIFY that all attached analytical data are correct.
Signature _____
Title Lab Manager Date 04/17/96

COMPLIANCE INFORMATION (to be completed by State)

Sample Collection Satisfactory:_____ Sample Analysis Satisfactory:_____
Resample Requested for:_____ Reason:_____
Person notified to resample:_____ Date Notified:_____
DER/ACPHU Reviewing Official:_____

TRI-COUNTY ENVIRONMENTAL & ANALYTICAL LAB INC.

2822 Land O' Lakes Blvd. / Land O' Lakes, FL 34639
Phone: (813) 949-1069 Fax (813) 949-4392
HRS#E84338 / 84420 / QA 9209 LD-048

REPORT NUMBER: 960229 / 0497-4

FOR: ALOHA UTILITIES
2514 ALOHA PLACE
HOLIDAY, FL. 34691

SAMPLE DATE :02/29/96
DATE RECEIVED :02/29/96
TIME SAMPLED : 8:00 am

PRIMARY INORGANIC ANALYSIS
62-550.310 (1)

SAMPLE MARKINGS: Annual Sampling

SITE: SEVEN SPRINGS WELL # 4

LABORATORY FINDINGS

PARAMETER ID	NAME	METHOD NUMBER	ANALYSIS RESULT (mg/l)	DETECTION LIMIT	DATE OF ANALYSIS
1005	Arsenic	SM3113B	<0.001	0.001	03/08/96
1010	Barium	208.2	<0.005	0.005	03/08/96
1015	Cadmium	213.2	<0.002	0.002	03/08/96
1020	Chromium	SM3113B	<0.005	0.005	03/08/96
1024	Cyanide	335.2	<0.002	0.002	03/08/96
1025	Fluoride	SM4500F C	0.071	0.01	03/05/96
1030	Lead	SM3113B	<0.001	0.001	03/08/96
1035	Mercury	245.1	<0.0002	0.0002	03/09/96
1036	Nickel	SM3111B	0.102	0.003	03/07/96
1040	Nitrate	353.2	<0.01	0.01	03/07/96
1041	Nitrite	353.2	<0.01	0.01	03/07/96
otal	No2/No3	353.2	<0.01	0.01	03/07/96
1045	Selenium	SM3113B	<0.001	0.001	03/09/96
1052	Sodium	SM3111B	20.2	0.002	03/09/96
1074	Antimony	204.2	<0.001	0.001	03/09/96
1075	Berylium	210.1	<0.002	0.002	03/09/96
1085	Thallium	279.2	<0.001	0.001	03/09/96

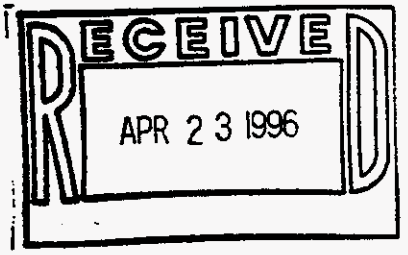
LAB MANAGER
TAI IGBINOSUN

PUBLIC DRINKING WATER ANALYSIS REPORTING FORMAT

PUBLIC WATER SYSTEM INFORMATION (to be completed by system or lab)

System Name: ALOHA UTILITIES, INC. I.D.#: 6512214

Address: 2514 ALOHA PLACE HOLIDAY, FLORIDA 34691 Phone #: (813)937-4275
Type (check one): ( ) Community ( ) Nontransient Noncommunity ( ) Noncommunity



SAMPLE INFORMATION (to be completed by sampler)

Sample Date (MMDDYY) 02/29/96 Sample Time: 10:10 am

Sample Location (be specific): SEVEN SPRINGS WELL 6

Sampler's Signature: ALLAN CLARK Title: OPERATOR

Check Type(s): ( ) Distribution ( ) Recheck of MCL ( ) Resample of Lab Invalidated Sample
( ) Clearance ( ) Thm Max Res Time ( ) Plant Tap
( ) Distrib entry pt ( ) Raw ( ) Composite of Multiple Sites--Attach a format for each site

LABORATORY CERTIFICATION INFORMATION (to be completed by lab)

Lab Name: Tri-County Env. & Anal. Lab Inc. HRS#: 86140/E86070 Expiration Date: 6/30/96
Address: 2822 Land O' Lake Blvd., Land O' Lakes, FL 34639 Phone #: (813) 949-1069
Group Analyzed: INORGANIC CHEMICAL ANALYSIS

ANALYSIS INFORMATION (to be completed by lab)

Date Sample(s) Received: 02/29/96 Group(s) Analyzed & Results attached for compliance with 17-550, F.A.C.:

( ) Nitrate ( ) Nitrite ( ) Asbestos ( ) Turbidity

Inorganics--	Trihalomethanes --	Volatile Organics--	Secondaries --
(X) All 18 ( ) Partial	( ) All 4 ( ) Partial	( )All 21 ( ) Partial	( ) All 14 ( ) Partial

Pesticides & PCBs--	Group 1 Unregulateds--	Group 11 Unregulateds--	Radiochemicals--
( ) All 29 ( ) Partial	( ) All 13 ( ) Partial	( ) All 37 ( ) Partial	( ) Single Sample ( ) Qtrly Composite*

*Provide radiochemical sample dates & locations for each quarter

I, Tai Igbinosun, do HEARBY CERTIFY that all attached analytical data are correct.
Signature _____
Title Lab Manager Date 04/17/96

COMPLIANCE INFORMATION (to be completed by State)

Sample Collection Satisfactory:_____ Sample Analysis Satisfactory:_____
Resample Requested for:_____ Reason:_____
Person notified to resample:_____ Date Notified:_____
DER/ACPHU Reviewing Official:_____

TRI-COUNTY ENVIRONMENTAL & ANALYTICAL LAB INC.

2822 Land O' Lakes Blvd. / Land O' Lakes, FL 34639
Phone: (813) 949-1069 Fax (813) 949-4392
HRS#E84338 / 84420 / QA 9209 LD-048

REPORT NUMBER: 960229 / 0497-5

FOR: ALOHA UTILITIES
2514 ALOHA PLACE
HOLIDAY, FL. 34691

SAMPLE DATE :02/29/96
DATE RECEIVED :02/29/96
TIME SAMPLED :10:10 am

PRIMARY INORGANIC ANALYSIS
62-550.310 (1)

SAMPLE MARKINGS: Annual Sampling

SITE: SEVEN SPRINGS WELL # 6

LABORATORY FINDINGS

PARAMETER ID	NAME	METHOD NUMBER	ANALYSIS RESULT (mg/l)	DETECTION LIMIT	DATE OF ANALYSIS
1005	Arsenic	SM3113B	<0.001	0.001	03/08/96
1010	Barium	208.2	<0.005	0.005	03/08/96
1015	Cadmium	213.2	<0.002	0.002	03/08/96
1020	Chromium	SM3113B	<0.005	0.005	03/08/96
1024	Cyanide	335.2	<0.002	0.002	03/08/96
1025	Fluoride	SM4500F C	0.062	0.01	03/05/96
1030	Lead	SM3113B	<0.001	0.001	03/08/96
1035	Mercury	245.1	<0.0002	0.0002	03/09/96
1036	Nickel	SM3111B	<0.003	0.003	03/07/96
1040	Nitrate	353.2	0.06	0.01	03/07/96
1041	Nitrite	353.2	<0.01	0.01	03/07/96
otal	No2/No3	353.2	0.06	0.01	03/07/96
1045	Selenium	SM3113B	<0.001	0.001	03/09/96
1052	Sodium	SM3111B	22.8	0.002	03/09/96
1074	Antimony	204.2	<0.001	0.001	03/09/96
1075	Berylium	210.1	<0.002	0.002	03/09/96
1085	Thallium	279.2	<0.001	0.001	03/09/96

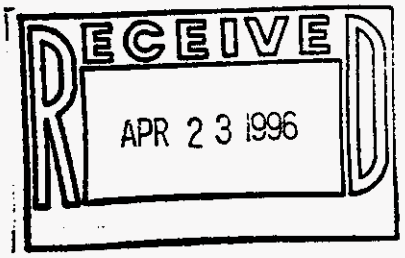
LAB MANAGER
TAI IGBINOSUN

PUBLIC DRINKING WATER ANALYSIS REPORTING FORMAT

PUBLIC WATER SYSTEM INFORMATION (to be completed by system or lab)

System Name: ALOHA UTILITIES, INC. I.D.#: 6512214

Address: 2514 ALOHA PLACE HOLIDAY, FLORIDA 34691 Phone #: (813)937-4275
Type (check one): ( ) Community ( ) Nontransient Noncommunity ( ) Noncommunity



SAMPLE INFORMATION (to be completed by sampler)

Sample Date (MMDDYY) 02/29/96 Sample Time: 10:30 am

Sample Location (be specific): SEVEN SPRINGS WELL 7

Sampler's Signature: ALLAN CLARK Title: OPERATOR

Check Type(s): ( ) Distribution ( ) Recheck of MCL ( ) Resample of Lab Invalidated Sample
( ) Clearance ( ) Thm Max Res Time ( ) Plant Tap
( ) Distrib entry pt ( ) Raw ( ) Composite of Multiple Sites--Attach a format for each site

LABORATORY CERTIFICATION INFORMATION (to be completed by lab)

Lab Name: Tri-County Env. & Anal. Lab Inc. HRS#: 86140/E86070 Expiration Date: 6/30/96
Address: 2822 Land O' Lake Blvd., Land O' Lakes, FL 34639 Phone #: (813) 949-1069
Group Analyzed: INORGANIC CHEMICAL ANALYSIS

ANALYSIS INFORMATION (to be completed by lab)

Date Sample(s) Received: 02/29/96 Group(s) Analyzed & Results attached for compliance with 17-550, F.A.C.:

( ) Nitrate ( ) Nitrite ( ) Asbestos ( ) Turbidity

Inorganics--	Trihalomethanes --	Volatile Organics--	Secondaries --
(X) All 18 ( ) Partial	( ) All 4 ( ) Partial	( )All 21 ( ) Partial	( ) All 14 ( ) Partial

Pesticides & PCBs--	Group 1 Unregulateds--	Group 11 Unregulateds--	Radiochemicals--
( ) All 29 ( ) Partial	( ) All 13 ( ) Partial	( ) All 37 ( ) Partial	( ) Single Sample
			( ) Qtrly Composite*

*Provide radiochemical sample dates & locations for each quarter

I, Tai Igbinosun, do HEARBY CERTIFY that all attached analytical data are correct.
Signature _____
Title Lab Manager Date 04/17/96

COMPLIANCE INFORMATION (to be completed by State)

Sample Collection Satisfactory:_____ Sample Analysis Satisfactory:_____
Resample Requested for:_____ Reason:_____
Person notified to resample:_____ Date Notified:_____
DER/ACPHU Reviewing Official:_____

TRI-COUNTY ENVIRONMENTAL & ANALYTICAL LAB INC.

2822 Land O' Lakes Blvd. / Land O' Lakes, FL 34639
Phone: (813) 949-1069 Fax (813) 949-4392
HRS#E84338 / 84420 / QA 9209 LD-048

REPORT NUMBER: 960229 / 0497-6

FOR: ALOHA UTILITIES
2514 ALOHA PLACE
HOLIDAY, FL. 34691

SAMPLE DATE :02/29/96
DATE RECEIVED :02/29/96
TIME SAMPLED :10:30 am

PRIMARY INORGANIC ANALYSIS
62-550.310 (1)

SAMPLE MARKINGS: Annual Sampling

SITE: SEVEN SPRINGS WELL # 7

LABORATORY FINDINGS

PARAMETER ID	NAME	METHOD NUMBER	ANALYSIS RESULT (mg/l)	DETECTION LIMIT	DATE OF ANALYSIS
1005	Arsenic	SM3113B	<0.001	0.001	03/08/96
1010	Barium	208.2	<0.005	0.005	03/08/96
1015	Cadmium	213.2	<0.002	0.002	03/08/96
1020	Chromium	SM3113B	<0.005	0.005	03/08/96
1024	Cyanide	335.2	<0.002	0.002	03/08/96
1025	Fluoride	SM4500F C	0.07	0.01	03/05/96
1030	Lead	SM3113B	<0.001	0.001	03/08/96
1035	Mercury	245.1	<0.0002	0.0002	03/09/96
1036	Nickel	SM3111B	0.04	0.003	03/07/96
1040	Nitrate	353.2	0.15	0.01	03/07/96
1041	Nitrite	353.2	<0.01	0.01	03/07/96
otal	No2/No3	353.2	0.15	0.01	03/07/96
1045	Selenium	SM3113B	<0.001	0.001	03/09/96
1052	Sodium	SM3111B	20.0	0.002	03/09/96
1074	Antimony	204.2	<0.001	0.001	03/09/96
1075	Berylium	210.1	<0.002	0.002	03/09/96
1085	Thallium	279.2	<0.001	0.001	03/09/96

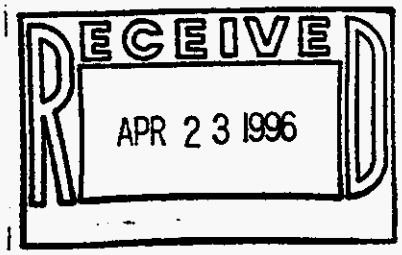
LAB MANAGER
"AI IGBINOSUN

PUBLIC DRINKING WATER ANALYSIS REPORTING FORMAT

PUBLIC WATER SYSTEM INFORMATION (to be completed by system or lab)

System Name: ALOHA UTILITIES, INC. I.D.#: 6512214

Address: 2514 ALOHA PLACE HOLIDAY, FLORIDA 34691 Phone #: (813)937-4275
Type (check one): ( ) Community ( ) Nontransient Noncommunity ( ) Noncommunity



SAMPLE INFORMATION (to be completed by sampler)

Sample Date (MMDDYY) 02/29/96 Sample Time: 10:45 am

Sample Location (be specific): SEVEN SPRINGS WELL 8

Sampler's Signature: ALLAN CLARK Title: OPERATOR

Check Type(s): ( ) Distribution ( ) Recheck of MCL ( ) Resample of Lab Invalidated Sample
( ) Clearance ( ) Thm Max Res Time ( ) Plant Tap
( ) Distrib entry pt ( ) Raw ( ) Composite of Multiple Sites--Attach a format for each site

LABORATORY CERTIFICATION INFORMATION (to be completed by lab)

Lab Name: Tri-County Env. & Anal. Lab Inc. HRS#: 86140/E86070 Expiration Date: 6/30/96
Address: 2822 Land O' Lake Blvd., Land O' Lakes, FL 34639 Phone #: (813) 949-1069
Group Analyzed: INORGANIC CHEMICAL ANALYSIS

ANALYSIS INFORMATION (to be completed by lab)

Date Sample(s) Received: 02/29/96 Group(s) Analyzed & Results attached for compliance with 17-550, F.A.C.:

( ) Nitrate ( ) Nitrite ( ) Asbestos ( ) Turbidity

Inorganics--	Trihalomethanes --	Volatile Organics--	Secondaries --
(X) All 18 ( ) Partial	( ) All 4 ( ) Partial	( )All 21 ( ) Partial	( ) All 14 ( ) Partial

Pesticides & PCBs--	Group 1 Unregulateds--	Group 11 Unregulateds--	Radiochemicals--
( ) All 29 ( ) Partial	( ) All 13 ( ) Partial	( ) All 37 ( ) Partial	( ) Single Sample ( ) Qtrly Composite*

*Provide radiochemical sample dates & locations for each quarter

I, Tai Igbinosun, do HEARBY CERTIFY that all attached analytical data are correct.
Signature _____
Title Lab Manager Date 04/17/96

COMPLIANCE INFORMATION (to be completed by State)

Sample Collection Satisfactory:_____ Sample Analysis Satisfactory:_____
Resample Requested for:_____ Reason:_____
Person notified to resample:_____ Date Notified:_____
DER/ACPHU Reviewing Official:_____

TRI-COUNTY ENVIRONMENTAL & ANALYTICAL LAB INC.

2822 Land O' Lakes Blvd. / Land O' Lakes, FL 34639
Phone: (813) 949-1069 Fax (813) 949-4392
HRS#E84338 / 84420 / QA 9209 LD-048

REPORT NUMBER: 960229 / 0497-7

FOR: ALOHA UTILITIES
2514 ALOHA PLACE
HOLIDAY, FL. 34691

SAMPLE DATE :02/29/96
DATE RECEIVED :02/29/96
TIME SAMPLED :10:45 am

PRIMARY INORGANIC ANALYSIS
62-550.310 (1)

SAMPLE MARKINGS: Annual Sampling

SITE: SEVEN SPRINGS WELL # 8

LABORATORY FINDINGS

PARAMETER ID	NAME	METHOD NUMBER	ANALYSIS RESULT (mg/l)	DETECTION LIMIT	DATE OF ANALYSIS
1005	Arsenic	SM3113B	<0.001	0.001	03/08/96
1010	Barium	208.2	<0.005	0.005	03/08/96
1015	Cadmium	213.2	<0.002	0.002	03/08/96
1020	Chromium	SM3113B	<0.005	0.005	03/08/96
1024	Cyanide	335.2	<0.002	0.002	03/08/96
1025	Fluoride	SM4500F C	0.08	0.01	03/05/96
1030	Lead	SM3113B	<0.001	0.001	03/08/96
1035	Mercury	245.1	<0.0002	0.0002	03/09/96
1036	Nickel	SM3111B	<0.003	0.003	03/07/96
1040	Nitrate	353.2	2.07	0.01	03/07/96
1041	Nitrite	353.2	<0.01	0.01	03/07/96
otal	No2/No3	353.2	2.07	0.01	03/07/96
1045	Selenium	SM3113B	<0.001	0.001	03/09/96
1052	Sodium	SM3111B	22.8	0.002	03/09/96
1074	Antimony	204.2	<0.001	0.001	03/09/96
1075	Berylium	210.1	<0.002	0.002	03/09/96
1085	Thallium	279.2	<0.001	0.001	03/09/96

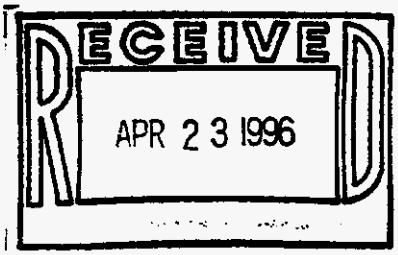
LAB MANAGER
TAI IGBINOSUN

PUBLIC DRINKING WATER ANALYSIS REPORTING FORMAT

PUBLIC WATER SYSTEM INFORMATION (to be completed by system or lab)

System Name: ALOHA UTILITIES, INC. I.D.#: 6512214

Address: 2514 ALOHA PLACE HOLIDAY, FLORIDA 34691 Phone #: (813)937-4275
Type (check one): ( ) Community ( ) Nontransient Noncommunity ( ) Noncommunity



SAMPLE INFORMATION (to be completed by sampler)

Sample Date (MMDDYY) 02/29/96 Sample Time: 11:00 am

Sample Location (be specific): SEVEN SPRINGS WELL 9

Sampler's Signature: ALLAN CLARK Title: OPERATOR

Check Type(s): ( ) Distribution ( ) Recheck of MCL ( ) Resample of Lab Invalidated Sample
( ) Clearance ( ) Thm Max Res Time ( ) Plant Tap
( ) Distrib entry pt ( ) Raw ( ) Composite of Multiple Sites--Attach a format for each site

LABORATORY CERTIFICATION INFORMATION (to be completed by lab)

Lab Name: Tri-County Env. & Anal. Lab Inc. HRS#: 86140/E86070 Expiration Date: 6/30/96
Address: 2822 Land O' Lake Blvd., Land O' Lakes, FL 34639 Phone #: (813) 949-1069
Group Analyzed: INORGANIC CHEMICAL ANALYSIS

ANALYSIS INFORMATION (to be completed by lab)

Date Sample(s) Received: 02/29/96 Group(s) Analyzed & Results attached for compliance with 17-550, F.A.C.:

( ) Nitrate ( ) Nitrite ( ) Asbestos ( ) Turbidity

Inorganics--	Trihalomethanes --	Volatile Organics--	Secondaries --
(X) All 18 ( ) Partial	( ) All 4 ( ) Partial	( )All 21 ( ) Partial	( ) All 14 ( ) Partial

Pesticides & PCBs--	Group 1 Unregulateds--	Group 11 Unregulateds--	Radiochemicals--
( ) All 29 ( ) Partial	( ) All 13 ( ) Partial	( ) All 37 ( ) Partial	( ) Single Sample ( ) Qtrly Composite*

*Provide radiochemical sample dates & locations for each quarter

I, Tai Igbinosun, do HEARBY CERTIFY that all attached analytical data are correct.
Signature _____
Title Lab Manager Date 04/17/96

COMPLIANCE INFORMATION (to be completed by State)

Sample Collection Satisfactory:_____ Sample Analysis Satisfactory:_____
Resample Requested for:_____ Reason:_____
Person notified to resample:_____ Date Notified:_____
DER/ACPHU Reviewing Official:_____

TRI-COUNTY ENVIRONMENTAL & ANALYTICAL LAB INC.

2822 Land O' Lakes Blvd. / Land O' Lakes, FL 34639
Phone: (813) 949-1069 Fax (813) 949-4392
HRS#E84338 / 84420 / QA 9209 LD-048

REPORT NUMBER: 960229 / 0497-8

FOR: ALOHA UTILITIES
2514 ALOHA PLACE
HOLIDAY, FL. 34691

SAMPLE DATE :02/29/96
DATE RECEIVED :02/29/96
TIME SAMPLED :11:00 am

PRIMARY INORGANIC ANALYSIS
62-550.310 (1)

SAMPLE MARKINGS: Annual Sampling

SITE: SEVEN SPRINGS WELL # 9

LABORATORY FINDINGS

PARAMETER ID	NAME	METHOD NUMBER	ANALYSIS RESULT (mg/l)	DETECTION LIMIT	DATE OF ANALYSIS
1005	Arsenic	SM3113B	<0.001	0.001	03/08/96
1010	Barium	208.2	<0.005	0.005	03/08/96
1015	Cadmium	213.2	<0.002	0.002	03/08/96
1020	Chromium	SM3113B	<0.005	0.005	03/08/96
1024	Cyanide	335.2	<0.002	0.002	03/08/96
1025	Fluoride	SM4500F C	0.041	0.01	03/05/96
1030	Lead	SM3113B	<0.001	0.001	03/08/96
1035	Mercury	245.1	<0.0002	0.0002	03/09/96
1036	Nickel	SM3111B	<0.003	0.003	03/07/96
1040	Nitrate	353.2	0.06	0.01	03/07/96
1041	Nitrite	353.2	<0.01	0.01	03/07/96
otal	No2/No3	353.2	0.06	0.01	03/07/96
1045	Selenium	SM3113B	<0.001	0.001	03/09/96
1052	Sodium	SM3111B	20.0	0.002	03/09/96
1074	Antimony	204.2	<0.001	0.001	03/09/96
1075	Berylium	210.1	<0.002	0.002	03/09/96
1085	Thallium	279.2	<0.001	0.001	03/09/96

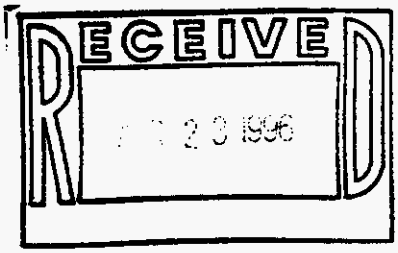
LAB MANAGER
"AI IGBINOSUN

PUBLIC DRINKING WATER ANALYSIS REPORTING FORMAT

PUBLIC WATER SYSTEM INFORMATION (to be completed by system or lab)

System Name: ALOHA UTILITIES, INC. I.D.#: 6512214

Address: 2514 ALOHA PLACE HOLIDAY, FLORIDA 34691 Phone #: (813)937-4275
Type (check one): ( ) Community ( ) Nontransient Noncommunity ( ) Noncommunity



SAMPLE INFORMATION (to be completed by sampler)

Sample Date (MMDDYY) 02/29/96 Sample Time: 9:00 am

Sample Location (be specific): SEVEN SPRINGS WELL 1

Sampler's Signature: ALLAN CLARK Title: OPERATOR

Check Type(s): ( ) Distribution ( ) Recheck of MCL ( ) Resample of Lab Invalidated Sample
( ) Clearance ( ) Thm Max Res Time ( ) Plant Tap
( ) Distrib entry pt ( ) Raw ( ) Composite of Multiple Sites--Attach a format for each site

LABORATORY CERTIFICATION INFORMATION (to be completed by lab)

Lab Name: Tri-County Env. & Anal. Lab Inc. HRS#: 86140/E86070 Expiration Date: 6/30/96
Address: 2822 Land O' Lake Blvd., Land O' Lakes, FL 34639 Phone #: (813) 949-1069
Group Analyzed: SECONDARY CHEMICAL ANALYSIS

ANALYSIS INFORMATION (to be completed by lab)

Date Sample(s) Received: 02/29/96 Group(s) Analyzed & Results attached for compliance with 17-550, F.A.C.:

( ) Nitrate ( ) Nitrite ( ) Asbestos ( ) Turbidity

Inorganics--	Trihalomethanes --	Volatile Organics--	Secondaries --
( ) All 18 ( ) Partial	( ) All 4 ( ) Partial	( )All 21 ( ) Partial	(X) All 14 ( ) Partial

Pesticides & PCBs--	Group 1 Unregulateds--	Group 11 Unregulateds--	Radiochemicals--
( ) All 29 ( ) Partial	( ) All 13 ( ) Partial	( ) All 37 ( ) Partial	( ) Single Sample ( ) Qtrly Composite*

*Provide radiochemical sample dates & locations for each quarter

I, Tai Igbinosun, do HEARBY CERTIFY that all attached analytical data are correct.
Signature _____
Title Lab Manager Date 04/17/96

COMPLIANCE INFORMATION (to be completed by State)

Sample Collection Satisfactory:_____ Sample Analysis Satisfactory:_____
Resample Requested for:_____ Reason:_____
Person notified to resample:_____ Date Notified:_____
DER/ACPHU Reviewing Official:_____

TRI-COUNTY ENVIRONMENTAL & ANALYTICAL LAB INC.

2822 Land O' Lakes Blvd. / Land O' Lakes, FL 34639
Phone: (813) 949-1069 Fax (813) 949-4392
HRS#E84338 / 84420 / QA 9209 LD-048

NAME: **ALOHA UTILITIES**
2514 ALOHA PLACE
HOLIDAY, FL. 34691

SAMPLE DATE: 02/29/96
DATE RECEIVED: 02/29/96
TIME SAMPLED: 9:00 am

SECONDARY CHEMICAL ANALYSIS
17-550.320
(PWS031)

SITE: SEVEN SPRINGS WELL # 1

PARAMETER ID	NAME	ANALYSIS RESULTS (mg/l)	ANALYSIS METHOD	DET. LIMIT	DATE OF ANALYSIS
1002	Aluminum	<0.001	202.2	0.001	03/09/96
1017	Chloride	16.00	325.3	2.0	03/06/96
1022	Copper	<0.01	SM3111B	0.01	03/09/96
1028	Iron	0.02	SM3111B	0.001	03/09/96
1032	Manganese	<0.001	SM3111B	0.001	03/09/96
1050	Silver	<0.001	SM3111B	0.001	03/09/96
1055	Sulfate	7.0	375.4	2.0	03/09/96
1095	Zinc	<0.001	SM3111B	0.001	03/09/96
1905	Color (color unt)	0.08	110.3	0.05	03/09/96
1920	Odor (tot odor #)	NO ODOR	SM2150B	1	02/29/96
1925	pH	6.8	std/units	1.0	02/29/96
1930	TDS	300	160.3	5.0	03/09/96
2905	Foaming agents	<0.05	425.1	0.05	03/09/96

Tai Igbinosun
Lab Manager

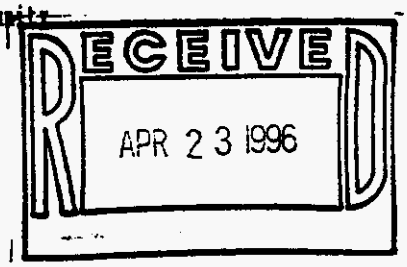
Tunde Daramola
QA/QC Approved Officer

PUBLIC DRINKING WATER ANALYSIS REPORTING FORMAT

PUBLIC WATER SYSTEM INFORMATION (to be completed by system or lab)

System Name: ALOHA UTILITIES, INC. I.D.#: 6512214

Address: 2514 ALOHA PLACE HOLIDAY, FLORIDA 34691 Phone #: (813)937-4275
Type (check one): ( ) Community ( ) Nontransient Noncommunity ( ) Noncommunity



SAMPLE INFORMATION (to be completed by sampler)

Sample Date (MMDDYY) 02/29/96 Sample Time: 9:16 am

Sample Location (be specific): SEVEN SPRINGS WELL 2

Sampler's Signature: ALLAN CLARK Title: OPERATOR

Check Type(s): ( ) Distribution ( ) Recheck of MCL ( ) Resample of Lab Invalidated Sample
( ) Clearance ( ) Thm Max Res Time ( ) Plant Tap
( ) Distrib entry pt ( ) Raw ( ) Composite of Multiple Sites--Attach a format for each site

LABORATORY CERTIFICATION INFORMATION (to be completed by lab)

Lab Name: Tri-County Env. & Anal. Lab Inc. HRS#: 86140/E86070 Expiration Date: 6/30/96
Address: 2822 Land O' Lake Blvd., Land O' Lakes, FL 34639 Phone #: (813) 949-1069
Group Analyzed: SECONDARY CHEMICAL ANALYSIS

ANALYSIS INFORMATION (to be completed by lab)

Date Sample(s) Received: 02/29/96 Group(s) Analyzed & Results attached for compliance with 17-550, F.A.C.:

( ) Nitrate ( ) Nitrite ( ) Asbestos ( ) Turbidity

Inorganics--	Trihalomethanes --	Volatile Organics--	Secondaries --
( ) All 18 ( ) Partial	( ) All 4 ( ) Partial	( )All 21 ( ) Partial	(X) All 14 ( ) Partial

Pesticides & PCBs--	Group 1 Unregulateds--	Group 11 Unregulateds--	Radiochemicals--
( ) All 29 ( ) Partial	( ) All 13 ( ) Partial	( ) All 37 ( ) Partial	( ) Single Sample ( ) Qtrly Composite*

*Provide radiochemical sample dates & locations for each quarter

I, Tai Igbinosun, do HEARBY CERTIFY that all attached analytical data are correct.
Signature _____
Title Lab Manager Date 04/17/96

COMPLIANCE INFORMATION (to be completed by State)

Sample Collection Satisfactory:_____ Sample Analysis Satisfactory:_____
Resample Requested for:_____ Reason:_____
Person notified to resample:_____ Date Notified:_____
DER/ACPHU Reviewing Official:_____

TRI-COUNTY ENVIRONMENTAL & ANALYTICAL LAB INC.

2822 Land O' Lakes Blvd. / Land O' Lakes, FL 34639
Phone: (813) 949-1069 Fax (813) 949-4392
HRS#E84338 / 84420 / QA 9209 LD-048

NAME: ALOHA UTILITIES
2514 ALOHA PLACE
HOLIDAY, FL. 34691

SAMPLE DATE: 02/29/96
DATE RECEIVED: 02/29/96
TIME SAMPLED: 9:16 am

SECONDARY CHEMICAL ANALYSIS
17-550.320
(PWS031)

SITE: SEVEN SPRINGS WELL # 2

PARAMETER ID	NAME	ANALYSIS RESULTS (mg/l)	ANALYSIS METHOD	DET. LIMIT	DATE OF ANALYSIS
1002	Aluminum	<0.001	202.2	0.001	03/09/96
1017	Chloride	12.00	325.3	2.0	03/06/96
1022	Copper	<0.01	SM3111B	0.01	03/09/96
1028	Iron	<0.001	SM3111B	0.001	03/09/96
1032	Manganese	<0.001	SM3111B	0.001	03/09/96
1050	Silver	<0.001	SM3111B	0.001	03/09/96
1055	Sulfate	8.0	375.4	2.0	03/09/96
1095	Zinc	<0.001	SM3111B	0.001	03/09/96
1905	Color (color unt)	0.07	110.3	0.05	03/09/96
1920	Odor (tot odor #)	NO ODOR	SM2150B	1.0	02/29/96
1925	pH	6.9	std/units	1.0	02/29/96
1930	TDS	244	160.3	5.0	03/09/96
2905	Foaming agents	<0.05	425.1	0.05	03/09/96

Tai Igbinosun
Lab Manager

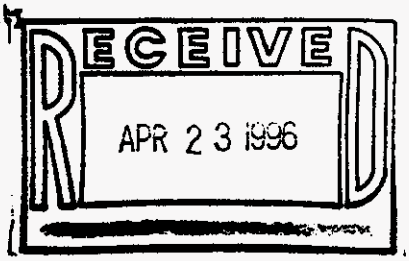
Tunde Daramola
QA/QC Approved Officer

PUBLIC DRINKING WATER ANALYSIS REPORTING FORMAT

PUBLIC WATER SYSTEM INFORMATION (to be completed by system or lab)

System Name: ALOHA UTILITIES, INC. I.D.#: 6512214

Address: 2514 ALOHA PLACE HOLIDAY, FLORIDA 34691 Phone #: (813)937-4275
Type (check one): ( ) Community ( ) Nontransient Noncommunity ( ) Noncommunity



SAMPLE INFORMATION (to be completed by sampler)

Sample Date (MMDDYY) 02/29/96 Sample Time: 8:20 am

Sample Location (be specific): SEVEN SPRINGS WELL 3

Sampler's Signature: ALLAN CLARK Title: OPERATOR

Check Type(s): ( ) Distribution ( ) Recheck of MCL ( ) Resample of Lab Invalidated Sample
( ) Clearance ( ) Thm Max Res Time ( ) Plant Tap
( ) Distrib entry pt ( ) Raw ( ) Composite of Multiple Sites--Attach a format for each site

LABORATORY CERTIFICATION INFORMATION (to be completed by lab)

Lab Name: Tri-County Env. & Anal. Lab Inc. HRS#: 86140/E86070 Expiration Date: 6/30/96
Address: 2822 Land O' Lake Blvd., Land O' Lakes, FL 34639 Phone #: (813) 949-1069
Group Analyzed: SECONDARY CHEMICAL ANALYSIS

ANALYSIS INFORMATION (to be completed by lab)

Date Sample(s) Received: 02/29/96 Group(s) Analyzed & Results attached for compliance with 17-550, F.A.C.:

( ) Nitrate ( ) Nitrite ( ) Asbestos ( ) Turbidity

Inorganics--	Trihalomethanes --	Volatile Organics--	Secondaries --
( ) All 18 ( ) Partial	( ) All 4 ( ) Partial	( )All 21 ( ) Partial	(X) All 14 ( ) Partial

Pesticides & PCBs--	Group 1 Unregulateds--	Group 11 Unregulateds--	Radiochemicals--
( ) All 29 ( ) Partial	( ) All 13 ( ) Partial	( ) All 37 ( ) Partial	( ) Single Sample ( ) Qtrly Composite*

*Provide radiochemical sample dates & locations for each quarter

I, Tai Igbinosun, do HEARBY CERTIFY that all attached analytical data are correct.
Signature _____
Title Lab Manager Date 04/17/96

COMPLIANCE INFORMATION (to be completed by State)

Sample Collection Satisfactory:_____ Sample Analysis Satisfactory:_____
Resample Requested for:_____ Reason:_____
Person notified to resample:_____ Date Notified:_____
DER/ACPHU Reviewing Official:_____

TRI-COUNTY ENVIRONMENTAL & ANALYTICAL LAB INC.

2822 Land O' Lakes Blvd. / Land O' Lakes, FL 34639
Phone: (813) 949-1069 Fax (813) 949-4392
HRS#E84338 / 84420 / QA 9209 LD-048

NAME: ALOHA UTILITIES
2514 ALOHA PLACE
HOLIDAY, FL. 34691

SAMPLE DATE: 02/29/96
DATE RECEIVED: 02/29/96
TIME SAMPLED: 8:20 am

SECONDARY CHEMICAL ANALYSIS
17-550.320
(PWS031)

SITE: SEVEN SPRINGS WELL # 3

PARAMETER ID	NAME	ANALYSIS RESULTS (mg/l)	ANALYSIS METHOD	DET. LIMIT	DATE OF ANALYSIS
1002	Aluminum	<0.001	202.2	0.001	03/09/96
1017	Chloride	11.00	325.3	2.0	03/06/96
1022	Copper	<0.01	SM3111B	0.01	03/09/96
1028	Iron	<0.001	SM3111B	0.001	03/09/96
1032	Manganese	<0.001	SM3111B	0.001	03/09/96
1050	Silver	<0.001	SM3111B	0.001	03/09/96
1055	Sulfate	16.0	375.4	2.0	03/09/96
1095	Zinc	<0.001	SM3111B	0.001	03/09/96
1905	Color (color unt)	0.07	110.3	0.05	03/09/96
1920	Odor (tot odor #)	NO ODOR	SM2150B	1.0	02/29/96
1925	pH	6.8	std/units	1.0	02/29/96
1930	TDS	240	160.3	5.0	03/09/96
2905	Foaming agents	<0.05	425.1	0.05	03/09/96

Tai Igbinosun
Lab Manager

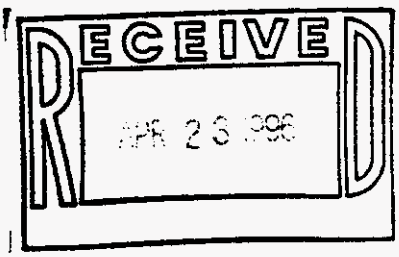
Tunde Daramola
QA/QC Approved Officer

PUBLIC DRINKING WATER ANALYSIS REPORTING FORMAT

PUBLIC WATER SYSTEM INFORMATION (to be completed by system or lab)

System Name: ALOHA UTILITIES, INC. I.D.#: 6512214

Address: 2514 ALOHA PLACE HOLIDAY, FLORIDA 34691 Phone #: (813)937-4275
Type (check one): ( ) Community ( ) Nontransient Noncommunity ( ) Noncommunity



SAMPLE INFORMATION (to be completed by sampler)

Sample Date (MMDDYY) 02/29/96 Sample Time: 8:00 am

Sample Location (be specific): SEVEN SPRINGS WELL 4

Sampler's Signature: ALLAN CLARK Title: OPERATOR

Check Type(s): ( ) Distribution ( ) Recheck of MCL ( ) Resample of Lab Invalidated Sample
( ) Clearance ( ) Thm Max Res Time ( ) Plant Tap
( ) Distrib entry pt ( ) Raw ( ) Composite of Multiple Sites--Attach a format for each site

LABORATORY CERTIFICATION INFORMATION (to be completed by lab)

Lab Name: Tri-County Env. & Anal. Lab Inc. HRS#: 86140/E86070 Expiration Date: 6/30/96
Address: 2822 Land O' Lake Blvd., Land O' Lakes, FL 34639 Phone #: (813) 949-1069
Group Analyzed: SECONDARY CHEMICAL ANALYSIS

ANALYSIS INFORMATION (to be completed by lab)

Date Sample(s) Received: 02/29/96 Group(s) Analyzed & Results attached for compliance with 17-550, F.A.C.:

( ) Nitrate ( ) Nitrite ( ) Asbestos ( ) Turbidity

Inorganics--	Trihalomethanes --	Volatile Organics--	Secondaries --
( ) All 18 ( ) Partial	( ) All 4 ( ) Partial	( )All 21 ( ) Partial	(X) All 14 ( ) Partial

Pesticides & PCBs--	Group 1 Unregulateds--	Group 11 Unregulateds--	Radiochemicals--
( ) All 29 ( ) Partial	( ) All 13 ( ) Partial	( ) All 37 ( ) Partial	( ) Single Sample
			( ) Qtrly Composite*

*Provide radiochemical sample dates & locations for each quarter

I, Tai Igbinosun, do HEARBY CERTIFY that all attached analytical data are correct.
Signature _____
Title Lab Manager Date 04/17/96

COMPLIANCE INFORMATION (to be completed by State)

Sample Collection Satisfactory:_____ Sample Analysis Satisfactory:_____
Resample Requested for:_____ Reason:_____
Person notified to resample:_____ Date Notified:_____
DER/ACPHU Reviewing Official:_____

TRI-COUNTY ENVIRONMENTAL & ANALYTICAL LAB INC.

2822 Land O' Lakes Blvd. / Land O' Lakes, FL 34639
Phone: (813) 949-1069 Fax (813) 949-4392
HRS#E84338 / 84420 / QA 9209 LD-048

NAME: ALOHA UTILITIES
2514 ALOHA PLACE
HOLIDAY, FL. 34691

SAMPLE DATE: 02/29/96
DATE RECEIVED: 02/29/96
TIME SAMPLED: 8:00 am

SECONDARY CHEMICAL ANALYSIS
17-550.320
(PWS031)

SITE: SEVEN SPRINGS WELL # 4

PARAMETER ID	NAME	ANALYSIS RESULTS (mg/l)	ANALYSIS METHOD	DET. LIMIT	DATE OF ANALYSIS
1002	Aluminum	<0.001	202.2	0.001	03/09/96
1017	Chloride	9.00	325.3	2.0	03/06/96
1022	Copper	<0.01	SM3111B	0.01	03/09/96
1028	Iron	0.018	SM3111B	0.001	03/09/96
1032	Manganese	<0.001	SM3111B	0.001	03/09/96
1050	Silver	<0.001	SM3111B	0.001	03/09/96
1055	Sulfate	8.0	375.4	2.0	03/09/96
1095	Zinc	<0.001	SM3111B	0.001	03/09/96
1905	Color (color unt)	0.07	110.3	0.05	03/09/96
1920	Odor (tot odor #)	NO ODOR	SM2150B	1.0	02/29/96
1925	pH	6.7	std/units	1.0	02/29/96
1930	TDS	260	160.3	5.0	03/09/96
2905	Foaming agents	<0.05	425.1	0.05	03/09/96

Tai Igbinosun
Lab Manager

Tunde Daramola
QA/QC Approved Officer

PUBLIC DRINKING WATER ANALYSIS REPORTING FORMAT

PUBLIC WATER SYSTEM INFORMATION (to be completed by system or lab)

System Name: ALOHA UTILITIES, INC. I.D.#: 6512214

Address: 2514 ALOHA PLACE HOLIDAY, FLORIDA 34691 Phone #: (813)937-4275
Type (check one): ( ) Community ( ) Nontransient Noncommunity ( ) Noncommunity

RECEIVED
APR 23 1996

SAMPLE INFORMATION (to be completed by sampler)

Sample Date (MMDDYY) 02/29/96 Sample Time: 10:10 am

Sample Location (be specific): SEVEN SPRINGS WELL 6

Sampler's Signature: ALLAN CLARK Title: OPERATOR

Check Type(s): ( ) Distribution ( ) Recheck of MCL ( ) Resample of Lab Invalidated Sample
( ) Clearance ( ) Thm Max Res Time ( ) Plant Tap
( ) Distrib entry pt ( ) Raw ( ) Composite of Multiple Sites--Attach a format for each site

LABORATORY CERTIFICATION INFORMATION (to be completed by lab)

Lab Name: Tri-County Env. & Anal. Lab Inc. HRS#: 86140/E86070 Expiration Date: 6/30/96
Address: 2822 Land O' Lake Blvd., Land O' Lakes, FL 34639 Phone #: (813) 949-1069
Group Analyzed: SECONDARY CHEMICAL ANALYSIS

ANALYSIS INFORMATION (to be completed by lab)

Date Sample(s) Received: 02/29/96 Group(s) Analyzed & Results attached for compliance with 17-550, F.A.C.:

( ) Nitrate ( ) Nitrite ( ) Asbestos ( ) Turbidity

Inorganics--	Trihalomethanes --	Volatile Organics--	Secondaries --
( ) All 18 ( ) Partial	( ) All 4 ( ) Partial	( )All 21 ( ) Partial	(X) All 14 ( ) Partial

Pesticides & PCBs--	Group 1 Unregulateds--	Group 11 Unregulateds--	Radiochemicals--
( ) All 29 ( ) Partial	( ) All 13 ( ) Partial	( ) All 37 ( ) Partial	( ) Single Sample ( ) Qtrly Composite*

*Provide radiochemical sample dates & locations for each quarter

I, Tai Igbinosun, do HEARBY CERTIFY that all attached analytical data are correct.
Signature _____
Title Lab Manager Date 04/17/96

COMPLIANCE INFORMATION (to be completed by State)

Sample Collection Satisfactory:_____ Sample Analysis Satisfactory:_____
Resample Requested for:_____ Reason:_____
Person notified to resample:_____ Date Notified:_____
DER/ACPHU Reviewing Official:_____

TRI-COUNTY ENVIRONMENTAL & ANALYTICAL LAB INC.

2822 Land O' Lakes Blvd. / Land O' Lakes, FL 34639
Phone: (813) 949-1069 Fax (813) 949-4392
HRS#E84338 / 84420 / QA 9209 LD-048

NAME: ALOHA UTILITIES
2514 ALOHA PLACE
HOLIDAY, FL. 34691

SAMPLE DATE: 02/29/96
DATE RECEIVED: 02/29/96
TIME SAMPLED: 10:10 am

SECONDARY CHEMICAL ANALYSIS
17-550.320
(PWS031)

SITE: SEVEN SPRINGS WELL # 6

PARAMETER ID	NAME	ANALYSIS RESULTS (mg/l)	ANALYSIS METHOD	DET. LIMIT	DATE OF ANALYSIS
1002	Aluminum	<0.001	202.2	0.001	03/09/96
1017	Chloride	18.00	325.3	2.0	03/06/96
1022	Copper	<0.01	SM3111B	0.01	03/09/96
1028	Iron	0.018	SM3111B	0.001	03/09/96
1032	Manganese	<0.001	SM3111B	0.001	03/09/96
1050	Silver	<0.001	SM3111B	0.001	03/09/96
1055	Sulfate	8.0	375.4	2.0	03/09/96
1095	Zinc	<0.001	SM3111B	0.001	03/09/96
1905	Color (color unt)	0.05	110.3	0.05	03/09/96
1920	Odor (tot odor #)	NO ODOR	SM2150B	1.0	02/29/96
1925	pH	7.0	std/units	1.0	02/29/96
1930	TDS	228	160.3	5.0	03/09/96
2905	Foaming agents	<0.05	425.1	0.05	03/09/96

Tai Igbinosun
Lab Manager

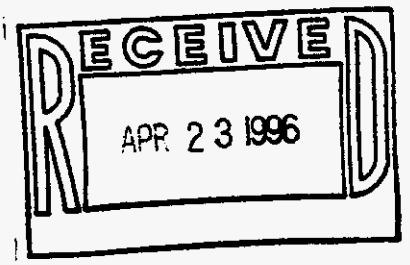
Tunde Daramola
QA/QC Approved Officer

PUBLIC DRINKING WATER ANALYSIS REPORTING FORMAT

PUBLIC WATER SYSTEM INFORMATION (to be completed by system or lab)

Systen Name: ALOHA UTILITIES, INC. I.D.#: 6512214

Address: 2514 ALOHA PLACE HOLIDAY, FLORIDA 34691 Phone #: (813)937-4275
Type (check one): ( ) Community ( ) Nontransient Noncommunity ( ) Noncommunity



SAMPLE INFORMATION (to be completed by sampler)

Sample Date (MMDDYY) 02/29/96 Sample Time: 10:30 am

Sample Location (be specific): SEVEN SPRINGS WELL 7

Sampler's Signature: ALLAN CLARK Title: OPERATOR

Check Type(s): ( ) Distribution ( ) Recheck of MCL ( ) Resample of Lab Invalidated Sample
( ) Clearance ( ) Thm Max Res Time ( ) Plant Tap
( ) Distrib entry pt ( ) Raw ( ) Composite of Multiple Sites--Attach a format for each site

LABORATORY CERTIFICATION INFORMATION (to be completed by lab)

Lab Name: Tri-County Env. & Anal. Lab Inc. HRS#: 86140/E86070 Expiration Date: 6/30/96
Address: 2822 Land O' Lake Blvd., Land O' Lakes, FL 34639 Phone #: (813) 949-1069
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ANALYSIS INFORMATION (to be completed by lab)

Date Sample(s) Received: 02/29/96 Group(s) Analyzed & Results attached for compliance with 17-550, F.A.C.:

( ) Nitrate ( ) Nitrite ( ) Asbestos ( ) Turbidity

Inorganics--	Trihalomethanes --	Volatile Organics--	Secondaries --
( ) All 18 ( ) Partial	( ) All 4 ( ) Partial	( )All 21 ( ) Partial	(X) All 14 ( ) Partial

Pesticides & PCBs--	Group 1 Unregulateds--	Group 11 Unregulateds--	Radiochemicals--
( ) All 29 ( ) Partial	( ) All 13 ( ) Partial	( ) All 37 ( ) Partial	( ) Single Sample ( ) Qtrly Composite*

*Provide radiochemical sample dates & locations for each quarter

I, Tai Igbinosun, do HEARBY CERTIFY that all attached analytical data are correct.
Signature _____
Title Lab Manager Date 04/17/96

COMPLIANCE INFORMATION (to be completed by State)

Sample Collection Satisfactory:_____ Sample Analysis Satisfactory:_____
Resample Requested for:_____ Reason:_____
Person notified to resample:_____ Date Notified:_____
DER/ACPHU Reviewing Official:_____

TRI-COUNTY ENVIRONMENTAL & ANALYTICAL LAB INC.

2822 Land O' Lakes Blvd. / Land O' Lakes, FL 34639
Phone: (813) 949-1069 Fax (813) 949-4392
HRS#E84338 / 84420 / QA 9209 LD-048

NAME: ALOHA UTILITIES
2514 ALOHA PLACE
HOLIDAY, FL. 34691

SAMPLE DATE: 02/29/96
DATE RECEIVED: 02/29/96
TIME SAMPLED: 10:30 am

SECONDARY CHEMICAL ANALYSIS
17-550.320
(PWS031)

SITE: SEVEN SPRINGS WELL # 7

PARAMETER ID	NAME	ANALYSIS RESULTS (mg/l)	ANALYSIS METHOD	DET. LIMIT	DATE OF ANALYSIS
1002	Aluminum	<0.001	202.2	0.001	03/09/96
1017	Chloride	11.00	325.3	2.0	03/06/96
1022	Copper	<0.01	SM3111B	0.01	03/09/96
1028	Iron	<0.001	SM3111B	0.001	03/09/96
1032	Manganese	<0.001	SM3111B	0.001	03/09/96
1050	Silver	<0.001	SM3111B	0.001	03/09/96
1055	Sulfate	12.0	375.4	2.0	03/09/96
1095	Zinc	<0.001	SM3111B	0.001	03/09/96
1905	Color (color unt)	0.07	110.3	0.05	03/09/96
1920	Odor (tot odor #)	NO ODOR	SM2150B	1.0	02/29/96
1925	pH	7.0	std/units	1.0	02/29/96
1930	TDS	212	160.3	5.0	03/09/96
2905	Foaming agents	<0.05	425.1	0.05	03/09/96

Tai Igbinosun
Lab Manager

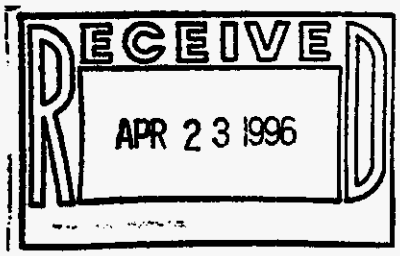
Tunde Daramola
QA/QC Approved Officer

PUBLIC DRINKING WATER ANALYSIS REPORTING FORMAT

PUBLIC WATER SYSTEM INFORMATION (to be completed by system or lab)

System Name: ALOHA UTILITIES, INC. I.D.#: 6512214

Address: 2514 ALOHA PLACE HOLIDAY, FLORIDA 34691 Phone #: (813)937-4275
Type (check one): ( ) Community ( ) Nontransient Noncommunity ( ) Noncommunity



SAMPLE INFORMATION (to be completed by sampler)

Sample Date (MMDDYY) 02/29/96 Sample Time: 10:45 am

Sample Location (be specific): SEVEN SPRINGS WELL 8

Sampler's Signature: ALLAN CLARK Title: OPERATOR

Check Type(s): ( ) Distribution ( ) Recheck of MCL ( ) Resample of Lab Invalidated Sample
( ) Clearance ( ) Thm Max Res Time ( ) Plant Tap
( ) Distrib entry pt ( ) Raw ( ) Composite of Multiple Sites--Attach a format for each site

LABORATORY CERTIFICATION INFORMATION (to be completed by lab)

Lab Name: Tri-County Env. & Anal. Lab Inc. HRS#: 86140/E86070 Expiration Date: 6/30/96
Address: 2822 Land O' Lake Blvd., Land O' Lakes, FL 34639 Phone #: (813) 949-1069
Group Analyzed: SECONDARY CHEMICAL ANALYSIS

ANALYSIS INFORMATION (to be completed by lab)

Date Sample(s) Received: 02/29/96 Group(s) Analyzed & Results attached for compliance with 17-550, F.A.C.:

( ) Nitrate ( ) Nitrite ( ) Asbestos ( ) Turbidity

Inorganics--	Trihalomethanes --	Volatile Organics--	Secondaries --
( ) All 18 ( ) Partial	( ) All 4 ( ) Partial	( )All 21 ( ) Partial	(X) All 14 ( ) Partial

Pesticides & PCBs--	Group 1 Unregulateds--	Group 11 Unregulateds--	Radiochemicals--
( ) All 29 ( ) Partial	( ) All 13 ( ) Partial	( ) All 37 ( ) Partial	( ) Single Sample ( ) Qtrly Composite*

*Provide radiochemical sample dates & locations for each quarter

I, Tai Igbinosun, do HEARBY CERTIFY that all attached analytical data are correct.
Signature _____
Title Lab Manager Date 04/17/96

COMPLIANCE INFORMATION (to be completed by State)

Sample Collection Satisfactory:_____ Sample Analysis Satisfactory:_____
Resample Requested for:_____ Reason:_____
Person notified to resample:_____ Date Notified:_____
DER/ACPHU Reviewing Official:_____

TRI-COUNTY ENVIRONMENTAL & ANALYTICAL LAB INC.

2822 Land O' Lakes Blvd. / Land O' Lakes, FL 34639
Phone: (813) 949-1069 Fax (813) 949-4392
HRS#E84338 / 84420 / QA 9209 LD-048

NAME: ALOHA UTILITIES
2514 ALOHA PLACE
HOLIDAY, FL. 34691

SAMPLE DATE: 02/29/96
DATE RECEIVED: 02/29/96
TIME SAMPLED: 10:45 am

SECONDARY CHEMICAL ANALYSIS
17-550.320
(PWS031)

SITE: SEVEN SPRINGS WELL # 8

PARAMETER ID	NAME	ANALYSIS RESULTS (mg/l)	ANALYSIS METHOD	DET. LIMIT	DATE OF ANALYSIS
1002	Aluminum	<0.001	202.2	0.001	03/09/96
1017	Chloride	14.00	325.3	2.0	03/06/96
1022	Copper	<0.01	SM3111B	0.01	03/09/96
1028	Iron	<0.001	SM3111B	0.001	03/09/96
1032	Manganese	<0.001	SM3111B	0.001	03/09/96
1050	Silver	<0.001	SM3111B	0.001	03/09/96
1055	Sulfate	7.0	375.4	2.0	03/09/96
1095	Zinc	<0.001	SM3111B	0.001	03/09/96
1905	Color (color unt)	0.08	110.3	0.05	03/09/96
1920	Odor (tot odor #)	NO ODOR	SM2150B	1.0	02/29/96
1925	pH	7.2	std/units	1.0	02/29/96
1930	TDS	252	160.3	5.0	03/09/96
2905	Foaming agents	<0.05	425.1	0.05	03/09/96

Tai Igbinosun
Lab Manager

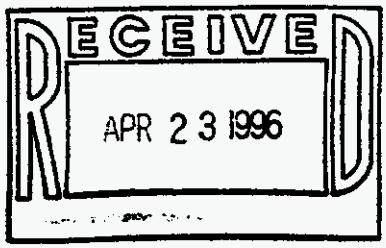
Tunde Daramola
QA/QC Approved Officer

PUBLIC DRINKING WATER ANALYSIS REPORTING FORMAT

PUBLIC WATER SYSTEM INFORMATION (to be completed by system or lab)

System Name: ALOHA UTILITIES, INC. I.D.#: 6512214

Address: 2514 ALOHA PLACE HOLIDAY, FLORIDA 34691 Phone #: (813)937-4275
Type (check one): ( ) Community ( ) Nontransient Noncommunity ( ) Noncommunity



SAMPLE INFORMATION (to be completed by sampler)

Sample Date (MMDDYY) 02/29/96 Sample Time: 11:00 am

Sample Location (be specific): SEVEN SPRINGS WELL 9

Sampler's Signature: ALLAN CLARK Title: OPERATOR

Check Type(s): ( ) Distribution ( ) Recheck of MCL ( ) Resample of Lab Invalidated Sample
( ) Clearance ( ) Thm Max Res Time ( ) Plant Tap
( ) Distrib entry pt ( ) Raw ( ) Composite of Multiple Sites--Attach a format for each site

LABORATORY CERTIFICATION INFORMATION (to be completed by lab)

Lab Name: Tri-County Env. & Anal. Lab Inc. HRS#: 86140/E86070 Expiration Date: 6/30/96
Address: 2822 Land O' Lake Blvd., Land O' Lakes, FL 34639 Phone #: (813) 949-1069
Group Analyzed: SECONDARY CHEMICAL ANALYSIS

ANALYSIS INFORMATION (to be completed by lab)

Date Sample(s) Received: 02/29/96 Group(s) Analyzed & Results attached for compliance with 17-550, F.A.C.:

( ) Nitrate ( ) Nitrite ( ) Asbestos ( ) Turbidity

Inorganics--	Trihalomethanes --	Volatile Organics--	Secondaries --
( ) All 18 ( ) Partial	( ) All 4 ( ) Partial	( )All 21 ( ) Partial	(X) All 14 ( ) Partial

Pesticides & PCBs--	Group 1 Unregulateds--	Group 11 Unregulateds--	Radiochemicals--
( ) All 29 ( ) Partial	( ) All 13 ( ) Partial	( ) All 37 ( ) Partial	( ) Single Sample ( ) Qtrly Composite*

*Provide radiochemical sample dates & locations for each quarter

I, Tai Igbinosun, do HEARBY CERTIFY that all attached analytical data are correct.
Signature _____
Title Lab Manager Date 04/17/96

COMPLIANCE INFORMATION (to be completed by State)

Sample Collection Satisfactory:_____ Sample Analysis Satisfactory:_____
Resample Requested for:_____ Reason:_____
Person notified to resample:_____ Date Notified:_____
DER/ACPHU Reviewing Official:_____

TRI-COUNTY ENVIRONMENTAL & ANALYTICAL LAB INC.

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HRS#E84338 / 84420 / QA 9209 LD-048

NAME: ALOHA UTILITIES
2514 ALOHA PLACE
HOLIDAY, FL. 34691

SAMPLE DATE: 02/29/96
DATE RECEIVED: 02/29/96
TIME SAMPLED: 11:00 am

SECONDARY CHEMICAL ANALYSIS
17-550.320
(PWS031)

SITE: SEVEN SPRINGS WELL # 9

PARAMETER ID	NAME	ANALYSIS RESULTS (mg/l)	ANALYSIS METHOD	DET. LIMIT	DATE OF ANALYSIS
1002	Aluminum	<0.001	202.2	0.001	03/09/96
1017	Chloride	12.00	325.3	2.0	03/06/96
1022	Copper	<0.01	SM3111B	0.01	03/09/96
1028	Iron	0.018	SM3111B	0.001	03/09/96
1032	Manganese	<0.001	SM3111B	0.001	03/09/96
1050	Silver	<0.001	SM3111B	0.001	03/09/96
1055	Sulfate	16.0	375.4	2.0	03/09/96
1095	Zinc	<0.001	SM3111B	0.001	03/09/96
1905	Color (color unt)	0.08	110.3	0.05	03/09/96
1920	Odor (tot odor #)	NO ODOR	SM2150B	1.0	02/29/96
1925	pH	6.9	std/units	1.0	02/29/96
1930	TDS	276	160.3	5.0	03/09/96
2905	Foaming agents	<0.05	425.1	0.05	03/09/96

Tai Igbinosun
Lab Manager

Tunde Daramola
QA/QC Approved Officer

Appendix C

1998 and 2015 Water System Demographics and Water Demands

1998 Water System Demographics and Water Demands

A. Introduction

This section of the report describes the method utilized to project future water demands for the Seven Springs Water System and presents the results of the projection. The intent of the projection is to look twenty years into the future so that improvements made to serve today's customers can be part of the system required to serve the system in the future. For the purpose of this report, we have looked at the years 1998 and 2015. The year 1998 was selected because any improvements embarked upon today will not be in service before 1998. The year 2015 was selected instead of 2018 because it is the current horizon in available demographic data for the area.

B. Population Projection

The Growth Management department of Pasco County is the entity that maintains records on current growth patterns and develops projections for future growth within the County. They divide Pasco County into hundreds of small zones, which are similar in land use and density, called Traffic Analysis Zones (TAZ). The primary use of Traffic Analysis Zones is to project traffic flow on major roadways to establish long range roadway improvement schedules. The Growth Management staff also utilizes these zones in establishing future growth in the county.

The Traffic Analysis Zones for this part of the County, which include the Seven Springs service area, are shown on Figure C-1. It can be seen that by utilizing appropriate zones, the Seven Springs Water System service area can be represented very well. The zones, which provide the closest representation of the service area, are shown in Table C-1.

Table C-1

Projected Growth in Service Area Traffic Analysis Zones

TAZ No.	Year					
	1990	1995	2000	2005	2010	2015
60	509	555	618	682	743	806
61	1,246	1,306	1,387	1,474	1,555	1,638
62	1,219	1,336	1,494	1,664	1,882	1,985
68	1,109	1,157	1,222	1,292	1,357	1,424
69	1,166	1,300	1,479	1,670	1,648	2,031
81	0	695	1,204	1,516	1,806	2,105
96	432	805	1,304	1,670	1,953	2,160
102	80	181	316	461	596	735
104	0	8	134	269	395	524
105	5	5	5	38	69	101
106	49	87	449	838	1,200	1,573
Total	5,815	7,435	9,612	11,574	13,204	15,082

Table C-1 also shows the projected population, through the year 2015, for each TAZ. Although the TAZ's do not exactly match the Seven Springs Service Area boundary, they are a close enough match to allow the population, and corresponding water demand, of the service area to be projected into the future.

C. Projecting Future Average Daily Water Demands

The purpose of this report is to project the future water demands of the service area and determine what capital improvements are necessary to provide that service. To accomplish that, we have elected to utilize the population growth rates established by the TAZ population projection and apply it directly to the adjusted 1995 water demand. This could lead to significant variation in projected future water demands, depending which year you picked as a base year. We have elected to adjust the base year to more fairly represent the average usage.

The demand for the base year was adjusted by determining the average usage per connection, for the past 5 years of record and multiplying it times the average number of customers in the year 1995. The average water use per connection is established by the information presented in Table C-2. The water demand utilized for the base year of 1995 is different from the actual amount of water for the year 1995 shown in Table C-2.

No differentiation has been made between commercial customers and residential customers. Although some commercial users use far more water than a residential customer there are many commercial accounts which use less water than a single family residence. Also, most commercial peak demands do not occur at the same times that domestic peak flows occur. We believe this leads to a more conservative model.

Table C-2

Actual Average Water Usage
Seven Springs Water System

Year	Residential Connections	Commercial Connections	Total Connections	Average Connections	Ave. Daily Flow (MGD)	Ave Flow per Unit
1991	6,112	120	6,232	---	2.849	---
1992	6,432	144	6,576	6,404	1.89	295
1993	6,884	142	7,026	6,801	2.037	300
1994	7,343	149	7,492	7,259	2.089	288
1995	7,644	152	7,796	7,644	2.231	292
1996	7,925	165	8,090	7,943	2.384	300

By averaging the average flow per unit for the years 1992 through 1996, we get an average annual usage per connection of 295 gallons per day. To get the average daily flow for the base year of 1995, we multiply the average number of connections in 1995 (7,796) times the annual average usage per customer (295). This yields an adjusted annual demand in the year 1995 of 2.299 MGD.

Utilizing this value of 2.299 MGD as the usage in the base year of 1995, we can utilize the TAZ growth rates to project the average annual water demand to the year 2015. Table C-3 shows the projected annual average daily demand through the study period. Note that when projecting the 1995 value back to 1990, the projected value of 1.610 MGD is the actual average usage for that year.

Table C-3

Projected Annual Average Water Demand
Seven Springs Water System

Year	TAZ Projection	Growth Factor	Demand Projection
1995	7,435		2.23
		1.049	
2000	7,796		2.34
		1.485	
2005	11,574		3.47
		1.141	
2010	13,204		3.96
		1.142	
2015	15,082		4.52

We have now established the projected annual average daily flow for the designated five-year increments of the planning period. This value alone is not very useful in the design of supply, treatment, storage, pumping, transmission, and distribution system components. It is restricted in use to evaluating the annual amount of power and chemicals required for the system but its real value is that it is the basis for determining Maximum Daily flow rates and Peak hourly flow rates.

Maximum Daily Flow rate is defined as the greatest amount of water used in the system in any one day during the calendar year. Maximum daily flow rate is the value used for determining the capacity of water supply and treatment system components.

Peak hourly flow is defined as the greatest amount of water used in the system in any one-hour period during the calendar year. Peak Hourly Flow rate is utilized to determine the capacity of storage and high service pumping systems. It is also the flow rate utilized

in performing hydraulic analyses to determine the required size of transmission and distribution system piping.

There are presently six wells pumping directly into the distribution system and two wells pumping into the storage tank at the Mitchell Road water plant. The plants high service pumps then pump the water in the storage tank into the distribution system. Although all of these inflow points are metered, the flow is only recorded on a daily basis. There is no established maximum daily flow rate for the system.

For design of the water distribution system for individual subdivisions, Pasco County requires utilization of maximum daily flow rate of 1.67 for individually metered systems and 1.25 for bulk-metered customers. For this analysis of the Seven Springs System, we have used a maximum daily flow rate of 1.7, which should be conservative.

There is no way to determine the actual peak hourly flow rate with the present metering and data gathering system. Peak hourly flow rate is usually expressed as a multiple of the average daily flow rate and can range from a value of 2.7 times ADF, for a system the size of the City of Tampa, to 10.0 times ADF for a small trailer park system.

In 1996, the peak hourly flow rate for the Pasco County System was 3.1 times their annual average daily flow rate. For the purpose of this report, we have utilized a peak hourly flow rate of 3.5 times average daily flow rate for the Seven Springs Water System. Table C-4 presents the average daily, maximum daily, and peak hourly demand rates for the Seven Springs Water System for each five-year increment of the planning period.

Table C-4

Projected Water Demand Rates
Seven Springs Water System

Year	Average Connections	Average Daily Flow		Maximum Daily Flow		Peak Hourly Flow	
		MGD	GPM	MGD	GPM	MGD	GPM
1990	6,232	1.61	1,118	2.74	1,901	5.635	3,913
1995	7,796	2.23	1,549	3.79	2,633	7.805	5,420
2000	9,747	2.88	2,000	4.90	3,400	10.080	7,000
2005	11,637	3.47	2,410	5.90	4,097	12.145	8,434
2010	13,354	3.96	2,750	6.73	4,675	13.860	9,625
2015	15,044	4.52	3,139	7.68	5,336	15.820	10,986

Table C-5

Seven Springs Water System
Estimated Future Connections

No.	Folio Number	S/T/R	Acreage	Use	Density	Units	Average Daily Flow
1	00800-0000	13/26/16	13.6	MF	10.9	148.2	42,545
2	00100-0010	13/26/16	80.2	SF	3.0	240.6	69,052
3	00100-0116	13/26/16	41.5	SF	3.3	137.0	39,305
4	00300-0010	14/26/16	10.2	COM	2.8	28.6	8,197
5	00400-0010	14/26/16	2.8	MF	12.0	33.6	9,643
6	00400-0020	14/26/16	2.0	MF	12.0	24.1	6,917
7	00300-0037	14/26/16	4.5	COM	5.1	22.95	6,587
8	00300-0039	14/26/16	1.0	COM	5.1	5.1	1,464
9	00200-0030	14/26/16	2.5	COM	5.1	12.8	3,659
10	00200-0010	14/26/16	1.5	COM	5.1	7.7	2,196
11	00700-0000	14/26/16	1.0	COM	5.1	5.1	1,464
12	00100-0030	15/26/16	15.4	COM	5.1	78.5	22,541
13	01000-0032	23/26/16	16.1	COM	4.0	64.4	18,483
14	01000-0030	23/26/16	82.4	SF	3.5	288.4	82,771
15	01000-0031	23/26/16	11.1	SF	2.0	22.2	6,371
16	00700-0000	23/26/16	15.0	SF	3.0	45.0	12,915
17	00600-0000	23/26/16	16.8	MF	8.0	134.4	38,573
18	01800-0010	23/26/16	2.3	COM	5.1	11.7	3,367
19	01600-0000	23/26/16	20.0	MF	12.0	240.0	68,880
20	01400-0040	23/26/16	16.9	MF	12.0	202.8	58,204
21	01400-0020	23/26/16	2.6	MF	12.0	31.2	8,954
22	01400-0010	23/26/16	6.2	MF	12.6	78.1	22,420
23	01300-0000	23/26/16	32.4	SF	3.5	113.4	32,546
24	01200-0013	23/26/16	11.5	SF	3.5	40.3	11,552
25	01200-0000	23/26/16	48.7	SF	3.5	170.5	48,919
26	01200-0050	23/26/16	27.9	MF	8.0	223.2	64,058
27	01200-0010	23/26/16	3.5	COM	4.0	14.0	4,018
28	00100-0031	26/26/16	64.0	COM	5.1	326.4	93,677
29	00400-0000	26/26/16	47.0	ACLF	5.1	239.7	68,794
30	00500-0000	26/26/16	20.0	MF	12.0	240.0	68,880
31	00100-0034	26/26/16	19.4	HOSP	5.1	98.9	28,396
32	00100-0030	26/26/16	6.7	OFC	5.1	34.2	9,807
33	00300-0000	26/26/16	9.0	OFC	5.1	45.9	13,173

Table C-5 Continued

34	00500-0020	26/26/16	90.3	SF	3.4	307.0	88,115
35	00100-0010	26/26/16	33.7	SF	4.2	141.5	40,622
36	00100-0000	26/26/16	81.8	SF	3.0	245.4	70,430
37	00100-0080	26/26/16	121.5	SCHOOL	1.5	182.3	52,306
38	00100-0012	26/26/16	3.9	OFC	5.1	19.9	5,708
39	00100-0011	26/26/16	48.8	SF	4.2	205.0	58,824
40	00100-0010	27/26/16	80.0	MF	8.0	640.0	183,680
41	00100-0000	27/26/16	102.1	COM	4.0	408.4	117,211
42	00100-0020	27/26/16	2.4	SF	4.2	10.1	2,893
43	00300-0000	27/26/16	7.1	SF	4.2	29.8	8,558
44	00100-0040	27/26/16	18.9	MF	12.0	226.8	65,092
45	00100-0063	27/26/16	14.1	COM	5.1	71.9	20,638
46	00100-0076	28/26/16	5.6	COM	5.1	28.6	8,197
47	00200-0050	29/26/17	21.7	COM	5.1	110.7	31,762
48	00600-0000	29/26/17	53.1	RV	6.0	318.6	91,438
49	0010-00000	29/26/17	6.0	COM	5.1	30.6	8,782
50	0020-00000	29/26/17	40.0	COM	5.1	204.0	58,548
61	00100-0022	30/26/17	6.0	COM	5.1	30.6	8,782
62	00600-0000	30/26/17	15.5	SCHOOL	4.5	69.8	20,018
63	00400-0000	30/26/17	7.6	COM	5.1	38.8	11,124
64	00400-0010	30/26/17	7.7	COM	5.1	39.3	11,270
65	00100-0000	34/26/16	83.7	MIX	6.0	502.2	144,131
66	00100-00F0	34/26/16	3.5	MIX	6.0	21.0	6,027
67	00100-0090	34/26/16	15.1	MF	12.0	181.2	52,004
68	00100-0011	34/26/16	22.9	SF	2.0	45.8	13,145
69	00100-00A0	34/26/16	4.4	COM	2.0	8.8	2,526
70	00400-0090	34/26/16	7.6	COM	5.1	38.8	11,124
71	00500-0050	34/26/16	7.2	COM	5.1	36.7	10,539
72	00500-0000	35/26/16	242.0	SF	4.2	1016.4	291,707
73	00100-0050	35/26/16	3.0	COM	5.1	15.3	4,391
74	00100-0010	35/26/16	15.2	COM	5.1	77.5	22,248
75	00100-00A0	35/26/16	2.0	COM	5.1	10.2	2,927
76	00100-0020	35/26/16	17.5	COM	5.1	89.3	25,615
77	00100-0017	35/26/16	6.4	COM	5.1	32.6	9,368
78	00100-0014	35/26/16	11.2	COM	5.1	57.1	16,393
79	00300-0000	36/26/16	250.8	SF	3.4	852.7	1,254

Total New Connections = 9,753

Total Additional Average Daily Flow (Gal/Day) = 2,877,226

D. Water Demands at Service Area Buildout

In order to estimate what the water demand would be at buildout of the service area, the most recent (1995)aerial photographs of the service area, purchased from Pasco County, were utilized to determine which tracts were still undeveloped. The number of dwelling units, or equivalent units for commercial tracts, was then estimated by multiplying density times acreage. Density was derived from existing DRI reports or estimated, based on surrounding land use.

The estimated total number of additional customers, 9,753, is shown in Table C-5. This number added to the actual 7,796 connections for 1995 gives a total number of connections at buildout of the service area at 17,549.

The corresponding additional Average Daily Flow rate is 2,877,226 gallons per day. This added to the 1995 ADF gives an estimated Average Daily Flow rate at buildout of approximately 5.18 MGD. This is a 15% increase over the projected values for the year 2015.

E. Water Demands for Design and Analysis

The year 1995 passed two and one-half years ago and the year 2000 is two and one-half years in the future. As stated in the introduction, if we are to embark immediately upon design and construction of improvements to the water system, it will be 1998 before any improvements can be constructed and placed in service.

For this reason, 1998 has been the selected as the present design year. The year 2015 has been selected for the future design year. Table C-5 shows the design parameters for the two selected years.

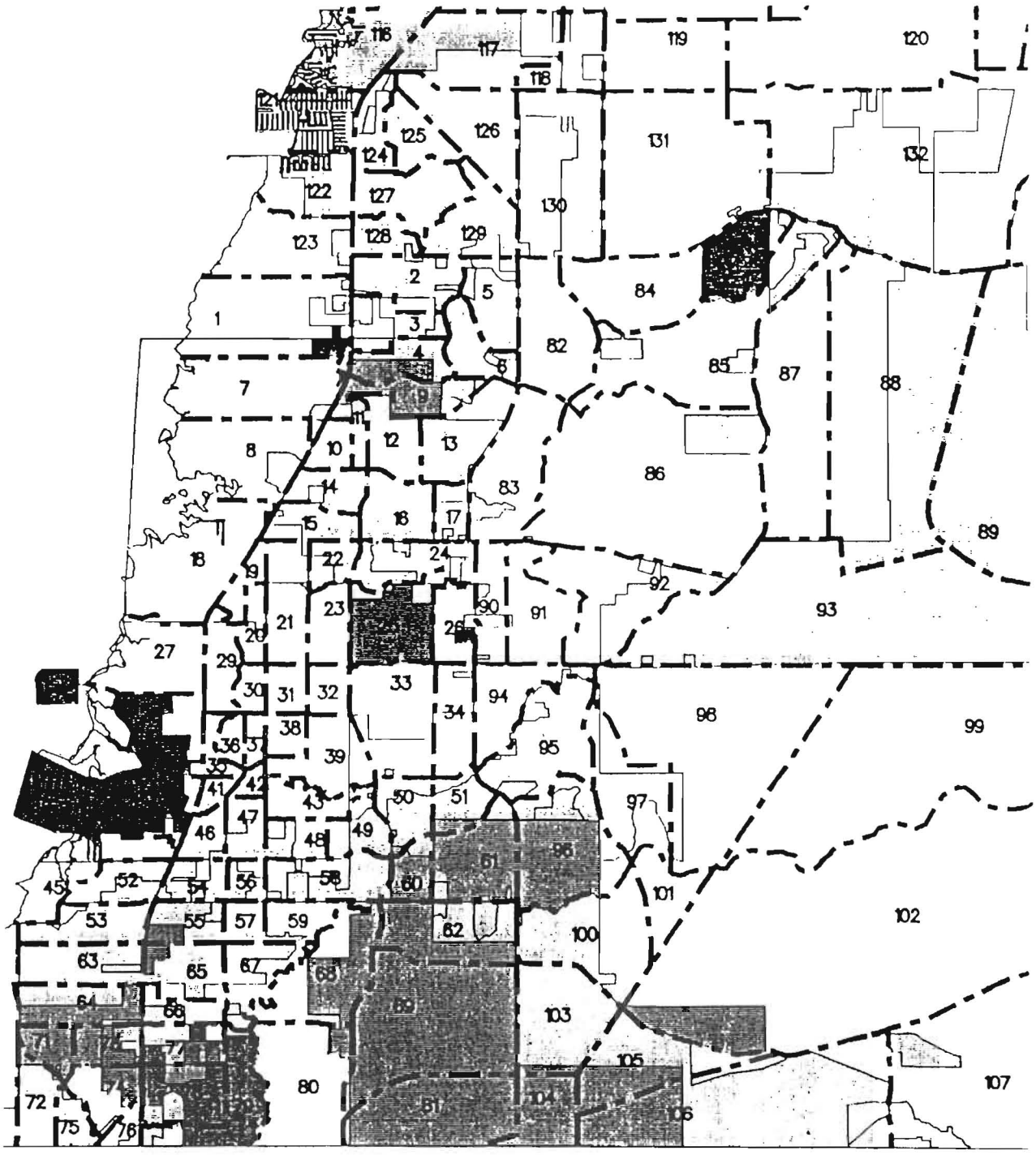
Table C-6

Water Demands for Design and Analysis
Seven Springs Water System

Year	Ave. Daily Flow	Max. Daily Flow	Peak Hourly Flow
1998	2.571	4.885	8.999
2015	4.520	7.681	15.815

The following two appendices, D & E, discuss the results of hydraulic modeling of the transmission and distribution system. For this modeling, the peak hourly flow rate is utilized to determine if the system can meet normal domestic demand, and maximum daily rate is used in conjunction with a 1,000 GPM fire flow to determine if the piping system can meet fire flow requirements.

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Civil Engineering Associates Inc. 720 E. FLETCHER AVE. TAMPA FLORIDA	SEVEN SPRINGS WATER SYSTEM TRAFFIC ANALYSIS ZONES	FIGURE C-1

Appendix D
1998 Water System
Hydraulic Model

1998 Water system Hydraulic Model

A. Introduction

The hydraulic modeling of the Seven Springs Water System is performed utilizing the software program "WaterCAD" developed and distributed by Haestad Methods, Inc., Waterbury, Connecticut. This is a recognized standard piping network analysis. This program uses the same mathematical algorithm for solving network equations as EPA Net and should produce the same results when utilizing the same data set. EPA Net does not presently utilize graphic input or produce graphic output. WaterCAD does utilize graphic or tabular input and produces graphic and tabular output.

The first step in preparing the hydraulic model for the Seven Springs Water System was to assemble existing system maps, existing record drawings, and discuss various sections of the system with maintenance staff, in order to prepare a scaled base map of the distribution system. The base map drawing file is then imported into the Hydraulic Analysis Program, where the model is then constructed over the base map so that the pipe lengths are automatically calculated.

B. System Design and Analysis Considerations

The present Seven Springs Water System has eight wells, six of which function as independent water plants. Each of these six wells uses chlorination for treatment and pumps directly into the Distribution system, functioning as a high service pump. There is virtually no storage to make up shortfalls between supply and demand. Wells #3 and #4 pump into the storage tank at the Mitchell Road water plant, and then repumped by the high service pumps.

Because of the sophisticated treatment required in the near future, with attendant higher degree of operator attention, storage and application of potentially hazardous chemicals, and highly sophisticated control system operation and maintenance, water supply and treatment will be consolidated into three water plant sites.

Each water plant will provide treatment, storage, and high service pumping. A very sophisticated data gathering and unit control system will be installed at each plant and all input and output information will be transmitted to a central microprocessor unit for record keeping and monitoring and control of the system operation.

The existing storage and pumping facility on Mitchell Ranch Road will essentially remain as is except for addition of treatment facilities, a monitoring and control system, and additional water supply.

A complete new water plant will be constructed in the industrial park on the site of Well #1, and will be referred to as the Industrial Park Plant. New transmission mains will be required to bring the water from this plant into the distribution system because the existing piping system in the industrial park and along SR 54 are too small to accommodate the flow rates from the new plant. The new transmission mains would consist of a 20-inch main from the water plant through the industrial park out to SR54 and then west along SR 54 to Foxwood Boulevard. A 16-inch main will be constructed

from Foxwood Boulevard to Trophy Boulevard to connect to the existing new 12-inch main constructed in 1996. The existing mains along SR 54 will have to be replaced in the near future to accommodate the continued widening of SR 54 eastward from Little Road. The roadway construction drawings for this section of SR 54 are at the 60% completion stage and proceeding forward.

Another complete plant will be constructed on Mitchell Boulevard, on a site presently owned by Aloha Utilities immediately north of Wyndtree Development and will be known as the Wyndtree plant. The two existing wells in the Heritage Village area will have to be abandoned and their capacity transferred to two new wells that would pump to the proposed water plants.

Two additional wells, which would be Well #10 and Well#11 will be necessary to provide sufficient supply to meet the 1998 system water demand. A tentative location of these wells has been shown on Figure D-1. The actual location will be determined by permitting conditions and hydrogeologic considerations, which are beyond the scope of this report.

Each of the water plants is modeled as a reservoir with its water level at a given hydraulic grade elevation. The elevation can be adjusted by trial and error until system pressures are at acceptable levels in all parts of the distribution system while the system demand is at peak hourly flow rate. The elevation of the reservoir level cannot be raised beyond that elevation which would raise the pressure in the distribution system above acceptable limits. We have tried to keep the pressure in the areas adjacent to the Industrial Park and Wyndtree plants below 65 psi. The pressure at the Mitchell road plant is kept below 60 psi due to the much older piping systems in the original subdivision. This area was constructed in the early 1970's.

Once the reservoir levels have been raised to their maximum levels, and pressure in sections of the distribution system are still below acceptable levels at peak hourly flow or fire flow, then improvements to the distribution system must be made. This is usually accomplished by constructing parallel mains to existing mains that are too small or by replacing undersized mains with larger new mains.

Another constraint on the system model is that the flow rate out of the Mitchell Road plant must be kept below 3,000 gpm. This is the total capacity of the existing high service pumps and the capacity of this station cannot be increased without totally replacing the pumping and piping system.

C. The 1998 Seven Springs System Model

The model for the 1998 water distribution system is shown in Figures D-1, D-2, and D-3. Each plant is represented by the Reservoir symbol and labeled R-1, R-2, and R-3. A line labeled P- xxx, where xxx represents the individual pipe number, represents each section of piping in the system. There are over 600 pipes in the 1998 model.

Where two or more pipes join, where a pipe changes in size, or where water enters or leaves the system, a node is placed in the piping system. Nodes are represented by small circles labeled J-xxx, where xxx is the number of the particular node. There are approximately 450 nodes in the model.

Demands are placed at strategic nodes that represent the water used by the homes or commercial buildings adjacent to the node. The demand for each node is derived from counting homes and commercial uses on aerial photographs and subdivision plat maps.

For this model, commercial meters were considered to be equal to residential meters. Commercial peak flows generally do not occur at the same time that residential peak usage occurs so that adding the water utilized by commercial properties to residential customers, the results should be on the conservative side.

The average usage per meter over the past five years was shown to be 295 gallons per meter. The projected average usage for 1998 has been shown to be 2.571 MGD. This equates to 8,715 meters. At peak hourly flow rate, each meter would have a demand of (295 gal/meter x 3.5 peak factor) divided by 1,440 minutes/day = 0.71 gal/minute/meter. By multiplying 8,715 meters, by 0.71 gpm per meter, the peak hourly system demand is 6,249 gpm. The system model has a demand of 6,249 gpm.

D. Modeling Protocol for 1998 System

Figure D-1, D-2, and D-3 show the model for the existing distribution system for the 1998 service area. Initially, the system was analyzed without any of the transmission or distribution system improvements other than those transmission improvements on SR 54 associated with the new Industrial Park water plant.

Improvements to the piping system were added piece by piece, with the system reanalyzed after each piping change or addition, to determine the minimum amount of improvements that would bring the minimum pressure in the system to an acceptable level. The goal was to have a minimum pressure in the system of 40 psi. Figures D-4, D-5, and D-6 show the final model with all proposed piping improvements.

E. Results of the Hydraulic Analysis

The results of the hydraulic analysis under the conditions described above are included in the rear of this appendix.

The Reservoir Report shows the hydraulic grade and water outflow from each plant.

The Junction Report shows the outflow at each node where water leaves the system and the pressure at every node. There are nodes which have no outflow because they occur at pipe junctions where there are no adjacent users or occur where homes have not yet been constructed adjacent to the piping system.

The Pipe Report shows the amount of water flowing through each section of pipe, the velocity in the pipe, and the pressure loss from one end of the pipe to the other.

The initial analysis, modeling the system without any of the proposed improvements other than those associated with the Industrial Park water plant, shows pressures in the system as low as 16 psi. This is totally unacceptable.

The final analysis models with the following improvements:

1. A 12-inch main added to the system from the Mitchell Road water plant to the intersection of Mitchell Ranch Road and Mexicali Road.

2. A 12-inch main added to the system running north from the Mitchell Road water plant to connect to the south end of the existing 12-inch main in the Florida Power right-of-way approximately 3,000 feet north of the plant.

3. A 12-inch main added to the system on old SR 54 from the Florida Power Right-of-way east to connect to the proposed 12-inch main at the intersection with Little Road. The 12-inch main on Little Road will be constructed shortly as part of the utility relocation work necessary for the widening of Little Road.

4. A 12-inch main added to the system on Mitchell boulevard extending west from the end of the existing 12-inch main in front of the State Farm site to tie into the existing 12-inch main at the intersection of Lytton Road.

These improvements, shown in Figure D-7, result in the minimum pressure in the distribution system, at peak hourly flow rate, to be 40 psi. The maximum pressure in the distribution system is 61 psi, which occurs on SR 54 immediately outside of the industrial park. The flow from the Mitchell Road water plant is 2,119 gpm and there is 80 gpm difference between the output of the Industrial Park water plant and the Wyndtree water plant. The desired operating parameters have been met.

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1998 Initial Hydraulic Analysis

Output Files

Steady State Analysis
Reservoir Report

Node Label	Reservoir Surface Elevation (ft)	Reservoir Inflow (gpm)	Hydraulic Grade (ft)
R-1	158.00	-1,706.89	158.00
R-2	180.00	-2,187.44	180.00
R-3	168.00	-2,365.97	168.00

Steady State Analysis
Pipe Report

Node Label	Reservoir Surface Elevation (ft)	Reservoir Inflow (gpm)	Hydraulic Grade (ft)
R-1	158.00	-1,706.89	158.00
R-2	180.00	-2,187.44	180.00
R-3	168.00	-2,365.97	168.00

Steady State Analysis
Pipe Report

Link Label	Length (ft)	Diameter (in)	Material	Roughness	Current Status	Discharge (gpm)	Start Hydraulic Grade (ft)	End Hydraulic Grade (ft)	Headloss (ft)	Friction Slope (ft/1000ft)
P-61	275.00	12	PVC	140.0	Open	16.80	71.14	71.14	0.32e-3	0.12e-2
P-62	245.00	8	PVC	140.0	Open	78.68	71.14	71.10	0.04	0.15
P-63	299.00	8	PVC	140.0	Open	89.25	71.10	71.05	0.05	0.18
P-64	477.00	6	PVC	140.0	Open	-4.54	71.05	71.05	0.14e-2	0.3e-2
P-65	214.00	8	PVC	140.0	Open	6.44	71.05	71.05	0.31e-3	0.14e-2
P-66	516.00	6	PVC	140.0	Open	6.41	71.05	71.05	0.29e-2	0.01
P-67	711.00	12	PVC	140.0	Open	-61.88	71.14	71.15	0.01	0.01
P-68	1,043.00	6	PVC	140.0	Open	-10.57	71.10	71.12	0.02	0.01
P-69	253.00	6	PVC	140.0	Open	-37.45	71.12	71.16	0.04	0.15
P-70	846.00	6	PVC	140.0	Open	-26.88	71.05	71.12	0.07	0.08
P-71	248.00	8	PVC	140.0	Open	-48.43	71.08	71.09	0.01	0.06
P-72	828.00	8	PVC	140.0	Open	-67.94	71.09	71.18	0.09	0.11
P-73	926.00	6	PVC	140.0	Open	-19.50	71.05	71.09	0.04	0.04
P-74	1,121.00	6	PVC	140.0	Open	-34.53	71.15	71.29	0.14	0.13
P-75	258.00	8	PVC	140.0	Open	7.02	71.05	71.05	0.43e-3	0.17e-2
P-76	1,016.00	6	PVC	140.0	Open	7.02	71.05	71.04	0.01	0.01
P-77	137.00	8	PVC	140.0	Open	-46.68	71.03	71.04	0.01	0.06
P-78	294.00	8	PVC	140.0	Open	-39.66	71.04	71.05	0.01	0.04
P-79	970.00	6	PVC	140.0	Open	7.02	71.04	71.04	0.01	0.01
P-80	1,059.00	8	PVC	140.0	Open	-402.11	72.47	75.62	3.15	2.97
P-81	749.00	8	PVC	140.0	Open	-464.29	75.62	78.52	2.90	3.88
P-82	395.00	8	PVC	140.0	Open	555.32	78.52	76.39	2.13	5.40
P-83	785.00	6	PVC	140.0	Open	-79.93	71.87	72.35	0.48	0.61
P-84	198.00	8	PVC	140.0	Open	240.89	71.41	71.18	0.23	1.15
P-85	965.00	10	PVC	140.0	Open	76.37	71.18	71.14	0.04	0.05
P-86	204.00	8	PVC	140.0	Open	154.39	71.18	71.08	0.10	0.51
P-87	1,196.00	10	PVC	140.0	Open	136.31	71.08	70.92	0.16	0.14
P-88	585.00	10	PVC	140.0	Open	-85.44	70.89	70.92	0.03	0.06
P-89	597.00	6	PVC	140.0	Open	71.51	71.90	71.60	0.29	0.49
P-90	879.00	6	PVC	140.0	Open	14.38	71.60	71.58	0.02	0.03
P-91	428.00	6	PVC	140.0	Open	-13.10	71.58	71.59	0.01	0.02
P-93	640.00	8	PVC	140.0	Open	-78.92	105.71	105.80	0.09	0.15
P-95	406.00	8	PVC	140.0	Open	-6.01	105.28	105.28	0.51e-3	0.13e-2
P-96	281.00	6	PVC	140.0	Open	-38.55	105.28	105.32	0.04	0.16
P-97	225.00	6	PVC	140.0	Open	-87.49	105.32	105.48	0.16	0.72
P-99	128.00	8	PVC	140.0	Open	52.68	105.65	105.64	0.01	0.07
P-100	506.00	10	PVC	140.0	Open	224.78	105.83	105.65	0.17	0.34
P-101	302.00	10	PVC	140.0	Open	262.04	105.96	105.83	0.14	0.45
P-102	714.00	8	PVC	140.0	Open	37.26	105.83	105.80	0.03	0.04
P-103	426.00	8	PVC	140.0	Open	-78.92	105.64	105.71	0.06	0.15
P-104	810.00	8	PVC	140.0	Open	36.65	105.32	105.29	0.03	0.04
P-105	945.00	8	PVC	140.0	Open	23.64	105.29	105.28	0.01	0.02
P-106	656.00	8	PVC	140.0	Open	7.73	105.28	105.28	0.13e-2	0.2e-2
P-110	438.00	8	PVC	140.0	Open	19.57	105.49	105.49	0.49e-2	0.01
P-111	207.00	8	PVC	140.0	Open	172.09	105.65	105.53	0.13	0.62
P-112	1,034.00	8	PVC	140.0	Open	-37.72	105.49	105.53	0.04	0.04
P-114	751.00	8	PVC	140.0	Open	-20.76	105.48	105.49	0.01	0.01
P-115	1,065.00	8	PVC	140.0	Open	13.02	105.48	105.47	0.01	0.01
P-116	775.00	6	PVC	140.0	Open	-9.24	105.48	105.49	0.01	0.01
P-117	391.00	10	PVC	140.0	Open	406.59	106.36	105.96	0.40	1.02
P-118	574.00	10	PVC	140.0	Open	-54.97	106.35	106.36	0.01	0.03
P-119	1,072.00	10	PVC	140.0	Open	-461.56	106.36	107.75	1.39	1.29

Steady State Analysis
Pipe Report

Link Label	Length (ft)	Diameter (in)	Material	Roughness	Current Status	Discharge (gpm)	Start Hydraulic Grade (ft)	End Hydraulic Grade (ft)	Headloss (ft)	Friction Slope (ft/1000ft)
P-120	725.00	12	PVC	140.0	Open	1,083.06	107.75	105.88	1.87	2.58
P-121	1,003.00	8	PVC	140.0	Open	1,029.73	105.88	88.91	16.97	16.92
P-122	614.00	8	PVC	140.0	Open	1,029.73	88.91	78.52	10.39	16.92
P-124	157.00	12	Ductile Iron	130.0	Open	-852.32	71.90	72.20	0.30	1.90
P-127	515.00	12	PVC	140.0	Open	-1,544.62	107.75	110.31	2.56	4.97
P-129	190.00	8	PVC	140.0	Open	1,237.20	155.96	151.45	4.51	23.76
P-130	1,006.00	8	PVC	140.0	Open	1,237.20	151.45	127.54	23.90	23.76
P-131	2,594.00	8	PVC	140.0	Open	246.38	127.54	124.43	3.11	1.20
P-132	291.00	8	PVC	140.0	Open	674.85	124.43	122.18	2.25	7.74
P-133	1,056.00	8	PVC	140.0	Open	519.21	122.18	117.14	5.03	4.77
P-134	540.00	8	PVC	140.0	Open	348.51	117.14	115.91	1.23	2.28
P-135	506.00	8	PVC	140.0	Open	301.51	115.91	115.03	0.88	1.74
P-137	649.00	6	PVC	140.0	Open	-95.18	111.35	111.89	0.54	0.84
P-138	3,015.00	8	PVC	140.0	Open	248.72	115.03	111.35	3.68	1.22
P-139	199.00	8	PVC	140.0	Open	-545.03	110.31	111.35	1.04	5.21
P-142	247.00	8	PVC	140.0	Open	-523.91	124.43	125.63	1.20	4.85
P-143	1,276.00	6	PVC	140.0	Open	1.74	125.63	125.63	0.66e-3	0.51e-3
P-144	1,300.00	6	PVC	140.0	Open	-129.13	125.63	127.54	1.92	1.47
P-145	294.00	8	PVC	140.0	Open	697.50	127.54	125.12	2.42	8.23
P-146	742.00	6	PVC	140.0	Open	312.12	125.12	119.52	5.60	7.55
P-147	2,077.00	6	PVC	140.0	Open	-119.48	119.52	122.18	2.65	1.28
P-148	2,441.00	6	PVC	140.0	Open	-261.01	111.89	125.12	13.23	5.42
P-149	638.00	8	PVC	140.0	Open	-561.81	125.63	129.15	3.52	5.52
P-151	477.00	8	PVC	140.0	Open	0.00	129.19	129.19	0.00	0.00
P-152	728.00	8	PVC	140.0	Open	-386.51	129.19	131.20	2.01	2.76
P-153	728.00	8	PVC	140.0	Open	-395.12	129.15	131.24	2.09	2.88
P-154	490.00	8	PVC	140.0	Open	-561.20	131.24	133.94	2.70	5.50
P-155	83.00	8	PVC	140.0	Open	-159.57	131.20	131.24	0.04	0.54
P-156	969.00	8	PVC	140.0	Open	-226.93	131.20	132.19	1.00	1.03
P-157	623.00	8	PVC	140.0	Open	-234.89	132.19	132.88	0.68	1.10
P-158	67.00	8	PVC	140.0	Open	166.69	129.19	129.15	0.04	0.58
P-159	3,213.00	12	PVC	140.0	Open	-692.84	133.94	137.56	3.63	1.13
P-160	871.00	8	PVC	140.0	Open	-276.84	132.88	134.18	1.30	1.49
P-161	1,288.00	8	PVC	140.0	Open	-340.49	134.18	136.99	2.81	2.18
P-162	186.00	8	PVC	140.0	Open	-479.32	136.99	137.75	0.76	4.11
P-163	163.00	12	PVC	140.0	Open	-707.31	137.56	137.75	0.19	1.17
P-164	2,102.00	8	PVC	140.0	Open	14.47	137.56	137.55	0.01	0.01
P-165	621.00	8	PVC	140.0	Open	5.42	137.55	137.55	0.63e-3	0.1e-2
P-166	631.00	8	PVC	140.0	Open	7.23	137.55	137.55	0.11e-2	0.18e-2
P-167	621.00	8	PVC	140.0	Open	5.42	137.55	137.55	0.63e-3	0.1e-2
P-168	1,298.00	12	PVC	140.0	Open	-1,186.63	137.75	141.72	3.96	3.05
P-169	436.00	10	PVC	140.0	Open	269.71	141.72	141.51	0.21	0.48
P-170	241.00	10	PVC	140.0	Open	199.33	141.51	141.44	0.07	0.27
P-171	827.00	10	PVC	140.0	Open	147.89	141.44	141.31	0.13	0.16
P-172	666.00	10	PVC	140.0	Open	105.55	141.31	141.26	0.06	0.08
P-173	517.00	8	PVC	140.0	Open	120.83	141.26	141.09	0.17	0.32
P-174	573.00	8	PVC	140.0	Open	67.79	141.09	141.03	0.06	0.11
P-175	1,119.00	6	PVC	140.0	Open	5.61	141.03	141.02	0.5e-2	0.44e-2
P-176	1,199.00	6	PVC	140.0	Open	-15.36	141.02	141.06	0.03	0.03
P-178	1,015.00	6	PVC	140.0	Open	44.35	141.51	141.30	0.21	0.20
P-179	495.00	6	PVC	140.0	Open	-13.42	141.30	141.31	0.01	0.02
P-180	1,486.00	6	PVC	140.0	Open	34.09	141.44	141.26	0.19	0.13

Steady State Analysis
Pipe Report

Link Label	Length (ft)	Diameter (in)	Material	Roughness	Current Status	Discharge (gpm)	Start Hydraulic Grade (ft)	End Hydraulic Grade (ft)	Headloss (ft)	Friction Slope (ft/1000ft)
P-181	162.00	8	PVC	140.0	Open	-67.42	141.06	141.07	0.02	0.11
P-182	339.00	8	PVC	140.0	Open	-42.92	141.07	141.09	0.02	0.05
P-183	1,464.00	6	PVC	140.0	Open	38.24	141.30	141.07	0.23	0.16
P-184	294.00	8	PVC	140.0	Open	33.26	141.06	141.05	0.01	0.03
P-187	593.00	8	PVC	140.0	Open	36.15	140.99	140.97	0.02	0.03
P-188	920.00	8	PVC	140.0	Open	17.23	140.97	140.97	0.01	0.01
P-189	920.00	6	PVC	140.0	Open	8.08	140.97	140.97	0.01	0.01
P-190	107.00	8	PVC	140.0	Open	47.00	141.03	141.02	0.01	0.06
P-191	464.00	8	PVC	140.0	Open	47.00	141.02	140.99	0.03	0.06
P-196	613.00	12	PVC	140.0	Open	856.66	165.34	164.32	1.02	1.67
P-197	1,072.00	12	PVC	140.0	Open	856.66	164.32	162.53	1.79	1.67
P-198	151.00	6	PVC	140.0	Open	0.00	161.41	161.41	0.00	0.00
P-199	447.00	6	PVC	140.0	Open	67.97	161.41	161.21	0.20	0.45
P-200	1,613.00	12	PVC	140.0	Open	531.47	162.53	161.41	1.11	0.69
P-201	810.00	6	PVC	140.0	Open	36.16	161.21	161.10	0.11	0.14
P-202	299.00	6	PVC	140.0	Open	16.63	161.10	161.09	0.01	0.03
P-203	464.00	4	PVC	140.0	Open	5.06	161.09	161.08	0.01	0.03
P-204	161.00	8	PVC	140.0	Open	-1,135.06	158.42	161.68	3.26	20.26
P-205	717.00	12	Ductile Iron	130.0	Open	-1,455.08	161.68	165.34	3.66	5.11
P-206	873.00	8	PVC	140.0	Open	320.01	161.68	159.98	1.70	1.95
P-207	759.00	8	PVC	140.0	Open	301.33	159.98	158.66	1.32	1.74
P-208	862.00	12	PVC	140.0	Open	324.90	158.66	158.42	0.24	0.28
P-209	1,195.00	12	PVC	140.0	Open	-23.57	158.66	158.66	0.26e-2	0.22e-2
P-210	538.00	10	PVC	140.0	Open	-23.57	158.66	158.66	0.28e-2	0.01
P-212	391.00	8	PVC	140.0	Open	-192.74	158.71	159.01	0.30	0.76
P-213	1,013.00	8	PVC	140.0	Open	-217.33	159.01	159.97	0.96	0.95
P-214	882.00	8	PVC	140.0	Open	-18.68	159.97	159.98	0.01	0.01
P-215	134.00	8	PVC	140.0	Open	31.09	158.66	158.66	0.35e-2	0.03
P-216	955.00	8	PVC	140.0	Open	13.74	158.66	158.65	0.01	0.01
P-217	183.00	6	PVC	140.0	Open	6.51	158.65	158.65	0.11e-2	0.01
P-218	579.00	8	PVC	140.0	Open	30.01	158.71	158.70	0.01	0.02
P-219	527.00	8	PVC	140.0	Open	13.38	158.70	158.69	0.29e-2	0.01
P-220	1,123.00	10	PVC	140.0	Open	-54.66	158.66	158.69	0.03	0.02
P-221	817.00	10	PVC	140.0	Open	-50.68	158.69	158.71	0.02	0.02
P-222	345.00	6	PVC	140.0	Open	-3.98	158.69	158.69	0.75e-3	0.22e-2
P-223	1,175.00	8	PVC	140.0	Open	289.03	162.53	160.63	1.89	1.61
P-224	1,170.00	8	PVC	140.0	Open	163.78	160.63	159.97	0.66	0.56
P-225	1,170.00	6	PVC	140.0	Open	76.80	160.63	159.97	0.66	0.56
P-226	415.00	8	PVC	140.0	Open	15.91	160.63	160.63	0.31e-2	0.01
P-227	339.00	4	PVC	140.0	Open	2.89	160.63	160.63	0.32e-2	0.01
P-228	623.00	10	PVC	140.0	Open	112.05	158.71	158.65	0.06	0.09
P-229	626.00	10	PVC	140.0	Open	64.96	158.65	158.63	0.02	0.03
P-230	453.00	10	PVC	140.0	Open	16.85	158.63	158.63	0.13e-2	0.28e-2
P-231	512.00	10	PVC	140.0	Open	70.38	158.63	158.61	0.02	0.04
P-232	478.00	8	PVC	140.0	Open	30.61	158.61	158.60	0.01	0.03
P-233	752.00	6	PVC	140.0	Open	13.26	158.60	158.58	0.02	0.02
P-234	707.00	6	PVC	140.0	Open	-25.07	158.58	158.63	0.05	0.07
P-235	274.00	10	PVC	140.0	Open	39.77	158.61	158.60	0.38e-2	0.01
P-237	567.00	10	PVC	140.0	Open	18.08	158.60	158.60	0.18e-2	0.32e-2
P-238	651.00	6	PVC	140.0	Open	18.08	158.60	158.58	0.03	0.04
P-239	862.00	6	PVC	140.0	Open	21.79	158.65	158.60	0.05	0.05
P-240	423.00	6	PVC	140.0	Open	-23.05	158.60	158.63	0.03	0.06

Steady State Analysis
Pipe Report

Link Label	Length (ft)	Diameter (in)	Material	Roughness	Current Status	Discharge (gpm)	Start Hydraulic Grade (ft)	End Hydraulic Grade (ft)	Headloss (ft)	Friction Slope (ft/1000ft)
P-241	234.00	6	PVC	140.0	Open	20.97	158.60	158.59	0.01	0.05
P-242	430.00	4	PVC	140.0	Open	7.23	158.59	158.57	0.02	0.05
P-243	594.00	8	PVC	140.0	Open	-104.87	158.63	158.77	0.15	0.25
P-244	645.00	6	PVC	140.0	Open	-35.79	158.77	158.86	0.09	0.14
P-245	787.00	8	PVC	140.0	Open	-146.09	158.86	159.22	0.36	0.46
P-246	442.00	8	PVC	140.0	Open	-156.21	159.22	159.45	0.23	0.52
P-247	386.00	8	PVC	140.0	Open	-170.67	159.45	159.69	0.23	0.61
P-248	645.00	8	PVC	140.0	Open	-76.32	158.77	158.86	0.09	0.14
P-251	1,262.00	12	PVC	140.0	Open	-34.90	159.75	159.76	0.01	0.45e-2
P-252	429.00	12	PVC	140.0	Open	-63.10	159.76	159.76	0.01	0.01
P-253	529.00	12	PVC	140.0	Open	-92.01	159.76	159.78	0.01	0.03
P-254	802.00	12	PVC	140.0	Open	-106.47	159.78	159.80	0.03	0.04
P-255	236.00	12	PVC	140.0	Open	-216.38	159.80	159.84	0.03	0.13
P-256	736.00	12	PVC	140.0	Open	-301.61	159.84	160.01	0.18	0.24
P-257	658.00	8	PVC	140.0	Open	109.94	160.01	159.84	0.18	0.27
P-258	848.00	8	PVC	140.0	Open	87.52	159.84	159.69	0.15	0.18
P-259	317.00	8	PVC	140.0	Open	36.98	159.75	159.74	0.01	0.04
P-260	577.00	8	PVC	140.0	Open	24.69	159.74	159.73	0.01	0.02
P-261	547.00	8	PVC	140.0	Open	12.40	159.73	159.73	0.26e-2	0.47e-2
P-262	415.00	8	PVC	140.0	Open	-5.68	159.73	159.73	0.46e-3	0.11e-2
P-263	769.00	6	PVC	140.0	Open	-8.85	159.73	159.73	0.01	0.01
P-264	876.00	6	PVC	140.0	Open	-15.90	159.73	159.76	0.03	0.03
P-265	468.00	8	PVC	140.0	Open	-12.74	159.73	159.73	0.23e-2	0.01
P-266	688.00	8	PVC	140.0	Open	-29.37	159.73	159.75	0.02	0.02
P-267	327.00	8	PVC	140.0	Open	-46.73	159.75	159.76	0.02	0.06
P-268	501.00	8	PVC	140.0	Open	-78.00	159.76	159.84	0.07	0.14
P-269	383.00	6	PVC	140.0	Open	-13.20	159.73	159.74	0.01	0.02
P-270	327.00	6	PVC	140.0	Open	-23.32	159.74	159.76	0.02	0.06
P-271	302.00	8	PVC	140.0	Open	0.00	159.74	159.74	0.00	0.00
P-272	565.00	8	PVC	140.0	Open	6.51	159.84	159.84	0.82e-3	0.15e-2
P-273	627.00	12	PVC	140.0	Open	-425.29	160.01	160.30	0.29	0.46
P-274	583.00	12	PVC	140.0	Open	-441.92	160.30	160.59	0.29	0.49
P-275	568.00	4	PVC	140.0	Open	7.95	160.30	160.27	0.03	0.06
P-276	554.00	8	PVC	140.0	Open	96.89	159.80	159.69	0.12	0.21
P-277	2,295.00	12	PVC	140.0	Open	-449.15	160.59	161.75	1.16	0.51
P-279	159.00	12	PVC	140.0	Open	-449.15	161.75	161.83	0.08	0.51
P-280	340.00	6	PVC	140.0	Open	14.63	161.83	161.82	0.01	0.03
P-281	488.00	6	PVC	140.0	Open	5.23	161.82	161.82	0.19e-2	0.39e-2
P-282	781.00	12	PVC	140.0	Open	-463.78	161.83	162.25	0.42	0.54
P-283	705.00	6	PVC	140.0	Open	17.39	162.25	162.22	0.03	0.04
P-284	991.00	6	PVC	140.0	Open	8.71	162.22	162.21	0.01	0.01
P-286	587.00	6	PVC	140.0	Open	13.05	162.68	162.67	0.01	0.02
P-287	408.00	4	PVC	140.0	Open	4.34	162.67	162.66	0.01	0.02
P-288	229.00	12	PVC	140.0	Open	-508.85	162.68	162.83	0.15	0.64
P-289	410.00	12	PVC	140.0	Open	-456.76	162.83	163.04	0.21	0.52
P-290	208.00	12	PVC	140.0	Open	-464.60	163.04	163.16	0.11	0.54
P-291	603.00	12	PVC	140.0	Open	-539.90	163.16	163.58	0.43	0.71
P-292	987.00	6	PVC	140.0	Open	13.92	163.58	163.56	0.02	0.02
P-293	518.00	6	PVC	140.0	Open	4.34	163.56	163.56	0.14e-2	0.28e-2
P-294	174.00	6	PVC	140.0	Open	-52.10	162.83	162.88	0.05	0.28
P-295	499.00	6	PVC	140.0	Open	-24.90	162.88	162.91	0.04	0.07
P-296	270.00	6	PVC	140.0	Open	-30.99	162.91	162.94	0.03	0.11

Steady State Analysis
Pipe Report

Link Label	Length (ft)	Diameter (in)	Material	Roughness	Current Status	Discharge (gpm)	Start Hydraulic Grade (ft)	End Hydraulic Grade (ft)	Headloss (ft)	Friction Slope (ft/1000ft)
P-297	395.00	6	PVC	140.0	Open	-75.31	162.94	163.16	0.21	0.54
P-298	403.00	6	PVC	140.0	Open	38.53	162.94	162.88	0.06	0.16
P-299	233.00	4	PVC	140.0	Open	-6.10	164.55	164.55	0.01	0.04
P-300	189.00	6	PVC	140.0	Open	-6.10	164.55	164.56	0.98e-3	0.01
P-301	337.00	6	PVC	140.0	Open	-12.20	164.56	164.56	0.01	0.02
P-302	402.00	6	PVC	140.0	Open	-20.04	164.56	164.58	0.02	0.05
P-303	1,310.00	12	PVC	140.0	Open	559.93	164.58	163.58	1.00	0.76
P-304	594.00	12	PVC	140.0	Open	-579.96	164.58	165.06	0.48	0.81
P-305	447.00	12	PVC	140.0	Open	-504.07	165.06	165.34	0.28	0.63
P-306	1,327.00	12	PVC	140.0	Open	-511.47	165.34	166.20	0.85	0.64
P-307	505.00	6	PVC	140.0	Open	-75.89	165.06	165.34	0.28	0.55
P-308	292.00	8	PVC	140.0	Open	-76.45	165.34	165.38	0.04	0.14
P-309	285.00	8	PVC	140.0	Open	-76.45	165.38	165.42	0.04	0.14
P-310	623.00	8	PVC	140.0	Open	-7.40	165.34	165.34	0.11e-2	0.18e-2
P-311	171.00	8	PVC	140.0	Open	-7.40	165.34	165.34	0.32e-3	0.19e-2
P-312	290.00	12	PVC	140.0	Open	134.31	166.20	166.18	0.02	0.05
P-313	348.00	12	PVC	140.0	Open	134.31	166.18	166.16	0.02	0.05
P-314	1,008.00	12	PVC	140.0	Open	110.73	166.16	166.12	0.04	0.04
P-315	336.00	12	PVC	140.0	Open	134.31	166.12	166.11	0.02	0.05
P-316	227.00	12	PVC	140.0	Open	134.31	166.11	166.09	0.01	0.05
P-317	518.00	8	PVC	140.0	Open	-23.58	166.12	166.13	0.01	0.02
P-318	671.00	8	PVC	140.0	Open	-23.58	166.13	166.14	0.01	0.02
P-319	440.00	8	PVC	140.0	Open	-23.58	166.14	166.15	0.01	0.02
P-320	409.00	8	PVC	140.0	Open	-23.58	166.15	166.16	0.01	0.02
P-321	411.00	8	PVC	140.0	Open	-23.58	166.16	166.16	0.01	0.02
P-322	933.00	12	PVC	140.0	Open	72.29	166.09	166.08	0.02	0.02
P-323	375.00	8	PVC	140.0	Open	32.51	166.08	166.07	0.01	0.03
P-324	910.00	8	PVC	140.0	Open	32.51	166.07	166.04	0.03	0.03
P-325	561.00	8	PVC	140.0	Open	-62.02	166.04	166.09	0.05	0.09
P-326	1,296.00	8	PVC	140.0	Open	-76.45	165.42	165.60	0.18	0.14
P-327	1,049.00	8	PVC	140.0	Open	-94.52	165.60	165.81	0.21	0.20
P-328	1,116.00	8	PVC	140.0	Open	-94.52	165.81	166.04	0.23	0.20
P-329	546.00	8	PVC	140.0	Open	0.00	166.16	166.16	0.00	0.00
P-330	331.00	8	PVC	140.0	Open	0.00	166.16	166.16	0.00	0.00
P-331	299.00	8	PVC	140.0	Open	0.00	166.11	166.11	0.00	0.00
P-332	259.00	8	PVC	140.0	Open	0.00	166.11	166.11	0.00	0.00
P-333	320.00	8	PVC	140.0	Open	0.00	166.11	166.11	0.00	0.00
P-334	808.00	8	PVC	140.0	Open	0.00	166.11	166.11	0.00	0.00
P-335	331.00	8	PVC	140.0	Open	0.00	166.11	166.11	0.00	0.00
P-336	783.00	12	PVC	140.0	Open	39.78	166.08	166.07	0.45e-2	0.01
P-337	674.00	8	PVC	140.0	Open	20.98	166.07	166.06	0.01	0.01
P-338	1,249.00	8	PVC	140.0	Open	10.13	166.06	166.06	0.41e-2	0.33e-2
P-340	566.00	12	PVC	140.0	Open	-653.01	167.42	167.99	0.57	1.01
P-341	520.00	8	PVC	140.0	Open	7.23	167.42	167.42	0.92e-3	0.18e-2
P-342	465.00	8	PVC	140.0	Open	7.23	167.42	167.42	0.81e-3	0.17e-2
P-343	477.00	6	PVC	140.0	Open	7.23	167.42	167.41	0.34e-2	0.01
P-344	221.00	6	PVC	140.0	Open	7.23	167.41	167.41	0.16e-2	0.01
P-345	682.00	8	PVC	140.0	Open	0.00	167.42	167.42	0.00	0.00
P-346	140.00	4	PVC	140.0	Open	0.00	167.42	167.42	0.00	0.00
P-347	287.00	12	PVC	140.0	Open	-653.01	167.99	168.28	0.29	1.01
P-348	271.00	12	PVC	140.0	Open	-653.01	168.28	168.56	0.27	1.01
P-349	282.00	12	PVC	140.0	Open	-671.09	168.56	168.86	0.30	1.06

Steady State Analysis
Pipe Report

Link Label	Length (ft)	Diameter (in)	Material	Roughness	Current Status	Discharge (gpm)	Start Hydraulic Grade (ft)	End Hydraulic Grade (ft)	Headloss (ft)	Friction Slope (ft/1000ft)
P-350	394.00	12	PVC	140.0	Open	-692.79	168.86	169.30	0.44	1.13
P-351	856.00	8	PVC	140.0	Open	18.08	168.56	168.55	0.01	0.01
P-352	843.00	8	PVC	140.0	Open	21.70	168.86	168.84	0.01	0.01
P-353	311.00	4	PVC	140.0	Open	11.57	168.84	168.81	0.04	0.12
P-354	276.00	12	PVC	140.0	Open	-702.91	169.30	169.62	0.32	1.16
P-355	1,014.00	12	PVC	140.0	Open	-714.49	169.62	170.83	1.21	1.19
P-356	429.00	12	PVC	140.0	Open	-723.89	170.83	171.36	0.52	1.22
P-357	398.00	12	PVC	140.0	Open	-744.14	171.36	171.87	0.51	1.29
P-358	652.00	6	PVC	140.0	Open	0.00	170.83	170.83	0.00	0.00
P-359	112.00	8	PVC	140.0	Open	0.00	170.83	170.83	0.00	0.00
P-360	452.00	12	PVC	140.0	Open	-744.14	171.87	172.45	0.58	1.29
P-361	590.00	12	PVC	140.0	Open	-744.14	172.45	173.21	0.76	1.29
P-362	244.00	12	PVC	140.0	Open	-744.14	173.21	173.52	0.31	1.29
P-363	456.00	12	PVC	140.0	Open	-744.14	173.52	174.11	0.59	1.29
P-364	162.00	8	PVC	140.0	Open	0.00	172.45	172.45	0.00	0.00
P-365	669.00	6	PVC	140.0	Open	0.00	172.45	172.45	0.00	0.00
P-367	113.00	4	PVC	140.0	Open	7.95	171.35	171.35	0.01	0.06
P-368	1,926.00	12	PVC	140.0	Open	-744.14	174.11	176.59	2.48	1.29
P-369	764.00	16	Ductile Iron	130.0	Open	1,164.71	176.59	175.95	0.64	0.83
P-370	438.00	10	PVC	140.0	Open	-28.20	175.95	175.96	0.32e-2	0.01
P-371	167.00	10	PVC	140.0	Open	-72.32	175.96	175.96	0.01	0.04
P-372	1,172.00	6	PVC	140.0	Open	-44.33	175.96	176.20	0.24	0.20
P-374	555.00	6	PVC	140.0	Open	16.36	175.81	175.80	0.02	0.03
P-375	184.00	6	PVC	140.0	Open	-8.22	175.80	175.80	0.17e-2	0.01
P-376	680.00	6	PVC	140.0	Open	44.11	175.96	175.82	0.14	0.20
P-377	198.00	6	PVC	140.0	Open	16.36	175.82	175.81	0.01	0.03
P-378	611.00	6	PVC	140.0	Open	-17.63	175.80	175.82	0.02	0.04
P-379	186.00	6	PVC	140.0	Open	-17.36	175.64	175.65	0.01	0.04
P-380	948.00	6	PVC	140.0	Open	-34.00	175.65	175.76	0.12	0.12
P-381	231.00	6	PVC	140.0	Open	-39.78	175.76	175.80	0.04	0.17
P-382	778.00	6	PVC	140.0	Open	-44.84	175.80	175.96	0.16	0.21
P-383	918.00	6	PVC	140.0	Open	-58.79	176.20	176.52	0.32	0.34
P-385	647.00	6	PVC	140.0	Open	90.19	176.46	175.96	0.49	0.76
P-386	609.00	6	PVC	140.0	Open	-16.64	176.46	176.48	0.02	0.03
P-387	357.00	6	PVC	140.0	Open	-17.51	176.48	176.49	0.01	0.04
P-388	170.00	10	PVC	140.0	Open	153.26	176.52	176.49	0.03	0.17
P-389	573.00	10	PVC	140.0	Open	88.74	176.49	176.46	0.04	0.06
P-390	570.00	10	PVC	140.0	Open	-17.51	176.49	176.49	0.17e-2	0.3e-2
P-391	292.00	8	PVC	140.0	Open	-212.06	176.52	176.79	0.27	0.91
P-392	915.00	6	PVC	140.0	Open	-43.12	176.79	176.96	0.18	0.19
P-393	149.00	8	PVC	140.0	Open	-51.80	176.96	176.97	0.01	0.07
P-394	632.00	8	PVC	140.0	Open	76.92	176.97	176.88	0.09	0.14
P-395	278.00	8	PVC	140.0	Open	76.92	176.88	176.85	0.04	0.14
P-396	465.00	8	PVC	140.0	Open	-4.27	176.85	176.85	0.32e-3	0.69e-3
P-397	146.00	6	PVC	140.0	Open	30.18	176.85	176.83	0.01	0.10
P-398	462.00	6	PVC	140.0	Open	30.18	176.83	176.79	0.05	0.10
P-399	871.00	20	Ductile Iron	130.0	Open	-1,908.85	176.59	177.20	0.61	0.70
P-401	291.00	8	PVC	140.0	Open	-57.57	176.85	176.87	0.02	0.08
P-402	289.00	6	PVC	140.0	Open	0.00	176.87	176.87	0.00	0.00
P-403	457.00	8	PVC	140.0	Open	34.44	176.87	176.86	0.01	0.03
P-404	776.00	8	PVC	140.0	Open	0.00	176.86	176.86	0.00	0.00
P-405	127.00	8	PVC	140.0	Open	0.00	176.86	176.86	0.00	0.00

Steady State Analysis
Pipe Report

Link Label	Length (ft)	Diameter (in)	Material	Roughness	Current Status	Discharge (gpm)	Start Hydraulic Grade (ft)	End Hydraulic Grade (ft)	Headloss (ft)	Friction Slope (ft/1000ft)
P-406	286.00	8	PVC	140.0	Open	-34.44	176.85	176.86	0.01	0.03
P-407	1,674.00	8	PVC	140.0	Open	-114.43	176.87	177.36	0.49	0.29
P-408	337.00	8	PVC	140.0	Open	-2.17	179.15	179.16	0.61e-4	0.18e-3
P-409	427.00	8	PVC	140.0	Open	-256.06	179.16	179.71	0.55	1.29
P-410	981.00	8	PVC	140.0	Open	250.27	179.16	177.94	1.21	1.24
P-411	364.00	8	PVC	140.0	Open	121.38	177.94	177.83	0.12	0.32
P-412	708.00	8	PVC	140.0	Open	119.21	177.83	177.60	0.22	0.31
P-413	105.00	8	PVC	140.0	Open	20.37	177.20	177.20	0.13e-2	0.01
P-414	560.00	8	PVC	140.0	Open	137.40	177.20	176.97	0.23	0.41
P-415	1,329.00	8	PVC	140.0	Open	117.04	177.60	177.20	0.40	0.30
P-416	1,043.00	8	PVC	140.0	Open	125.27	177.94	177.58	0.36	0.34
P-418	704.00	8	PVC	140.0	Open	121.66	177.58	177.36	0.23	0.33
P-419	562.00	8	PVC	140.0	Open	3.62	177.36	177.36	0.27e-3	0.49e-3
P-426	248.00	12	PVC	140.0	Open	1,192.91	160.21	159.44	0.76	3.08
P-427	984.00	12	PVC	140.0	Open	1,192.91	159.44	156.41	3.03	3.08
P-430	113.00	12	PVC	140.0	Open	707.31	156.09	155.96	0.13	1.17
P-437	278.00	12	Ductile Iron	130.0	Open	1,706.89	158.00	156.09	1.91	6.86
P-439	683.00	6	PVC	140.0	Open	-189.37	112.63	114.67	2.05	2.99
P-440	249.00	6	PVC	140.0	Open	-88.49	114.67	114.86	0.18	0.73
P-441	910.00	6	PVC	140.0	Open	-114.53	114.86	115.93	1.07	1.18
P-442	249.00	6	PVC	140.0	Open	-136.22	115.93	116.34	0.41	1.63
P-443	204.00	8	PVC	140.0	Open	-297.11	116.34	116.68	0.35	1.70
P-444	1,262.00	8	PVC	140.0	Open	-346.28	116.68	119.52	2.84	2.25
P-445	910.00	6	PVC	140.0	Open	-144.99	114.67	116.34	1.66	1.83
P-446	242.00	6	PVC	140.0	Open	11.76	111.89	111.89	0.42e-2	0.02
P-447	247.00	6	PVC	140.0	Open	-189.37	111.89	112.63	0.74	2.99
P-448	655.00	8	PVC	140.0	Open	-201.12	111.35	111.89	0.54	0.82
P-449	146.00	8	PVC	140.0	Open	-138.76	176.79	176.85	0.06	0.41
P-450	672.00	8	PVC	140.0	Open	-91.75	105.83	105.96	0.13	0.19
P-451	166.00	8	PVC	140.0	Open	-93.72	105.80	105.83	0.03	0.20
P-453	189.00	6	PVC	140.0	Open	-15.39	105.48	105.48	0.01	0.03
P-454	725.00	6	PVC	140.0	Open	-6.15	105.48	105.49	0.38e-2	0.01
P-455	429.00	12	PVC	140.0	Open	-529.90	155.96	156.25	0.29	0.69
P-456	980.00	12	PVC	140.0	Open	-117.66	156.25	156.30	0.04	0.04
P-460	660.00	8	PVC	140.0	Open	-53.32	105.83	105.88	0.05	0.07
P-462	691.00	8	PVC	140.0	Open	-101.23	105.48	105.64	0.16	0.23
P-464	622.00	8	PVC	140.0	Open	46.16	105.53	105.49	0.03	0.05
P-477	1,115.00	12	PVC	140.0	Open	-432.49	158.23	158.75	0.53	0.47
P-479	519.00	12	PVC	140.0	Open	-440.44	158.75	159.01	0.25	0.49
P-488	400.00	12	PVC	140.0	Open	-490.58	162.25	162.49	0.24	0.60
P-489	331.00	12	PVC	140.0	Open	-490.58	162.49	162.68	0.20	0.60
P-491	952.00	8	PVC	140.0	Open	1,070.19	156.41	139.11	17.30	18.17
P-492	372.00	8	PVC	140.0	Open	1,058.62	139.11	132.49	6.62	17.81
P-493	239.00	8	PVC	140.0	Open	1,047.05	132.49	128.32	4.17	17.45
P-494	545.00	8	PVC	140.0	Open	1,036.93	128.32	118.98	9.34	17.14
P-496	202.00	12	Ductile Iron	130.0	Open	-907.99	72.20	72.63	0.43	2.13
P-497	592.00	8	PVC	140.0	Open	-991.37	72.63	81.97	9.34	15.77
P-499	1,016.00	6	PVC	140.0	Open	18.91	62.50	62.46	0.04	0.04
P-500	170.00	8	PVC	140.0	Open	5.33	62.46	62.46	0.17e-3	0.99e-3
P-501	1,205.00	8	PVC	140.0	Open	-3.35	62.46	62.46	0.51e-3	0.42e-3
P-502	415.00	6	PVC	140.0	Open	7.91	62.46	62.45	0.35e-2	0.01
P-503	317.00	6	PVC	140.0	Open	-2.93	62.45	62.46	0.42e-3	0.13e-2

Steady State Analysis
Pipe Report

Link Label	Length (ft)	Diameter (in)	Material	Roughness	Current Status	Discharge (gpm)	Start Hydraulic Grade (ft)	End Hydraulic Grade (ft)	Headloss (ft)	Friction Slope (ft/1000ft)
P-504	1,092.00	6	PVC	140.0	Open	-11.61	62.46	62.47	0.02	0.02
P-505	243.00	6	PVC	140.0	Open	-31.86	62.47	62.50	0.03	0.11
P-506	253.00	8	PVC	140.0	Open	-30.78	62.46	62.46	0.01	0.03
P-507	666.00	8	PVC	140.0	Open	-46.13	62.46	62.50	0.04	0.05
P-508	351.00	6	PVC	140.0	Open	11.01	62.46	62.46	0.01	0.02
P-509	307.00	4	PVC	140.0	Open	0.72	62.46	62.46	0.22e-3	0.72e-3
P-510	638.00	6	PVC	140.0	Open	3.78	62.46	62.46	0.14e-2	0.21e-2
P-511	233.00	4	PVC	140.0	Open	4.34	62.45	62.45	0.46e-2	0.02
P-514	2,929.00	12	PVC	140.0	Open	-1,192.91	160.21	169.24	9.03	3.08
P-518	508.00	12	PVC	140.0	Open	-645.78	166.20	166.70	0.50	0.99
P-519	725.00	12	PVC	140.0	Open	-645.78	166.70	167.42	0.72	0.99
P-534	1,268.00	12	PVC	140.0	Open	-1,456.34	141.72	147.37	5.65	4.46
P-535	2,466.00	12	PVC	140.0	Open	-1,459.96	147.37	158.42	11.05	4.48
P-538	1,858.00	8	PVC	140.0	Open	2.17	158.75	158.75	0.35e-3	0.19e-3
P-544	659.00	12	PVC	140.0	Open	-441.16	159.01	159.33	0.32	0.49
P-545	664.00	12	PVC	140.0	Open	-444.78	159.33	159.66	0.33	0.50
P-546	1,518.00	12	PVC	140.0	Open	3.62	158.75	158.75	0.11e-3	0.7e-4
P-552	649.00	12	PVC	140.0	Open	-428.87	157.92	158.23	0.30	0.46
P-554	1,512.00	12	PVC	140.0	Open	-425.25	157.23	157.92	0.69	0.46
P-561	367.00	8	PVC	140.0	Open	3.62	137.55	137.55	0.18e-3	0.5e-3
P-565	399.00	8	PVC	140.0	Open	0.00	141.02	141.02	0.00	0.00
P-570	117.00	12	PVC	140.0	Open	-425.25	156.25	156.31	0.05	0.46
P-575	1,159.00	12	PVC	140.0	Open	-425.25	156.31	156.84	0.53	0.46
P-576	862.00	12	PVC	140.0	Open	-425.25	156.84	157.23	0.39	0.46
P-578	1,531.00	8	PVC	140.0	Open	-999.59	110.31	134.83	24.52	16.01
P-579	1,328.00	8	PVC	140.0	Open	-999.59	134.83	156.09	21.27	16.01
P-580	1,376.00	12	PVC	140.0	Open	-119.11	156.30	156.36	0.06	0.04
P-581	1,226.00	12	PVC	140.0	Open	-120.55	156.36	156.41	0.05	0.04
P-583	661.00	8	PVC	140.0	Open	-1,036.93	107.65	118.98	11.33	17.14
P-584	506.00	8	PVC	140.0	Open	-1,034.03	81.97	90.59	8.63	17.05
P-585	998.00	8	PVC	140.0	Open	-1,035.48	90.59	107.65	17.06	17.09
P-586	874.00	12	Ductile Iron	130.0	Open	-432.78	71.01	71.49	0.47	0.54
P-587	684.00	12	Ductile Iron	140.0	Open	-437.12	71.49	71.81	0.33	0.48
P-595	478.00	8	PVC	140.0	Open	-25.42	69.36	69.36	0.01	0.02
P-596	519.00	8	PVC	140.0	Open	-76.82	69.36	69.44	0.07	0.14
P-597	2,036.00	8	PVC	140.0	Open	51.40	69.36	69.23	0.13	0.07
P-598	995.00	8	PVC	140.0	Open	30.83	69.23	69.20	0.03	0.03
P-599	840.00	8	PVC	140.0	Open	51.40	69.20	69.15	0.06	0.07
P-602	5,720.00	16	Ductile Iron	130.0	Open	-1,192.91	169.24	174.22	4.98	0.87
P-603	1,989.00	16	Ductile Iron	130.0	Open	-1,192.91	174.22	175.95	1.73	0.87
P-605	237.00	8	PVC	140.0	Open	-315.22	71.29	71.74	0.45	1.89
P-606	464.00	8	PVC	140.0	Open	-322.45	71.74	72.66	0.92	1.97
P-607	448.00	8	PVC	140.0	Open	0.00	71.74	71.74	0.00	0.00
P-611	646.00	8	PVC	140.0	Open	533.63	76.39	73.15	3.24	5.01
P-612	156.00	12	Ductile Iron	130.0	Open	-437.12	71.81	71.90	0.09	0.55
P-613	1,006.00	8	PVC	140.0	Open	0.00	64.20	64.20	0.00	0.00
P-614	816.00	8	PVC	140.0	Closed	0.00	64.20	69.20	0.00	0.00
P-615	792.00	8	PVC	140.0	Closed	0.00	62.46	69.22	0.00	0.00
P-616	1,056.00	8	PVC	140.0	Open	-20.57	69.20	69.22	0.01	0.01
P-617	757.00	8	PVC	140.0	Open	0.00	69.22	69.22	0.00	0.00
P-618	1,048.00	8	PVC	140.0	Open	-20.57	69.22	69.23	0.01	0.01
P-619	187.00	12	PVC	140.0	Open	-445.50	159.66	159.75	0.09	0.50

Steady State Analysis
Pipe Report

Link Label	Length (ft)	Diameter (in)	Material	Roughness	Current Status	Discharge (gpm)	Start Hydraulic Grade (ft)	End Hydraulic Grade (ft)	Headloss (ft)	Friction Slope (ft/1000ft)
P-620	534.00	12	PVC	140.0	Open	17.99	159.75	159.75	0.7e-3	0.13e-2
P-622	611.00	20	Ductile Iron	130.0	Open	2,365.97	168.00	167.36	0.64	1.04
P-623	161.00	12	Ductile Iron	130.0	Open	2,365.97	167.36	165.34	2.02	12.55
P-626	3,097.00	12	PVC	140.0	Open	463.50	161.41	159.75	1.66	0.54
P-627	339.00	4	PVC	140.0	Open	83.38	72.63	71.03	1.60	4.73
P-628	680.00	6	PVC	140.0	Open	99.90	71.03	70.40	0.62	0.92
P-629	346.00	6	PVC	140.0	Open	48.34	71.11	71.03	0.08	0.24
P-631	225.00	8	PVC	140.0	Open	-258.23	179.71	180.00	0.29	1.31
P-632	1,284.00	20	Ductile Iron	130.0	Open	1,929.21	180.00	179.08	0.92	0.72
P-633	2,629.00	20	Ductile Iron	130.0	Open	1,929.21	179.08	177.20	1.88	0.72

Steady State Analysis
Junction Report

Node Label	Elevation (ft)	Demand Type	Demand (gpm)	Demand Pattern	Calculated Demand (gpm)	Hydraulic Grade (ft)	Pressure (psi)
J-1	24.00	Demand	26.99	Fixed	19.52	62.46	16.63
J-2	24.00	Demand	15.00	Fixed	10.85	62.50	16.65
J-3	24.00	Demand	182.95	Fixed	132.32	62.64	16.71
J-4	25.00	Demand	187.94	Fixed	135.94	64.20	16.95
J-5	25.00	Demand	249.93	Fixed	180.77	68.14	18.66
J-6	25.00	Demand	153.95	Fixed	111.36	69.33	19.17
J-7	24.00	Demand	0.00	Fixed	0.00	70.69	20.19
J-8	24.00	Demand	18.99	Fixed	13.74	69.19	19.54
J-9	23.00	Demand	23.99	Fixed	17.35	69.46	20.09
J-10	23.00	Demand	55.98	Fixed	40.49	70.58	20.57
J-11	22.00	Demand	0.00	Fixed	0.00	71.01	21.19
J-12	24.00	Demand	22.99	Fixed	16.63	68.98	19.45
J-13	24.00	Demand	105.97	Fixed	76.65	69.15	19.52
J-14	24.00	Demand	14.00	Fixed	10.12	69.36	19.61
J-17	23.00	Demand	79.98	Fixed	57.85	69.44	20.08
J-18	23.00	Demand	48.00	Fixed	34.72	69.54	20.13
J-19	20.00	Demand	64.00	Fixed	46.29	70.08	21.66
J-20	21.00	Demand	172.00	Fixed	124.41	70.40	21.36
J-21	22.00	Demand	2.00	Fixed	1.45	71.11	21.24
J-22	22.00	Demand	0.00	Fixed	0.00	71.90	21.58
J-23	22.00	Demand	2.00	Fixed	1.45	70.68	21.05
J-26	22.00	Demand	0.00	Fixed	0.00	71.03	21.20
J-27	21.00	Demand	20.99	Fixed	15.18	71.05	21.64
J-28	20.00	Demand	0.00	Fixed	0.00	71.08	22.09
J-29	20.00	Demand	24.99	Fixed	18.08	71.18	22.13
J-30	20.00	Demand	29.99	Fixed	21.69	71.16	22.12
J-31	21.00	Demand	16.99	Fixed	12.29	71.15	21.69
J-32	21.00	Demand	30.99	Fixed	22.42	71.15	21.69
J-33	18.00	Demand	0.00	Fixed	0.00	71.29	23.04
J-34	20.00	Demand	0.00	Fixed	0.00	72.66	22.77
J-35	22.00	Demand	47.99	Fixed	34.71	73.15	22.12
J-36	23.00	Demand	54.98	Fixed	39.77	72.49	21.40
J-37	23.00	Demand	19.99	Fixed	14.46	72.43	21.37
J-38	22.00	Demand	48.99	Fixed	35.43	72.25	21.73
J-39	22.00	Demand	25.99	Fixed	18.80	71.41	21.37
J-40	24.00	Demand	24.99	Fixed	18.08	71.51	20.54
J-41	23.00	Demand	0.00	Fixed	0.00	71.59	21.01
J-42	23.00	Demand	41.99	Fixed	30.37	71.66	21.04
J-43	23.00	Demand	13.00	Fixed	9.40	71.87	21.13
J-44	24.00	Demand	55.98	Fixed	40.49	71.90	20.71
J-45	23.00	Demand	48.99	Fixed	35.43	72.47	21.39
J-46	23.00	Demand	15.00	Fixed	10.85	72.35	21.34
J-47	21.00	Demand	30.99	Fixed	22.42	71.14	21.68
J-48	22.00	Demand	0.00	Fixed	0.00	71.14	21.25
J-49	23.00	Demand	0.00	Fixed	0.00	70.92	20.72
J-50	23.00	Demand	0.00	Fixed	0.00	70.92	20.72
J-51	23.00	Demand	75.98	Fixed	54.95	70.92	20.72
J-52	23.00	Demand	15.00	Fixed	10.85	70.89	20.71
J-53	24.00	Demand	0.00	Fixed	0.00	70.73	20.21
J-54	18.00	Demand	24.99	Fixed	18.08	71.25	23.03
J-55	21.00	Demand	0.00	Fixed	0.00	71.14	21.68
J-56	22.00	Demand	0.00	Fixed	0.00	71.10	21.23
J-57	24.00	Demand	119.96	Fixed	86.77	71.05	20.35

Steady State Analysis
Junction Report

Node Label	Elevation (ft)	Demand Type	Demand (gpm)	Demand Pattern	Calculated Demand (gpm)	Hydraulic Grade (ft)	Pressure (psi)
J-58	23.00	Demand	21.99	Fixed	15.91	71.05	20.78
J-59	23.00	Demand	26.99	Fixed	19.52	71.05	20.78
J-60	20.00	Demand	0.00	Fixed	0.00	71.12	22.11
J-61	20.00	Demand	0.00	Fixed	0.00	71.09	22.09
J-62	24.00	Demand	0.00	Fixed	0.00	71.05	20.35
J-63	23.00	Demand	0.00	Fixed	0.00	71.04	20.77
J-64	21.00	Demand	0.00	Fixed	0.00	71.04	21.64
J-65	23.00	Demand	85.97	Fixed	62.19	75.62	22.75
J-66	22.00	Demand	14.00	Fixed	10.12	78.52	24.44
J-67	22.00	Demand	29.99	Fixed	21.69	76.39	23.52
J-68	22.00	Demand	14.00	Fixed	10.12	71.18	21.27
J-69	22.00	Demand	24.99	Fixed	18.08	71.08	21.22
J-70	24.00	Demand	78.98	Fixed	57.12	71.60	20.59
J-71	23.00	Demand	38.00	Fixed	27.49	71.58	21.01
J-73	24.00	Demand	0.00	Fixed	0.00	105.88	35.41
J-74	24.00	Demand	71.98	Fixed	52.06	105.80	35.37
J-75	24.00	Demand	0.00	Fixed	0.00	105.71	35.33
J-76	24.00	Demand	18.99	Fixed	13.74	105.28	35.15
J-77	23.00	Demand	44.99	Fixed	32.54	105.28	35.58
J-78	23.00	Demand	16.99	Fixed	12.29	105.32	35.60
J-79	23.00	Demand	18.99	Fixed	13.74	105.48	35.67
J-80	24.00	Demand	41.99	Fixed	30.37	105.64	35.31
J-81	24.00	Demand	0.00	Fixed	0.00	105.65	35.31
J-82	23.00	Demand	0.00	Fixed	0.00	105.83	35.82
J-83	24.00	Demand	73.00	Fixed	52.80	105.96	35.44
J-84	22.00	Demand	17.99	Fixed	13.02	105.29	36.02
J-85	24.00	Demand	21.99	Fixed	15.91	105.28	35.15
J-86	23.00	Demand	17.99	Fixed	13.02	105.47	35.66
J-87	24.00	Demand	76.00	Fixed	54.97	106.35	35.61
J-88	24.00	Demand	23.99	Fixed	17.35	105.49	35.24
J-89	24.00	Demand	121.96	Fixed	88.22	105.53	35.25
J-90	24.00	Demand	31.99	Fixed	23.14	105.48	35.23
J-91	25.00	Demand	0.00	Fixed	0.00	106.36	35.18
J-93	20.00	Demand	0.00	Fixed	0.00	107.75	37.95
J-94	24.00	Demand	0.00	Fixed	0.00	88.91	28.07
J-95	22.00	Demand	0.00	Fixed	0.00	71.81	21.54
J-96	21.00	Demand	76.98	Fixed	55.68	72.20	22.14
J-98	21.00	Demand	0.00	Fixed	0.00	110.31	38.62
J-99	23.00	Demand	0.00	Fixed	0.00	155.96	57.50
J-100	23.00	Demand	0.00	Fixed	0.00	151.45	55.54
J-101	24.00	Demand	227.00	Fixed	164.19	127.54	44.78
J-102	23.00	Demand	131.96	Fixed	95.45	124.43	43.86
J-103	24.00	Demand	49.99	Fixed	36.15	122.18	42.46
J-104	23.00	Demand	236.00	Fixed	170.70	117.14	40.71
J-105	20.00	Demand	64.98	Fixed	47.00	115.91	41.48
J-106	18.00	Demand	72.98	Fixed	52.79	115.03	41.96
J-107	22.00	Demand	213.00	Fixed	154.06	111.89	38.87
J-108	21.00	Demand	0.00	Fixed	0.00	111.35	39.07
J-109	23.00	Demand	49.99	Fixed	36.15	125.63	44.38
J-110	23.00	Demand	180.95	Fixed	130.88	125.63	44.38
J-111	23.00	Demand	171.95	Fixed	124.37	125.12	44.16
J-112	23.00	Demand	117.96	Fixed	85.32	119.52	41.74
J-113	25.00	Demand	0.00	Fixed	0.00	129.15	45.04

Steady State Analysis
Junction Report

Node Label	Elevation (ft)	Demand Type	Demand (gpm)	Demand Pattern	Calculated Demand (gpm)	Hydraulic Grade (ft)	Pressure (psi)
J-114	24.00	Demand	182.00	Fixed	131.64	133.94	47.54
J-115	23.00	Demand	0.00	Fixed	0.00	129.19	45.92
J-116	25.00	Demand	303.91	Fixed	219.82	129.19	45.05
J-117	24.00	Demand	0.00	Fixed	0.00	131.20	46.35
J-118	24.00	Demand	9.00	Fixed	6.51	131.24	46.37
J-119	24.00	Demand	11.00	Fixed	7.95	132.19	46.79
J-120	23.00	Demand	58.00	Fixed	41.95	132.88	47.52
J-121	23.00	Demand	0.00	Fixed	0.00	137.56	49.54
J-122	23.00	Demand	88.00	Fixed	63.65	134.18	48.08
J-123	23.00	Demand	191.94	Fixed	138.83	136.99	49.29
J-124	23.00	Demand	0.00	Fixed	0.00	137.75	49.62
J-125	22.00	Demand	5.00	Fixed	3.62	137.55	49.97
J-126	23.00	Demand	5.00	Fixed	3.62	137.55	49.53
J-127	22.00	Demand	5.00	Fixed	3.62	137.55	49.97
J-128	22.00	Demand	0.00	Fixed	0.00	141.72	51.77
J-129	22.00	Demand	35.99	Fixed	26.03	141.51	51.68
J-130	22.00	Demand	23.99	Fixed	17.35	141.44	51.65
J-131	22.00	Demand	39.99	Fixed	28.92	141.31	51.59
J-132	23.00	Demand	25.99	Fixed	18.80	141.26	51.14
J-133	21.00	Demand	14.00	Fixed	10.12	141.09	51.93
J-134	23.00	Demand	20.99	Fixed	15.18	141.03	51.04
J-135	21.00	Demand	28.99	Fixed	20.97	141.02	51.90
J-136	22.00	Demand	25.99	Fixed	18.80	141.06	51.48
J-137	23.00	Demand	26.99	Fixed	19.52	141.30	51.16
J-138	21.00	Demand	18.99	Fixed	13.74	141.07	51.92
J-139	21.00	Demand	45.99	Fixed	33.26	141.05	51.91
J-141	22.00	Demand	15.00	Fixed	10.85	140.99	51.46
J-142	22.00	Demand	15.00	Fixed	10.85	140.97	51.45
J-143	23.00	Demand	34.99	Fixed	25.31	140.97	51.01
J-144	23.00	Demand	0.00	Fixed	0.00	141.02	51.04
J-145	23.00	Demand	0.00	Fixed	0.00	161.41	59.85
J-146	23.00	Demand	43.99	Fixed	31.82	161.21	59.77
J-147	22.00	Demand	0.00	Fixed	0.00	158.42	58.99
J-148	23.00	Demand	74.98	Fixed	54.23	165.34	61.55
J-149	23.00	Demand	0.00	Fixed	0.00	164.32	61.11
J-150	23.00	Demand	49.99	Fixed	36.15	162.53	60.34
J-151	23.00	Demand	0.00	Fixed	0.00	161.41	59.85
J-152	23.00	Demand	26.99	Fixed	19.52	161.10	59.72
J-153	24.00	Demand	16.00	Fixed	11.57	161.09	59.28
J-154	22.00	Demand	7.00	Fixed	5.06	161.08	60.14
J-155	22.00	Demand	0.00	Fixed	0.00	161.68	60.40
J-156	21.00	Demand	0.00	Fixed	0.00	159.98	60.10
J-157	22.00	Demand	0.00	Fixed	0.00	158.66	59.10
J-158	22.00	Demand	0.00	Fixed	0.00	158.66	59.10
J-159	21.00	Demand	0.00	Fixed	0.00	158.66	59.53
J-160	21.00	Demand	0.00	Fixed	0.00	158.71	59.55
J-161	22.00	Demand	33.99	Fixed	24.58	159.01	59.25
J-162	21.00	Demand	57.98	Fixed	41.94	159.97	60.10
J-163	22.00	Demand	23.99	Fixed	17.35	158.66	59.10
J-164	22.00	Demand	10.00	Fixed	7.23	158.65	59.09
J-165	22.00	Demand	9.00	Fixed	6.51	158.65	59.09
J-166	22.00	Demand	22.99	Fixed	16.63	158.70	59.11
J-167	21.00	Demand	13.00	Fixed	9.40	158.69	59.54

Steady State Analysis
Junction Report

Node Label	Elevation (ft)	Demand Type	Demand (gpm)	Demand Pattern	Calculated Demand (gpm)	Hydraulic Grade (ft)	Pressure (psi)
J-168	21.00	Demand	0.00	Fixed	0.00	158.69	59.54
J-169	22.00	Demand	44.99	Fixed	32.54	160.63	59.95
J-170	22.00	Demand	17.99	Fixed	13.02	160.63	59.95
J-171	21.00	Demand	4.00	Fixed	2.89	160.63	60.38
J-172	22.00	Demand	34.99	Fixed	25.31	158.65	59.09
J-173	22.00	Demand	0.00	Fixed	0.00	158.63	59.08
J-174	23.00	Demand	70.98	Fixed	51.34	158.63	58.65
J-175	24.00	Demand	0.00	Fixed	0.00	158.61	58.21
J-176	23.00	Demand	23.99	Fixed	17.35	158.60	58.64
J-177	23.00	Demand	52.98	Fixed	38.32	158.58	58.63
J-178	24.00	Demand	29.99	Fixed	21.69	158.60	58.21
J-179	24.00	Demand	24.99	Fixed	18.08	158.58	58.20
J-180	24.00	Demand	0.00	Fixed	0.00	158.60	58.21
J-181	23.00	Demand	32.99	Fixed	23.86	158.60	58.64
J-182	24.00	Demand	18.99	Fixed	13.74	158.59	58.20
J-183	25.00	Demand	10.00	Fixed	7.23	158.57	57.76
J-184	26.00	Demand	10.00	Fixed	7.23	158.77	57.42
J-185	25.00	Demand	46.99	Fixed	33.98	158.86	57.89
J-186	25.00	Demand	14.00	Fixed	10.12	159.22	58.04
J-187	25.00	Demand	19.99	Fixed	14.46	159.45	58.14
J-188	25.00	Demand	18.99	Fixed	13.74	159.69	58.24
J-189	24.00	Demand	1.00	Fixed	0.72	159.66	58.66
J-190	25.00	Demand	21.99	Fixed	15.91	159.75	58.27
J-191	24.00	Demand	38.99	Fixed	28.20	159.76	58.71
J-192	24.00	Demand	17.99	Fixed	13.02	159.76	58.71
J-193	24.00	Demand	19.99	Fixed	14.46	159.78	58.71
J-194	25.00	Demand	17.99	Fixed	13.02	159.80	58.29
J-195	25.00	Demand	10.00	Fixed	7.23	159.84	58.31
J-196	25.00	Demand	18.99	Fixed	13.74	160.01	58.38
J-197	26.00	Demand	21.99	Fixed	15.91	159.84	57.88
J-198	25.00	Demand	16.99	Fixed	12.29	159.74	58.27
J-199	25.00	Demand	16.99	Fixed	12.29	159.73	58.26
J-200	26.00	Demand	25.00	Fixed	18.08	159.73	57.83
J-201	27.00	Demand	21.99	Fixed	15.91	159.73	57.40
J-202	26.00	Demand	27.99	Fixed	20.25	159.73	57.83
J-203	26.00	Demand	22.99	Fixed	16.63	159.73	57.83
J-204	25.00	Demand	23.99	Fixed	17.35	159.75	58.27
J-205	26.00	Demand	11.00	Fixed	7.95	159.76	57.84
J-206	25.00	Demand	14.00	Fixed	10.12	159.74	58.27
J-207	26.00	Demand	0.00	Fixed	0.00	159.74	57.84
J-208	26.00	Demand	9.00	Fixed	6.51	159.84	57.87
J-209	25.00	Demand	12.00	Fixed	8.68	160.30	58.51
J-210	26.00	Demand	10.00	Fixed	7.23	160.59	58.20
J-211	25.00	Demand	11.00	Fixed	7.95	160.27	58.49
J-212	33.00	Demand	0.00	Fixed	0.00	161.75	55.67
J-214	33.00	Demand	0.00	Fixed	0.00	161.83	55.71
J-215	32.00	Demand	13.00	Fixed	9.40	161.82	56.14
J-216	32.00	Demand	7.23	Fixed	5.23	161.82	56.14
J-217	33.00	Demand	13.00	Fixed	9.40	162.25	55.89
J-218	33.00	Demand	12.00	Fixed	8.68	162.22	55.88
J-219	33.00	Demand	12.04	Fixed	8.71	162.21	55.88
J-220	34.00	Demand	7.23	Fixed	5.23	162.68	55.65
J-221	34.00	Demand	12.04	Fixed	8.71	162.67	55.64

Steady State Analysis
Junction Report

Node Label	Elevation (ft)	Demand Type	Demand (gpm)	Demand Pattern	Calculated Demand (gpm)	Hydraulic Grade (ft)	Pressure (psi)
J-222	35.00	Demand	6.00	Fixed	4.34	162.66	55.21
J-223	34.00	Demand	0.00	Fixed	0.00	162.83	55.71
J-224	34.00	Demand	10.84	Fixed	7.84	163.04	55.80
J-225	35.00	Demand	0.00	Fixed	0.00	163.16	55.42
J-226	35.00	Demand	8.43	Fixed	6.10	163.58	55.60
J-227	35.00	Demand	13.25	Fixed	9.58	163.56	55.59
J-228	34.00	Demand	6.00	Fixed	4.34	163.56	56.03
J-229	34.00	Demand	15.66	Fixed	11.33	162.88	55.73
J-230	35.00	Demand	8.43	Fixed	6.10	162.91	55.31
J-231	34.00	Demand	8.00	Fixed	5.79	162.94	55.76
J-232	35.00	Demand	8.43	Fixed	6.10	164.55	56.02
J-233	34.00	Demand	0.00	Fixed	0.00	164.55	56.46
J-234	34.00	Demand	8.43	Fixed	6.10	164.56	56.46
J-235	35.00	Demand	10.84	Fixed	7.84	164.56	56.03
J-236	34.00	Demand	0.00	Fixed	0.00	164.58	56.47
J-237	35.00	Demand	0.00	Fixed	0.00	165.06	56.24
J-238	34.00	Demand	0.00	Fixed	0.00	165.34	56.80
J-239	33.00	Demand	0.00	Fixed	0.00	166.20	57.60
J-240	34.00	Demand	11.00	Fixed	7.96	165.34	56.80
J-241	34.00	Demand	0.00	Fixed	0.00	165.38	56.81
J-242	34.00	Demand	0.00	Fixed	0.00	165.42	56.83
J-243	34.00	Demand	0.00	Fixed	0.00	165.34	56.80
J-244	35.00	Demand	0.00	Fixed	0.00	166.18	56.73
J-245	33.00	Demand	0.00	Fixed	0.00	166.16	57.58
J-246	35.00	Demand	0.00	Fixed	0.00	166.12	56.70
J-247	35.00	Demand	0.00	Fixed	0.00	166.11	56.69
J-248	35.00	Demand	0.00	Fixed	0.00	166.09	56.69
J-249	34.00	Demand	0.00	Fixed	0.00	166.13	57.14
J-250	33.00	Demand	0.00	Fixed	0.00	166.14	57.58
J-251	34.00	Demand	0.00	Fixed	0.00	166.15	57.15
J-252	33.00	Demand	0.00	Fixed	0.00	166.16	57.58
J-253	34.00	Demand	0.00	Fixed	0.00	166.08	57.11
J-254	33.00	Demand	0.00	Fixed	0.00	166.07	57.54
J-255	34.00	Demand	0.00	Fixed	0.00	166.04	57.10
J-256	33.00	Demand	24.99	Fixed	18.08	165.60	57.34
J-257	34.00	Demand	0.00	Fixed	0.00	165.81	57.00
J-258	34.00	Demand	0.00	Fixed	0.00	166.16	57.15
J-259	35.00	Demand	0.00	Fixed	0.00	166.16	56.72
J-260	35.00	Demand	0.00	Fixed	0.00	166.11	56.69
J-261	35.00	Demand	0.00	Fixed	0.00	166.11	56.69
J-262	34.00	Demand	0.00	Fixed	0.00	166.11	57.13
J-263	34.00	Demand	0.00	Fixed	0.00	166.11	57.13
J-264	35.00	Demand	0.00	Fixed	0.00	166.11	56.69
J-265	34.00	Demand	26.00	Fixed	18.81	166.07	57.11
J-266	35.00	Demand	15.00	Fixed	10.85	166.06	56.68
J-267	34.00	Demand	14.00	Fixed	10.13	166.06	57.11
J-268	34.00	Demand	0.00	Fixed	0.00	167.42	57.69
J-269	33.00	Demand	0.00	Fixed	0.00	167.99	58.37
J-270	33.00	Demand	0.00	Fixed	0.00	167.42	58.13
J-271	33.00	Demand	0.00	Fixed	0.00	167.42	58.13
J-272	34.00	Demand	0.00	Fixed	0.00	167.41	57.69
J-273	34.00	Demand	10.00	Fixed	7.23	167.41	57.69
J-274	35.00	Demand	0.00	Fixed	0.00	167.42	57.26

Steady State Analysis
Junction Report

Node Label	Elevation (ft)	Demand Type	Demand (gpm)	Demand Pattern	Calculated Demand (gpm)	Hydraulic Grade (ft)	Pressure (psi)
J-275	35.00	Demand	0.00	Fixed	0.00	167.42	57.26
J-276	33.00	Demand	0.00	Fixed	0.00	168.28	58.50
J-277	34.00	Demand	0.00	Fixed	0.00	168.56	58.19
J-278	34.00	Demand	0.00	Fixed	0.00	168.86	58.32
J-279	34.00	Demand	14.00	Fixed	10.13	169.30	58.51
J-280	34.00	Demand	24.99	Fixed	18.08	168.55	58.18
J-281	34.00	Demand	14.00	Fixed	10.13	168.84	58.31
J-282	33.00	Demand	16.00	Fixed	11.57	168.81	58.73
J-283	34.00	Demand	16.00	Fixed	11.57	169.62	58.65
J-284	34.00	Demand	13.00	Fixed	9.40	170.83	59.17
J-285	35.00	Demand	17.00	Fixed	12.30	171.36	58.96
J-286	36.00	Demand	0.00	Fixed	0.00	171.87	58.75
J-287	34.00	Demand	0.00	Fixed	0.00	170.83	59.17
J-288	34.00	Demand	0.00	Fixed	0.00	170.83	59.17
J-289	36.00	Demand	0.00	Fixed	0.00	172.45	59.01
J-290	37.00	Demand	0.00	Fixed	0.00	173.21	58.90
J-291	38.00	Demand	0.00	Fixed	0.00	173.52	58.61
J-292	38.00	Demand	0.00	Fixed	0.00	174.11	58.86
J-293	36.00	Demand	0.00	Fixed	0.00	172.45	59.01
J-294	38.00	Demand	0.00	Fixed	0.00	172.45	58.14
J-295	34.00	Demand	0.00	Fixed	0.00	171.35	59.40
J-296	34.00	Demand	11.00	Fixed	7.95	171.35	59.39
J-297	38.00	Demand	0.00	Fixed	0.00	176.59	59.93
J-298	38.00	Demand	0.00	Fixed	0.00	175.95	59.66
J-299	39.00	Demand	0.00	Fixed	0.00	175.96	59.23
J-300	39.00	Demand	24.00	Fixed	17.36	175.96	59.23
J-301	39.00	Demand	20.00	Fixed	14.47	176.20	59.33
J-302	40.00	Demand	0.00	Fixed	0.00	175.81	58.73
J-303	40.00	Demand	33.99	Fixed	24.58	175.80	58.72
J-304	40.00	Demand	13.00	Fixed	9.40	175.80	58.72
J-305	40.00	Demand	14.00	Fixed	10.13	175.82	58.73
J-306	40.00	Demand	24.00	Fixed	17.36	175.64	58.65
J-307	40.00	Demand	23.00	Fixed	16.64	175.65	58.66
J-308	40.00	Demand	8.00	Fixed	5.79	175.76	58.71
J-309	40.00	Demand	7.00	Fixed	5.06	175.80	58.73
J-310	40.00	Demand	0.00	Fixed	0.00	176.52	59.04
J-311	40.00	Demand	20.99	Fixed	15.18	176.46	59.01
J-312	40.00	Demand	1.20	Fixed	0.87	176.48	59.02
J-313	40.00	Demand	0.00	Fixed	0.00	176.49	59.02
J-314	40.00	Demand	65.00	Fixed	47.01	176.49	59.02
J-315	40.00	Demand	0.00	Fixed	0.00	176.79	59.15
J-316	40.00	Demand	12.00	Fixed	8.68	176.96	59.23
J-317	40.00	Demand	12.00	Fixed	8.68	176.97	59.23
J-318	39.00	Demand	0.00	Fixed	0.00	176.88	59.63
J-319	39.00	Demand	0.00	Fixed	0.00	176.85	59.61
J-320	40.00	Demand	0.00	Fixed	0.00	176.85	59.18
J-321	41.00	Demand	0.00	Fixed	0.00	176.83	58.74
J-322	39.00	Demand	0.00	Fixed	0.00	177.20	59.76
J-323	39.00	Demand	30.99	Fixed	22.42	176.87	59.62
J-324	39.00	Demand	0.00	Fixed	0.00	176.87	59.62
J-325	40.00	Demand	0.00	Fixed	0.00	176.86	59.18
J-326	39.00	Demand	0.00	Fixed	0.00	176.86	59.61
J-327	39.00	Demand	0.00	Fixed	0.00	176.86	59.61

Steady State Analysis
Junction Report

Node Label	Elevation (ft)	Demand Type	Demand (gpm)	Demand Pattern	Calculated Demand (gpm)	Hydraulic Grade (ft)	Pressure (psi)
J-328	44.00	Demand	3.00	Fixed	2.17	179.15	58.45
J-329	44.00	Demand	5.00	Fixed	3.62	179.16	58.45
J-330	44.00	Demand	3.00	Fixed	2.17	179.71	58.68
J-331	41.00	Demand	5.00	Fixed	3.62	177.94	59.22
J-332	42.00	Demand	3.00	Fixed	2.17	177.83	58.74
J-333	41.00	Demand	3.00	Fixed	2.17	177.60	59.07
J-334	39.00	Demand	0.00	Fixed	0.00	177.20	59.76
J-335	44.00	Demand	5.00	Fixed	3.62	177.58	57.77
J-336	43.00	Demand	5.00	Fixed	3.62	177.36	58.10
J-337	43.00	Demand	5.00	Fixed	3.62	177.36	58.10
J-338	40.00	Demand	0.00	Fixed	0.00	160.21	51.98
J-339	39.00	Demand	3.00	Fixed	2.17	156.41	50.77
J-340	25.00	Demand	2.00	Fixed	1.45	156.30	56.78
J-341	40.00	Demand	0.00	Fixed	0.00	159.44	51.65
J-342	24.00	Demand	0.00	Fixed	0.00	156.09	57.12
J-344	21.00	Demand	0.00	Fixed	0.00	112.63	39.62
J-345	20.00	Demand	60.98	Fixed	44.11	114.67	40.94
J-346	20.00	Demand	36.00	Fixed	26.04	114.86	41.02
J-347	22.00	Demand	29.99	Fixed	21.69	115.93	40.62
J-348	22.00	Demand	21.99	Fixed	15.91	116.34	40.79
J-349	23.00	Demand	67.98	Fixed	49.17	116.68	40.51
J-350	21.00	Demand	0.00	Fixed	0.00	111.89	39.30
J-360	24.00	Demand	41.99	Fixed	30.37	105.49	35.24
J-361	24.00	Demand	0.00	Fixed	0.00	105.48	35.24
J-362	24.00	Demand	17.99	Fixed	13.02	156.25	57.19
J-363	25.00	Demand	3.00	Fixed	2.17	158.75	57.84
J-364	26.00	Demand	5.00	Fixed	3.62	158.23	57.18
J-366	25.00	Demand	1.00	Fixed	0.72	159.01	57.95
J-369	34.00	Demand	0.00	Fixed	0.00	162.49	55.56
J-370	37.00	Demand	16.00	Fixed	11.57	139.11	44.16
J-371	38.00	Demand	16.00	Fixed	11.57	132.49	40.86
J-372	38.00	Demand	14.00	Fixed	10.12	128.32	39.06
J-373	39.00	Demand	0.00	Fixed	0.00	118.98	34.59
J-374	22.00	Demand	0.00	Fixed	0.00	72.63	21.89
J-375	23.00	Demand	58.98	Fixed	42.66	81.97	25.50
J-376	25.00	Demand	23.99	Fixed	17.35	62.46	16.20
J-377	25.00	Demand	12.00	Fixed	8.68	62.46	16.20
J-378	23.00	Demand	9.00	Fixed	6.51	62.45	17.06
J-379	22.00	Demand	12.00	Fixed	8.68	62.46	17.49
J-380	23.00	Demand	27.99	Fixed	20.25	62.47	17.07
J-381	23.00	Demand	6.00	Fixed	4.34	62.46	17.07
J-382	25.00	Demand	9.00	Fixed	6.51	62.46	16.20
J-383	24.00	Demand	1.00	Fixed	0.72	62.46	16.63
J-384	23.00	Demand	6.00	Fixed	4.34	62.45	17.06
J-385	26.00	Demand	0.00	Fixed	0.00	169.24	61.94
J-387	34.00	Demand	0.00	Fixed	0.00	166.70	57.38
J-394	23.00	Demand	5.00	Fixed	3.62	147.37	53.78
J-396	26.00	Demand	3.00	Fixed	2.17	158.75	57.41
J-399	25.00	Demand	5.00	Fixed	3.62	159.33	58.09
J-400	24.00	Demand	5.00	Fixed	3.62	158.75	58.27
J-402	26.00	Demand	5.00	Fixed	3.62	157.92	57.05
J-403	25.00	Demand	0.00	Fixed	0.00	157.23	57.18
J-408	26.00	Demand	5.00	Fixed	3.62	137.55	48.24

Steady State Analysis
Junction Report

Node Label	Elevation (ft)	Demand Type	Demand (gpm)	Demand Pattern	Calculated Demand (gpm)	Hydraulic Grade (ft)	Pressure (psi)
J-410	26.00	Demand	0.00	Fixed	0.00	141.02	49.74
J-413	26.00	Demand	0.00	Fixed	0.00	156.31	56.35
J-416	25.00	Demand	0.00	Fixed	0.00	156.84	57.01
J-417	25.00	Demand	0.00	Fixed	0.00	134.83	47.49
J-418	26.00	Demand	2.00	Fixed	1.45	156.36	56.37
J-419	22.00	Demand	2.00	Fixed	1.45	107.65	37.04
J-420	22.00	Demand	2.00	Fixed	1.45	90.59	29.66
J-421	22.00	Demand	6.00	Fixed	4.34	71.49	21.40
J-429	22.00	Demand	0.00	Fixed	0.00	69.36	20.48
J-430	20.00	Demand	0.00	Fixed	0.00	69.23	21.29
J-431	24.00	Demand	0.00	Fixed	0.00	69.20	19.55
J-433	38.00	Demand	0.00	Fixed	0.00	174.22	58.91
J-434	20.00	Demand	10.00	Fixed	7.23	71.74	22.37
J-435	20.00	Demand	0.00	Fixed	0.00	71.74	22.37
J-437	20.00	Demand	0.00	Fixed	0.00	64.20	19.11
J-438	25.00	Demand	0.00	Fixed	0.00	69.22	19.12
J-439	24.00	Demand	0.00	Fixed	0.00	69.22	19.55
J-440	28.00	Demand	0.00	Fixed	0.00	159.75	56.97
J-441	28.00	Demand	0.00	Fixed	0.00	167.36	60.27
J-442	28.00	Demand	44.00	Fixed	31.83	71.03	18.61
J-443	28.00	Demand	0.00	Fixed	0.00	179.08	65.33
J-450	24.00	Demand	71.00	Fixed	51.35	105.83	35.39

1998 Final Hydraulic Analysis

Output Files

Steady State Analysis
Reservoir Report

Node Label	Reservoir Surface Elevation (ft)	Reservoir Inflow (gpm)	Hydraulic Grade (ft)
R-1	158.00	-2,118.91	158.00
R-2	180.00	-2,110.21	180.00
R-3	168.00	-2,031.18	168.00

Steady State Analysis
Junction Report

Node Label	Elevation (ft)	Demand Type	Demand (gpm)	Demand Pattern	Calculated Demand (gpm)	Hydraulic Grade (ft)	Pressure (psi)
J-1	24.00	Demand	26.99	Fixed	19.52	117.89	40.60
J-2	24.00	Demand	15.00	Fixed	10.85	117.93	40.62
J-3	24.00	Demand	182.95	Fixed	132.32	118.07	40.68
J-4	25.00	Demand	187.94	Fixed	135.94	119.63	40.92
J-5	25.00	Demand	249.93	Fixed	180.77	123.57	42.63
J-6	25.00	Demand	153.95	Fixed	111.36	124.75	43.13
J-7	24.00	Demand	0.00	Fixed	0.00	126.08	44.14
J-8	24.00	Demand	18.99	Fixed	13.74	124.65	43.52
J-9	23.00	Demand	23.99	Fixed	17.35	124.91	44.07
J-10	23.00	Demand	55.98	Fixed	40.49	126.04	44.56
J-11	22.00	Demand	0.00	Fixed	0.00	126.47	45.17
J-12	24.00	Demand	22.99	Fixed	16.63	124.42	43.43
J-13	24.00	Demand	105.97	Fixed	76.65	124.60	43.50
J-14	24.00	Demand	14.00	Fixed	10.12	124.81	43.59
J-17	23.00	Demand	79.98	Fixed	57.85	124.90	44.06
J-18	23.00	Demand	48.00	Fixed	34.72	125.00	44.11
J-19	20.00	Demand	64.00	Fixed	46.29	125.56	45.65
J-20	21.00	Demand	172.00	Fixed	124.41	125.88	45.35
J-21	22.00	Demand	2.00	Fixed	1.45	126.60	45.23
J-22	22.00	Demand	0.00	Fixed	0.00	127.46	45.60
J-23	22.00	Demand	2.00	Fixed	1.45	126.15	45.04
J-26	22.00	Demand	0.00	Fixed	0.00	126.47	45.18
J-27	21.00	Demand	20.99	Fixed	15.18	126.47	45.61
J-28	20.00	Demand	0.00	Fixed	0.00	126.50	46.06
J-29	20.00	Demand	24.99	Fixed	18.08	126.62	46.10
J-30	20.00	Demand	29.99	Fixed	21.69	126.55	46.08
J-31	21.00	Demand	16.99	Fixed	12.29	126.52	45.63
J-32	21.00	Demand	30.99	Fixed	22.42	126.51	45.63
J-33	18.00	Demand	0.00	Fixed	0.00	126.81	47.05
J-34	20.00	Demand	0.00	Fixed	0.00	127.51	46.49
J-35	22.00	Demand	47.99	Fixed	34.71	127.53	45.64
J-36	23.00	Demand	54.98	Fixed	39.77	126.92	44.94
J-37	23.00	Demand	19.99	Fixed	14.46	126.86	44.91
J-38	22.00	Demand	48.99	Fixed	35.43	126.70	45.27
J-39	22.00	Demand	25.99	Fixed	18.80	126.43	45.16
J-40	24.00	Demand	24.99	Fixed	18.08	126.43	44.29
J-41	23.00	Demand	0.00	Fixed	0.00	126.43	44.73
J-42	23.00	Demand	41.99	Fixed	30.37	126.44	44.73
J-43	23.00	Demand	13.00	Fixed	9.40	126.49	44.75
J-44	24.00	Demand	55.98	Fixed	40.49	126.49	44.32
J-45	23.00	Demand	48.99	Fixed	35.43	126.72	44.85
J-46	23.00	Demand	15.00	Fixed	10.85	126.70	44.84
J-47	21.00	Demand	30.99	Fixed	22.42	126.48	45.61
J-48	22.00	Demand	0.00	Fixed	0.00	126.46	45.17
J-49	23.00	Demand	0.00	Fixed	0.00	126.24	44.65
J-50	23.00	Demand	0.00	Fixed	0.00	126.24	44.65
J-51	23.00	Demand	75.98	Fixed	54.95	126.24	44.64
J-52	23.00	Demand	15.00	Fixed	10.85	126.22	44.64
J-53	24.00	Demand	0.00	Fixed	0.00	126.11	44.16
J-54	18.00	Demand	24.99	Fixed	18.08	126.75	47.03
J-55	21.00	Demand	0.00	Fixed	0.00	126.49	45.62
J-56	22.00	Demand	0.00	Fixed	0.00	126.48	45.18
J-57	24.00	Demand	119.96	Fixed	86.77	126.45	44.30

Steady State Analysis
Junction Report

Node Label	Elevation (ft)	Demand Type	Demand (gpm)	Demand Pattern	Calculated Demand (gpm)	Hydraulic Grade (ft)	Pressure (psi)
J-58	23.00	Demand	21.99	Fixed	15.91	126.47	44.74
J-59	23.00	Demand	26.99	Fixed	19.52	126.47	44.74
J-60	20.00	Demand	0.00	Fixed	0.00	126.51	46.06
J-61	20.00	Demand	0.00	Fixed	0.00	126.52	46.06
J-62	24.00	Demand	0.00	Fixed	0.00	126.45	44.30
J-63	23.00	Demand	0.00	Fixed	0.00	126.46	44.74
J-64	21.00	Demand	0.00	Fixed	0.00	126.47	45.61
J-65	23.00	Demand	85.97	Fixed	62.19	127.81	45.32
J-66	22.00	Demand	14.00	Fixed	10.12	129.00	46.27
J-67	22.00	Demand	29.99	Fixed	21.69	128.39	46.01
J-68	22.00	Demand	14.00	Fixed	10.12	126.42	45.15
J-69	22.00	Demand	24.99	Fixed	18.08	126.35	45.12
J-70	24.00	Demand	78.98	Fixed	57.12	126.36	44.26
J-71	23.00	Demand	38.00	Fixed	27.49	126.37	44.70
J-73	24.00	Demand	0.00	Fixed	0.00	137.13	48.92
J-74	24.00	Demand	71.98	Fixed	52.06	137.18	48.94
J-75	24.00	Demand	0.00	Fixed	0.00	137.11	48.91
J-76	24.00	Demand	18.99	Fixed	13.74	136.71	48.74
J-77	23.00	Demand	44.99	Fixed	32.54	136.71	49.17
J-78	23.00	Demand	16.99	Fixed	12.29	136.75	49.19
J-79	23.00	Demand	18.99	Fixed	13.74	136.91	49.26
J-80	24.00	Demand	41.99	Fixed	30.37	137.07	48.90
J-81	24.00	Demand	0.00	Fixed	0.00	137.09	48.90
J-82	23.00	Demand	0.00	Fixed	0.00	137.28	49.42
J-83	24.00	Demand	73.00	Fixed	52.80	137.48	49.07
J-84	22.00	Demand	17.99	Fixed	13.02	136.72	49.61
J-85	24.00	Demand	21.99	Fixed	15.91	136.71	48.74
J-86	23.00	Demand	17.99	Fixed	13.02	136.91	49.26
J-87	24.00	Demand	76.00	Fixed	54.97	138.09	49.34
J-88	24.00	Demand	23.99	Fixed	17.35	136.92	48.83
J-89	24.00	Demand	121.96	Fixed	88.22	136.96	48.85
J-90	24.00	Demand	31.99	Fixed	23.14	136.91	48.83
J-91	25.00	Demand	0.00	Fixed	0.00	138.10	48.91
J-93	20.00	Demand	0.00	Fixed	0.00	140.17	51.96
J-94	24.00	Demand	0.00	Fixed	0.00	132.60	46.96
J-95	22.00	Demand	0.00	Fixed	0.00	127.46	45.60
J-96	21.00	Demand	76.98	Fixed	55.68	127.54	46.07
J-98	21.00	Demand	0.00	Fixed	0.00	144.22	53.28
J-99	23.00	Demand	0.00	Fixed	0.00	155.27	57.20
J-100	23.00	Demand	0.00	Fixed	0.00	154.88	57.03
J-101	24.00	Demand	227.00	Fixed	164.19	152.82	55.71
J-102	23.00	Demand	131.96	Fixed	95.45	147.78	53.96
J-103	24.00	Demand	49.99	Fixed	36.15	146.95	53.17
J-104	23.00	Demand	236.00	Fixed	170.70	144.88	52.71
J-105	20.00	Demand	64.98	Fixed	47.00	144.62	53.89
J-106	18.00	Demand	72.98	Fixed	52.79	144.50	54.70
J-107	22.00	Demand	213.00	Fixed	154.06	144.37	52.92
J-108	21.00	Demand	0.00	Fixed	0.00	144.31	53.32
J-109	23.00	Demand	49.99	Fixed	36.15	147.92	54.02
J-110	23.00	Demand	180.95	Fixed	130.88	148.51	54.28
J-111	23.00	Demand	171.95	Fixed	124.37	151.10	55.39
J-112	23.00	Demand	117.96	Fixed	85.32	146.69	53.49
J-113	25.00	Demand	0.00	Fixed	0.00	148.17	53.26

Steady State Analysis
Junction Report

Node Label	Elevation (ft)	Demand Type	Demand (gpm)	Demand Pattern	Calculated Demand (gpm)	Hydraulic Grade (ft)	Pressure (psi)
J-114	24.00	Demand	182.00	Fixed	131.64	149.36	54.21
J-115	23.00	Demand	0.00	Fixed	0.00	148.17	54.13
J-116	25.00	Demand	303.91	Fixed	219.82	148.17	53.26
J-117	24.00	Demand	0.00	Fixed	0.00	148.64	53.90
J-118	24.00	Demand	9.00	Fixed	6.51	148.65	53.90
J-119	24.00	Demand	11.00	Fixed	7.95	148.81	53.97
J-120	23.00	Demand	58.00	Fixed	41.95	148.94	54.46
J-121	23.00	Demand	0.00	Fixed	0.00	150.70	55.22
J-122	23.00	Demand	88.00	Fixed	63.65	149.30	54.62
J-123	23.00	Demand	191.94	Fixed	138.83	150.36	55.08
J-124	23.00	Demand	0.00	Fixed	0.00	150.77	55.25
J-125	22.00	Demand	5.00	Fixed	3.62	150.68	55.65
J-126	23.00	Demand	5.00	Fixed	3.62	150.68	55.21
J-127	22.00	Demand	5.00	Fixed	3.62	150.68	55.65
J-128	22.00	Demand	0.00	Fixed	0.00	152.50	56.43
J-129	22.00	Demand	35.99	Fixed	26.03	152.30	56.34
J-130	22.00	Demand	23.99	Fixed	17.35	152.23	56.32
J-131	22.00	Demand	39.99	Fixed	28.92	152.10	56.26
J-132	23.00	Demand	25.99	Fixed	18.80	152.04	55.80
J-133	21.00	Demand	14.00	Fixed	10.12	151.88	56.60
J-134	23.00	Demand	20.99	Fixed	15.18	151.81	55.70
J-135	21.00	Demand	28.99	Fixed	20.97	151.81	56.57
J-136	22.00	Demand	25.99	Fixed	18.80	151.84	56.15
J-137	23.00	Demand	26.99	Fixed	19.52	152.09	55.82
J-138	21.00	Demand	18.99	Fixed	13.74	151.86	56.59
J-139	21.00	Demand	45.99	Fixed	33.26	151.84	56.58
J-141	22.00	Demand	15.00	Fixed	10.85	151.78	56.12
J-142	22.00	Demand	15.00	Fixed	10.85	151.76	56.11
J-143	23.00	Demand	34.99	Fixed	25.31	151.75	55.68
J-144	23.00	Demand	0.00	Fixed	0.00	151.81	55.70
J-145	23.00	Demand	0.00	Fixed	0.00	162.49	60.32
J-146	23.00	Demand	43.99	Fixed	31.82	162.29	60.23
J-147	22.00	Demand	0.00	Fixed	0.00	161.30	60.24
J-148	23.00	Demand	74.98	Fixed	54.23	166.00	61.84
J-149	23.00	Demand	0.00	Fixed	0.00	165.12	61.46
J-150	23.00	Demand	49.99	Fixed	36.15	163.59	60.80
J-151	23.00	Demand	0.00	Fixed	0.00	162.49	60.32
J-152	23.00	Demand	26.99	Fixed	19.52	162.18	60.18
J-153	24.00	Demand	16.00	Fixed	11.57	162.17	59.75
J-154	22.00	Demand	7.00	Fixed	5.06	162.15	60.61
J-155	22.00	Demand	0.00	Fixed	0.00	163.47	61.18
J-156	21.00	Demand	0.00	Fixed	0.00	162.14	61.03
J-157	22.00	Demand	0.00	Fixed	0.00	161.34	60.25
J-158	22.00	Demand	0.00	Fixed	0.00	161.30	60.24
J-159	21.00	Demand	0.00	Fixed	0.00	161.25	60.65
J-160	21.00	Demand	0.00	Fixed	0.00	161.18	60.62
J-161	22.00	Demand	33.99	Fixed	24.58	161.38	60.27
J-162	21.00	Demand	57.98	Fixed	41.94	162.08	61.01
J-163	22.00	Demand	23.99	Fixed	17.35	161.25	60.21
J-164	22.00	Demand	10.00	Fixed	7.23	161.24	60.21
J-165	22.00	Demand	9.00	Fixed	6.51	161.24	60.21
J-166	22.00	Demand	22.99	Fixed	16.63	161.18	60.18
J-167	21.00	Demand	13.00	Fixed	9.40	161.18	60.62

Steady State Analysis
Junction Report

Node Label	Elevation (ft)	Demand Type	Demand (gpm)	Demand Pattern	Calculated Demand (gpm)	Hydraulic Grade (ft)	Pressure (psi)
J-168	21.00	Demand	0.00	Fixed	0.00	161.20	60.63
J-169	22.00	Demand	44.99	Fixed	32.54	162.44	60.73
J-170	22.00	Demand	17.99	Fixed	13.02	162.43	60.73
J-171	21.00	Demand	4.00	Fixed	2.89	162.43	61.16
J-172	22.00	Demand	34.99	Fixed	25.31	160.99	60.11
J-173	22.00	Demand	0.00	Fixed	0.00	160.89	60.06
J-174	23.00	Demand	70.98	Fixed	51.34	160.85	59.61
J-175	24.00	Demand	0.00	Fixed	0.00	160.84	59.17
J-176	23.00	Demand	23.99	Fixed	17.35	160.83	59.60
J-177	23.00	Demand	52.98	Fixed	38.32	160.82	59.60
J-178	24.00	Demand	29.99	Fixed	21.69	160.83	59.17
J-179	24.00	Demand	24.99	Fixed	18.08	160.81	59.16
J-180	24.00	Demand	0.00	Fixed	0.00	160.83	59.17
J-181	23.00	Demand	32.99	Fixed	23.86	160.89	59.63
J-182	24.00	Demand	18.99	Fixed	13.74	160.87	59.19
J-183	25.00	Demand	10.00	Fixed	7.23	160.85	58.75
J-184	26.00	Demand	10.00	Fixed	7.23	160.86	58.32
J-185	25.00	Demand	46.99	Fixed	33.98	160.86	58.75
J-186	25.00	Demand	14.00	Fixed	10.12	160.91	58.77
J-187	25.00	Demand	19.99	Fixed	14.46	160.95	58.79
J-188	25.00	Demand	18.99	Fixed	13.74	161.00	58.81
J-189	24.00	Demand	1.00	Fixed	0.72	160.73	59.13
J-190	25.00	Demand	21.99	Fixed	15.91	160.86	58.75
J-191	24.00	Demand	38.99	Fixed	28.20	160.89	59.20
J-192	24.00	Demand	17.99	Fixed	13.02	160.91	59.20
J-193	24.00	Demand	19.99	Fixed	14.46	160.94	59.22
J-194	25.00	Demand	17.99	Fixed	13.02	161.01	58.81
J-195	25.00	Demand	10.00	Fixed	7.23	161.03	58.83
J-196	25.00	Demand	18.99	Fixed	13.74	161.21	58.90
J-197	26.00	Demand	21.99	Fixed	15.91	161.09	58.42
J-198	25.00	Demand	16.99	Fixed	12.29	160.85	58.75
J-199	25.00	Demand	16.99	Fixed	12.29	160.85	58.75
J-200	26.00	Demand	25.00	Fixed	18.08	160.85	58.32
J-201	27.00	Demand	21.99	Fixed	15.91	160.86	57.89
J-202	26.00	Demand	27.99	Fixed	20.25	160.88	58.33
J-203	26.00	Demand	22.99	Fixed	16.63	160.87	58.32
J-204	25.00	Demand	23.99	Fixed	17.35	160.90	58.77
J-205	26.00	Demand	11.00	Fixed	7.95	160.93	58.35
J-206	25.00	Demand	14.00	Fixed	10.12	160.90	58.77
J-207	26.00	Demand	0.00	Fixed	0.00	160.90	58.33
J-208	26.00	Demand	9.00	Fixed	6.51	161.09	58.42
J-209	25.00	Demand	12.00	Fixed	8.68	161.47	59.02
J-210	26.00	Demand	10.00	Fixed	7.23	161.74	58.70
J-211	25.00	Demand	11.00	Fixed	7.95	161.44	59.00
J-212	33.00	Demand	0.00	Fixed	0.00	162.80	56.13
J-214	33.00	Demand	0.00	Fixed	0.00	162.88	56.16
J-215	32.00	Demand	13.00	Fixed	9.40	162.87	56.59
J-216	32.00	Demand	7.23	Fixed	5.23	162.87	56.59
J-217	33.00	Demand	13.00	Fixed	9.40	163.26	56.33
J-218	33.00	Demand	12.00	Fixed	8.68	163.24	56.32
J-219	33.00	Demand	12.04	Fixed	8.71	163.23	56.32
J-220	34.00	Demand	7.23	Fixed	5.23	163.67	56.07
J-221	34.00	Demand	12.04	Fixed	8.71	163.66	56.07

Steady State Analysis
Junction Report

Node Label	Elevation (ft)	Demand Type	Demand (gpm)	Demand Pattern	Calculated Demand (gpm)	Hydraulic Grade (ft)	Pressure (psi)
J-222	35.00	Demand	6.00	Fixed	4.34	163.65	55.63
J-223	34.00	Demand	0.00	Fixed	0.00	163.80	56.13
J-224	34.00	Demand	10.84	Fixed	7.84	164.00	56.22
J-225	35.00	Demand	0.00	Fixed	0.00	164.11	55.83
J-226	35.00	Demand	8.43	Fixed	6.10	164.51	56.00
J-227	35.00	Demand	13.25	Fixed	9.58	164.48	55.99
J-228	34.00	Demand	6.00	Fixed	4.34	164.48	56.42
J-229	34.00	Demand	15.66	Fixed	11.33	163.85	56.15
J-230	35.00	Demand	8.43	Fixed	6.10	163.88	55.73
J-231	34.00	Demand	8.00	Fixed	5.79	163.91	56.18
J-232	35.00	Demand	8.43	Fixed	6.10	165.40	56.39
J-233	34.00	Demand	0.00	Fixed	0.00	165.41	56.83
J-234	34.00	Demand	8.43	Fixed	6.10	165.41	56.83
J-235	35.00	Demand	10.84	Fixed	7.84	165.42	56.40
J-236	34.00	Demand	0.00	Fixed	0.00	165.44	56.84
J-237	35.00	Demand	0.00	Fixed	0.00	165.89	56.60
J-238	34.00	Demand	0.00	Fixed	0.00	166.15	57.15
J-239	33.00	Demand	0.00	Fixed	0.00	166.96	57.93
J-240	34.00	Demand	11.00	Fixed	7.96	166.15	57.15
J-241	34.00	Demand	0.00	Fixed	0.00	166.19	57.16
J-242	34.00	Demand	0.00	Fixed	0.00	166.23	57.18
J-243	34.00	Demand	0.00	Fixed	0.00	166.15	57.15
J-244	35.00	Demand	0.00	Fixed	0.00	166.94	57.06
J-245	33.00	Demand	0.00	Fixed	0.00	166.92	57.91
J-246	35.00	Demand	0.00	Fixed	0.00	166.89	57.03
J-247	35.00	Demand	0.00	Fixed	0.00	166.87	57.02
J-248	35.00	Demand	0.00	Fixed	0.00	166.86	57.02
J-249	34.00	Demand	0.00	Fixed	0.00	166.89	57.47
J-250	33.00	Demand	0.00	Fixed	0.00	166.90	57.90
J-251	34.00	Demand	0.00	Fixed	0.00	166.91	57.47
J-252	33.00	Demand	0.00	Fixed	0.00	166.92	57.91
J-253	34.00	Demand	0.00	Fixed	0.00	166.84	57.44
J-254	33.00	Demand	0.00	Fixed	0.00	166.83	57.87
J-255	34.00	Demand	0.00	Fixed	0.00	166.81	57.43
J-256	33.00	Demand	24.99	Fixed	18.08	166.39	57.68
J-257	34.00	Demand	0.00	Fixed	0.00	166.59	57.34
J-258	34.00	Demand	0.00	Fixed	0.00	166.92	57.48
J-259	35.00	Demand	0.00	Fixed	0.00	166.92	57.05
J-260	35.00	Demand	0.00	Fixed	0.00	166.87	57.02
J-261	35.00	Demand	0.00	Fixed	0.00	166.87	57.02
J-262	34.00	Demand	0.00	Fixed	0.00	166.87	57.46
J-263	34.00	Demand	0.00	Fixed	0.00	166.87	57.46
J-264	35.00	Demand	0.00	Fixed	0.00	166.87	57.02
J-265	34.00	Demand	26.00	Fixed	18.81	166.84	57.44
J-266	35.00	Demand	15.00	Fixed	10.85	166.83	57.01
J-267	34.00	Demand	14.00	Fixed	10.13	166.82	57.44
J-268	34.00	Demand	0.00	Fixed	0.00	168.11	57.99
J-269	33.00	Demand	0.00	Fixed	0.00	168.65	58.66
J-270	33.00	Demand	0.00	Fixed	0.00	168.11	58.42
J-271	33.00	Demand	0.00	Fixed	0.00	168.11	58.42
J-272	34.00	Demand	0.00	Fixed	0.00	168.10	57.99
J-273	34.00	Demand	10.00	Fixed	7.23	168.10	57.99
J-274	35.00	Demand	0.00	Fixed	0.00	168.11	57.56

Steady State Analysis
Junction Report

Node Label	Elevation (ft)	Demand Type	Demand (gpm)	Demand Pattern	Calculated Demand (gpm)	Hydraulic Grade (ft)	Pressure (psi)
J-275	35.00	Demand	0.00	Fixed	0.00	168.11	57.56
J-276	33.00	Demand	0.00	Fixed	0.00	168.92	58.78
J-277	34.00	Demand	0.00	Fixed	0.00	169.18	58.46
J-278	34.00	Demand	0.00	Fixed	0.00	169.46	58.58
J-279	34.00	Demand	14.00	Fixed	10.13	169.88	58.76
J-280	34.00	Demand	24.99	Fixed	18.08	169.17	58.45
J-281	34.00	Demand	14.00	Fixed	10.13	169.45	58.57
J-282	33.00	Demand	16.00	Fixed	11.57	169.41	58.99
J-283	34.00	Demand	16.00	Fixed	11.57	170.19	58.89
J-284	34.00	Demand	13.00	Fixed	9.40	171.34	59.39
J-285	35.00	Demand	17.00	Fixed	12.30	171.84	59.17
J-286	36.00	Demand	0.00	Fixed	0.00	172.32	58.95
J-287	34.00	Demand	0.00	Fixed	0.00	171.34	59.39
J-288	34.00	Demand	0.00	Fixed	0.00	171.34	59.39
J-289	36.00	Demand	0.00	Fixed	0.00	172.88	59.19
J-290	37.00	Demand	0.00	Fixed	0.00	173.60	59.07
J-291	38.00	Demand	0.00	Fixed	0.00	173.90	58.77
J-292	38.00	Demand	0.00	Fixed	0.00	174.46	59.01
J-293	36.00	Demand	0.00	Fixed	0.00	172.88	59.19
J-294	38.00	Demand	0.00	Fixed	0.00	172.88	58.32
J-295	34.00	Demand	0.00	Fixed	0.00	171.83	59.60
J-296	34.00	Demand	11.00	Fixed	7.95	171.83	59.60
J-297	38.00	Demand	0.00	Fixed	0.00	176.81	60.03
J-298	38.00	Demand	0.00	Fixed	0.00	176.23	59.77
J-299	39.00	Demand	0.00	Fixed	0.00	176.23	59.34
J-300	39.00	Demand	24.00	Fixed	17.36	176.23	59.34
J-301	39.00	Demand	20.00	Fixed	14.47	176.45	59.44
J-302	40.00	Demand	0.00	Fixed	0.00	176.08	58.85
J-303	40.00	Demand	33.99	Fixed	24.58	176.07	58.84
J-304	40.00	Demand	13.00	Fixed	9.40	176.07	58.84
J-305	40.00	Demand	14.00	Fixed	10.13	176.09	58.85
J-306	40.00	Demand	24.00	Fixed	17.36	175.91	58.77
J-307	40.00	Demand	23.00	Fixed	16.64	175.91	58.77
J-308	40.00	Demand	8.00	Fixed	5.79	176.03	58.83
J-309	40.00	Demand	7.00	Fixed	5.06	176.07	58.84
J-310	40.00	Demand	0.00	Fixed	0.00	176.74	59.13
J-311	40.00	Demand	20.99	Fixed	15.18	176.68	59.10
J-312	40.00	Demand	1.20	Fixed	0.87	176.70	59.11
J-313	40.00	Demand	0.00	Fixed	0.00	176.71	59.12
J-314	40.00	Demand	65.00	Fixed	47.01	176.71	59.12
J-315	40.00	Demand	0.00	Fixed	0.00	176.99	59.24
J-316	40.00	Demand	12.00	Fixed	8.68	177.15	59.31
J-317	40.00	Demand	12.00	Fixed	8.68	177.16	59.31
J-318	39.00	Demand	0.00	Fixed	0.00	177.08	59.71
J-319	39.00	Demand	0.00	Fixed	0.00	177.04	59.69
J-320	40.00	Demand	0.00	Fixed	0.00	177.04	59.26
J-321	41.00	Demand	0.00	Fixed	0.00	177.03	58.82
J-322	39.00	Demand	0.00	Fixed	0.00	177.38	59.84
J-323	39.00	Demand	30.99	Fixed	22.42	177.06	59.70
J-324	39.00	Demand	0.00	Fixed	0.00	177.06	59.70
J-325	40.00	Demand	0.00	Fixed	0.00	177.05	59.27
J-326	39.00	Demand	0.00	Fixed	0.00	177.05	59.70
J-327	39.00	Demand	0.00	Fixed	0.00	177.05	59.70

Steady State Analysis
Junction Report

Node Label	Elevation (ft)	Demand Type	Demand (gpm)	Demand Pattern	Calculated Demand (gpm)	Hydraulic Grade (ft)	Pressure (psi)
J-328	44.00	Demand	3.00	Fixed	2.17	179.21	58.47
J-329	44.00	Demand	5.00	Fixed	3.62	179.21	58.47
J-330	44.00	Demand	3.00	Fixed	2.17	179.72	58.69
J-331	41.00	Demand	5.00	Fixed	3.62	178.07	59.27
J-332	42.00	Demand	3.00	Fixed	2.17	177.96	58.79
J-333	41.00	Demand	3.00	Fixed	2.17	177.76	59.14
J-334	39.00	Demand	0.00	Fixed	0.00	177.38	59.84
J-335	44.00	Demand	5.00	Fixed	3.62	177.73	57.83
J-336	43.00	Demand	5.00	Fixed	3.62	177.52	58.17
J-337	43.00	Demand	5.00	Fixed	3.62	177.52	58.17
J-338	40.00	Demand	0.00	Fixed	0.00	161.85	52.69
J-339	39.00	Demand	3.00	Fixed	2.17	158.38	51.62
J-340	25.00	Demand	2.00	Fixed	1.45	156.79	56.99
J-341	40.00	Demand	0.00	Fixed	0.00	161.15	52.39
J-342	24.00	Demand	0.00	Fixed	0.00	155.15	56.72
J-344	21.00	Demand	0.00	Fixed	0.00	144.48	53.40
J-345	20.00	Demand	60.98	Fixed	44.11	144.78	53.96
J-346	20.00	Demand	36.00	Fixed	26.04	144.81	53.97
J-347	22.00	Demand	29.99	Fixed	21.69	145.13	53.25
J-348	22.00	Demand	21.99	Fixed	15.91	145.29	53.32
J-349	23.00	Demand	67.98	Fixed	49.17	145.42	52.94
J-350	21.00	Demand	0.00	Fixed	0.00	144.37	53.35
J-360	24.00	Demand	41.99	Fixed	30.37	136.92	48.83
J-361	24.00	Demand	0.00	Fixed	0.00	136.92	48.83
J-362	24.00	Demand	17.99	Fixed	13.02	156.19	57.16
J-363	25.00	Demand	3.00	Fixed	2.17	159.53	58.17
J-364	26.00	Demand	5.00	Fixed	3.62	158.83	57.44
J-366	25.00	Demand	1.00	Fixed	0.72	159.86	58.32
J-369	34.00	Demand	0.00	Fixed	0.00	163.49	55.99
J-370	37.00	Demand	16.00	Fixed	11.57	151.80	49.64
J-371	38.00	Demand	16.00	Fixed	11.57	149.32	48.14
J-372	38.00	Demand	14.00	Fixed	10.12	147.78	47.47
J-373	39.00	Demand	0.00	Fixed	0.00	144.37	45.56
J-374	22.00	Demand	0.00	Fixed	0.00	127.68	45.70
J-375	23.00	Demand	58.98	Fixed	42.66	130.88	46.65
J-376	25.00	Demand	23.99	Fixed	17.35	117.89	40.17
J-377	25.00	Demand	12.00	Fixed	8.68	117.89	40.17
J-378	23.00	Demand	9.00	Fixed	6.51	117.88	41.03
J-379	22.00	Demand	12.00	Fixed	8.68	117.89	41.46
J-380	23.00	Demand	27.99	Fixed	20.25	117.90	41.04
J-381	23.00	Demand	6.00	Fixed	4.34	117.89	41.04
J-382	25.00	Demand	9.00	Fixed	6.51	117.89	40.17
J-383	24.00	Demand	1.00	Fixed	0.72	117.89	40.60
J-384	23.00	Demand	6.00	Fixed	4.34	117.88	41.03
J-385	26.00	Demand	0.00	Fixed	0.00	170.09	62.31
J-387	34.00	Demand	0.00	Fixed	0.00	167.43	57.70
J-394	23.00	Demand	5.00	Fixed	3.62	155.48	57.29
J-396	26.00	Demand	3.00	Fixed	2.17	159.53	57.74
J-399	25.00	Demand	5.00	Fixed	3.62	160.29	58.50
J-400	24.00	Demand	5.00	Fixed	3.62	159.53	58.61
J-402	26.00	Demand	5.00	Fixed	3.62	158.42	57.26
J-403	25.00	Demand	0.00	Fixed	0.00	157.50	57.30
J-408	26.00	Demand	5.00	Fixed	3.62	150.68	53.92

Steady State Analysis
Junction Report

Node Label	Elevation (ft)	Demand Type	Demand (gpm)	Demand Pattern	Calculated Demand (gpm)	Hydraulic Grade (ft)	Pressure (psi)
J-410	26.00	Demand	0.00	Fixed	0.00	151.81	54.40
J-413	26.00	Demand	0.00	Fixed	0.00	156.26	56.33
J-416	25.00	Demand	0.00	Fixed	0.00	156.97	57.07
J-417	25.00	Demand	0.00	Fixed	0.00	150.09	54.09
J-418	26.00	Demand	2.00	Fixed	1.45	157.63	56.92
J-419	22.00	Demand	2.00	Fixed	1.45	140.23	51.13
J-420	22.00	Demand	2.00	Fixed	1.45	134.02	48.44
J-421	22.00	Demand	6.00	Fixed	4.34	127.05	45.43
J-425	22.00	Demand	3.00	Fixed	2.17	128.07	45.87
J-426	22.00	Demand	7.00	Fixed	5.06	128.93	46.24
J-429	22.00	Demand	0.00	Fixed	0.00	124.82	44.46
J-430	20.00	Demand	0.00	Fixed	0.00	124.68	45.27
J-431	24.00	Demand	0.00	Fixed	0.00	124.66	43.53
J-433	38.00	Demand	0.00	Fixed	0.00	174.64	59.09
J-434	20.00	Demand	0.00	Fixed	0.00	127.48	46.48
J-435	20.00	Demand	0.00	Fixed	0.00	128.70	47.00
J-436	20.00	Demand	0.00	Fixed	0.00	129.27	47.25
J-437	20.00	Demand	0.00	Fixed	0.00	119.63	43.08
J-438	25.00	Demand	0.00	Fixed	0.00	124.67	43.10
J-439	24.00	Demand	0.00	Fixed	0.00	124.67	43.53
J-440	28.00	Demand	0.00	Fixed	0.00	160.85	57.45
J-441	28.00	Demand	0.00	Fixed	0.00	167.52	60.33
J-442	28.00	Demand	44.00	Fixed	31.83	126.48	42.59
J-443	28.00	Demand	0.00	Fixed	0.00	179.14	65.36
J-450	24.00	Demand	71.00	Fixed	51.35	137.18	48.94

Steady State Analysis
Pipe Report

Link Label	Length (ft)	Diameter (in)	Material	Roughness	Current Status	Discharge (gpm)	Start Hydraulic Grade (ft)	End Hydraulic Grade (ft)	Headloss (ft)	Friction Slope (ft/1000ft)
P-1	658.00	8	PVC	140.0	Open	7.95	171.84	171.83	0.14e-2	0.21e-2
P-2	540.00	8	PVC	140.0	Open	-107.74	117.93	118.07	0.14	0.26
P-3	1,364.00	8	PVC	140.0	Open	-240.07	118.07	119.63	1.56	1.14
P-4	1,503.00	8	PVC	140.0	Open	-376.01	119.63	123.57	3.94	2.62
P-5	511.00	8	PVC	140.0	Open	-349.66	123.57	124.75	1.17	2.29
P-6	490.00	8	PVC	140.0	Open	-383.94	124.75	126.08	1.34	2.73
P-8	475.00	8	PVC	140.0	Open	-163.12	124.65	124.91	0.27	0.56
P-9	831.00	8	PVC	140.0	Open	-263.11	124.91	126.04	1.13	1.36
P-10	2,274.00	6	PVC	140.0	Open	-77.08	124.75	126.04	1.29	0.57
P-11	341.00	8	PVC	140.0	Open	-252.67	126.04	126.47	0.43	1.26
P-12	977.00	8	PVC	140.0	Open	-207.12	123.57	124.42	0.85	0.87
P-13	463.00	8	PVC	140.0	Open	-149.38	124.42	124.65	0.22	0.48
P-14	1,346.00	8	PVC	140.0	Open	-74.37	124.42	124.60	0.18	0.13
P-15	942.00	8	PVC	140.0	Open	-99.15	124.60	124.81	0.21	0.22
P-16	629.00	8	PVC	140.0	Open	-82.63	124.81	124.91	0.10	0.16
P-19	270.00	8	PVC	140.0	Open	-136.35	124.90	125.00	0.11	0.40
P-20	903.00	8	PVC	140.0	Open	-171.07	125.00	125.56	0.55	0.61
P-21	340.00	8	PVC	140.0	Open	-217.36	125.56	125.88	0.32	0.95
P-22	617.00	8	PVC	140.0	Open	-243.50	125.88	126.60	0.72	1.17
P-23	251.00	8	PVC	140.0	Open	-433.37	126.60	127.46	0.86	3.41
P-24	304.00	8	PVC	140.0	Open	-128.01	126.04	126.15	0.11	0.36
P-25	1,255.00	8	PVC	140.0	Open	-129.46	126.15	126.60	0.46	0.36
P-26	2,257.00	12	PVC	140.0	Open	-248.98	126.08	126.47	0.38	0.17
P-28	292.00	8	PVC	140.0	Open	-15.57	126.47	126.47	0.21e-2	0.01
P-30	500.00	8	PVC	140.0	Open	-48.50	126.47	126.50	0.03	0.06
P-32	413.00	12	PVC	140.0	Open	236.34	126.62	126.55	0.06	0.15
P-33	323.00	12	PVC	140.0	Open	176.34	126.55	126.52	0.03	0.09
P-34	251.00	8	PVC	140.0	Open	40.19	126.52	126.51	0.01	0.04
P-37	251.00	8	PVC	140.0	Open	-56.58	127.51	127.53	0.02	0.08
P-38	1,016.00	8	PVC	140.0	Open	169.67	127.53	126.92	0.61	0.60
P-39	162.00	8	PVC	140.0	Open	129.91	126.92	126.86	0.06	0.37
P-40	556.00	8	PVC	140.0	Open	115.44	126.86	126.70	0.16	0.30
P-41	1,325.00	8	PVC	140.0	Open	93.05	126.70	126.43	0.26	0.20
P-42	547.00	8	PVC	140.0	Open	16.55	126.43	126.43	0.44e-2	0.01
P-43	348.00	8	PVC	140.0	Open	-1.53	126.43	126.43	0.38e-4	0.11e-3
P-44	218.00	8	PVC	140.0	Open	-38.62	126.43	126.44	0.01	0.04
P-45	461.00	8	PVC	140.0	Open	-68.99	126.44	126.49	0.05	0.11
P-46	202.00	8	PVC	140.0	Open	-27.21	126.49	126.49	0.41e-2	0.02
P-47	784.00	8	PVC	140.0	Open	-115.22	126.49	126.72	0.23	0.29
P-48	194.00	8	PVC	140.0	Open	75.07	126.72	126.70	0.03	0.13
P-49	576.00	8	PVC	140.0	Open	13.04	126.70	126.70	0.3e-2	0.01
P-50	704.00	12	PVC	140.0	Open	114.27	126.51	126.48	0.03	0.04
P-51	236.00	12	PVC	140.0	Open	171.26	126.48	126.46	0.02	0.09
P-52	1,119.00	8	PVC	140.0	Open	92.54	126.46	126.24	0.22	0.20
P-53	200.00	8	PVC	140.0	Open	17.57	126.24	126.24	0.18e-2	0.01
P-54	315.00	8	PVC	140.0	Open	17.57	126.24	126.24	0.29e-2	0.01
P-55	534.00	10	PVC	140.0	Open	70.83	126.24	126.22	0.02	0.04
P-56	825.00	10	PVC	140.0	Open	134.96	126.22	126.11	0.11	0.13
P-57	196.00	10	PVC	140.0	Open	134.96	126.11	126.08	0.03	0.13
P-58	1,112.00	6	PVC	140.0	Open	-45.01	126.51	126.75	0.23	0.21
P-59	177.00	12	PVC	140.0	Open	-387.70	126.75	126.81	0.07	0.39
P-60	469.00	12	PVC	140.0	Open	-324.61	126.62	126.75	0.13	0.28

Steady State Analysis
Pipe Report

Link Label	Length (ft)	Diameter (in)	Material	Roughness	Current Status	Discharge (gpm)	Start Hydraulic Grade (ft)	End Hydraulic Grade (ft)	Headloss (ft)	Friction Slope (ft/1000ft)
P-61	275.00	12	PVC	140.0	Open	-79.41	126.48	126.49	0.01	0.02
P-62	245.00	8	PVC	140.0	Open	44.45	126.49	126.48	0.01	0.05
P-63	299.00	8	PVC	140.0	Open	61.20	126.48	126.45	0.03	0.09
P-64	477.00	6	PVC	140.0	Open	-17.22	126.45	126.47	0.02	0.04
P-65	214.00	8	PVC	140.0	Open	-11.56	126.47	126.47	0.89e-3	0.42e-2
P-66	516.00	6	PVC	140.0	Open	-9.39	126.47	126.47	0.01	0.01
P-67	711.00	12	PVC	140.0	Open	-123.86	126.49	126.52	0.03	0.05
P-68	1,043.00	6	PVC	140.0	Open	-16.75	126.48	126.51	0.04	0.03
P-69	253.00	6	PVC	140.0	Open	-38.31	126.51	126.55	0.04	0.16
P-70	846.00	6	PVC	140.0	Open	-21.57	126.47	126.51	0.05	0.05
P-71	248.00	8	PVC	140.0	Open	-48.50	126.50	126.52	0.01	0.06
P-72	828.00	8	PVC	140.0	Open	-70.19	126.52	126.62	0.10	0.12
P-73	926.00	6	PVC	140.0	Open	-21.69	126.47	126.52	0.05	0.05
P-74	1,121.00	6	PVC	140.0	Open	-51.48	126.51	126.81	0.30	0.27
P-75	258.00	8	PVC	140.0	Open	-8.35	126.45	126.45	0.6e-3	0.23e-2
P-76	1,016.00	6	PVC	140.0	Open	-8.35	126.45	126.46	0.01	0.01
P-77	137.00	8	PVC	140.0	Open	-15.57	126.47	126.47	0.99e-3	0.01
P-78	294.00	8	PVC	140.0	Open	-23.92	126.47	126.47	0.47e-2	0.02
P-79	970.00	6	PVC	140.0	Open	-8.35	126.46	126.47	0.01	0.01
P-80	1,059.00	8	PVC	140.0	Open	-225.72	126.72	127.81	1.08	1.02
P-81	749.00	8	PVC	140.0	Open	-287.90	127.81	129.00	1.20	1.60
P-82	395.00	8	PVC	140.0	Open	282.66	129.00	128.39	0.61	1.55
P-83	785.00	6	PVC	140.0	Open	-51.18	126.49	126.70	0.21	0.27
P-84	198.00	8	PVC	140.0	Open	57.70	126.43	126.42	0.02	0.08
P-85	965.00	10	PVC	140.0	Open	-78.71	126.42	126.46	0.05	0.05
P-86	204.00	8	PVC	140.0	Open	126.29	126.42	126.35	0.07	0.35
P-87	1,196.00	10	PVC	140.0	Open	108.22	126.35	126.24	0.11	0.09
P-88	585.00	10	PVC	140.0	Open	-74.97	126.22	126.24	0.03	0.04
P-89	597.00	6	PVC	140.0	Open	47.52	126.49	126.36	0.14	0.23
P-90	879.00	6	PVC	140.0	Open	-9.61	126.36	126.37	0.01	0.01
P-91	428.00	6	PVC	140.0	Open	-37.09	126.37	126.43	0.06	0.15
P-93	640.00	8	PVC	140.0	Open	-63.34	137.11	137.18	0.06	0.10
P-95	406.00	8	PVC	140.0	Open	-6.01	136.71	136.71	0.5e-3	0.12e-2
P-96	281.00	6	PVC	140.0	Open	-38.55	136.71	136.75	0.04	0.16
P-97	225.00	6	PVC	140.0	Open	-87.49	136.75	136.91	0.16	0.72
P-99	128.00	8	PVC	140.0	Open	68.26	137.09	137.07	0.01	0.11
P-100	506.00	10	PVC	140.0	Open	240.36	137.28	137.09	0.20	0.39
P-101	302.00	10	PVC	140.0	Open	320.10	137.48	137.28	0.20	0.66
P-102	714.00	8	PVC	140.0	Open	79.75	137.28	137.18	0.11	0.15
P-103	426.00	8	PVC	140.0	Open	-63.34	137.07	137.11	0.04	0.10
P-104	810.00	8	PVC	140.0	Open	36.65	136.75	136.72	0.03	0.04
P-105	945.00	8	PVC	140.0	Open	23.64	136.72	136.71	0.01	0.02
P-106	656.00	8	PVC	140.0	Open	7.73	136.71	136.71	0.13e-2	0.2e-2
P-110	438.00	8	PVC	140.0	Open	19.57	136.92	136.92	0.49e-2	0.01
P-111	207.00	8	PVC	140.0	Open	172.09	137.09	136.96	0.13	0.62
P-112	1,034.00	8	PVC	140.0	Open	-37.72	136.92	136.96	0.04	0.04
P-114	751.00	8	PVC	140.0	Open	-20.76	136.91	136.92	0.01	0.01
P-115	1,065.00	8	PVC	140.0	Open	13.02	136.91	136.91	0.01	0.01
P-116	775.00	6	PVC	140.0	Open	-9.24	136.92	136.92	0.01	0.01
P-117	391.00	10	PVC	140.0	Open	517.05	138.10	137.48	0.62	1.60
P-118	574.00	10	PVC	140.0	Open	-54.97	138.09	138.10	0.01	0.03
P-119	1,072.00	10	PVC	140.0	Open	-572.02	138.10	140.17	2.06	1.92

Steady State Analysis
Pipe Report

Link Label	Length (ft)	Diameter (in)	Material	Roughness	Current Status	Discharge (gpm)	Start Hydraulic Grade (ft)	End Hydraulic Grade (ft)	Headloss (ft)	Friction Slope (ft/1000ft)
P-120	725.00	12	PVC	140.0	Open	1,408.15	140.17	137.13	3.04	4.19
P-121	1,003.00	12	PVC	140.0	Open	1,465.29	137.13	132.60	4.52	4.51
P-122	614.00	8	PVC	140.0	Open	580.68	132.60	129.00	3.60	5.86
P-124	157.00	12	Ductile Iron	130.0	Open	-429.01	127.46	127.54	0.08	0.53
P-127	515.00	12	PVC	140.0	Open	-1,980.18	140.17	144.22	4.05	7.87
P-129	190.00	8	PVC	140.0	Open	328.97	155.27	154.88	0.39	2.05
P-130	1,006.00	8	PVC	140.0	Open	328.97	154.88	152.82	2.06	2.05
P-131	2,594.00	8	PVC	140.0	Open	319.74	152.82	147.78	5.04	1.94
P-132	291.00	8	PVC	140.0	Open	391.64	147.78	146.95	0.82	2.83
P-133	1,056.00	8	PVC	140.0	Open	321.01	146.95	144.88	2.07	1.96
P-134	540.00	8	PVC	140.0	Open	150.31	144.88	144.62	0.26	0.48
P-135	506.00	8	PVC	140.0	Open	103.31	144.62	144.50	0.12	0.24
P-137	649.00	6	PVC	140.0	Open	-29.94	144.31	144.37	0.06	0.10
P-138	3,015.00	8	PVC	140.0	Open	50.52	144.50	144.31	0.19	0.06
P-139	199.00	8	PVC	140.0	Open	-144.16	144.22	144.31	0.09	0.45
P-142	247.00	8	PVC	140.0	Open	-167.35	147.78	147.92	0.14	0.59
P-143	1,276.00	6	PVC	140.0	Open	-69.11	147.92	148.51	0.59	0.46
P-144	1,300.00	6	PVC	140.0	Open	-199.98	148.51	152.82	4.31	3.31
P-145	294.00	8	PVC	140.0	Open	579.83	152.82	151.10	1.72	5.85
P-146	742.00	6	PVC	140.0	Open	274.42	151.10	146.69	4.41	5.95
P-147	2,077.00	6	PVC	140.0	Open	-34.48	146.69	146.95	0.27	0.13
P-148	2,441.00	6	PVC	140.0	Open	-181.04	144.37	151.10	6.73	2.76
P-149	638.00	8	PVC	140.0	Open	-134.40	147.92	148.17	0.25	0.39
P-151	477.00	8	PVC	140.0	Open	0.00	148.17	148.17	0.00	0.00
P-152	728.00	8	PVC	140.0	Open	-175.95	148.17	148.64	0.47	0.64
P-153	728.00	8	PVC	140.0	Open	-178.27	148.17	148.65	0.48	0.66
P-154	490.00	8	PVC	140.0	Open	-272.66	148.65	149.36	0.71	1.45
P-155	83.00	8	PVC	140.0	Open	-87.88	148.64	148.65	0.01	0.18
P-156	969.00	8	PVC	140.0	Open	-88.07	148.64	148.81	0.17	0.18
P-157	623.00	8	PVC	140.0	Open	-96.03	148.81	148.94	0.13	0.21
P-158	67.00	8	PVC	140.0	Open	-43.87	148.17	148.17	0.33e-2	0.05
P-159	3,213.00	12	PVC	140.0	Open	-404.30	149.36	150.70	1.34	0.42
P-160	871.00	8	PVC	140.0	Open	-137.98	148.94	149.30	0.36	0.41
P-161	1,288.00	8	PVC	140.0	Open	-201.63	149.30	150.36	1.07	0.83
P-162	186.00	8	PVC	140.0	Open	-340.46	150.36	150.77	0.41	2.18
P-163	163.00	12	PVC	140.0	Open	-418.76	150.70	150.77	0.07	0.44
P-164	2,102.00	8	PVC	140.0	Open	14.47	150.70	150.68	0.01	0.01
P-165	621.00	8	PVC	140.0	Open	5.42	150.68	150.68	0.64e-3	0.1e-2
P-166	631.00	8	PVC	140.0	Open	7.23	150.68	150.68	0.11e-2	0.18e-2
P-167	621.00	8	PVC	140.0	Open	5.42	150.68	150.68	0.64e-3	0.1e-2
P-168	1,298.00	12	PVC	140.0	Open	-759.22	150.77	152.50	1.73	1.34
P-169	436.00	10	PVC	140.0	Open	269.71	152.50	152.30	0.21	0.48
P-170	241.00	10	PVC	140.0	Open	199.33	152.30	152.23	0.07	0.27
P-171	827.00	10	PVC	140.0	Open	147.89	152.23	152.10	0.13	0.16
P-172	666.00	10	PVC	140.0	Open	105.55	152.10	152.04	0.06	0.08
P-173	517.00	8	PVC	140.0	Open	120.83	152.04	151.88	0.17	0.32
P-174	573.00	8	PVC	140.0	Open	67.79	151.88	151.81	0.06	0.11
P-175	1,119.00	6	PVC	140.0	Open	5.61	151.81	151.81	0.5e-2	0.44e-2
P-176	1,199.00	6	PVC	140.0	Open	-15.36	151.81	151.84	0.03	0.03
P-178	1,015.00	6	PVC	140.0	Open	44.35	152.30	152.09	0.21	0.20
P-179	495.00	6	PVC	140.0	Open	-13.42	152.09	152.10	0.01	0.02
P-180	1,486.00	6	PVC	140.0	Open	34.09	152.23	152.04	0.19	0.13

Steady State Analysis
Pipe Report

Link Label	Length (ft)	Diameter (in)	Material	Roughness	Current Status	Discharge (gpm)	Start Hydraulic Grade (ft)	End Hydraulic Grade (ft)	Headloss (ft)	Friction Slope (ft/1000ft)
P-181	162.00	8	PVC	140.0	Open	-67.42	151.84	151.86	0.02	0.11
P-182	339.00	8	PVC	140.0	Open	-42.92	151.86	151.88	0.02	0.05
P-183	1,464.00	6	PVC	140.0	Open	38.24	152.09	151.86	0.23	0.16
P-184	294.00	8	PVC	140.0	Open	33.26	151.84	151.84	0.01	0.03
P-187	593.00	8	PVC	140.0	Open	36.15	151.78	151.76	0.02	0.03
P-188	920.00	8	PVC	140.0	Open	17.23	151.76	151.75	0.01	0.01
P-189	920.00	6	PVC	140.0	Open	8.08	151.76	151.75	0.01	0.01
P-190	107.00	8	PVC	140.0	Open	47.00	151.81	151.81	0.01	0.06
P-191	464.00	8	PVC	140.0	Open	47.00	151.81	151.78	0.03	0.06
P-196	613.00	12	PVC	140.0	Open	786.05	166.00	165.12	0.87	1.43
P-197	1,072.00	12	PVC	140.0	Open	786.05	165.12	163.59	1.53	1.43
P-198	151.00	6	PVC	140.0	Open	0.00	162.49	162.49	0.00	0.00
P-199	447.00	6	PVC	140.0	Open	67.97	162.49	162.29	0.20	0.45
P-200	1,613.00	12	PVC	140.0	Open	528.46	163.59	162.49	1.10	0.68
P-201	810.00	6	PVC	140.0	Open	36.16	162.29	162.18	0.11	0.14
P-202	299.00	6	PVC	140.0	Open	16.63	162.18	162.17	0.01	0.03
P-203	464.00	4	PVC	140.0	Open	5.06	162.17	162.15	0.01	0.03
P-204	161.00	8	PVC	140.0	Open	-910.41	161.30	163.47	2.17	13.47
P-205	717.00	12	Ductile Iron	130.0	Open	-1,190.90	163.47	166.00	2.53	3.53
P-206	873.00	8	PVC	140.0	Open	280.49	163.47	162.14	1.33	1.53
P-207	759.00	8	PVC	140.0	Open	229.31	162.14	161.34	0.80	1.05
P-208	862.00	12	PVC	140.0	Open	122.14	161.34	161.30	0.04	0.05
P-209	1,195.00	12	PVC	140.0	Open	107.17	161.34	161.30	0.04	0.04
P-210	538.00	10	PVC	140.0	Open	107.17	161.30	161.25	0.05	0.09
P-212	391.00	8	PVC	140.0	Open	-157.64	161.18	161.38	0.21	0.53
P-213	1,013.00	8	PVC	140.0	Open	-182.23	161.38	162.08	0.70	0.69
P-214	882.00	8	PVC	140.0	Open	-51.18	162.08	162.14	0.06	0.07
P-215	134.00	8	PVC	140.0	Open	31.09	161.25	161.25	0.35e-2	0.03
P-216	955.00	8	PVC	140.0	Open	13.74	161.25	161.24	0.01	0.01
P-217	183.00	6	PVC	140.0	Open	6.51	161.24	161.24	0.11e-2	0.01
P-218	579.00	8	PVC	140.0	Open	4.56	161.18	161.18	0.43e-3	0.74e-3
P-219	527.00	8	PVC	140.0	Open	-12.07	161.18	161.18	0.24e-2	0.45e-2
P-220	1,123.00	10	PVC	140.0	Open	76.08	161.25	161.20	0.05	0.05
P-221	817.00	10	PVC	140.0	Open	54.61	161.20	161.18	0.02	0.02
P-222	345.00	6	PVC	140.0	Open	21.47	161.20	161.18	0.02	0.05
P-223	1,175.00	8	PVC	140.0	Open	221.43	163.59	162.44	1.16	0.99
P-224	1,170.00	8	PVC	140.0	Open	117.76	162.44	162.08	0.36	0.31
P-225	1,170.00	6	PVC	140.0	Open	55.22	162.44	162.08	0.36	0.31
P-226	415.00	8	PVC	140.0	Open	15.91	162.44	162.43	0.31e-2	0.01
P-227	339.00	4	PVC	140.0	Open	2.89	162.43	162.43	0.32e-2	0.01
P-228	623.00	10	PVC	140.0	Open	207.69	161.18	160.99	0.18	0.30
P-229	626.00	10	PVC	140.0	Open	148.64	160.99	160.89	0.10	0.16
P-230	453.00	10	PVC	140.0	Open	107.15	160.89	160.85	0.04	0.09
P-231	512.00	10	PVC	140.0	Open	65.05	160.85	160.84	0.02	0.03
P-232	478.00	8	PVC	140.0	Open	25.28	160.84	160.83	0.01	0.02
P-233	752.00	6	PVC	140.0	Open	7.92	160.83	160.82	0.01	0.01
P-234	707.00	6	PVC	140.0	Open	-30.40	160.82	160.89	0.07	0.10
P-235	274.00	10	PVC	140.0	Open	39.77	160.84	160.83	0.38e-2	0.01
P-237	567.00	10	PVC	140.0	Open	18.08	160.83	160.83	0.18e-2	0.32e-2
P-238	651.00	6	PVC	140.0	Open	18.08	160.83	160.81	0.03	0.04
P-239	862.00	6	PVC	140.0	Open	33.74	160.99	160.89	0.11	0.12
P-240	423.00	6	PVC	140.0	Open	-11.09	160.89	160.89	0.01	0.02

Steady State Analysis
Pipe Report

Link Label	Length (ft)	Diameter (in)	Material	Roughness	Current Status	Discharge (gpm)	Start Hydraulic Grade (ft)	End Hydraulic Grade (ft)	Headloss (ft)	Friction Slope (ft/1000ft)
P-241	234.00	6	PVC	140.0	Open	20.97	160.89	160.87	0.01	0.05
P-242	430.00	4	PVC	140.0	Open	7.23	160.87	160.85	0.02	0.05
P-243	594.00	8	PVC	140.0	Open	-9.23	160.85	160.86	0.16e-2	0.28e-2
P-244	645.00	6	PVC	140.0	Open	-5.26	160.86	160.86	0.25e-2	0.4e-2
P-245	787.00	8	PVC	140.0	Open	-50.45	160.86	160.91	0.05	0.06
P-246	442.00	8	PVC	140.0	Open	-60.57	160.91	160.95	0.04	0.09
P-247	386.00	8	PVC	140.0	Open	-75.03	160.95	161.00	0.05	0.13
P-248	645.00	8	PVC	140.0	Open	-11.21	160.86	160.86	0.25e-2	0.4e-2
P-251	1,262.00	12	PVC	140.0	Open	-91.86	160.86	160.89	0.03	0.03
P-252	429.00	12	PVC	140.0	Open	-120.07	160.89	160.91	0.02	0.04
P-253	529.00	12	PVC	140.0	Open	-149.38	160.91	160.94	0.03	0.07
P-254	802.00	12	PVC	140.0	Open	-163.84	160.94	161.01	0.06	0.08
P-255	236.00	12	PVC	140.0	Open	-198.62	161.01	161.03	0.03	0.11
P-256	736.00	12	PVC	140.0	Open	-302.08	161.03	161.21	0.18	0.24
P-257	658.00	8	PVC	140.0	Open	89.43	161.21	161.09	0.12	0.18
P-258	848.00	8	PVC	140.0	Open	67.01	161.09	161.00	0.09	0.11
P-259	317.00	8	PVC	140.0	Open	18.36	160.86	160.85	0.31e-2	0.01
P-260	577.00	8	PVC	140.0	Open	6.07	160.85	160.85	0.73e-3	0.13e-2
P-261	547.00	8	PVC	140.0	Open	-6.23	160.85	160.85	0.73e-3	0.13e-2
P-262	415.00	8	PVC	140.0	Open	-24.31	160.85	160.86	0.01	0.02
P-263	769.00	6	PVC	140.0	Open	-14.95	160.86	160.88	0.02	0.03
P-264	876.00	6	PVC	140.0	Open	-16.30	160.88	160.91	0.03	0.03
P-265	468.00	8	PVC	140.0	Open	-25.27	160.86	160.87	0.01	0.02
P-266	688.00	8	PVC	140.0	Open	-41.90	160.87	160.90	0.03	0.05
P-267	327.00	8	PVC	140.0	Open	-59.26	160.90	160.93	0.03	0.09
P-268	501.00	8	PVC	140.0	Open	-96.23	160.93	161.03	0.11	0.21
P-269	383.00	6	PVC	140.0	Open	-18.89	160.88	160.90	0.02	0.04
P-270	327.00	6	PVC	140.0	Open	-29.02	160.90	160.93	0.03	0.09
P-271	302.00	8	PVC	140.0	Open	0.00	160.90	160.90	0.00	0.00
P-272	565.00	8	PVC	140.0	Open	6.51	161.09	161.09	0.82e-3	0.15e-2
P-273	627.00	12	PVC	140.0	Open	-405.24	161.21	161.47	0.26	0.42
P-274	583.00	12	PVC	140.0	Open	-421.87	161.47	161.74	0.26	0.45
P-275	568.00	4	PVC	140.0	Open	7.95	161.47	161.44	0.03	0.06
P-276	554.00	8	PVC	140.0	Open	21.76	161.01	161.00	0.01	0.01
P-277	2,295.00	12	PVC	140.0	Open	-429.10	161.74	162.80	1.07	0.47
P-279	159.00	12	PVC	140.0	Open	-429.10	162.80	162.88	0.07	0.47
P-280	340.00	6	PVC	140.0	Open	14.63	162.88	162.87	0.01	0.03
P-281	488.00	6	PVC	140.0	Open	5.23	162.87	162.87	0.19e-2	0.39e-2
P-282	781.00	12	PVC	140.0	Open	-443.73	162.88	163.26	0.39	0.49
P-283	705.00	6	PVC	140.0	Open	17.39	163.26	163.24	0.03	0.04
P-284	991.00	6	PVC	140.0	Open	8.71	163.24	163.23	0.01	0.01
P-286	587.00	6	PVC	140.0	Open	13.05	163.67	163.66	0.01	0.02
P-287	408.00	4	PVC	140.0	Open	4.34	163.66	163.65	0.01	0.02
P-288	229.00	12	PVC	140.0	Open	-488.81	163.67	163.80	0.14	0.59
P-289	410.00	12	PVC	140.0	Open	-439.32	163.80	164.00	0.20	0.49
P-290	208.00	12	PVC	140.0	Open	-447.16	164.00	164.11	0.10	0.50
P-291	603.00	12	PVC	140.0	Open	-519.86	164.11	164.51	0.40	0.66
P-292	987.00	6	PVC	140.0	Open	13.92	164.51	164.48	0.02	0.02
P-293	518.00	6	PVC	140.0	Open	4.34	164.48	164.48	0.14e-2	0.28e-2
P-294	174.00	6	PVC	140.0	Open	-49.48	163.80	163.85	0.04	0.25
P-295	499.00	6	PVC	140.0	Open	-23.81	163.85	163.88	0.03	0.06
P-296	270.00	6	PVC	140.0	Open	-29.91	163.88	163.91	0.03	0.10

Steady State Analysis
Pipe Report

Link Label	Length (ft)	Diameter (in)	Material	Roughness	Current Status	Discharge (gpm)	Start Hydraulic Grade (ft)	End Hydraulic Grade (ft)	Headloss (ft)	Friction Slope (ft/1000ft)
P-297	395.00	6	PVC	140.0	Open	-72.69	163.91	164.11	0.20	0.51
P-298	403.00	6	PVC	140.0	Open	37.00	163.91	163.85	0.06	0.15
P-299	233.00	4	PVC	140.0	Open	-6.10	165.40	165.41	0.01	0.04
P-300	189.00	6	PVC	140.0	Open	-6.10	165.41	165.41	0.98e-3	0.01
P-301	337.00	6	PVC	140.0	Open	-12.20	165.41	165.42	0.01	0.02
P-302	402.00	6	PVC	140.0	Open	-20.04	165.42	165.44	0.02	0.05
P-303	1,310.00	12	PVC	140.0	Open	539.88	165.44	164.51	0.93	0.71
P-304	594.00	12	PVC	140.0	Open	-559.92	165.44	165.89	0.45	0.76
P-305	447.00	12	PVC	140.0	Open	-486.68	165.89	166.15	0.26	0.59
P-306	1,327.00	12	PVC	140.0	Open	-494.46	166.15	166.96	0.80	0.60
P-307	505.00	6	PVC	140.0	Open	-73.24	165.89	166.15	0.26	0.52
P-308	292.00	8	PVC	140.0	Open	-73.41	166.15	166.19	0.04	0.13
P-309	285.00	8	PVC	140.0	Open	-73.41	166.19	166.23	0.04	0.13
P-310	623.00	8	PVC	140.0	Open	-7.78	166.15	166.15	0.13e-2	0.2e-2
P-311	171.00	8	PVC	140.0	Open	-7.78	166.15	166.15	0.35e-3	0.21e-2
P-312	290.00	12	PVC	140.0	Open	131.27	166.96	166.94	0.02	0.05
P-313	348.00	12	PVC	140.0	Open	131.27	166.94	166.92	0.02	0.05
P-314	1,008.00	12	PVC	140.0	Open	108.22	166.92	166.89	0.04	0.04
P-315	336.00	12	PVC	140.0	Open	131.27	166.89	166.87	0.02	0.05
P-316	227.00	12	PVC	140.0	Open	131.27	166.87	166.86	0.01	0.05
P-317	518.00	8	PVC	140.0	Open	-23.05	166.89	166.89	0.01	0.01
P-318	671.00	8	PVC	140.0	Open	-23.05	166.89	166.90	0.01	0.01
P-319	440.00	8	PVC	140.0	Open	-23.05	166.90	166.91	0.01	0.01
P-320	409.00	8	PVC	140.0	Open	-23.05	166.91	166.92	0.01	0.01
P-321	411.00	8	PVC	140.0	Open	-23.05	166.92	166.92	0.01	0.01
P-322	933.00	12	PVC	140.0	Open	71.12	166.86	166.84	0.02	0.02
P-323	375.00	8	PVC	140.0	Open	31.33	166.84	166.83	0.01	0.03
P-324	910.00	8	PVC	140.0	Open	31.33	166.83	166.81	0.02	0.03
P-325	561.00	8	PVC	140.0	Open	-60.16	166.81	166.86	0.05	0.09
P-326	1,296.00	8	PVC	140.0	Open	-73.41	166.23	166.39	0.17	0.13
P-327	1,049.00	8	PVC	140.0	Open	-91.49	166.39	166.59	0.20	0.19
P-328	1,116.00	8	PVC	140.0	Open	-91.49	166.59	166.81	0.21	0.19
P-329	546.00	8	PVC	140.0	Open	0.00	166.92	166.92	0.00	0.00
P-330	331.00	8	PVC	140.0	Open	0.00	166.92	166.92	0.00	0.00
P-331	299.00	8	PVC	140.0	Open	0.00	166.87	166.87	0.00	0.00
P-332	259.00	8	PVC	140.0	Open	0.00	166.87	166.87	0.00	0.00
P-333	320.00	8	PVC	140.0	Open	0.00	166.87	166.87	0.00	0.00
P-334	808.00	8	PVC	140.0	Open	0.00	166.87	166.87	0.00	0.00
P-335	331.00	8	PVC	140.0	Open	0.00	166.87	166.87	0.00	0.00
P-336	783.00	12	PVC	140.0	Open	39.78	166.84	166.84	0.45e-2	0.01
P-337	674.00	8	PVC	140.0	Open	20.98	166.84	166.83	0.01	0.01
P-338	1,249.00	8	PVC	140.0	Open	10.13	166.83	166.82	0.41e-2	0.33e-2
P-340	566.00	12	PVC	140.0	Open	-632.96	168.11	168.65	0.54	0.95
P-341	520.00	8	PVC	140.0	Open	7.23	168.11	168.11	0.9e-3	0.17e-2
P-342	465.00	8	PVC	140.0	Open	7.23	168.11	168.11	0.82e-3	0.18e-2
P-343	477.00	6	PVC	140.0	Open	7.23	168.11	168.10	0.34e-2	0.01
P-344	221.00	6	PVC	140.0	Open	7.23	168.10	168.10	0.16e-2	0.01
P-345	682.00	8	PVC	140.0	Open	0.00	168.11	168.11	0.00	0.00
P-346	140.00	4	PVC	140.0	Open	0.00	168.11	168.11	0.00	0.00
P-347	287.00	12	PVC	140.0	Open	-632.96	168.65	168.92	0.27	0.95
P-348	271.00	12	PVC	140.0	Open	-632.96	168.92	169.18	0.26	0.95
P-349	282.00	12	PVC	140.0	Open	-651.04	169.18	169.46	0.28	1.01

Steady State Analysis
Pipe Report

Link Label	Length (ft)	Diameter (in)	Material	Roughness	Current Status	Discharge (gpm)	Start Hydraulic Grade (ft)	End Hydraulic Grade (ft)	Headloss (ft)	Friction Slope (ft/1000ft)
P-350	394.00	12	PVC	140.0	Open	-672.74	169.46	169.88	0.42	1.07
P-351	856.00	8	PVC	140.0	Open	18.08	169.18	169.17	0.01	0.01
P-352	843.00	8	PVC	140.0	Open	21.70	169.46	169.45	0.01	0.01
P-353	311.00	4	PVC	140.0	Open	11.57	169.45	169.41	0.04	0.12
P-354	276.00	12	PVC	140.0	Open	-682.87	169.88	170.19	0.30	1.10
P-355	1,014.00	12	PVC	140.0	Open	-694.44	170.19	171.34	1.15	1.13
P-356	429.00	12	PVC	140.0	Open	-703.84	171.34	171.84	0.50	1.16
P-357	398.00	12	PVC	140.0	Open	-724.09	171.84	172.32	0.49	1.22
P-358	652.00	6	PVC	140.0	Open	0.00	171.34	171.34	0.00	0.00
P-359	112.00	8	PVC	140.0	Open	0.00	171.34	171.34	0.00	0.00
P-360	452.00	12	PVC	140.0	Open	-724.09	172.32	172.88	0.55	1.22
P-361	590.00	12	PVC	140.0	Open	-724.09	172.88	173.60	0.72	1.22
P-362	244.00	12	PVC	140.0	Open	-724.09	173.60	173.90	0.30	1.22
P-363	456.00	12	PVC	140.0	Open	-724.09	173.90	174.46	0.56	1.22
P-364	162.00	8	PVC	140.0	Open	0.00	172.88	172.88	0.00	0.00
P-365	669.00	6	PVC	140.0	Open	0.00	172.88	172.88	0.00	0.00
P-367	113.00	4	PVC	140.0	Open	7.95	171.83	171.83	0.01	0.06
P-368	1,926.00	12	PVC	140.0	Open	-724.09	174.46	176.81	2.36	1.22
P-369	764.00	16	Ductile Iron	130.0	Open	1,114.87	176.81	176.23	0.59	0.77
P-370	438.00	10	PVC	140.0	Open	-20.86	176.23	176.23	0.18e-2	0.42e-2
P-371	167.00	10	PVC	140.0	Open	-64.97	176.23	176.23	0.01	0.03
P-372	1,172.00	6	PVC	140.0	Open	-41.71	176.23	176.45	0.21	0.18
P-374	555.00	6	PVC	140.0	Open	16.36	176.08	176.07	0.02	0.03
P-375	184.00	6	PVC	140.0	Open	-8.22	176.07	176.07	0.17e-2	0.01
P-376	680.00	6	PVC	140.0	Open	44.11	176.23	176.09	0.14	0.20
P-377	198.00	6	PVC	140.0	Open	16.36	176.09	176.08	0.01	0.03
P-378	611.00	6	PVC	140.0	Open	-17.63	176.07	176.09	0.02	0.04
P-379	186.00	6	PVC	140.0	Open	-17.36	175.91	175.91	0.01	0.04
P-380	948.00	6	PVC	140.0	Open	-34.00	175.91	176.03	0.12	0.12
P-381	231.00	6	PVC	140.0	Open	-39.78	176.03	176.07	0.04	0.17
P-382	778.00	6	PVC	140.0	Open	-44.84	176.07	176.23	0.16	0.21
P-383	918.00	6	PVC	140.0	Open	-56.18	176.45	176.74	0.29	0.32
P-385	647.00	6	PVC	140.0	Open	85.47	176.68	176.23	0.44	0.69
P-386	609.00	6	PVC	140.0	Open	-15.88	176.68	176.70	0.02	0.03
P-387	357.00	6	PVC	140.0	Open	-16.75	176.70	176.71	0.01	0.03
P-388	170.00	10	PVC	140.0	Open	148.54	176.74	176.71	0.03	0.16
P-389	573.00	10	PVC	140.0	Open	84.77	176.71	176.68	0.03	0.06
P-390	570.00	10	PVC	140.0	Open	-16.75	176.71	176.71	0.16e-2	0.28e-2
P-391	292.00	8	PVC	140.0	Open	-204.71	176.74	176.99	0.25	0.85
P-392	915.00	6	PVC	140.0	Open	-41.85	176.99	177.15	0.17	0.18
P-393	149.00	8	PVC	140.0	Open	-50.53	177.15	177.16	0.01	0.06
P-394	632.00	8	PVC	140.0	Open	74.92	177.16	177.08	0.08	0.13
P-395	278.00	8	PVC	140.0	Open	74.92	177.08	177.04	0.04	0.13
P-396	465.00	8	PVC	140.0	Open	-3.85	177.04	177.04	0.26e-3	0.56e-3
P-397	146.00	6	PVC	140.0	Open	29.08	177.04	177.03	0.01	0.09
P-398	462.00	6	PVC	140.0	Open	29.08	177.03	176.99	0.04	0.09
P-399	871.00	20	Ductile Iron	130.0	Open	-1,838.96	176.81	177.38	0.57	0.65
P-401	291.00	8	PVC	140.0	Open	-55.01	177.04	177.06	0.02	0.07
P-402	289.00	6	PVC	140.0	Open	0.00	177.06	177.06	0.00	0.00
P-403	457.00	8	PVC	140.0	Open	32.93	177.06	177.05	0.01	0.03
P-404	776.00	8	PVC	140.0	Open	0.00	177.05	177.05	0.00	0.00
P-405	127.00	8	PVC	140.0	Open	0.00	177.05	177.05	0.00	0.00

Steady State Analysis
Pipe Report

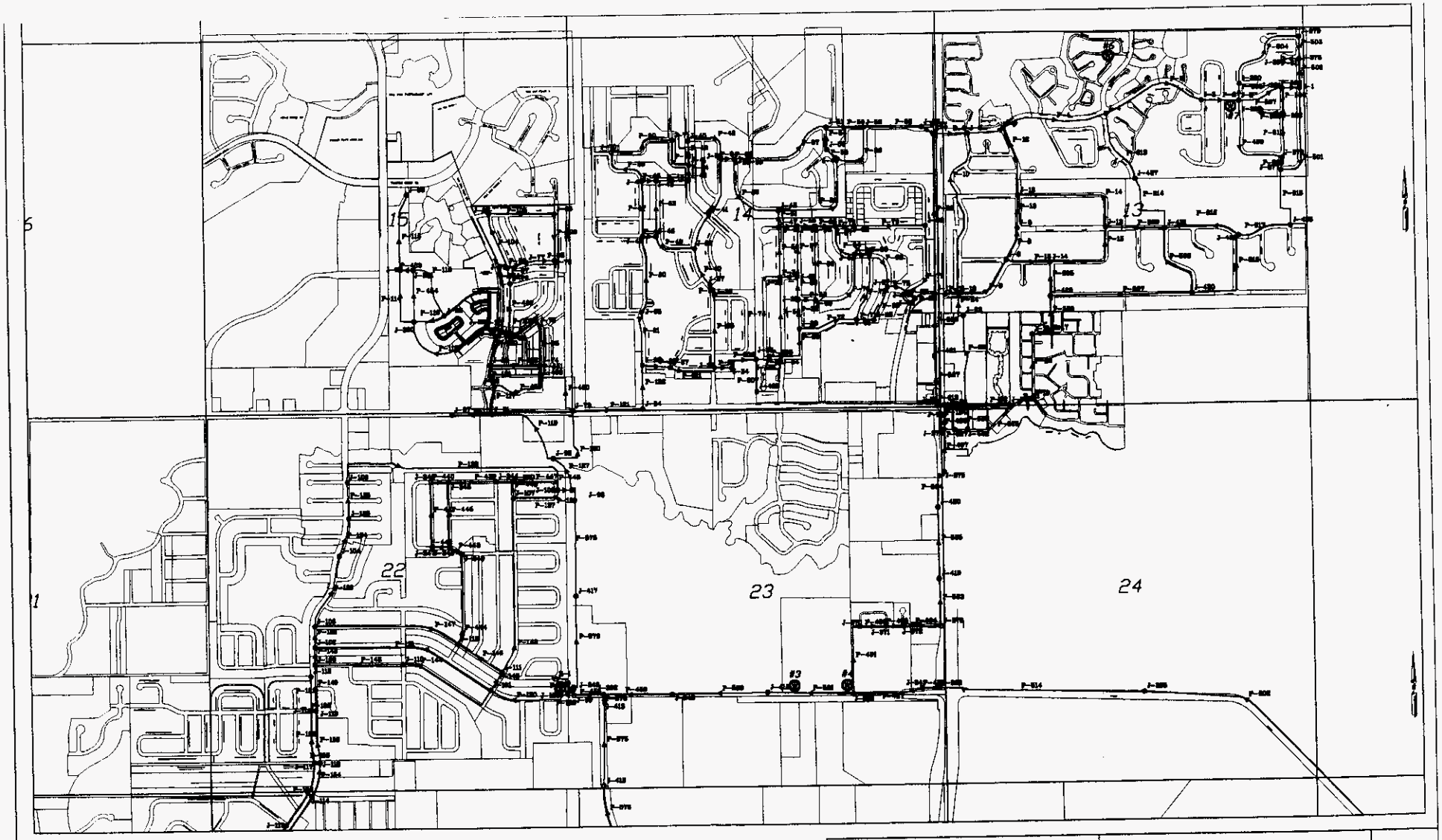
Link Label	Length (ft)	Diameter (in)	Material	Roughness	Current Status	Discharge (gpm)	Start Hydraulic Grade (ft)	End Hydraulic Grade (ft)	Headloss (ft)	Friction Slope (ft/1000ft)
P-406	286.00	8	PVC	140.0	Open	-32.93	177.04	177.05	0.01	0.03
P-407	1,674.00	8	PVC	140.0	Open	-110.36	177.06	177.52	0.45	0.27
P-408	337.00	8	PVC	140.0	Open	-2.17	179.21	179.21	0.61e-4	0.18e-3
P-409	427.00	8	PVC	140.0	Open	-247.39	179.21	179.72	0.52	1.21
P-410	981.00	8	PVC	140.0	Open	241.60	179.21	178.07	1.14	1.16
P-411	364.00	8	PVC	140.0	Open	116.78	178.07	177.96	0.11	0.30
P-412	708.00	8	PVC	140.0	Open	114.61	177.96	177.76	0.21	0.29
P-413	105.00	8	PVC	140.0	Open	21.69	177.38	177.38	0.14e-2	0.01
P-414	560.00	8	PVC	140.0	Open	134.13	177.38	177.16	0.22	0.39
P-415	1,329.00	8	PVC	140.0	Open	112.44	177.76	177.38	0.37	0.28
P-416	1,043.00	8	PVC	140.0	Open	121.21	178.07	177.73	0.34	0.32
P-418	704.00	8	PVC	140.0	Open	117.59	177.73	177.52	0.22	0.31
P-419	562.00	8	PVC	140.0	Open	3.62	177.52	177.52	0.27e-3	0.49e-3
P-426	248.00	12	PVC	140.0	Open	1,135.73	161.85	161.15	0.70	2.82
P-427	984.00	12	PVC	140.0	Open	1,135.73	161.15	158.38	2.77	2.82
P-430	113.00	12	PVC	140.0	Open	-651.88	155.15	155.27	0.11	1.01
P-436	2,758.00	8	PVC	140.0	Open	469.98	155.15	144.22	10.93	3.96
P-437	278.00	12	Ductile Iron	130.0	Open	2,118.91	158.00	155.15	2.85	10.24
P-439	683.00	6	PVC	140.0	Open	-66.66	144.48	144.78	0.30	0.43
P-440	249.00	6	PVC	140.0	Open	-33.95	144.78	144.81	0.03	0.12
P-441	910.00	6	PVC	140.0	Open	-59.99	144.81	145.13	0.32	0.36
P-442	249.00	6	PVC	140.0	Open	-81.69	145.13	145.29	0.16	0.63
P-443	204.00	8	PVC	140.0	Open	-174.41	145.29	145.42	0.13	0.63
P-444	1,262.00	8	PVC	140.0	Open	-223.58	145.42	146.69	1.27	1.00
P-445	910.00	6	PVC	140.0	Open	-76.82	144.78	145.29	0.51	0.56
P-446	242.00	6	PVC	140.0	Open	-2.96	144.37	144.37	0.34e-3	0.14e-2
P-447	247.00	6	PVC	140.0	Open	-66.66	144.37	144.48	0.11	0.43
P-448	655.00	8	PVC	140.0	Open	-63.70	144.31	144.37	0.06	0.10
P-449	146.00	8	PVC	140.0	Open	-133.78	176.99	177.04	0.06	0.39
P-450	672.00	8	PVC	140.0	Open	-144.15	137.18	137.48	0.30	0.45
P-451	166.00	8	PVC	140.0	Open	-35.65	137.18	137.18	0.01	0.03
P-453	189.00	6	PVC	140.0	Open	-15.39	136.91	136.92	0.01	0.03
P-454	725.00	6	PVC	140.0	Open	-6.15	136.92	136.92	0.38e-2	0.01
P-455	429.00	12	PVC	140.0	Open	-980.85	155.27	156.19	0.92	2.15
P-456	980.00	12	PVC	140.0	Open	-496.03	156.19	156.79	0.60	0.61
P-460	660.00	8	PVC	140.0	Open	57.14	137.18	137.13	0.05	0.08
P-462	691.00	8	PVC	140.0	Open	-101.23	136.91	137.07	0.16	0.23
P-464	622.00	8	PVC	140.0	Open	46.16	136.96	136.92	0.03	0.05
P-477	1,115.00	12	PVC	140.0	Open	-505.07	158.83	159.53	0.70	0.63
P-479	519.00	12	PVC	140.0	Open	-513.02	159.53	159.86	0.34	0.65
P-488	400.00	12	PVC	140.0	Open	-470.53	163.26	163.49	0.22	0.55
P-489	331.00	12	PVC	140.0	Open	-470.53	163.49	163.67	0.18	0.55
P-491	952.00	8	PVC	140.0	Open	634.63	158.38	151.80	6.58	6.91
P-492	372.00	8	PVC	140.0	Open	623.06	151.80	149.32	2.48	6.68
P-493	239.00	8	PVC	140.0	Open	611.49	149.32	147.78	1.54	6.45
P-494	545.00	8	PVC	140.0	Open	601.37	147.78	144.37	3.41	6.26
P-496	202.00	12	Ductile Iron	130.0	Open	-484.69	127.54	127.68	0.13	0.67
P-497	592.00	8	PVC	140.0	Open	-555.82	127.68	130.88	3.20	5.41
P-499	1,016.00	6	PVC	140.0	Open	18.75	117.93	117.89	0.04	0.04
P-500	170.00	8	PVC	140.0	Open	5.24	117.89	117.89	0.16e-3	0.94e-3
P-501	1,205.00	8	PVC	140.0	Open	-3.43	117.89	117.89	0.53e-3	0.44e-3
P-502	415.00	6	PVC	140.0	Open	8.04	117.89	117.88	0.36e-2	0.01

Steady State Analysis
Pipe Report

Link Label	Length (ft)	Diameter (in)	Material	Roughness	Current Status	Discharge (gpm)	Start Hydraulic Grade (ft)	End Hydraulic Grade (ft)	Headloss (ft)	Friction Slope (ft/1000ft)
P-503	317.00	6	PVC	140.0	Open	-2.81	117.88	117.89	0.39e-3	0.12e-2
P-504	1,092.00	6	PVC	140.0	Open	-11.48	117.89	117.90	0.02	0.02
P-505	243.00	6	PVC	140.0	Open	-31.73	117.90	117.93	0.03	0.11
P-506	253.00	8	PVC	140.0	Open	-31.00	117.89	117.89	0.01	0.03
P-507	644.00	8	PVC	140.0	Open	-46.42	117.89	117.93	0.04	0.05
P-508	351.00	6	PVC	140.0	Open	11.08	117.89	117.89	0.01	0.02
P-509	307.00	4	PVC	140.0	Open	0.72	117.89	117.89	0.22e-3	0.72e-3
P-510	638.00	6	PVC	140.0	Open	3.85	117.89	117.89	0.14e-2	0.22e-2
P-511	233.00	4	PVC	140.0	Open	4.34	117.88	117.88	0.46e-2	0.02
P-514	2,929.00	12	PVC	140.0	Open	-1,135.73	161.85	170.09	8.25	2.82
P-518	508.00	12	PVC	140.0	Open	-625.73	166.96	167.43	0.47	0.93
P-519	725.00	12	PVC	140.0	Open	-625.73	167.43	168.11	0.68	0.93
P-534	1,268.00	12	PVC	140.0	Open	-1,028.93	152.50	155.48	2.97	2.35
P-535	2,466.00	12	PVC	140.0	Open	-1,032.55	155.48	161.30	5.82	2.36
P-538	1,858.00	8	PVC	140.0	Open	2.17	159.53	159.53	0.35e-3	0.19e-3
P-544	659.00	12	PVC	140.0	Open	-513.75	159.86	160.29	0.43	0.65
P-545	664.00	12	PVC	140.0	Open	-517.36	160.29	160.73	0.44	0.66
P-546	1,518.00	12	PVC	140.0	Open	3.62	159.53	159.53	0.11e-3	0.7e-4
P-552	649.00	12	PVC	140.0	Open	-501.45	158.42	158.83	0.40	0.62
P-554	1,512.00	12	PVC	140.0	Open	-497.83	157.50	158.42	0.93	0.61
P-561	367.00	8	PVC	140.0	Open	3.62	150.68	150.68	0.18e-3	0.5e-3
P-565	399.00	8	PVC	140.0	Open	0.00	151.81	151.81	0.00	0.00
P-570	117.00	12	PVC	140.0	Open	-497.83	156.19	156.26	0.07	0.61
P-575	1,159.00	12	PVC	140.0	Open	-497.83	156.26	156.97	0.71	0.61
P-576	862.00	12	PVC	140.0	Open	-497.83	156.97	157.50	0.53	0.61
P-578	1,482.00	12	PVC	140.0	Open	-1,366.03	144.22	150.09	5.87	3.96
P-579	1,278.00	12	PVC	140.0	Open	-1,366.03	150.09	155.15	5.06	3.96
P-580	1,376.00	12	PVC	140.0	Open	-497.48	156.79	157.63	0.84	0.61
P-581	1,226.00	12	PVC	140.0	Open	-498.93	157.63	158.38	0.75	0.61
P-583	661.00	8	PVC	140.0	Open	-601.37	140.23	144.37	4.13	6.26
P-584	506.00	8	PVC	140.0	Open	-598.48	130.88	134.02	3.14	6.20
P-585	998.00	8	PVC	140.0	Open	-599.92	134.02	140.23	6.21	6.23
P-586	874.00	12	Ductile Iron	130.0	Open	-486.07	126.47	127.05	0.59	0.67
P-587	684.00	12	Ductile Iron	140.0	Open	-490.41	127.05	127.46	0.41	0.60
P-592	880.00	12	Ductile Iron	130.0	Open	494.77	128.07	127.46	0.61	0.69
P-594	1,230.00	12	Ductile Iron	130.0	Open	496.94	128.93	128.07	0.86	0.70
P-595	478.00	8	PVC	140.0	Open	-26.64	124.81	124.82	0.01	0.02
P-596	519.00	8	PVC	140.0	Open	-78.50	124.82	124.90	0.08	0.14
P-597	2,036.00	8	PVC	140.0	Open	51.87	124.82	124.68	0.14	0.07
P-598	995.00	8	PVC	140.0	Open	31.11	124.68	124.66	0.03	0.03
P-599	840.00	8	PVC	140.0	Open	51.87	124.66	124.60	0.06	0.07
P-602	5,720.00	16	Ductile Iron	130.0	Open	-1,135.73	170.09	174.64	4.55	0.80
P-603	1,989.00	16	Ductile Iron	130.0	Open	-1,135.73	174.64	176.23	1.58	0.80
P-605	191.00	8	PVC	140.0	Open	-439.19	126.81	127.48	0.67	3.50
P-606	367.00	8	PVC	140.0	Open	-56.58	127.48	127.51	0.03	0.08
P-607	448.00	8	PVC	140.0	Open	-382.60	127.48	128.70	1.21	2.71
P-608	1,642.00	12	Ductile Iron	130.0	Open	884.61	132.60	129.27	3.34	2.03
P-609	467.00	12	Ductile Iron	130.0	Open	502.01	129.27	128.93	0.33	0.71
P-610	210.00	8	PVC	140.0	Open	-382.60	128.70	129.27	0.57	2.71
P-611	646.00	8	PVC	140.0	Open	260.96	128.39	127.53	0.86	1.34
P-612	156.00	12	Ductile Iron	130.0	Open	4.36	127.46	127.46	0.23e-4	0.15e-3
P-613	1,006.00	8	PVC	140.0	Open	0.00	119.63	119.63	0.00	0.00

Steady State Analysis
Pipe Report

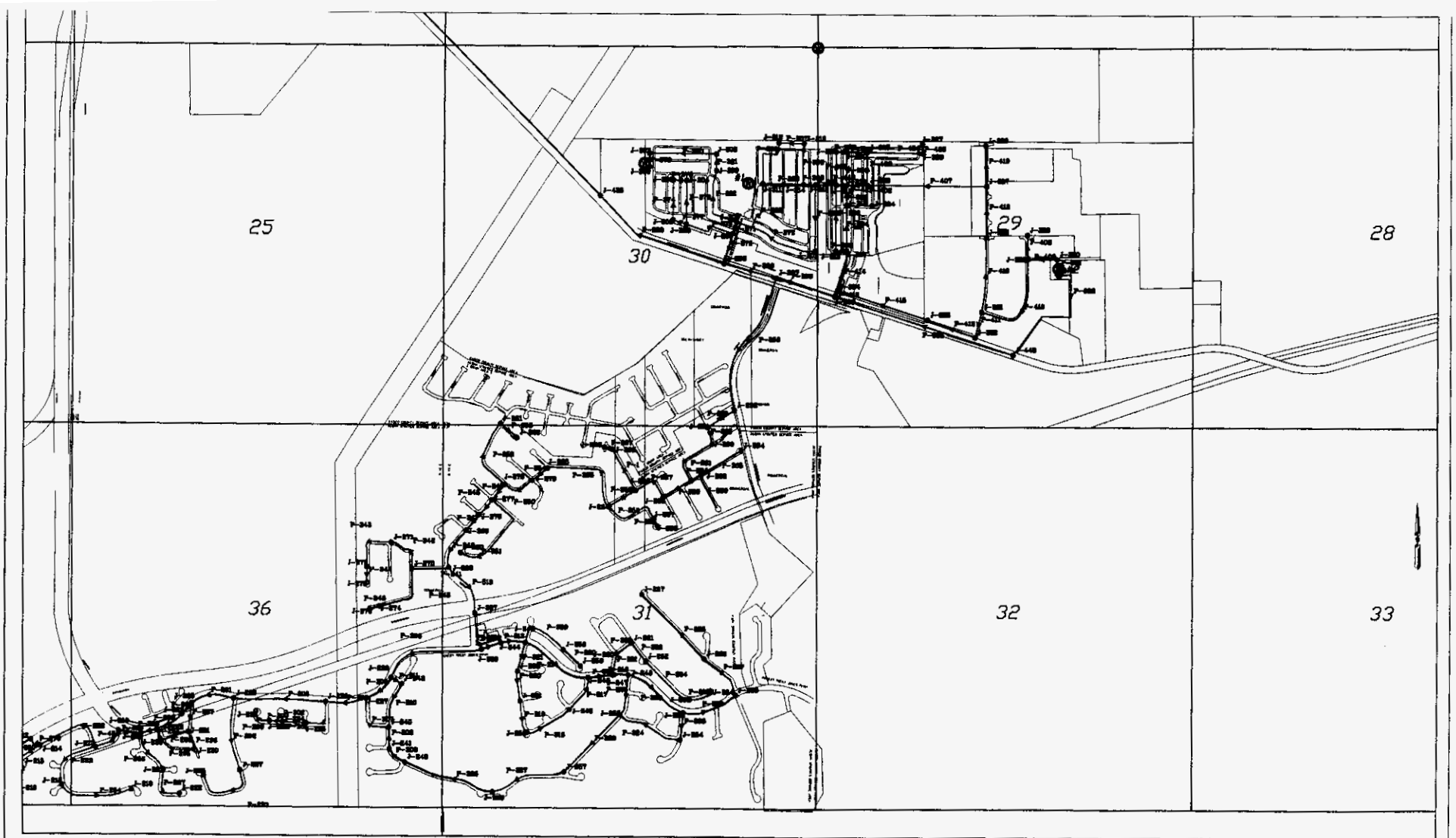
Link Label	Length (ft)	Diameter (in)	Material	Roughness	Current Status	Discharge (gpm)	Start Hydraulic Grade (ft)	End Hydraulic Grade (ft)	Headloss (ft)	Friction Slope (ft/1000ft)
P-614	816.00	8	PVC	140.0	Closed	0.00	119.63	124.66	0.00	0.00
P-615	792.00	8	PVC	140.0	Closed	0.00	117.89	124.67	0.00	0.00
P-616	1,056.00	8	PVC	140.0	Open	-20.76	124.66	124.67	0.01	0.01
P-617	757.00	8	PVC	140.0	Open	0.00	124.67	124.67	0.00	0.00
P-618	1,048.00	8	PVC	140.0	Open	-20.76	124.67	124.68	0.01	0.01
P-619	187.00	12	PVC	140.0	Open	-518.09	160.73	160.85	0.12	0.66
P-620	534.00	12	PVC	140.0	Open	-57.60	160.85	160.86	0.01	0.01
P-622	611.00	20	Ductile Iron	130.0	Open	2,031.18	168.00	167.52	0.48	0.79
P-623	161.00	12	Ductile Iron	130.0	Open	2,031.18	167.52	166.00	1.52	9.47
P-626	3,097.00	12	PVC	140.0	Open	460.49	162.49	160.85	1.64	0.53
P-627	339.00	4	PVC	140.0	Open	71.13	127.68	126.48	1.19	3.52
P-628	680.00	6	PVC	140.0	Open	98.27	126.48	125.88	0.60	0.89
P-629	346.00	6	PVC	140.0	Open	58.97	126.60	126.48	0.12	0.35
P-630	1,190.00	12	PVC	140.0	Open	934.78	155.15	152.82	2.34	1.96
P-631	225.00	8	PVC	140.0	Open	-249.56	179.72	180.00	0.28	1.23
P-632	1,284.00	20	Ductile Iron	130.0	Open	1,860.65	180.00	179.14	0.86	0.67
P-633	2,629.00	20	Ductile Iron	130.0	Open	1,860.65	179.14	177.38	1.76	0.67



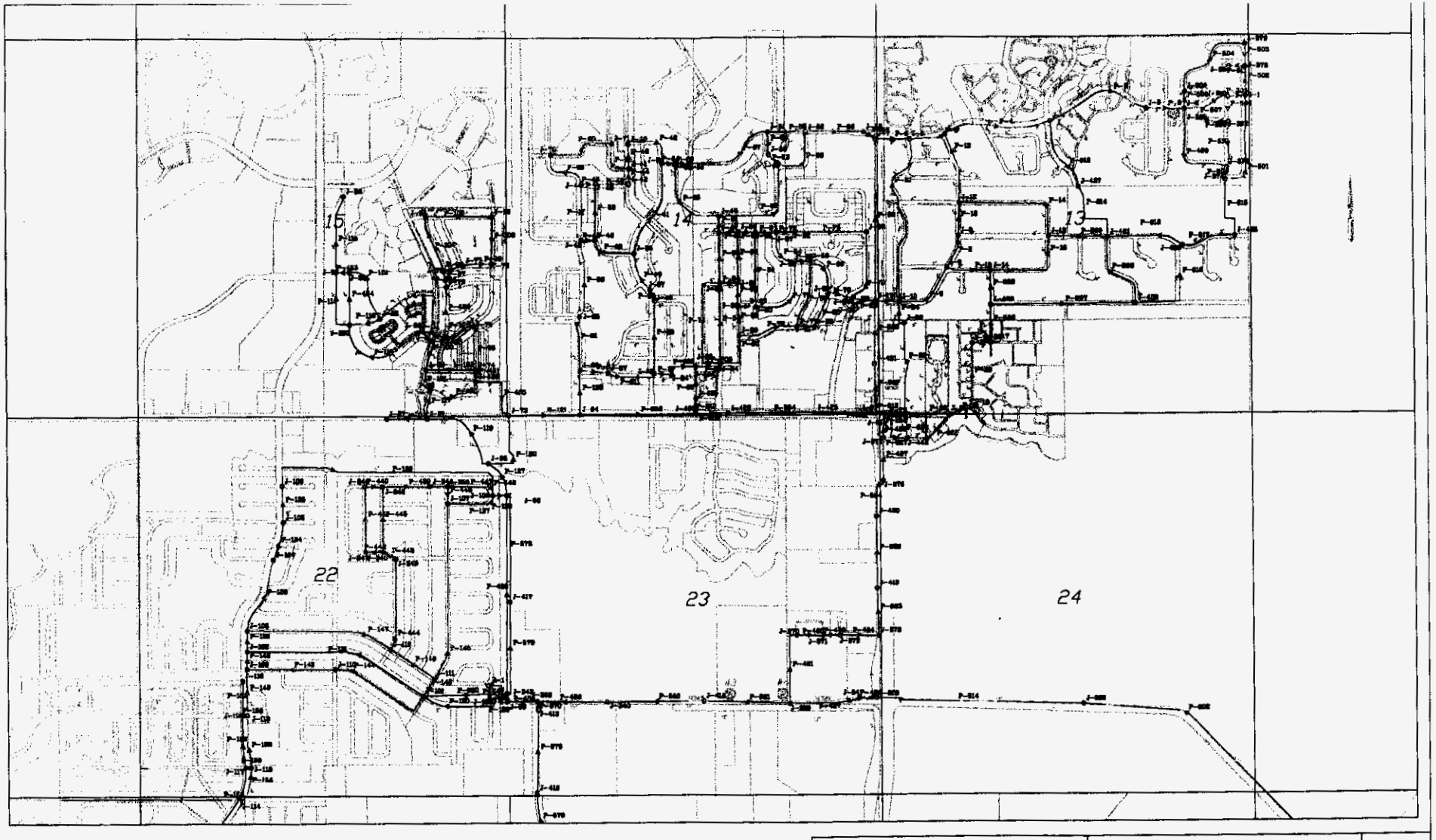
Civil Engineering Associates Inc. 720 E. FLETCHER AVE. TAMPA ,FL	SEVEN SPRINGS WATER SYSTEM 1998 INITIAL NODE MAP, PT.1	FIGURE D-1



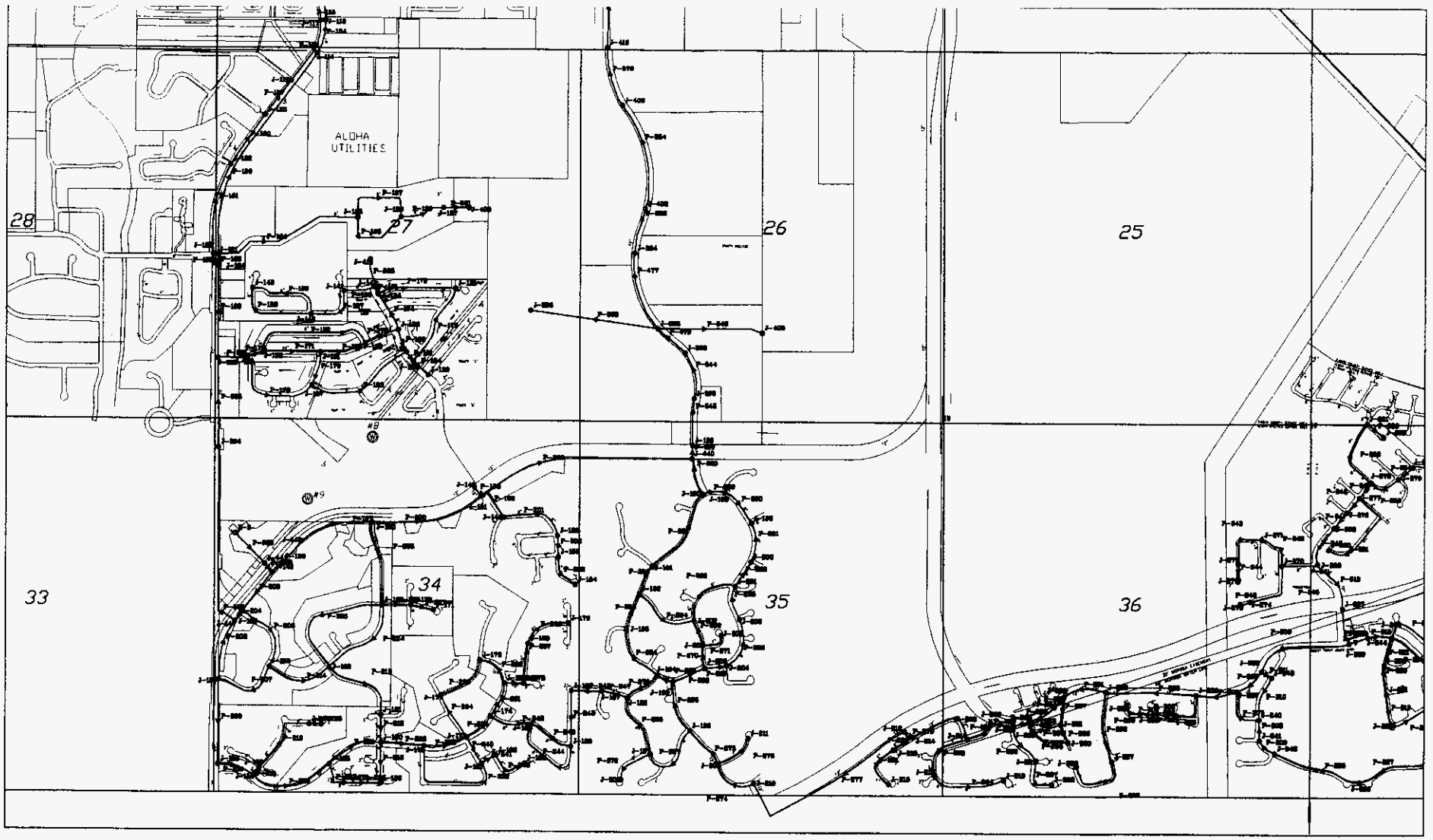
Civil Engineering Associates Inc. 720 E. FLETCHER AVE. TAMPA ,FL	SEVEN SPRINGS WATER SYSTEM 1998 INITIAL NODE MAP, PT.2	FIGURE D-2



Civil Engineering Associates Inc. 720 E. FLETCHER AVE. TAMPA ,FL	SEVEN SPRINGS WATER SYSTEM 1998 INITIAL NODE MAP, PT.3	FIGURE D-3



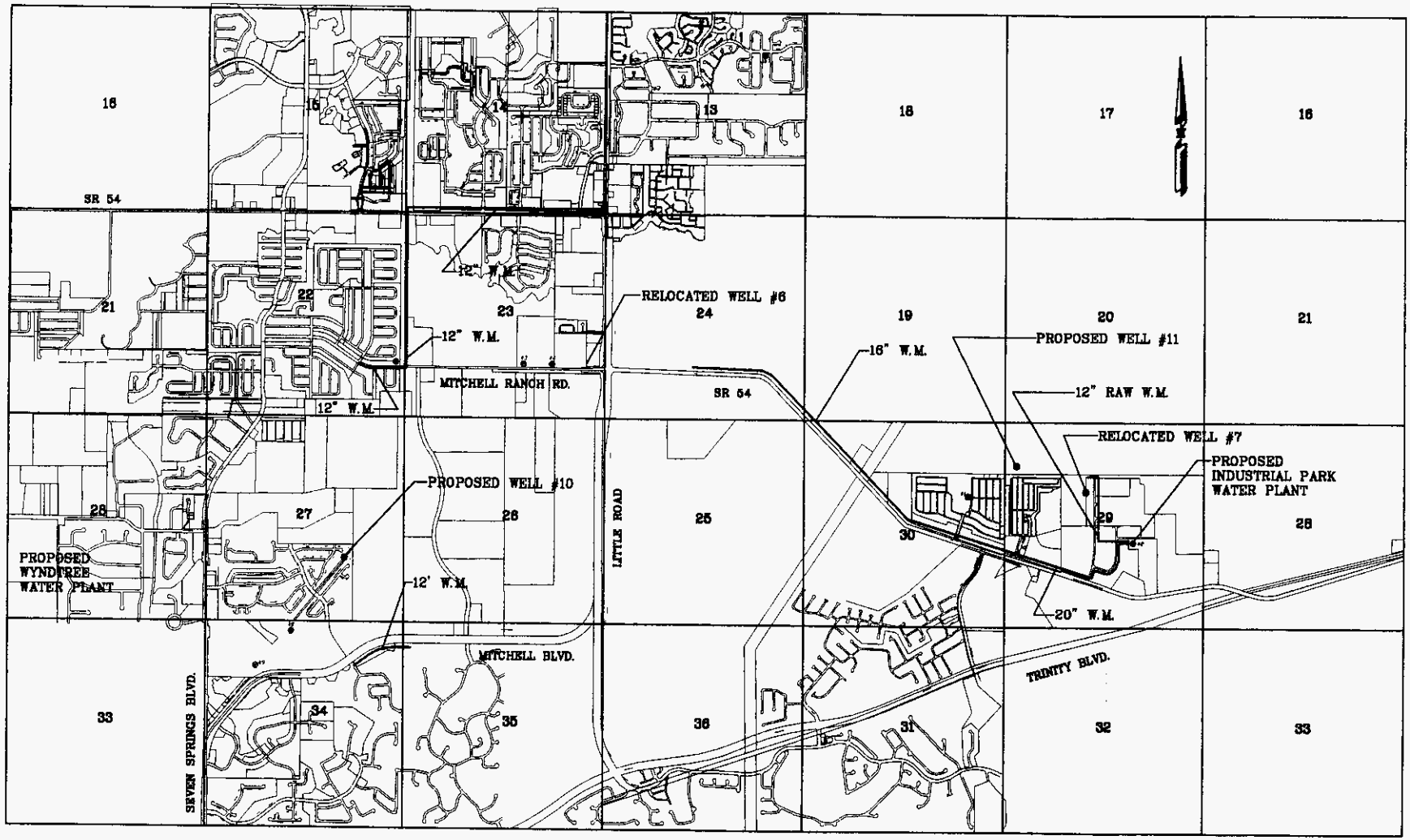
Civil Engineering Associates Inc. 720 E. FLETCHER AVE. TAMPA ,FL	SEVEN SPRINGS WATER SYSTEM 1998 FINAL NODE MAP, PT. 1	FIGURE D-4



Civil Engineering Associates Inc. 720 E. FLETCHER AVE. TAMPA ,FL	SEVEN SPRINGS WATER SYSTEM 1998 FINAL NODE MAP, PT. 2	FIGURE D-5



Civil Engineering Associates Inc. 720 E. FLETCHER AVE. TAMPA ,FL	SEVEN SPRINGS WATER SYSTEM 1998 FINAL NODE MAP, PT. 3	FIGURE D-8



Civil Engineering Associates Inc. 720 E. FLETCHER AVE. TAMPA FLORIDA	SEVEN SPRINGS WATER SYSTEM 1998 IMPROVEMENTS	FIGURE D-7

Appendix E
2015 Water System Hydraulic Model

A. Introduction

The hydraulic modeling of the system in the year 2015 has been accomplished in the same manner as the modeling of the system in the year 1998. The same modeling software has been utilized. The major difference is that the number of connections in the system have nearly doubled. We have assumed that the subdivisions that presently exist or are under construction will have virtually filled and the rest of the new connections will occur in vacant land within the service area. This puts the majority of the new customers around the periphery of the service area and should be a more conservative approach than placing them all in the undeveloped land in the center of the service area.

B. System Design and Analysis Considerations

The three water plants described in Appendix D are still adequate to provide service to the 2015 customer base. With the addition of an additional high service pump and treated water transfer pump, the plants have the treatment and pumping capacity required. The purpose of the hydraulic modeling is to see if the transmission and distribution system can provide adequate pressure throughout the system during peak hourly flow.

The same constraints are imposed on this model. Pressure in the distribution system should be more than 40 psi and less that 65 psi. Pressure in the older parts of the distribution system should be less than 55 psi. Output from the Mitchell Road water Plant should be 3,000 gpm or less, and the output from the other two plants should be approximately equal.

C. The 2015 Seven Springs System Model

The model for the initial 2015 water distribution system is shown in Figures E-1, E-2, and E-3. Each plant is represented by the Reservoir symbol and labeled R-1, R-2, and R-3. A line labeled P-xxx, where xxx represents the individual pipe number, represents each section of piping in the system. Nodes are represented by small circles labeled J-xxx, where xxx is the number of the particular node.

The same usage per connection has been maintained at 295 gallons per day. Peak hourly flow rate has been established as 3.5 times the average daily flow rate, which translates to 0.71 gpm per connection.

The projected usage for the year 2015 has been shown as 10,986 gpm, which is equivalent to 15, 322 connections. The system model has a demand of 10,986 gpm, which represents 15,322 connections at 0.71 gpm per connection.

D. Modeling Protocol for 2015 System

Initially, the system was analyzed with only the transmission and distribution system improvements established in the 1998 model plus improvements which would be expected to be constructed as part of the respective developments.

Improvements to the piping system were again added piece by piece, with the system reanalyzed after each piping change or addition, to determine the minimum amount of improvements that would bring the minimum and maximum pressure in the system within acceptable limits. The goal was to have a minimum pressure in the system of 40

psi and a maximum pressure of 65 psi. Figures E-4, E-5, and E-6 show the final model with all proposed piping improvements.

E. Results of the Hydraulic Analysis

The output files from the hydraulic analyses under the conditions described above are included in the rear of this appendix.

The Reservoir Report shows the hydraulic grade and water outflow from each plant.

The Junction Report shows the outflow at each node where water leaves the system, and the pressure at every node. There are nodes which have no outflow because they occur at pipe junctions where there are no adjacent users or occur where homes have not yet been constructed adjacent to the piping system.

The Pipe Report shows the amount of water flowing through each section of pipe, the velocity in the pipe, and the pressure loss from one end of the pipe to the other.

The initial analysis, modeling the system without any of the proposed improvements other than those associated with the Industrial Park water plant, shows pressures in the system in as low as 20 psi. This is totally unacceptable.

The improvements derived from the final analysis model, shown on Figure E-7 are as follows:

1. A 16-inch main added to the system from SR 54/Little Road intersection north to connect to the 12-inch main in the intersection of Little Road and Old SR 54. This section of piping includes a crossing of the Anclote River. This main will have to be constructed when the next phase of the widening of Little Road is constructed. This is currently estimated to be 5 years in the future.

2. A 12-inch main added to the system running east from the SR 54/Little Road intersection parallel to the existing 12-inch main to a connection to the existing 12-inch main at Trophy Boulevard.

3. A 12-inch main added to the system on Little Road from the SR 54/Little Road intersection south to connect with the 12-inch main on Trinity Boulevard.

These improvements result in the minimum pressure in the distribution system, at peak hourly flow rate, to be 40 psi. The maximum pressure in the distribution system is 67 psi, which occurs on SR 54 immediately outside of the industrial park. The flow from the Mitchell Road water plant is 3,013 gpm and there is 8-gpm difference between the output of the Industrial Park water plant and the Wyndtree water plant. The desired operating parameters have been met.

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Steady State Analysis
Reservoir Report

Node Label	Reservoir Surface Elevation (ft)	Reservoir Inflow (gpm)	Hydraulic Grade (ft)
R-1	150.00	-3,384.40	150.00
R-2	190.00	-3,558.21	190.00
R-3	180.00	-4,043.26	180.00

Steady State Analysis
Junction Report

Node Label	Elevation (ft)	Demand Type	Demand (gpm)	Demand Pattern	Calculated Demand (gpm)	Hydraulic Grade (ft)	Pressure (psi)
J-1	24.00	Demand	27.25	Fixed	27.25	78.71	23.66
J-2	24.00	Demand	15.06	Fixed	15.06	78.69	23.65
J-3	24.00	Demand	184.99	Fixed	184.99	78.69	23.65
J-4	25.00	Demand	190.01	Fixed	190.01	79.52	23.58
J-5	25.00	Demand	252.38	Fixed	252.38	81.65	24.50
J-6	25.00	Demand	155.59	Fixed	155.59	84.00	25.51
J-7	24.00	Demand	0.00	Fixed	0.00	86.71	27.12
J-8	24.00	Demand	19.36	Fixed	19.36	82.02	25.09
J-9	23.00	Demand	24.38	Fixed	24.38	82.47	25.72
J-10	23.00	Demand	56.64	Fixed	56.64	86.14	27.31
J-11	22.00	Demand	0.00	Fixed	0.00	87.43	28.29
J-12	24.00	Demand	22.94	Fixed	22.94	81.65	24.93
J-13	24.00	Demand	106.83	Fixed	106.83	80.91	24.61
J-14	24.00	Demand	14.34	Fixed	14.34	81.65	24.93
J-17	23.00	Demand	81.02	Fixed	81.02	81.89	25.47
J-18	23.00	Demand	48.76	Fixed	48.76	82.19	25.60
J-19	20.00	Demand	64.53	Fixed	64.53	83.63	27.52
J-20	21.00	Demand	173.51	Fixed	173.51	84.42	27.43
J-21	22.00	Demand	2.15	Fixed	2.15	87.42	28.29
J-22	22.00	Demand	0.00	Fixed	0.00	89.66	29.26
J-23	22.00	Demand	2.15	Fixed	2.15	86.39	27.84
J-26	22.00	Demand	0.00	Fixed	0.00	87.46	28.30
J-27	21.00	Demand	21.51	Fixed	21.51	87.49	28.75
J-28	20.00	Demand	0.00	Fixed	0.00	87.56	29.22
J-29	20.00	Demand	25.09	Fixed	25.09	87.82	29.33
J-30	20.00	Demand	30.11	Fixed	30.11	87.70	29.27
J-31	21.00	Demand	17.21	Fixed	17.21	87.64	28.82
J-32	21.00	Demand	31.55	Fixed	31.55	87.62	28.81
J-33	18.00	Demand	0.00	Fixed	0.00	88.20	30.36
J-34	20.00	Demand	0.00	Fixed	0.00	89.84	30.20
J-35	22.00	Demand	48.76	Fixed	48.76	89.97	29.39
J-36	23.00	Demand	55.21	Fixed	55.21	88.66	28.39
J-37	23.00	Demand	20.08	Fixed	20.08	88.53	28.34
J-38	22.00	Demand	49.47	Fixed	49.47	88.15	28.61
J-39	22.00	Demand	26.53	Fixed	26.53	87.54	28.34
J-40	24.00	Demand	25.09	Fixed	25.09	87.54	27.48
J-41	23.00	Demand	0.00	Fixed	0.00	87.54	27.91
J-42	23.00	Demand	42.30	Fixed	42.30	87.57	27.92
J-43	23.00	Demand	12.91	Fixed	12.91	87.70	27.98
J-44	24.00	Demand	56.64	Fixed	56.64	87.71	27.55
J-45	23.00	Demand	49.47	Fixed	49.47	88.21	28.20
J-46	23.00	Demand	15.06	Fixed	15.06	88.16	28.18
J-47	21.00	Demand	31.55	Fixed	31.55	87.57	28.79
J-48	22.00	Demand	0.00	Fixed	0.00	87.54	28.34
J-49	23.00	Demand	0.00	Fixed	0.00	87.09	27.71
J-50	23.00	Demand	0.00	Fixed	0.00	87.08	27.71
J-51	23.00	Demand	76.72	Fixed	76.72	87.08	27.71
J-52	23.00	Demand	15.06	Fixed	15.06	87.03	27.69
J-53	24.00	Demand	0.00	Fixed	0.00	86.77	27.14
J-54	18.00	Demand	25.09	Fixed	25.09	88.08	30.30
J-55	21.00	Demand	0.00	Fixed	0.00	87.58	28.79
J-56	22.00	Demand	0.00	Fixed	0.00	87.54	28.34
J-57	24.00	Demand	121.17	Fixed	121.17	87.47	27.45

Steady State Analysis
Junction Report

Node Label	Elevation (ft)	Demand Type	Demand (gpm)	Demand Pattern	Calculated Demand (gpm)	Hydraulic Grade (ft)	Pressure (psi)
J-58	23.00	Demand	22.23	Fixed	22.23	87.49	27.89
J-59	23.00	Demand	27.25	Fixed	27.25	87.49	27.89
J-60	20.00	Demand	0.00	Fixed	0.00	87.61	29.24
J-61	20.00	Demand	0.00	Fixed	0.00	87.59	29.23
J-62	24.00	Demand	0.00	Fixed	0.00	87.47	27.45
J-63	23.00	Demand	0.00	Fixed	0.00	87.47	27.88
J-64	21.00	Demand	0.00	Fixed	0.00	87.47	28.74
J-65	23.00	Demand	86.76	Fixed	86.76	90.44	29.16
J-66	22.00	Demand	14.34	Fixed	14.34	92.86	30.64
J-67	22.00	Demand	30.11	Fixed	30.11	91.66	30.12
J-68	22.00	Demand	14.34	Fixed	14.34	87.48	28.31
J-69	22.00	Demand	25.09	Fixed	25.09	87.32	28.25
J-70	24.00	Demand	79.59	Fixed	79.59	87.43	27.43
J-71	23.00	Demand	38.72	Fixed	38.72	87.44	27.87
J-73	24.00	Demand	0.00	Fixed	0.00	109.74	37.08
J-74	24.00	Demand	72.42	Fixed	72.42	110.23	37.29
J-75	24.00	Demand	0.00	Fixed	0.00	110.16	37.26
J-76	24.00	Demand	19.36	Fixed	19.36	109.44	36.95
J-77	23.00	Demand	45.17	Fixed	45.17	109.45	37.38
J-78	23.00	Demand	16.49	Fixed	16.49	109.53	37.42
J-79	23.00	Demand	19.36	Fixed	19.36	109.82	37.54
J-80	24.00	Demand	42.30	Fixed	42.30	110.12	37.24
J-81	24.00	Demand	0.00	Fixed	0.00	110.15	37.26
J-82	23.00	Demand	0.00	Fixed	0.00	110.47	37.82
J-83	24.00	Demand	73.85	Fixed	73.85	110.82	37.54
J-84	22.00	Demand	17.93	Fixed	17.92	109.47	37.83
J-85	24.00	Demand	22.23	Fixed	22.23	109.45	36.95
J-86	23.00	Demand	17.93	Fixed	17.92	109.83	37.55
J-88	24.00	Demand	76.72	Fixed	76.72	109.86	37.13
J-89	24.00	Demand	24.38	Fixed	24.38	109.99	37.19
J-90	24.00	Demand	32.98	Fixed	32.98	109.84	37.12
J-91	25.00	Demand	32.27	Fixed	32.26	111.95	37.60
J-92	24.00	Demand	43.02	Fixed	43.02	111.94	38.03
J-93	20.00	Demand	0.00	Fixed	0.00	115.70	41.38
J-94	24.00	Demand	0.00	Fixed	0.00	100.00	32.86
J-95	22.00	Demand	0.00	Fixed	0.00	89.66	29.26
J-96	21.00	Demand	8.60	Fixed	8.60	89.88	29.78
J-98	21.00	Demand	0.00	Fixed	0.00	123.48	44.31
J-99	23.00	Demand	0.00	Fixed	0.00	143.27	52.01
J-100	23.00	Demand	0.00	Fixed	0.00	142.69	51.76
J-101	24.00	Demand	229.44	Fixed	229.44	139.64	50.01
J-102	23.00	Demand	133.36	Fixed	133.36	133.62	47.84
J-103	24.00	Demand	50.19	Fixed	50.19	131.42	46.45
J-104	23.00	Demand	238.04	Fixed	238.04	126.44	44.73
J-105	20.00	Demand	61.66	Fixed	61.66	125.63	45.68
J-106	18.00	Demand	73.85	Fixed	73.85	125.15	46.33
J-107	22.00	Demand	215.10	Fixed	215.10	124.01	44.11
J-108	21.00	Demand	0.00	Fixed	0.00	123.83	44.47
J-109	23.00	Demand	50.19	Fixed	50.19	134.52	48.23
J-110	23.00	Demand	182.83	Fixed	182.84	134.67	48.29
J-111	23.00	Demand	173.51	Fixed	173.51	136.64	49.14
J-112	23.00	Demand	119.02	Fixed	119.02	129.49	46.05
J-113	25.00	Demand	0.00	Fixed	0.00	137.01	48.44

Steady State Analysis
Junction Report

Node Label	Elevation (ft)	Demand Type	Demand (gpm)	Demand Pattern	Calculated Demand (gpm)	Hydraulic Grade (ft)	Pressure (psi)
J-114	24.00	Demand	162.04	Fixed	162.04	141.84	50.96
J-115	23.00	Demand	0.00	Fixed	0.00	137.02	49.30
J-116	25.00	Demand	306.88	Fixed	306.88	137.02	48.44
J-117	24.00	Demand	0.00	Fixed	0.00	138.99	49.73
J-118	24.00	Demand	9.32	Fixed	9.32	139.04	49.75
J-119	24.00	Demand	10.76	Fixed	10.76	139.85	50.10
J-120	23.00	Demand	58.79	Fixed	58.79	140.46	50.79
J-121	23.00	Demand	0.00	Fixed	0.00	145.88	53.14
J-122	23.00	Demand	88.91	Fixed	88.91	141.77	51.36
J-123	23.00	Demand	193.59	Fixed	193.59	145.01	52.76
J-124	23.00	Demand	0.00	Fixed	0.00	146.04	53.21
J-125	22.00	Demand	5.02	Fixed	5.02	146.36	53.78
J-126	23.00	Demand	5.02	Fixed	5.02	146.41	53.37
J-127	22.00	Demand	5.02	Fixed	5.02	146.58	53.87
J-128	22.00	Demand	0.00	Fixed	0.00	150.05	55.37
J-129	22.00	Demand	36.57	Fixed	36.57	149.39	55.09
J-130	22.00	Demand	24.38	Fixed	24.38	149.18	55.00
J-131	22.00	Demand	40.15	Fixed	40.15	148.73	54.80
J-132	23.00	Demand	26.53	Fixed	26.53	148.51	54.27
J-133	21.00	Demand	14.34	Fixed	14.34	147.80	54.83
J-134	23.00	Demand	21.51	Fixed	21.51	147.23	53.72
J-135	21.00	Demand	29.40	Fixed	29.40	147.04	54.50
J-136	22.00	Demand	26.53	Fixed	26.53	147.76	54.38
J-137	23.00	Demand	27.25	Fixed	27.25	148.70	54.36
J-138	21.00	Demand	19.36	Fixed	19.36	147.79	54.83
J-139	21.00	Demand	46.61	Fixed	46.60	147.76	54.82
J-140	21.00	Demand	12.19	Fixed	12.19	147.80	54.83
J-141	22.00	Demand	15.06	Fixed	15.06	147.13	54.11
J-142	22.00	Demand	15.06	Fixed	15.06	147.09	54.09
J-143	23.00	Demand	35.13	Fixed	35.13	147.08	53.65
J-144	23.00	Demand	0.00	Fixed	0.00	147.18	53.70
J-145	23.00	Demand	0.00	Fixed	0.00	147.97	54.04
J-146	23.00	Demand	44.45	Fixed	44.45	156.71	57.82
J-147	22.00	Demand	0.00	Fixed	0.00	163.16	61.04
J-148	23.00	Demand	76.00	Fixed	76.00	173.58	65.11
J-149	23.00	Demand	0.00	Fixed	0.00	168.64	62.98
J-150	23.00	Demand	43.02	Fixed	43.02	161.05	59.70
J-151	23.00	Demand	0.00	Fixed	0.00	157.08	57.98
J-152	23.00	Demand	27.25	Fixed	27.25	156.49	57.73
J-153	24.00	Demand	16.49	Fixed	16.49	156.47	57.29
J-154	22.00	Demand	7.17	Fixed	7.17	156.45	58.14
J-155	22.00	Demand	0.00	Fixed	0.00	168.02	63.14
J-156	21.00	Demand	0.00	Fixed	0.00	163.29	61.53
J-157	22.00	Demand	0.00	Fixed	0.00	162.82	60.89
J-158	22.00	Demand	0.00	Fixed	0.00	161.88	60.49
J-159	21.00	Demand	0.00	Fixed	0.00	160.86	60.48
J-160	21.00	Demand	0.00	Fixed	0.00	158.22	59.34
J-161	22.00	Demand	34.42	Fixed	34.42	158.86	59.18
J-162	21.00	Demand	58.79	Fixed	58.79	160.91	60.50
J-163	22.00	Demand	24.38	Fixed	24.38	160.85	60.04
J-164	22.00	Demand	10.04	Fixed	10.04	160.84	60.04
J-165	22.00	Demand	9.32	Fixed	9.32	160.84	60.04
J-166	22.00	Demand	22.94	Fixed	22.94	158.34	58.96

Steady State Analysis
Junction Report

Node Label	Elevation (ft)	Demand Type	Demand (gpm)	Demand Pattern	Calculated Demand (gpm)	Hydraulic Grade (ft)	Pressure (psi)
J-167	21.00	Demand	12.91	Fixed	12.91	158.50	59.46
J-168	21.00	Demand	0.00	Fixed	0.00	159.01	59.68
J-169	22.00	Demand	45.17	Fixed	45.17	160.91	60.07
J-170	22.00	Demand	17.93	Fixed	17.92	160.90	60.07
J-171	21.00	Demand	4.30	Fixed	4.30	160.90	60.50
J-172	22.00	Demand	35.13	Fixed	35.13	156.08	57.98
J-173	22.00	Demand	0.00	Fixed	0.00	154.69	57.38
J-174	23.00	Demand	71.70	Fixed	71.70	153.79	56.56
J-175	24.00	Demand	0.00	Fixed	0.00	153.79	56.12
J-176	23.00	Demand	24.38	Fixed	24.38	153.80	56.56
J-177	23.00	Demand	53.78	Fixed	53.78	153.99	56.64
J-178	24.00	Demand	30.11	Fixed	30.11	153.78	56.12
J-179	24.00	Demand	25.09	Fixed	25.09	153.73	56.10
J-180	24.00	Demand	0.00	Fixed	0.00	153.78	56.12
J-181	23.00	Demand	32.98	Fixed	32.98	154.86	57.02
J-182	24.00	Demand	19.36	Fixed	19.36	154.83	56.58
J-183	25.00	Demand	10.04	Fixed	10.04	154.79	56.13
J-184	26.00	Demand	10.04	Fixed	10.04	151.35	54.21
J-185	25.00	Demand	47.32	Fixed	47.32	150.10	54.10
J-186	25.00	Demand	14.34	Fixed	14.34	147.55	52.99
J-187	25.00	Demand	16.49	Fixed	16.49	146.20	52.41
J-188	25.00	Demand	19.36	Fixed	19.36	145.12	51.94
J-189	24.00	Demand	0.72	Fixed	0.72	144.55	52.13
J-190	25.00	Demand	22.23	Fixed	22.23	144.52	51.68
J-191	24.00	Demand	39.43	Fixed	39.44	144.52	52.12
J-192	24.00	Demand	14.34	Fixed	14.34	144.52	52.12
J-193	24.00	Demand	20.08	Fixed	20.08	144.53	52.12
J-194	25.00	Demand	17.93	Fixed	17.92	144.55	51.70
J-195	25.00	Demand	10.04	Fixed	10.04	144.54	51.69
J-196	25.00	Demand	19.36	Fixed	19.36	144.54	51.69
J-197	26.00	Demand	22.23	Fixed	22.23	144.73	51.34
J-198	25.00	Demand	17.21	Fixed	17.21	144.48	51.66
J-199	25.00	Demand	17.21	Fixed	17.21	144.42	51.64
J-200	26.00	Demand	25.09	Fixed	25.09	144.40	51.20
J-201	27.00	Demand	22.23	Fixed	22.23	144.40	50.77
J-202	26.00	Demand	27.96	Fixed	27.96	144.42	51.21
J-203	26.00	Demand	22.94	Fixed	22.94	144.40	51.20
J-204	25.00	Demand	24.38	Fixed	24.38	144.42	51.64
J-205	26.00	Demand	10.76	Fixed	10.76	144.44	51.22
J-206	25.00	Demand	14.34	Fixed	14.34	144.42	51.64
J-207	26.00	Demand	0.00	Fixed	0.00	144.42	51.21
J-208	26.00	Demand	9.32	Fixed	9.32	144.73	51.34
J-209	25.00	Demand	12.19	Fixed	12.19	144.52	51.68
J-210	26.00	Demand	10.04	Fixed	10.04	144.50	51.24
J-211	25.00	Demand	10.76	Fixed	10.76	144.46	51.66
J-212	33.00	Demand	0.00	Fixed	0.00	144.46	48.20
J-214	33.00	Demand	0.00	Fixed	0.00	144.46	48.20
J-215	32.00	Demand	27.25	Fixed	27.25	144.41	48.61
J-216	32.00	Demand	10.04	Fixed	10.04	144.40	48.61
J-217	33.00	Demand	24.38	Fixed	24.38	144.47	48.20
J-218	33.00	Demand	30.11	Fixed	30.11	144.30	48.13
J-219	33.00	Demand	17.93	Fixed	17.92	144.26	48.11
J-220	34.00	Demand	9.32	Fixed	9.32	144.49	47.78

Steady State Analysis
Junction Report

Node Label	Elevation (ft)	Demand Type	Demand (gpm)	Demand Pattern	Calculated Demand (gpm)	Hydraulic Grade (ft)	Pressure (psi)
J-221	34.00	Demand	14.34	Fixed	14.34	144.44	47.76
J-222	35.00	Demand	13.62	Fixed	13.62	144.37	47.30
J-223	34.00	Demand	0.00	Fixed	0.00	144.50	47.78
J-224	34.00	Demand	36.57	Fixed	36.57	144.53	47.80
J-225	35.00	Demand	0.00	Fixed	0.00	144.55	47.37
J-226	35.00	Demand	10.76	Fixed	10.76	144.63	47.41
J-227	35.00	Demand	17.93	Fixed	17.92	144.52	47.36
J-228	34.00	Demand	13.62	Fixed	13.62	144.51	47.79
J-229	34.00	Demand	21.51	Fixed	21.51	144.50	47.78
J-230	35.00	Demand	11.47	Fixed	11.47	144.49	47.35
J-231	34.00	Demand	16.49	Fixed	16.49	144.50	47.78
J-232	35.00	Demand	9.32	Fixed	9.32	144.79	47.48
J-233	34.00	Demand	0.00	Fixed	0.00	144.81	47.92
J-234	34.00	Demand	10.76	Fixed	10.76	144.81	47.92
J-235	35.00	Demand	10.76	Fixed	10.76	144.63	47.49
J-236	34.00	Demand	3.59	Fixed	3.59	144.87	47.94
J-237	35.00	Demand	3.59	Fixed	3.59	145.01	47.57
J-238	34.00	Demand	0.00	Fixed	0.00	145.10	48.05
J-239	33.00	Demand	0.00	Fixed	0.00	145.57	48.68
J-240	34.00	Demand	20.79	Fixed	20.79	145.01	48.01
J-241	34.00	Demand	10.76	Fixed	10.76	145.01	48.00
J-242	34.00	Demand	25.81	Fixed	25.81	145.00	48.00
J-243	34.00	Demand	15.77	Fixed	15.77	145.08	48.03
J-244	35.00	Demand	17.93	Fixed	17.92	145.48	47.77
J-245	33.00	Demand	0.00	Fixed	0.00	145.37	48.59
J-246	35.00	Demand	0.00	Fixed	0.00	145.22	47.66
J-247	35.00	Demand	0.00	Fixed	0.00	145.16	47.64
J-248	35.00	Demand	21.51	Fixed	21.51	145.13	47.63
J-249	34.00	Demand	21.51	Fixed	21.51	145.22	48.09
J-250	33.00	Demand	15.77	Fixed	15.77	145.24	48.54
J-251	34.00	Demand	13.62	Fixed	13.62	145.27	48.12
J-252	33.00	Demand	15.77	Fixed	15.77	145.31	48.57
J-253	34.00	Demand	13.62	Fixed	13.62	145.10	48.04
J-254	33.00	Demand	12.91	Fixed	12.91	145.09	48.47
J-255	34.00	Demand	12.91	Fixed	12.91	145.09	48.04
J-256	33.00	Demand	24.38	Fixed	24.38	145.00	48.43
J-257	34.00	Demand	22.94	Fixed	22.94	145.02	48.01
J-258	34.00	Demand	9.32	Fixed	9.32	145.37	48.16
J-259	35.00	Demand	9.32	Fixed	9.32	145.37	47.73
J-260	35.00	Demand	20.79	Fixed	20.79	145.13	47.62
J-261	35.00	Demand	18.64	Fixed	18.64	145.11	47.62
J-262	34.00	Demand	0.00	Fixed	0.00	145.11	48.05
J-263	34.00	Demand	0.00	Fixed	0.00	145.09	48.04
J-264	35.00	Demand	25.81	Fixed	25.81	145.09	47.60
J-265	34.00	Demand	43.02	Fixed	43.02	145.08	48.04
J-266	35.00	Demand	17.93	Fixed	17.92	145.07	47.60
J-267	34.00	Demand	14.34	Fixed	14.34	145.06	48.03
J-268	34.00	Demand	4.30	Fixed	4.30	148.27	49.42
J-269	33.00	Demand	18.64	Fixed	18.64	150.09	50.63
J-270	33.00	Demand	31.55	Fixed	31.55	148.22	49.82
J-271	33.00	Demand	3.59	Fixed	3.59	148.21	49.82
J-272	34.00	Demand	10.04	Fixed	10.04	148.20	49.38
J-273	34.00	Demand	7.17	Fixed	7.17	148.19	49.38

Steady State Analysis
Junction Report

Node Label	Elevation (ft)	Demand Type	Demand (gpm)	Demand Pattern	Calculated Demand (gpm)	Hydraulic Grade (ft)	Pressure (psi)
J-274	35.00	Demand	0.00	Fixed	0.00	148.21	48.96
J-275	35.00	Demand	14.34	Fixed	14.34	148.19	48.95
J-276	33.00	Demand	14.34	Fixed	14.34	151.04	51.04
J-277	34.00	Demand	13.62	Fixed	13.62	151.95	51.01
J-278	34.00	Demand	6.45	Fixed	6.45	152.96	51.44
J-279	34.00	Demand	17.93	Fixed	17.92	154.52	52.11
J-280	34.00	Demand	24.38	Fixed	24.38	151.94	51.00
J-281	34.00	Demand	46.61	Fixed	46.60	152.86	51.40
J-282	33.00	Demand	21.51	Fixed	21.51	152.74	51.78
J-283	34.00	Demand	21.51	Fixed	21.51	155.63	52.60
J-284	34.00	Demand	22.94	Fixed	22.94	159.86	54.43
J-285	35.00	Demand	25.09	Fixed	25.09	161.75	54.81
J-286	36.00	Demand	15.77	Fixed	15.77	163.58	55.17
J-287	34.00	Demand	0.00	Fixed	0.00	159.83	54.41
J-288	34.00	Demand	18.64	Fixed	18.64	159.83	54.41
J-289	36.00	Demand	20.79	Fixed	20.79	165.70	56.09
J-290	37.00	Demand	30.83	Fixed	30.83	168.54	56.88
J-291	38.00	Demand	0.00	Fixed	0.00	169.76	56.98
J-292	38.00	Demand	0.00	Fixed	0.00	172.04	57.96
J-293	36.00	Demand	0.00	Fixed	0.00	165.70	56.09
J-294	38.00	Demand	0.00	Fixed	0.00	165.70	55.22
J-295	34.00	Demand	0.00	Fixed	0.00	161.75	55.24
J-296	34.00	Demand	10.76	Fixed	10.76	161.73	55.24
J-297	38.00	Demand	0.00	Fixed	0.00	181.67	62.13
J-298	38.00	Demand	0.00	Fixed	0.00	180.53	61.63
J-299	39.00	Demand	0.00	Fixed	0.00	180.54	61.21
J-300	39.00	Demand	24.38	Fixed	24.38	180.56	61.22
J-301	39.00	Demand	20.08	Fixed	20.08	181.13	61.46
J-302	40.00	Demand	0.00	Fixed	0.00	180.28	60.66
J-303	40.00	Demand	34.42	Fixed	34.42	180.24	60.65
J-304	40.00	Demand	12.91	Fixed	12.91	180.25	60.65
J-305	40.00	Demand	14.34	Fixed	14.34	180.29	60.67
J-306	40.00	Demand	24.38	Fixed	24.38	179.96	60.52
J-307	40.00	Demand	22.94	Fixed	22.94	179.98	60.53
J-308	40.00	Demand	7.89	Fixed	7.89	180.19	60.62
J-309	40.00	Demand	7.17	Fixed	7.17	180.26	60.65
J-310	40.00	Demand	0.00	Fixed	0.00	181.83	61.33
J-311	40.00	Demand	21.51	Fixed	21.51	181.69	61.27
J-312	40.00	Demand	1.43	Fixed	1.43	181.73	61.29
J-313	40.00	Demand	0.00	Fixed	0.00	181.76	61.30
J-314	40.00	Demand	65.96	Fixed	65.96	181.77	61.30
J-315	40.00	Demand	0.00	Fixed	0.00	182.40	61.58
J-316	40.00	Demand	12.19	Fixed	12.19	182.75	61.73
J-317	40.00	Demand	12.19	Fixed	12.19	182.77	61.74
J-318	39.00	Demand	0.00	Fixed	0.00	182.60	62.10
J-319	39.00	Demand	0.00	Fixed	0.00	182.53	62.07
J-320	40.00	Demand	0.00	Fixed	0.00	182.53	61.64
J-321	41.00	Demand	0.00	Fixed	0.00	182.50	61.19
J-322	39.00	Demand	0.00	Fixed	0.00	183.21	62.36
J-323	39.00	Demand	31.55	Fixed	31.55	182.59	62.09
J-324	39.00	Demand	0.00	Fixed	0.00	182.59	62.09
J-325	40.00	Demand	0.00	Fixed	0.00	182.55	61.65
J-326	39.00	Demand	0.00	Fixed	0.00	182.55	62.08

Steady State Analysis
Junction Report

Node Label	Elevation (ft)	Demand Type	Demand (gpm)	Demand Pattern	Calculated Demand (gpm)	Hydraulic Grade (ft)	Pressure (psi)
J-327	39.00	Demand	0.00	Fixed	0.00	182.55	62.08
J-328	44.00	Demand	2.87	Fixed	2.87	187.97	62.26
J-329	44.00	Demand	5.02	Fixed	5.02	187.97	62.26
J-330	44.00	Demand	2.87	Fixed	2.87	189.27	62.82
J-331	41.00	Demand	5.02	Fixed	5.02	185.08	62.30
J-332	42.00	Demand	2.87	Fixed	2.87	184.78	61.74
J-333	41.00	Demand	2.87	Fixed	2.87	184.23	61.94
J-334	39.00	Demand	0.00	Fixed	0.00	183.21	62.36
J-335	44.00	Demand	5.02	Fixed	5.02	184.26	60.65
J-336	43.00	Demand	5.02	Fixed	5.02	183.73	60.85
J-337	43.00	Demand	5.02	Fixed	5.02	183.73	60.86
J-338	40.00	Demand	0.00	Fixed	0.00	153.12	48.92
J-339	39.00	Demand	2.87	Fixed	2.87	147.01	46.71
J-340	25.00	Demand	2.15	Fixed	2.15	144.69	51.76
J-341	40.00	Demand	0.00	Fixed	0.00	151.89	48.39
J-342	24.00	Demand	0.00	Fixed	0.00	143.23	51.56
J-344	21.00	Demand	0.00	Fixed	0.00	124.34	44.69
J-345	20.00	Demand	61.66	Fixed	61.66	125.26	45.52
J-346	20.00	Demand	36.57	Fixed	36.57	125.36	45.56
J-347	22.00	Demand	25.09	Fixed	25.09	126.16	45.04
J-348	22.00	Demand	22.23	Fixed	22.23	126.50	45.19
J-349	23.00	Demand	68.83	Fixed	68.83	126.78	44.88
J-350	21.00	Demand	0.00	Fixed	0.00	124.01	44.55
J-360	24.00	Demand	42.30	Fixed	42.30	109.86	37.13
J-361	24.00	Demand	0.00	Fixed	0.00	109.85	37.13
J-362	24.00	Demand	17.93	Fixed	17.92	143.82	51.81
J-363	25.00	Demand	2.87	Fixed	2.87	144.32	51.60
J-364	26.00	Demand	5.02	Fixed	5.02	144.20	51.11
J-365	26.00	Demand	41.59	Fixed	41.59	144.29	51.15
J-366	25.00	Demand	0.72	Fixed	0.72	144.40	51.63
J-367	40.00	Demand	60.95	Fixed	60.94	153.12	48.92
J-369	34.00	Demand	0.00	Fixed	0.00	144.48	47.77
J-370	37.00	Demand	16.49	Fixed	16.49	133.70	41.82
J-371	38.00	Demand	16.49	Fixed	16.49	128.67	39.21
J-372	38.00	Demand	14.34	Fixed	14.34	125.54	37.86
J-373	39.00	Demand	0.00	Fixed	0.00	118.62	34.43
J-374	22.00	Demand	0.00	Fixed	0.00	91.64	30.11
J-375	23.00	Demand	5.74	Fixed	5.74	96.80	31.91
J-376	25.00	Demand	24.38	Fixed	24.38	78.80	23.26
J-377	25.00	Demand	12.19	Fixed	12.19	78.83	23.28
J-378	23.00	Demand	9.32	Fixed	9.32	78.68	24.08
J-379	22.00	Demand	12.19	Fixed	12.19	78.67	24.51
J-380	23.00	Demand	27.96	Fixed	27.96	78.67	24.07
J-381	23.00	Demand	5.74	Fixed	5.74	78.71	24.09
J-382	25.00	Demand	9.32	Fixed	9.32	78.73	23.23
J-383	24.00	Demand	0.72	Fixed	0.72	78.73	23.67
J-384	23.00	Demand	5.74	Fixed	5.74	78.67	24.07
J-385	37.00	Demand	0.00	Fixed	0.00	168.73	56.96
J-386	26.00	Demand	57.36	Fixed	57.36	144.48	51.23
J-387	34.00	Demand	0.00	Fixed	0.00	146.19	48.52
J-388	34.00	Demand	189.29	Fixed	189.29	144.56	47.81
J-389	34.00	Demand	124.76	Fixed	124.76	144.89	47.95
J-390	24.00	Demand	20.79	Fixed	20.79	144.47	52.10

Steady State Analysis
Junction Report

Node Label	Elevation (ft)	Demand Type	Demand (gpm)	Demand Pattern	Calculated Demand (gpm)	Hydraulic Grade (ft)	Pressure (psi)
J-391	26.00	Demand	169.21	Fixed	169.21	144.38	51.19
J-392	26.00	Demand	58.79	Fixed	58.79	144.38	51.19
J-393	26.00	Demand	7.17	Fixed	7.17	145.38	51.63
J-394	23.00	Demand	5.02	Fixed	5.02	157.55	58.18
J-395	23.00	Demand	145.55	Fixed	145.55	158.85	58.75
J-396	26.00	Demand	2.87	Fixed	2.87	144.31	51.16
J-397	24.00	Demand	7.17	Fixed	7.17	146.30	52.89
J-398	24.00	Demand	58.79	Fixed	58.79	144.68	52.19
J-399	25.00	Demand	115.44	Fixed	115.44	144.44	51.65
J-400	24.00	Demand	5.02	Fixed	5.02	144.30	52.02
J-401	26.00	Demand	0.00	Fixed	0.00	144.30	51.16
J-402	26.00	Demand	5.02	Fixed	5.02	144.13	51.08
J-403	25.00	Demand	0.00	Fixed	0.00	143.97	51.44
J-404	25.00	Demand	41.59	Fixed	41.59	143.90	51.42
J-405	26.00	Demand	3.59	Fixed	3.59	143.89	50.98
J-406	26.00	Demand	0.00	Fixed	0.00	143.87	50.97
J-407	26.00	Demand	65.25	Fixed	65.25	143.86	50.96
J-408	26.00	Demand	22.94	Fixed	22.94	146.69	52.19
J-409	26.00	Demand	22.94	Fixed	22.94	146.93	52.29
J-410	26.00	Demand	22.94	Fixed	22.94	147.09	52.37
J-411	26.00	Demand	116.87	Fixed	116.87	143.99	51.02
J-412	26.00	Demand	25.09	Fixed	25.09	144.20	51.11
J-413	24.00	Demand	0.00	Fixed	0.00	143.83	51.82
J-416	24.00	Demand	0.00	Fixed	0.00	143.91	51.85
J-417	25.00	Demand	35.13	Fixed	35.13	133.92	47.10
J-418	26.00	Demand	0.00	Fixed	0.00	145.92	51.86
J-419	40.00	Demand	150.57	Fixed	150.57	110.23	30.37
J-420	40.00	Demand	5.74	Fixed	5.74	101.27	26.50
J-421	40.00	Demand	12.19	Fixed	12.19	88.74	21.08
J-425	22.00	Demand	15.06	Fixed	15.06	90.90	29.79
J-428	22.00	Demand	17.21	Fixed	17.21	92.69	30.57
J-429	24.00	Demand	0.00	Fixed	0.00	81.62	24.92
J-430	20.00	Demand	127.63	Fixed	127.63	79.87	25.89
J-431	24.00	Demand	72.42	Fixed	72.42	79.87	24.16
J-433	38.00	Demand	55.93	Fixed	55.93	177.34	60.25
J-434	20.00	Demand	0.00	Fixed	0.00	89.80	30.18
J-435	20.00	Demand	0.00	Fixed	0.00	92.22	31.23
J-436	20.00	Demand	0.00	Fixed	0.00	93.39	31.74
J-437	25.00	Demand	0.00	Fixed	0.00	79.72	23.66
J-438	25.00	Demand	0.00	Fixed	0.00	79.28	23.47
J-439	24.00	Demand	0.00	Fixed	0.00	79.71	24.09
J-440	42.00	Demand	0.00	Fixed	0.00	187.86	63.08
J-450	24.00	Demand	0.00	Fixed	0.00	110.23	37.29

Steady State Analysis
Pipe Report

Link Label	Length (ft)	Diameter (in)	Material	Roughness	Current Status	Discharge (gpm)	Start Hydraulic Grade (ft)	End Hydraulic Grade (ft)	Headloss (ft)	Friction Slope (ft/1000ft)
P-2	540.00	8	PVC	140.0	Open	14.25	78.69	78.69	0.33e-2	0.01
P-3	1,364.00	8	PVC	140.0	Open	-170.73	78.69	79.52	0.83	0.61
P-4	1,503.00	8	PVC	140.0	Open	-269.17	79.52	81.65	2.12	1.41
P-5	511.00	8	PVC	140.0	Open	-509.16	81.65	84.00	2.35	4.60
P-6	490.00	8	PVC	140.0	Open	-563.26	84.00	86.71	2.72	5.54
P-8	475.00	8	PVC	140.0	Open	-216.42	82.02	82.47	0.45	0.94
P-9	831.00	8	PVC	140.0	Open	-498.66	82.47	86.14	3.68	4.42
P-10	2,274.00	6	PVC	140.0	Open	-101.49	84.00	86.14	2.15	0.94
P-11	341.00	8	PVC	140.0	Open	-457.82	86.14	87.43	1.29	3.78
P-12	977.00	8	PVC	140.0	Open	-12.40	81.65	81.65	0.47e-2	0.48e-2
P-13	463.00	8	PVC	140.0	Open	-197.06	81.65	82.02	0.37	0.79
P-14	1,346.00	8	PVC	140.0	Open	161.71	81.65	80.91	0.74	0.55
P-15	942.00	8	PVC	140.0	Open	-195.37	80.91	81.65	0.74	0.78
P-16	629.00	8	PVC	140.0	Open	-257.87	81.65	82.47	0.82	1.31
P-19	270.00	8	PVC	140.0	Open	-238.33	81.89	82.19	0.30	1.13
P-20	903.00	8	PVC	140.0	Open	-287.08	82.19	83.63	1.44	1.59
P-21	340.00	8	PVC	140.0	Open	-351.61	83.63	84.42	0.79	2.32
P-22	617.00	8	PVC	140.0	Open	-525.13	84.42	87.42	3.00	4.87
P-23	251.00	8	PVC	140.0	Open	-728.40	87.42	89.66	2.24	8.92
P-24	304.00	8	PVC	140.0	Open	-198.97	86.14	86.39	0.25	0.81
P-25	1,255.00	8	PVC	140.0	Open	-201.12	86.39	87.42	1.03	0.82
P-26	2,257.00	12	PVC	140.0	Open	-350.03	86.71	87.43	0.72	0.32
P-28	292.00	8	PVC	140.0	Open	-57.74	87.43	87.46	0.02	0.08
P-30	500.00	8	PVC	140.0	Open	-77.63	87.49	87.56	0.07	0.14
P-32	413.00	12	PVC	140.0	Open	337.67	87.82	87.70	0.12	0.30
P-33	323.00	12	PVC	140.0	Open	247.97	87.70	87.64	0.05	0.17
P-34	251.00	8	PVC	140.0	Open	54.31	87.64	87.62	0.02	0.07
P-37	251.00	6	PVC	140.0	Open	-71.32	89.84	89.97	0.12	0.49
P-38	1,016.00	8	PVC	140.0	Open	255.78	89.97	88.66	1.31	1.29
P-39	162.00	8	PVC	140.0	Open	200.57	88.66	88.53	0.13	0.82
P-40	556.00	8	PVC	140.0	Open	180.50	88.53	88.15	0.38	0.67
P-41	1,325.00	8	PVC	140.0	Open	147.48	88.15	87.54	0.62	0.46
P-42	547.00	8	PVC	140.0	Open	2.45	87.54	87.54	0.13e-3	0.24e-3
P-43	348.00	8	PVC	140.0	Open	-22.64	87.54	87.54	0.01	0.01
P-44	218.00	8	PVC	140.0	Open	-71.03	87.54	87.57	0.03	0.12
P-45	461.00	8	PVC	140.0	Open	-113.33	87.57	87.70	0.13	0.29
P-46	202.00	8	PVC	140.0	Open	-48.06	87.70	87.71	0.01	0.06
P-47	784.00	8	PVC	140.0	Open	-174.62	87.71	88.21	0.50	0.63
P-48	194.00	8	PVC	140.0	Open	109.69	88.21	88.16	0.05	0.27
P-49	576.00	8	PVC	140.0	Open	16.46	88.16	88.15	0.46e-2	0.01
P-50	704.00	12	PVC	140.0	Open	161.28	87.62	87.57	0.05	0.08
P-51	236.00	12	PVC	140.0	Open	225.94	87.57	87.54	0.03	0.14
P-52	1,119.00	8	PVC	140.0	Open	136.44	87.54	87.09	0.45	0.40
P-53	200.00	8	PVC	140.0	Open	21.33	87.09	87.08	0.26e-2	0.01
P-54	315.00	8	PVC	140.0	Open	21.33	87.08	87.08	0.41e-2	0.01
P-55	534.00	10	PVC	140.0	Open	113.17	87.08	87.03	0.05	0.10
P-56	825.00	10	PVC	140.0	Open	213.23	87.03	86.77	0.26	0.31
P-57	196.00	10	PVC	140.0	Open	213.23	86.77	86.71	0.06	0.31
P-58	1,112.00	6	PVC	140.0	Open	-64.74	87.62	88.08	0.46	0.41
P-59	163.00	12	PVC	140.0	Open	-562.66	88.08	88.20	0.13	0.77
P-60	469.00	12	PVC	140.0	Open	-472.83	87.82	88.08	0.26	0.56
P-61	275.00	12	PVC	140.0	Open	-96.20	87.57	87.58	0.01	0.03

Steady State Analysis
Pipe Report

Link Label	Length (ft)	Diameter (in)	Material	Roughness	Current Status	Discharge (gpm)	Start Hydraulic Grade (ft)	End Hydraulic Grade (ft)	Headloss (ft)	Friction Slope (ft/1000ft)
P-62	245.00	8	PVC	140.0	Open	80.25	87.58	87.54	0.04	0.15
P-63	299.00	8	PVC	140.0	Open	103.81	87.54	87.47	0.07	0.24
P-64	477.00	6	PVC	140.0	Open	-19.36	87.47	87.49	0.02	0.04
P-65	214.00	8	PVC	140.0	Open	-5.56	87.49	87.49	0.23e-3	0.11e-2
P-66	516.00	6	PVC	140.0	Open	-0.37	87.49	87.49	0.15e-4	0.3e-4
P-67	711.00	12	PVC	140.0	Open	-176.45	87.58	87.64	0.06	0.09
P-68	1,043.00	6	PVC	140.0	Open	-23.56	87.54	87.61	0.07	0.06
P-69	253.00	6	PVC	140.0	Open	-59.58	87.61	87.70	0.09	0.35
P-70	846.00	6	PVC	140.0	Open	-36.02	87.49	87.61	0.12	0.14
P-71	248.00	8	PVC	140.0	Open	-77.63	87.56	87.59	0.04	0.14
P-72	828.00	8	PVC	140.0	Open	-110.07	87.59	87.82	0.22	0.27
P-73	926.00	6	PVC	140.0	Open	-32.44	87.49	87.59	0.11	0.11
P-74	1,112.00	6	PVC	140.0	Open	-73.78	87.62	88.20	0.58	0.52
P-75	258.00	8	PVC	140.0	Open	1.99	87.47	87.47	0.46e-4	0.18e-3
P-76	1,016.00	6	PVC	140.0	Open	1.99	87.47	87.47	0.66e-3	0.65e-3
P-77	137.00	8	PVC	140.0	Open	-57.74	87.46	87.47	0.01	0.08
P-78	294.00	8	PVC	140.0	Open	-55.75	87.47	87.49	0.02	0.08
P-79	970.00	6	PVC	140.0	Open	1.99	87.47	87.47	0.63e-3	0.65e-3
P-80	1,059.00	8	PVC	140.0	Open	-333.79	88.21	90.44	2.23	2.10
P-81	749.00	8	PVC	140.0	Open	-420.54	90.44	92.86	2.42	3.23
P-82	395.00	8	PVC	140.0	Open	405.97	92.86	91.66	1.19	3.02
P-83	785.00	6	PVC	140.0	Open	-78.18	87.70	88.16	0.46	0.58
P-84	198.00	8	PVC	140.0	Open	118.50	87.54	87.48	0.06	0.31
P-85	965.00	10	PVC	140.0	Open	-89.50	87.48	87.54	0.06	0.06
P-86	204.00	8	PVC	140.0	Open	193.66	87.48	87.32	0.16	0.77
P-87	1,196.00	10	PVC	140.0	Open	168.56	87.32	87.08	0.24	0.20
P-88	585.00	10	PVC	140.0	Open	-115.11	87.03	87.09	0.06	0.10
P-89	597.00	6	PVC	140.0	Open	69.92	87.71	87.43	0.28	0.47
P-90	879.00	6	PVC	140.0	Open	-9.67	87.43	87.44	0.01	0.01
P-91	428.00	6	PVC	140.0	Open	-48.39	87.44	87.54	0.10	0.24
P-93	640.00	8	PVC	140.0	Open	-66.77	110.16	110.23	0.07	0.11
P-95	406.00	8	PVC	140.0	Open	-8.54	109.44	109.45	0.97e-3	0.24e-2
P-96	281.00	6	PVC	140.0	Open	-53.71	109.45	109.53	0.08	0.29
P-97	225.00	6	PVC	140.0	Open	-121.17	109.53	109.82	0.29	1.31
P-99	128.00	8	PVC	140.0	Open	116.06	110.15	110.12	0.04	0.30
P-100	506.00	10	PVC	140.0	Open	310.37	110.47	110.15	0.31	0.62
P-101	302.00	10	PVC	140.0	Open	433.62	110.82	110.47	0.35	1.15
P-102	714.00	8	PVC	140.0	Open	123.24	110.47	110.23	0.24	0.33
P-103	426.00	8	PVC	140.0	Open	-66.77	110.12	110.16	0.05	0.11
P-104	810.00	8	PVC	140.0	Open	50.97	109.53	109.47	0.05	0.07
P-105	945.00	8	PVC	140.0	Open	33.05	109.47	109.45	0.03	0.03
P-106	656.00	8	PVC	140.0	Open	10.82	109.45	109.44	0.24e-2	0.37e-2
P-110	438.00	8	PVC	140.0	Open	9.18	109.86	109.86	0.11e-2	0.25e-2
P-111	207.00	8	PVC	140.0	Open	194.31	110.15	109.99	0.16	0.77
P-112	1,034.00	8	PVC	140.0	Open	-73.55	109.86	109.99	0.13	0.13
P-114	751.00	8	PVC	140.0	Open	-30.21	109.84	109.86	0.02	0.02
P-115	1,065.00	8	PVC	140.0	Open	17.92	109.84	109.83	0.01	0.01
P-116	775.00	6	PVC	140.0	Open	-10.48	109.85	109.86	0.01	0.01
P-117	391.00	10	PVC	140.0	Open	714.50	111.95	110.82	1.13	2.90
P-118	574.00	10	PVC	140.0	Open	-43.02	111.94	111.95	0.01	0.02
P-119	1,072.00	10	PVC	140.0	Open	-789.79	111.95	115.70	3.75	3.49
P-120	725.00	12	PVC	140.0	Open	2,026.87	115.70	109.74	5.96	8.22

Steady State Analysis
Pipe Report

Link Label	Length (ft)	Diameter (in)	Material	Roughness	Current Status	Discharge (gpm)	Start Hydraulic Grade (ft)	End Hydraulic Grade (ft)	Headloss (ft)	Friction Slope (ft/1000ft)
P-121	1,003.00	12	PVC	140.0	Open	2,217.96	109.74	100.00	9.74	9.71
P-122	614.00	8	PVC	140.0	Open	840.85	100.00	92.86	7.14	11.63
P-124	157.00	12	Ductile Iron	130.0	Open	-710.99	89.66	89.88	0.21	1.36
P-127	515.00	12	PVC	140.0	Open	-2,816.65	115.70	123.48	7.78	15.11
P-129	190.00	8	PVC	140.0	Open	406.69	143.27	142.69	0.58	3.03
P-130	1,006.00	8	PVC	140.0	Open	406.69	142.69	139.64	3.05	3.03
P-131	2,594.00	8	PVC	140.0	Open	351.74	139.64	133.62	6.02	2.32
P-132	291.00	8	PVC	140.0	Open	666.88	133.62	131.42	2.20	7.57
P-133	1,056.00	8	PVC	140.0	Open	516.23	131.42	126.44	4.98	4.72
P-134	540.00	8	PVC	140.0	Open	278.19	126.44	125.63	0.81	1.50
P-135	506.00	8	PVC	140.0	Open	216.53	125.63	125.15	0.48	0.95
P-137	649.00	6	PVC	140.0	Open	-51.54	123.83	124.01	0.17	0.27
P-138	3,015.00	8	PVC	140.0	Open	142.68	125.15	123.83	1.32	0.44
P-139	199.00	8	PVC	140.0	Open	-305.09	123.48	123.83	0.35	1.78
P-142	247.00	8	PVC	140.0	Open	-448.50	133.62	134.52	0.90	3.64
P-143	1,276.00	6	PVC	140.0	Open	-33.17	134.52	134.67	0.15	0.12
P-144	1,300.00	6	PVC	140.0	Open	-216.01	134.67	139.64	4.97	3.82
P-145	294.00	8	PVC	140.0	Open	783.97	139.64	136.64	3.00	10.22
P-146	742.00	6	PVC	140.0	Open	355.96	136.64	129.49	7.14	9.62
P-147	2,077.00	6	PVC	140.0	Open	-100.46	129.49	131.42	1.92	0.93
P-148	2,441.00	6	PVC	140.0	Open	-254.50	124.01	136.64	12.63	5.17
P-149	638.00	8	PVC	140.0	Open	-465.52	134.52	137.01	2.49	3.90
P-151	477.00	8	PVC	140.0	Open	0.00	137.02	137.02	0.00	0.00
P-152	728.00	8	PVC	140.0	Open	-383.01	137.02	138.99	1.98	2.71
P-153	728.00	8	PVC	140.0	Open	-389.39	137.01	139.04	2.04	2.80
P-154	490.00	8	PVC	140.0	Open	-572.50	139.04	141.84	2.80	5.71
P-155	83.00	8	PVC	140.0	Open	-173.79	138.99	139.04	0.05	0.63
P-156	969.00	8	PVC	140.0	Open	-209.22	138.99	139.85	0.86	0.89
P-157	623.00	8	PVC	140.0	Open	-219.97	139.85	140.46	0.61	0.97
P-158	67.00	8	PVC	140.0	Open	76.13	137.02	137.01	0.01	0.14
P-159	3,213.00	12	PVC	140.0	Open	-734.55	141.84	145.88	4.04	1.26
P-160	871.00	8	PVC	140.0	Open	-278.77	140.46	141.77	1.31	1.51
P-161	1,288.00	8	PVC	140.0	Open	-367.67	141.77	145.01	3.24	2.52
P-162	186.00	8	PVC	140.0	Open	-561.26	145.01	146.04	1.02	5.51
P-163	163.00	12	PVC	140.0	Open	-633.67	145.88	146.04	0.16	0.96
P-164	2,102.00	8	PVC	140.0	Open	-100.88	145.88	146.36	0.48	0.23
P-165	621.00	8	PVC	140.0	Open	-52.95	146.36	146.41	0.04	0.07
P-166	631.00	8	PVC	140.0	Open	-110.91	146.41	146.58	0.17	0.27
P-167	621.00	8	PVC	140.0	Open	-52.95	146.36	146.41	0.04	0.07
P-168	1,298.00	12	PVC	140.0	Open	-1,194.93	146.04	150.05	4.01	3.09
P-169	436.00	10	PVC	140.0	Open	501.16	150.05	149.39	0.66	1.51
P-170	241.00	10	PVC	140.0	Open	379.50	149.39	149.18	0.22	0.90
P-171	827.00	10	PVC	140.0	Open	287.08	149.18	148.73	0.44	0.54
P-172	666.00	10	PVC	140.0	Open	223.65	148.73	148.51	0.23	0.34
P-173	517.00	8	PVC	140.0	Open	265.17	148.51	147.80	0.71	1.38
P-174	573.00	8	PVC	140.0	Open	221.46	147.80	147.23	0.56	0.99
P-175	1,119.00	6	PVC	140.0	Open	40.56	147.23	147.04	0.19	0.17
P-176	1,199.00	6	PVC	140.0	Open	-79.46	147.04	147.76	0.72	0.60
P-178	1,015.00	6	PVC	140.0	Open	85.10	149.39	148.70	0.69	0.68
P-179	495.00	6	PVC	140.0	Open	-23.28	148.70	148.73	0.03	0.06
P-180	1,486.00	6	PVC	140.0	Open	68.04	149.18	148.51	0.67	0.45
P-181	162.00	8	PVC	140.0	Open	-91.13	147.76	147.79	0.03	0.19

Steady State Analysis
Pipe Report

Link Label	Length (ft)	Diameter (in)	Material	Roughness	Current Status	Discharge (gpm)	Start Hydraulic Grade (ft)	End Hydraulic Grade (ft)	Headloss (ft)	Friction Slope (ft/1000ft)
P-182	339.00	8	PVC	140.0	Open	-29.37	147.79	147.80	0.01	0.02
P-183	1,464.00	6	PVC	140.0	Open	81.13	148.70	147.79	0.91	0.62
P-184	294.00	8	PVC	140.0	Open	-14.85	147.76	147.76	0.2e-2	0.01
P-185	406.00	8	PVC	140.0	Open	-61.46	147.76	147.80	0.04	0.09
P-187	593.00	8	PVC	140.0	Open	50.19	147.13	147.09	0.04	0.06
P-188	920.00	8	PVC	140.0	Open	23.92	147.09	147.08	0.01	0.02
P-189	920.00	6	PVC	140.0	Open	11.22	147.09	147.08	0.01	0.02
P-190	107.00	8	PVC	140.0	Open	159.39	147.23	147.18	0.06	0.54
P-191	464.00	8	PVC	140.0	Open	65.25	147.18	147.13	0.05	0.10
P-192	1,319.00	8	PVC	140.0	Open	-73.65	147.80	147.97	0.17	0.13
P-196	613.00	12	PVC	140.0	Open	2,003.67	173.58	168.64	4.93	8.05
P-197	1,072.00	12	PVC	150.0	Open	2,003.67	168.64	161.05	7.59	7.08
P-198	151.00	6	PVC	140.0	Open	-960.40	147.97	157.08	9.12	60.37
P-199	447.00	6	PVC	140.0	Open	95.36	157.08	156.71	0.38	0.84
P-200	1,613.00	12	PVC	140.0	Open	1,055.76	161.05	157.08	3.97	2.46
P-201	810.00	6	PVC	140.0	Open	50.91	156.71	156.49	0.21	0.26
P-202	299.00	6	PVC	140.0	Open	23.66	156.49	156.47	0.02	0.06
P-203	464.00	4	PVC	140.0	Open	7.17	156.47	156.45	0.02	0.05
P-204	161.00	8	PVC	140.0	Open	-1,407.60	163.16	168.02	4.86	30.16
P-205	717.00	12	PVC	140.0	Open	-1,963.59	168.02	173.58	5.56	7.75
P-206	873.00	8	PVC	140.0	Open	555.99	168.02	163.29	4.72	5.41
P-207	759.00	8	PVC	140.0	Open	173.83	163.29	162.82	0.48	0.63
P-208	862.00	12	PVC	140.0	Open	-395.16	162.82	163.16	0.34	0.40
P-209	1,195.00	12	PVC	140.0	Open	568.99	162.82	161.88	0.94	0.78
P-210	538.00	10	PVC	140.0	Open	568.99	161.88	160.86	1.02	1.90
P-212	391.00	8	PVC	140.0	Open	-292.22	158.22	158.86	0.64	1.65
P-213	1,013.00	8	PVC	140.0	Open	-326.63	158.86	160.91	2.05	2.02
P-214	882.00	8	PVC	140.0	Open	-382.16	160.91	163.29	2.38	2.70
P-215	134.00	8	PVC	140.0	Open	43.74	160.86	160.85	0.01	0.05
P-216	955.00	8	PVC	140.0	Open	19.36	160.85	160.84	0.01	0.01
P-217	183.00	6	PVC	140.0	Open	9.32	160.84	160.84	0.21e-2	0.01
P-218	579.00	8	PVC	140.0	Open	-94.21	158.22	158.34	0.12	0.20
P-219	527.00	8	PVC	140.0	Open	-117.16	158.34	158.50	0.16	0.30
P-220	1,123.00	10	PVC	140.0	Open	525.25	160.86	159.01	1.84	1.64
P-221	817.00	10	PVC	140.0	Open	395.19	159.01	158.22	0.79	0.97
P-222	345.00	6	PVC	140.0	Open	130.06	159.01	158.50	0.52	1.49
P-223	1,175.00	8	PVC	140.0	Open	70.67	161.05	160.91	0.14	0.12
P-224	1,170.00	8	PVC	140.0	Open	2.16	160.91	160.91	0.21e-3	0.18e-3
P-225	1,170.00	6	PVC	140.0	Open	1.11	160.91	160.91	0.21e-3	0.18e-3
P-226	415.00	8	PVC	140.0	Open	22.23	160.91	160.90	0.01	0.01
P-227	339.00	4	PVC	140.0	Open	4.30	160.90	160.90	0.01	0.02
P-228	623.00	10	PVC	140.0	Open	781.62	158.22	156.08	2.13	3.43
P-229	626.00	10	PVC	140.0	Open	619.88	156.08	154.69	1.40	2.23
P-230	453.00	10	PVC	140.0	Open	580.21	154.69	153.79	0.89	1.97
P-231	512.00	10	PVC	140.0	Open	29.46	153.79	153.79	0.41e-2	0.01
P-232	478.00	8	PVC	140.0	Open	-25.74	153.79	153.80	0.01	0.02
P-233	752.00	6	PVC	140.0	Open	-50.12	153.80	153.99	0.19	0.26
P-234	707.00	6	PVC	140.0	Open	-103.90	153.99	154.69	0.70	0.99
P-235	274.00	10	PVC	140.0	Open	55.21	153.79	153.78	0.01	0.03
P-237	567.00	10	PVC	140.0	Open	25.09	153.78	153.78	0.34e-2	0.01
P-238	651.00	6	PVC	140.0	Open	25.09	153.78	153.73	0.05	0.07
P-239	862.00	6	PVC	140.0	Open	126.61	156.08	154.86	1.23	1.42

Steady State Analysis
Pipe Report

Link Label	Length (ft)	Diameter (in)	Material	Roughness	Current Status	Discharge (gpm)	Start Hydraulic Grade (ft)	End Hydraulic Grade (ft)	Headloss (ft)	Friction Slope (ft/1000ft)
P-240	423.00	6	PVC	140.0	Open	64.23	154.86	154.69	0.17	0.41
P-241	234.00	6	PVC	140.0	Open	29.40	154.86	154.83	0.02	0.10
P-242	430.00	4	PVC	140.0	Open	10.04	154.83	154.79	0.04	0.09
P-243	594.00	8	PVC	140.0	Open	479.05	153.79	151.35	2.44	4.11
P-244	645.00	6	PVC	140.0	Open	149.72	151.35	150.10	1.25	1.94
P-245	787.00	8	PVC	140.0	Open	421.69	150.10	147.55	2.55	3.24
P-246	442.00	8	PVC	140.0	Open	407.35	147.55	146.20	1.34	3.04
P-247	386.00	8	PVC	140.0	Open	390.86	146.20	145.12	1.09	2.82
P-248	645.00	8	PVC	140.0	Open	319.29	151.35	150.10	1.25	1.94
P-250	712.00	12	PVC	140.0	Open	116.65	144.55	144.52	0.03	0.04
P-251	1,262.00	12	PVC	140.0	Open	16.18	144.52	144.52	0.14e-2	0.11e-2
P-252	429.00	12	PVC	140.0	Open	-23.25	144.52	144.52	0.9e-3	0.21e-2
P-253	529.00	12	PVC	140.0	Open	-70.61	144.52	144.53	0.01	0.02
P-254	802.00	12	PVC	140.0	Open	-90.68	144.53	144.55	0.02	0.03
P-255	236.00	12	PVC	140.0	Open	117.10	144.55	144.54	0.01	0.04
P-256	736.00	12	PVC	140.0	Open	15.17	144.54	144.54	0.7e-3	0.95e-3
P-257	658.00	8	PVC	140.0	Open	-114.24	144.54	144.73	0.19	0.29
P-258	848.00	8	PVC	140.0	Open	-145.79	144.73	145.12	0.39	0.45
P-259	317.00	8	PVC	140.0	Open	78.24	144.52	144.48	0.05	0.14
P-260	577.00	8	PVC	140.0	Open	61.03	144.48	144.42	0.05	0.09
P-261	547.00	8	PVC	140.0	Open	43.83	144.42	144.40	0.03	0.05
P-262	415.00	8	PVC	140.0	Open	-2.30	144.40	144.40	0.76e-4	0.18e-3
P-263	769.00	6	PVC	140.0	Open	-14.85	144.40	144.42	0.02	0.03
P-264	876.00	6	PVC	140.0	Open	-33.01	144.42	144.52	0.10	0.12
P-265	468.00	8	PVC	140.0	Open	-9.68	144.40	144.40	0.14e-2	0.3e-2
P-266	688.00	8	PVC	140.0	Open	-32.62	144.40	144.42	0.02	0.03
P-267	327.00	8	PVC	140.0	Open	-57.00	144.42	144.44	0.03	0.08
P-268	501.00	8	PVC	140.0	Open	-91.89	144.44	144.54	0.10	0.19
P-269	383.00	6	PVC	140.0	Open	-9.80	144.42	144.42	0.48e-2	0.01
P-270	327.00	6	PVC	140.0	Open	-24.14	144.42	144.44	0.02	0.07
P-271	302.00	8	PVC	140.0	Open	0.00	144.42	144.42	0.00	0.00
P-272	565.00	8	PVC	140.0	Open	9.32	144.73	144.73	0.16e-2	0.28e-2
P-273	627.00	12	PVC	140.0	Open	110.05	144.54	144.52	0.02	0.04
P-274	583.00	12	PVC	140.0	Open	87.11	144.52	144.50	0.01	0.02
P-275	568.00	4	PVC	140.0	Open	10.76	144.52	144.46	0.06	0.11
P-276	554.00	8	PVC	140.0	Open	-225.71	144.55	145.12	0.57	1.02
P-277	2,295.00	12	PVC	140.0	Open	77.07	144.50	144.46	0.04	0.02
P-279	159.00	12	PVC	140.0	Open	15.19	144.46	144.46	0.15e-3	0.96e-3
P-280	340.00	6	PVC	140.0	Open	37.28	144.46	144.41	0.05	0.15
P-281	488.00	6	PVC	140.0	Open	10.04	144.41	144.40	0.01	0.01
P-282	781.00	8	PVC	140.0	Open	-22.10	144.46	144.47	0.01	0.01
P-283	705.00	6	PVC	140.0	Open	48.04	144.47	144.30	0.17	0.24
P-284	991.00	6	PVC	140.0	Open	17.92	144.30	144.26	0.04	0.04
P-286	587.00	6	PVC	140.0	Open	27.96	144.49	144.44	0.05	0.09
P-287	408.00	4	PVC	140.0	Open	13.62	144.44	144.37	0.07	0.17
P-288	229.00	12	PVC	140.0	Open	-131.80	144.49	144.50	0.01	0.05
P-289	410.00	12	PVC	140.0	Open	-147.49	144.50	144.53	0.03	0.06
P-290	208.00	12	PVC	140.0	Open	-184.06	144.53	144.55	0.02	0.10
P-291	603.00	12	PVC	140.0	Open	-217.84	144.55	144.63	0.08	0.13
P-292	987.00	6	PVC	140.0	Open	31.55	144.63	144.52	0.11	0.11
P-293	518.00	6	PVC	140.0	Open	13.62	144.52	144.51	0.01	0.02
P-294	174.00	6	PVC	140.0	Open	15.69	144.50	144.50	0.01	0.03

Steady State Analysis
Pipe Report

Link Label	Length (ft)	Diameter (in)	Material	Roughness	Current Status	Discharge (gpm)	Start Hydraulic Grade (ft)	End Hydraulic Grade (ft)	Headloss (ft)	Friction Slope (ft/1000ft)
P-295	499.00	6	PVC	140.0	Open	1.76	144.50	144.49	0.2e-3	0.4e-3
P-296	270.00	6	PVC	140.0	Open	-9.71	144.49	144.50	0.33e-2	0.01
P-297	395.00	6	PVC	140.0	Open	-33.78	144.50	144.55	0.05	0.12
P-298	403.00	6	PVC	140.0	Open	7.58	144.50	144.50	0.31e-2	0.01
P-299	233.00	4	PVC	140.0	Open	-9.32	144.79	144.81	0.02	0.08
P-300	189.00	6	PVC	140.0	Open	-9.32	144.81	144.81	0.22e-2	0.01
P-301	337.00	6	PVC	140.0	Open	-20.08	144.81	144.83	0.02	0.05
P-302	402.00	6	PVC	140.0	Open	-30.83	144.83	144.87	0.04	0.10
P-303	1,310.00	12	PVC	140.0	Open	260.14	144.87	144.63	0.24	0.18
P-304	594.00	12	PVC	140.0	Open	-294.56	144.87	145.01	0.14	0.23
P-305	447.00	12	PVC	140.0	Open	-287.15	145.01	145.10	0.10	0.22
P-306	1,327.00	12	PVC	140.0	Open	-368.53	145.10	145.57	0.47	0.35
P-307	505.00	6	PVC	140.0	Open	-10.99	145.01	145.01	0.01	0.02
P-308	292.00	8	PVC	140.0	Open	33.82	145.01	145.01	0.01	0.03
P-309	285.00	8	PVC	140.0	Open	23.06	145.01	145.00	0.43e-2	0.01
P-310	623.00	8	PVC	140.0	Open	-65.60	145.01	145.08	0.06	0.10
P-311	171.00	8	PVC	140.0	Open	-81.37	145.08	145.10	0.03	0.15
P-312	290.00	12	PVC	140.0	Open	354.80	145.57	145.48	0.09	0.33
P-313	348.00	12	PVC	140.0	Open	336.87	145.48	145.37	0.10	0.30
P-314	1,008.00	12	PVC	140.0	Open	237.79	145.37	145.22	0.16	0.16
P-315	336.00	12	PVC	140.0	Open	251.55	145.22	145.16	0.06	0.17
P-316	227.00	12	PVC	140.0	Open	186.30	145.16	145.13	0.02	0.10
P-317	518.00	8	PVC	140.0	Open	-13.76	145.22	145.22	0.3e-2	0.01
P-318	671.00	8	PVC	140.0	Open	-35.27	145.22	145.24	0.02	0.03
P-319	440.00	8	PVC	140.0	Open	-51.04	145.24	145.27	0.03	0.07
P-320	409.00	8	PVC	140.0	Open	-64.67	145.27	145.31	0.04	0.10
P-321	411.00	8	PVC	140.0	Open	-80.44	145.31	145.37	0.06	0.15
P-322	933.00	12	PVC	140.0	Open	109.99	145.13	145.10	0.03	0.04
P-323	375.00	8	PVC	140.0	Open	21.08	145.10	145.09	0.48e-2	0.01
P-324	910.00	8	PVC	140.0	Open	8.18	145.09	145.09	0.2e-2	0.22e-2
P-325	561.00	8	PVC	140.0	Open	-54.80	145.09	145.13	0.04	0.07
P-326	1,296.00	8	PVC	140.0	Open	-2.75	145.00	145.00	0.38e-3	0.29e-3
P-327	1,049.00	8	PVC	140.0	Open	-27.13	145.00	145.02	0.02	0.02
P-328	1,116.00	8	PVC	140.0	Open	-50.07	145.02	145.09	0.07	0.06
P-329	546.00	8	PVC	140.0	Open	18.64	145.37	145.37	0.01	0.01
P-330	331.00	8	PVC	140.0	Open	9.32	145.37	145.37	0.93e-3	0.28e-2
P-331	299.00	8	PVC	140.0	Open	65.25	145.16	145.13	0.03	0.10
P-332	259.00	8	PVC	140.0	Open	44.45	145.13	145.11	0.01	0.05
P-333	320.00	8	PVC	140.0	Open	25.81	145.11	145.11	0.01	0.02
P-334	808.00	8	PVC	140.0	Open	25.81	145.11	145.09	0.01	0.02
P-335	331.00	8	PVC	140.0	Open	25.81	145.09	145.09	0.01	0.02
P-336	783.00	12	PVC	140.0	Open	75.28	145.10	145.08	0.01	0.02
P-337	674.00	8	PVC	140.0	Open	32.27	145.08	145.07	0.02	0.03
P-338	1,249.00	8	PVC	140.0	Open	14.34	145.07	145.06	0.01	0.01
P-340	566.00	12	PVC	140.0	Open	-1,219.18	148.27	150.09	1.82	3.21
P-341	520.00	8	PVC	140.0	Open	66.68	148.27	148.22	0.06	0.11
P-342	465.00	8	PVC	140.0	Open	20.79	148.22	148.21	0.01	0.01
P-343	477.00	6	PVC	140.0	Open	17.21	148.21	148.20	0.02	0.04
P-344	221.00	6	PVC	140.0	Open	7.17	148.20	148.19	0.15e-2	0.01
P-345	682.00	8	PVC	140.0	Open	14.34	148.22	148.21	0.42e-2	0.01
P-346	140.00	4	PVC	140.0	Open	14.34	148.21	148.19	0.03	0.18
P-347	287.00	12	PVC	140.0	Open	-1,237.82	150.09	151.04	0.95	3.30

Steady State Analysis
Pipe Report

Link Label	Length (ft)	Diameter (in)	Material	Roughness	Current Status	Discharge (gpm)	Start Hydraulic Grade (ft)	End Hydraulic Grade (ft)	Headloss (ft)	Friction Slope (ft/1000ft)
P-348	271.00	12	PVC	140.0	Open	-1,252.16	151.04	151.95	0.91	3.37
P-349	282.00	12	PVC	140.0	Open	-1,290.16	151.95	152.96	1.01	3.56
P-350	394.00	12	PVC	140.0	Open	-1,364.73	152.96	154.52	1.56	3.95
P-351	856.00	8	PVC	140.0	Open	24.38	151.95	151.94	0.01	0.02
P-352	843.00	8	PVC	140.0	Open	68.11	152.96	152.86	0.09	0.11
P-353	311.00	4	PVC	140.0	Open	21.51	152.86	152.74	0.12	0.39
P-354	276.00	12	PVC	140.0	Open	-1,382.66	154.52	155.63	1.12	4.05
P-355	1,014.00	12	PVC	140.0	Open	-1,404.17	155.63	159.86	4.23	4.17
P-356	429.00	12	PVC	140.0	Open	-1,445.75	159.86	161.75	1.89	4.40
P-357	398.00	12	PVC	140.0	Open	-1,481.60	161.75	163.58	1.83	4.60
P-358	652.00	6	PVC	140.0	Open	18.64	159.86	159.83	0.03	0.04
P-359	112.00	8	PVC	140.0	Open	18.64	159.83	159.83	0.11e-2	0.01
P-360	452.00	12	PVC	140.0	Open	-1,497.38	163.58	165.70	2.12	4.69
P-361	590.00	12	PVC	140.0	Open	-1,518.17	165.70	168.54	2.84	4.82
P-362	244.00	12	PVC	140.0	Open	-1,549.00	168.54	169.76	1.22	5.00
P-363	456.00	12	PVC	140.0	Open	-1,549.00	169.76	172.04	2.28	5.00
P-364	162.00	8	PVC	140.0	Open	0.00	165.70	165.70	0.00	0.00
P-365	669.00	6	PVC	140.0	Open	0.00	165.70	165.70	0.00	0.00
P-367	113.00	4	PVC	140.0	Open	10.76	161.75	161.73	0.01	0.11
P-368	1,926.00	12	PVC	140.0	Open	-1,549.00	172.04	181.67	9.63	5.00
P-369	764.00	16	Ductile Iron	130.0	Open	1,596.07	181.67	180.53	1.14	1.49
P-370	438.00	10	PVC	140.0	Open	-63.24	180.53	180.54	0.01	0.03
P-371	167.00	10	PVC	140.0	Open	-124.90	180.54	180.56	0.02	0.12
P-372	1,172.00	6	PVC	140.0	Open	-70.45	180.56	181.13	0.56	0.48
P-374	555.00	6	PVC	140.0	Open	22.79	180.28	180.24	0.03	0.06
P-375	184.00	6	PVC	140.0	Open	-11.62	180.24	180.25	0.32e-2	0.02
P-376	680.00	6	PVC	140.0	Open	61.66	180.54	180.29	0.26	0.38
P-377	198.00	6	PVC	140.0	Open	22.79	180.29	180.28	0.01	0.06
P-378	611.00	6	PVC	140.0	Open	-24.53	180.25	180.29	0.04	0.07
P-379	186.00	6	PVC	140.0	Open	-24.38	179.96	179.98	0.01	0.07
P-380	948.00	6	PVC	140.0	Open	-47.32	179.98	180.19	0.22	0.23
P-381	231.00	6	PVC	140.0	Open	-55.21	180.19	180.26	0.07	0.31
P-382	778.00	6	PVC	140.0	Open	-62.38	180.26	180.56	0.30	0.38
P-383	918.00	6	PVC	140.0	Open	-90.53	181.13	181.83	0.70	0.76
P-385	647.00	6	PVC	140.0	Open	141.21	181.69	180.56	1.13	1.74
P-386	609.00	6	PVC	140.0	Open	-25.66	181.69	181.73	0.05	0.07
P-387	357.00	6	PVC	140.0	Open	-27.10	181.73	181.76	0.03	0.08
P-388	170.00	10	PVC	140.0	Open	230.11	181.83	181.77	0.06	0.36
P-389	573.00	10	PVC	140.0	Open	137.05	181.77	181.69	0.08	0.14
P-390	570.00	10	PVC	140.0	Open	-27.10	181.76	181.77	0.39e-2	0.01
P-391	292.00	8	PVC	140.0	Open	-320.64	181.83	182.40	0.57	1.95
P-392	915.00	6	PVC	140.0	Open	-62.52	182.40	182.75	0.35	0.39
P-393	149.00	8	PVC	140.0	Open	-74.71	182.75	182.77	0.02	0.13
P-394	632.00	8	PVC	140.0	Open	108.50	182.77	182.60	0.17	0.26
P-395	278.00	8	PVC	140.0	Open	108.50	182.60	182.53	0.07	0.26
P-396	465.00	8	PVC	140.0	Open	-9.59	182.53	182.53	0.14e-2	0.3e-2
P-397	146.00	6	PVC	140.0	Open	46.21	182.53	182.50	0.03	0.22
P-398	462.00	6	PVC	140.0	Open	46.21	182.50	182.40	0.10	0.22
P-399	871.00	20	Ductile Iron	130.0	Open	-3,145.07	181.67	183.21	1.54	1.77
P-401	291.00	8	PVC	140.0	Open	-93.82	182.53	182.59	0.06	0.20
P-402	289.00	6	PVC	140.0	Open	0.00	182.59	182.59	0.00	0.00
P-403	457.00	8	PVC	140.0	Open	55.80	182.59	182.55	0.04	0.08

Steady State Analysis
Pipe Report

Link Label	Length (ft)	Diameter (in)	Material	Roughness	Current Status	Discharge (gpm)	Start Hydraulic Grade (ft)	End Hydraulic Grade (ft)	Headloss (ft)	Friction Slope (ft/1000ft)
P-404	776.00	8	PVC	140.0	Open	0.00	182.55	182.55	0.00	0.00
P-405	127.00	8	PVC	140.0	Open	0.00	182.55	182.55	0.00	0.00
P-406	286.00	8	PVC	140.0	Open	-55.80	182.53	182.55	0.02	0.08
P-407	1,674.00	8	PVC	140.0	Open	-181.17	182.59	183.73	1.14	0.68
P-408	337.00	8	PVC	140.0	Open	-2.87	187.97	187.97	0.11e-3	0.32e-3
P-409	427.00	8	PVC	140.0	Open	-408.12	187.97	189.27	1.30	3.05
P-410	981.00	8	PVC	140.0	Open	400.23	187.97	185.08	2.89	2.95
P-411	364.00	8	PVC	140.0	Open	198.99	185.08	184.78	0.29	0.81
P-412	708.00	8	PVC	140.0	Open	196.12	184.78	184.23	0.56	0.79
P-413	105.00	8	PVC	140.0	Open	2.15	183.21	183.21	0.15e-4	0.15e-3
P-414	560.00	8	PVC	140.0	Open	195.40	183.21	182.77	0.44	0.78
P-415	1,329.00	8	PVC	140.0	Open	193.25	184.23	183.21	1.02	0.77
P-416	1,043.00	8	PVC	140.0	Open	196.22	185.08	184.26	0.82	0.79
P-418	704.00	8	PVC	140.0	Open	191.21	184.26	183.73	0.53	0.75
P-419	562.00	8	PVC	140.0	Open	5.02	183.73	183.73	0.5e-3	0.9e-3
P-426	248.00	12	PVC	140.0	Open	1,542.44	153.12	151.89	1.23	4.96
P-427	984.00	12	PVC	140.0	Open	1,542.44	151.89	147.01	4.88	4.96
P-430	113.00	12	PVC	140.0	Open	-336.77	143.23	143.27	0.03	0.30
P-436	2,758.00	8	PVC	140.0	Open	647.09	143.23	123.48	19.76	7.16
P-437	278.00	12	Ductile Iron	130.0	Open	3,384.40	150.00	143.23	6.77	24.34
P-439	683.00	6	PVC	140.0	Open	-123.01	124.34	125.26	0.92	1.35
P-440	249.00	6	PVC	140.0	Open	-61.35	125.26	125.36	0.09	0.37
P-441	910.00	6	PVC	140.0	Open	-97.91	125.36	126.16	0.80	0.88
P-442	249.00	6	PVC	140.0	Open	-123.01	126.16	126.50	0.34	1.35
P-443	204.00	8	PVC	140.0	Open	-268.56	126.50	126.78	0.29	1.41
P-444	1,262.00	8	PVC	140.0	Open	-337.39	126.78	129.49	2.71	2.15
P-445	910.00	6	PVC	140.0	Open	-123.33	125.26	126.50	1.23	1.35
P-446	242.00	6	PVC	140.0	Open	-12.14	124.01	124.01	0.45e-2	0.02
P-447	247.00	6	PVC	140.0	Open	-123.01	124.01	124.34	0.33	1.35
P-448	655.00	8	PVC	140.0	Open	-110.87	123.83	124.01	0.18	0.27
P-449	146.00	8	PVC	140.0	Open	-211.90	182.40	182.53	0.13	0.91
P-450	672.00	8	PVC	140.0	Open	-207.04	110.23	110.82	0.58	0.87
P-451	166.00	8	PVC	140.0	Open	-15.94	110.23	110.23	0.13e-2	0.01
P-453	189.00	6	PVC	140.0	Open	-20.70	109.84	109.85	0.01	0.05
P-454	725.00	6	PVC	140.0	Open	-10.21	109.85	109.86	0.01	0.01
P-455	429.00	12	PVC	140.0	Open	-743.45	143.27	143.82	0.55	1.29
P-456	980.00	12	PVC	140.0	Open	-608.46	143.82	144.69	0.87	0.89
P-460	660.00	8	PVC	140.0	Open	191.09	110.23	109.74	0.50	0.75
P-462	691.00	8	PVC	140.0	Open	-140.53	109.82	110.12	0.29	0.42
P-464	622.00	8	PVC	140.0	Open	96.38	109.99	109.86	0.13	0.21
P-477	1,115.00	12	PVC	140.0	Open	-190.01	144.20	144.32	0.11	0.10
P-479	519.00	12	PVC	140.0	Open	-246.37	144.32	144.40	0.09	0.17
P-483	197.00	12	PVC	140.0	Open	60.94	153.12	153.12	0.25e-2	0.01
P-488	400.00	12	PVC	140.0	Open	-94.51	144.47	144.48	0.01	0.03
P-489	331.00	12	PVC	140.0	Open	-94.51	144.48	144.49	0.01	0.03
P-491	952.00	8	PVC	140.0	Open	928.95	147.01	133.70	13.31	13.98
P-492	372.00	8	PVC	140.0	Open	912.46	133.70	128.67	5.03	13.53
P-493	239.00	8	PVC	140.0	Open	895.97	128.67	125.54	3.13	13.08
P-494	545.00	8	PVC	140.0	Open	881.63	125.54	118.62	6.92	12.69
P-496	202.00	8	PVC	140.0	Open	-719.59	89.88	91.64	1.76	8.72
P-497	592.00	8	PVC	140.0	Open	-719.59	91.64	96.80	5.16	8.72
P-499	1,016.00	6	PVC	140.0	Open	-30.78	78.69	78.80	0.11	0.10

Steady State Analysis
Pipe Report

Link Label	Length (ft)	Diameter (in)	Material	Roughness	Current Status	Discharge (gpm)	Start Hydraulic Grade (ft)	End Hydraulic Grade (ft)	Headloss (ft)	Friction Slope (ft/1000ft)
P-500	170.00	8	PVC	140.0	Open	-87.41	78.80	78.83	0.03	0.18
P-501	1,205.00	8	PVC	140.0	Open	64.51	78.83	78.71	0.12	0.10
P-502	415.00	6	PVC	140.0	Open	26.23	78.71	78.68	0.03	0.08
P-503	317.00	6	PVC	140.0	Open	11.18	78.68	78.67	0.01	0.02
P-504	1,092.00	6	PVC	140.0	Open	-1.01	78.67	78.67	0.21e-3	0.19e-3
P-505	243.00	6	PVC	140.0	Open	-28.98	78.67	78.69	0.02	0.09
P-506	253.00	8	PVC	140.0	Open	11.03	78.71	78.71	0.97e-3	0.38e-2
P-507	644.00	8	PVC	140.0	Open	27.50	78.71	78.69	0.01	0.02
P-508	351.00	6	PVC	140.0	Open	-22.21	78.71	78.73	0.02	0.06
P-509	307.00	4	PVC	140.0	Open	0.72	78.73	78.73	0.21e-3	0.7e-3
P-510	638.00	6	PVC	140.0	Open	-32.25	78.73	78.80	0.07	0.11
P-511	233.00	4	PVC	140.0	Open	5.74	78.68	78.67	0.01	0.03
P-513	771.00	16	Ductile Iron	130.0	Open	4,043.26	180.00	173.58	6.42	8.33
P-514	2,929.00	12	PVC	140.0	Open	-1,603.38	153.12	168.73	15.61	5.33
P-518	508.00	12	PVC	140.0	Open	-723.32	145.57	146.19	0.62	1.22
P-519	725.00	12	PVC	140.0	Open	-1,148.20	146.19	148.27	2.08	2.87
P-521	2,326.00	12	PVC	140.0	Open	-110.83	144.48	144.56	0.09	0.04
P-523	1,353.00	12	PVC	140.0	Open	-300.12	144.56	144.89	0.32	0.24
P-524	2,851.00	12	PVC	140.0	Open	-424.87	144.89	146.19	1.30	0.46
P-526	2,053.00	12	PVC	140.0	Open	-112.42	144.47	144.55	0.08	0.04
P-527	1,405.00	10	PVC	140.0	Open	91.62	144.47	144.38	0.09	0.06
P-528	1,371.00	8	PVC	140.0	Open	-53.47	144.38	144.48	0.10	0.07
P-529	1,010.00	8	PVC	140.0	Open	21.03	144.40	144.38	0.01	0.01
P-530	718.00	10	PVC	140.0	Open	24.12	144.38	144.38	0.39e-2	0.01
P-531	2,357.00	10	PVC	140.0	Open	-61.88	144.38	144.46	0.07	0.03
P-533	1,465.00	12	PVC	140.0	Open	478.24	145.38	144.55	0.83	0.57
P-534	1,268.00	12	PVC	140.0	Open	-1,696.10	150.05	157.55	7.50	5.91
P-535	2,466.00	12	PVC	140.0	Open	-1,012.44	157.55	163.16	5.61	2.28
P-536	1,171.00	12	PVC	140.0	Open	-688.67	157.55	158.85	1.31	1.12
P-537	1,380.00	12	PVC	140.0	Open	-834.23	158.85	161.05	2.20	1.59
P-538	1,858.00	8	PVC	140.0	Open	6.89	144.32	144.31	0.29e-2	0.16e-2
P-539	937.00	12	PVC	140.0	Open	886.75	147.97	146.30	1.67	1.78
P-540	892.00	12	PVC	140.0	Open	658.27	146.30	145.38	0.92	1.03
P-541	2,017.00	8	PVC	140.0	Open	-221.30	144.31	146.30	1.98	0.98
P-542	962.00	8	PVC	140.0	Open	-114.07	144.40	144.68	0.28	0.29
P-543	1,127.00	8	PVC	140.0	Open	-172.86	144.68	145.38	0.70	0.62
P-544	659.00	12	PVC	140.0	Open	-133.02	144.40	144.44	0.04	0.05
P-545	664.00	12	PVC	140.0	Open	-248.46	144.44	144.55	0.11	0.17
P-546	1,518.00	12	PVC	140.0	Open	46.60	144.32	144.30	0.01	0.01
P-547	2,414.00	12	PVC	140.0	Open	41.59	144.30	144.29	0.01	0.01
P-550	2,642.00	8	PVC	140.0	Open	0.00	144.30	144.30	0.00	0.00
P-552	649.00	12	PVC	140.0	Open	-199.52	144.13	144.20	0.07	0.11
P-554	1,512.00	12	PVC	140.0	Open	-194.50	143.97	144.13	0.16	0.11
P-555	1,676.00	12	PVC	140.0	Open	110.42	143.97	143.90	0.06	0.04
P-556	814.00	12	PVC	140.0	Open	68.83	143.90	143.89	0.01	0.02
P-557	1,208.00	12	PVC	140.0	Open	65.25	143.89	143.87	0.02	0.01
P-560	1,150.00	12	PVC	140.0	Open	65.25	143.87	143.86	0.02	0.01
P-561	367.00	8	PVC	140.0	Open	-115.93	146.58	146.69	0.11	0.30
P-562	566.00	8	PVC	140.0	Open	-138.88	146.69	146.93	0.24	0.42
P-563	601.00	8	PVC	140.0	Open	-90.63	146.93	147.04	0.11	0.19
P-564	1,399.00	8	PVC	140.0	Open	-71.20	146.93	147.09	0.17	0.12
P-565	399.00	8	PVC	140.0	Open	-94.14	147.09	147.18	0.08	0.20

Steady State Analysis
Pipe Report

Link Label	Length (ft)	Diameter (in)	Material	Roughness	Current Status	Discharge (gpm)	Start Hydraulic Grade (ft)	End Hydraulic Grade (ft)	Headloss (ft)	Friction Slope (ft/1000ft)
P-566	1,560.00	12	PVC	140.0	Open	-68.83	143.97	143.99	0.02	0.02
P-567	2,155.00	12	PVC	140.0	Open	-185.70	143.99	144.20	0.21	0.10
P-568	1,723.00	12	PVC	140.0	Open	14.53	144.20	144.20	0.15e-2	0.88e-3
P-569	782.00	12	PVC	140.0	Open	-225.32	144.20	144.31	0.11	0.14
P-570	117.00	12	PVC	140.0	Open	-152.91	143.82	143.83	0.01	0.07
P-575	1,159.00	12	PVC	140.0	Open	-152.91	143.83	143.91	0.08	0.07
P-576	862.00	12	PVC	140.0	Open	-152.91	143.91	143.97	0.06	0.07
P-578	1,482.00	12	PVC	140.0	Open	-1,864.48	123.48	133.92	10.44	7.04
P-579	1,278.00	12	PVC	140.0	Open	-1,899.61	133.92	143.23	9.32	7.29
P-580	1,376.00	12	PVC	140.0	Open	-610.62	144.69	145.92	1.23	0.89
P-581	1,226.00	12	PVC	140.0	Open	-610.62	145.92	147.01	1.10	0.89
P-583	661.00	8	PVC	140.0	Open	-881.63	110.23	118.62	8.39	12.69
P-584	506.00	8	PVC	140.0	Open	-725.33	96.80	101.27	4.48	8.85
P-585	998.00	8	PVC	140.0	Open	-731.06	101.27	110.23	8.96	8.98
P-586	874.00	12	Ductile Iron	130.0	Open	-750.11	87.43	88.74	1.31	1.50
P-587	684.00	12	Ductile Iron	140.0	Open	-762.30	88.74	89.66	0.92	1.35
P-592	880.00	12	PVC	140.0	Open	779.71	90.90	89.66	1.24	1.40
P-594	1,230.00	12	PVC	140.0	Open	794.77	92.69	90.90	1.79	1.45
P-595	478.00	8	PVC	140.0	Open	48.16	81.65	81.62	0.03	0.06
P-596	519.00	8	PVC	140.0	Open	-157.31	81.62	81.89	0.27	0.52
P-597	2,036.00	8	PVC	140.0	Open	205.47	81.62	79.87	1.75	0.86
P-598	995.00	8	PVC	140.0	Open	-4.29	79.87	79.87	0.66e-3	0.67e-3
P-599	840.00	8	PVC	140.0	Open	-250.25	79.87	80.91	1.04	1.24
P-602	5,720.00	16	Ductile Iron	130.0	Open	-1,603.38	168.73	177.34	8.61	1.51
P-603	1,989.00	16	Ductile Iron	130.0	Open	-1,659.31	177.34	180.53	3.19	1.60
P-605	230.00	8	PVC	140.0	Open	-636.45	88.20	89.80	1.60	6.95
P-606	343.00	8	PVC	140.0	Open	-71.32	89.80	89.84	0.04	0.12
P-607	434.00	8	PVC	140.0	Open	-565.13	89.80	92.22	2.42	5.58
P-608	1,642.00	12	PVC	140.0	Open	1,377.11	100.00	93.39	6.60	4.02
P-609	467.00	12	PVC	140.0	Open	811.98	93.39	92.69	0.71	1.51
P-610	210.00	8	PVC	140.0	Open	-565.13	92.22	93.39	1.17	5.58
P-611	646.00	8	PVC	140.0	Open	375.86	91.66	89.97	1.69	2.62
P-612	156.00	12	Ductile Iron	130.0	Open	17.42	89.66	89.66	0.22e-3	0.14e-2
P-613	1,006.00	8	PVC	140.0	Open	-91.57	79.52	79.72	0.19	0.19
P-614	816.00	8	PVC	140.0	Open	-91.57	79.72	79.87	0.16	0.19
P-615	792.00	8	PVC	140.0	Open	-164.11	78.83	79.28	0.45	0.57
P-616	1,056.00	8	PVC	140.0	Open	81.97	79.87	79.71	0.17	0.16
P-617	757.00	8	PVC	140.0	Open	164.11	79.71	79.28	0.43	0.57
P-618	1,048.00	8	PVC	140.0	Open	-82.13	79.71	79.87	0.16	0.16
P-619	1,200.00	12	PVC	140.0	Open	1,174.47	143.23	139.64	3.59	3.00
P-620	1,209.00	20	Ductile Iron	130.0	Open	3,147.22	190.00	187.86	2.14	1.77
P-621	2,632.00	20	Ductile Iron	130.0	Open	3,147.22	187.86	183.21	4.65	1.77
P-622	236.00	8	PVC	140.0	Open	410.98	190.00	189.27	0.73	3.09
P-657	658.00	8	PVC	140.0	Open	10.76	161.75	161.75	0.24e-2	0.37e-2

Steady State Analysis
Reservoir Report

Node Label	Reservoir Surface Elevation (ft)	Reservoir Inflow (gpm)	Hydraulic Grade (ft)
R-1	150.00	-3,013.53	150.00
R-2	185.00	-3,982.21	185.00
R-3	180.00	-3,990.14	180.00

Steady State Analysis
Junction Report

Node Label	Elevation (ft)	Demand Type	Demand (gpm)	Demand Pattern	Calculated Demand (gpm)	Hydraulic Grade (ft)	Pressure (psi)
J-1	24.00	Demand	27.25	Fixed	27.25	118.89	41.04
J-2	24.00	Demand	15.06	Fixed	15.06	118.88	41.03
J-3	24.00	Demand	184.99	Fixed	184.99	118.87	41.03
J-4	25.00	Demand	190.01	Fixed	190.01	119.70	40.95
J-5	25.00	Demand	252.38	Fixed	252.38	121.76	41.84
J-6	25.00	Demand	155.59	Fixed	155.59	123.83	42.74
J-7	24.00	Demand	0.00	Fixed	0.00	126.17	44.18
J-8	24.00	Demand	19.36	Fixed	19.36	122.22	42.47
J-9	23.00	Demand	24.38	Fixed	24.38	122.73	43.13
J-10	23.00	Demand	56.64	Fixed	56.64	126.38	44.71
J-11	22.00	Demand	0.00	Fixed	0.00	127.30	45.53
J-12	24.00	Demand	22.94	Fixed	22.94	121.80	42.29
J-13	24.00	Demand	106.83	Fixed	106.83	121.17	42.02
J-14	24.00	Demand	14.34	Fixed	14.34	122.00	42.38
J-17	23.00	Demand	81.02	Fixed	81.02	122.39	42.98
J-18	23.00	Demand	48.76	Fixed	48.76	122.78	43.15
J-19	20.00	Demand	64.53	Fixed	64.53	124.56	45.22
J-20	21.00	Demand	173.51	Fixed	173.51	125.50	45.19
J-21	22.00	Demand	2.15	Fixed	2.15	128.89	46.22
J-22	22.00	Demand	0.00	Fixed	0.00	131.86	47.51
J-23	22.00	Demand	2.15	Fixed	2.15	126.86	45.35
J-26	22.00	Demand	0.00	Fixed	0.00	127.08	45.44
J-27	21.00	Demand	21.51	Fixed	21.51	126.84	45.77
J-28	20.00	Demand	0.00	Fixed	0.00	126.79	46.18
J-29	20.00	Demand	25.09	Fixed	25.09	126.75	46.16
J-30	20.00	Demand	30.11	Fixed	30.11	126.65	46.12
J-31	21.00	Demand	17.21	Fixed	17.21	126.59	45.66
J-32	21.00	Demand	31.55	Fixed	31.55	126.57	45.65
J-33	21.00	Demand	0.00	Fixed	0.00	126.95	45.82
J-34	20.00	Demand	0.00	Fixed	0.00	127.78	46.61
J-35	22.00	Demand	48.76	Fixed	48.76	127.61	45.67
J-36	23.00	Demand	55.21	Fixed	55.21	126.68	44.84
J-37	23.00	Demand	20.08	Fixed	20.08	126.60	44.80
J-38	22.00	Demand	49.47	Fixed	49.47	126.37	45.13
J-39	22.00	Demand	26.53	Fixed	26.53	126.27	45.09
J-40	24.00	Demand	25.09	Fixed	25.09	126.17	44.18
J-41	23.00	Demand	0.00	Fixed	0.00	126.13	44.60
J-42	23.00	Demand	42.30	Fixed	42.30	126.13	44.60
J-43	23.00	Demand	12.91	Fixed	12.91	126.15	44.60
J-44	24.00	Demand	56.64	Fixed	56.64	126.15	44.17
J-45	23.00	Demand	49.47	Fixed	49.47	126.37	44.70
J-46	23.00	Demand	15.06	Fixed	15.06	126.36	44.70
J-47	21.00	Demand	31.55	Fixed	31.55	126.52	45.63
J-48	22.00	Demand	0.00	Fixed	0.00	126.48	45.18
J-49	23.00	Demand	0.00	Fixed	0.00	126.23	44.64
J-50	23.00	Demand	0.00	Fixed	0.00	126.22	44.64
J-51	23.00	Demand	76.72	Fixed	76.72	126.21	44.63
J-52	23.00	Demand	15.06	Fixed	15.06	126.21	44.63
J-53	24.00	Demand	0.00	Fixed	0.00	126.17	44.18
J-54	23.00	Demand	25.09	Fixed	25.09	126.90	44.93
J-55	21.00	Demand	0.00	Fixed	0.00	126.54	45.64
J-56	22.00	Demand	0.00	Fixed	0.00	126.54	45.21
J-57	24.00	Demand	121.17	Fixed	121.17	126.53	44.34

Steady State Analysis
Junction Report

Node Label	Elevation (ft)	Demand Type	Demand (gpm)	Demand Pattern	Calculated Demand (gpm)	Hydraulic Grade (ft)	Pressure (psi)
J-58	23.00	Demand	22.23	Fixed	22.23	126.63	44.81
J-59	23.00	Demand	27.25	Fixed	27.25	126.65	44.82
J-60	20.00	Demand	0.00	Fixed	0.00	126.63	46.11
J-61	20.00	Demand	0.00	Fixed	0.00	126.77	46.17
J-62	24.00	Demand	0.00	Fixed	0.00	126.55	44.34
J-63	23.00	Demand	0.00	Fixed	0.00	126.77	44.87
J-64	21.00	Demand	0.00	Fixed	0.00	126.97	45.83
J-65	23.00	Demand	86.76	Fixed	86.76	127.21	45.06
J-66	22.00	Demand	14.34	Fixed	14.34	128.38	46.00
J-67	22.00	Demand	30.11	Fixed	30.11	128.03	45.85
J-68	22.00	Demand	14.34	Fixed	14.34	126.29	45.10
J-69	22.00	Demand	25.09	Fixed	25.09	126.25	45.08
J-70	24.00	Demand	79.59	Fixed	79.59	125.94	44.08
J-71	23.00	Demand	38.72	Fixed	38.72	125.98	44.53
J-73	24.00	Demand	0.00	Fixed	0.00	132.60	46.96
J-74	24.00	Demand	72.42	Fixed	72.42	132.19	46.79
J-75	24.00	Demand	0.00	Fixed	0.00	132.03	46.72
J-76	24.00	Demand	19.36	Fixed	19.36	131.25	46.38
J-77	23.00	Demand	45.17	Fixed	45.17	131.26	46.81
J-78	23.00	Demand	16.49	Fixed	16.49	131.34	46.85
J-79	23.00	Demand	19.36	Fixed	19.36	131.63	46.98
J-80	24.00	Demand	42.30	Fixed	42.30	131.93	46.67
J-81	24.00	Demand	0.00	Fixed	0.00	131.94	46.68
J-82	23.00	Demand	0.00	Fixed	0.00	132.19	47.22
J-83	24.00	Demand	73.85	Fixed	73.85	132.33	46.85
J-84	22.00	Demand	17.93	Fixed	17.92	131.28	47.26
J-85	24.00	Demand	22.23	Fixed	22.23	131.26	46.38
J-86	23.00	Demand	17.93	Fixed	17.92	131.62	46.97
J-88	24.00	Demand	76.72	Fixed	76.72	131.65	46.55
J-89	24.00	Demand	24.38	Fixed	24.38	131.78	46.61
J-90	24.00	Demand	32.98	Fixed	32.98	131.63	46.54
J-91	25.00	Demand	32.27	Fixed	32.26	132.68	46.57
J-92	24.00	Demand	43.02	Fixed	43.02	132.67	46.99
J-93	20.00	Demand	0.00	Fixed	0.00	134.03	49.31
J-94	24.00	Demand	0.00	Fixed	0.00	131.16	46.34
J-95	22.00	Demand	0.00	Fixed	0.00	131.23	47.23
J-96	21.00	Demand	8.60	Fixed	8.60	133.50	48.65
J-98	21.00	Demand	0.00	Fixed	0.00	136.13	49.79
J-99	23.00	Demand	0.00	Fixed	0.00	144.24	52.43
J-100	23.00	Demand	0.00	Fixed	0.00	143.90	52.28
J-101	24.00	Demand	229.44	Fixed	229.44	142.06	51.05
J-102	23.00	Demand	133.36	Fixed	133.36	138.54	49.96
J-103	24.00	Demand	50.19	Fixed	50.19	137.62	49.13
J-104	23.00	Demand	238.04	Fixed	238.04	135.70	48.74
J-105	20.00	Demand	61.66	Fixed	61.66	135.64	50.01
J-106	21.00	Demand	73.85	Fixed	73.85	135.64	49.57
J-107	22.00	Demand	215.10	Fixed	215.10	135.92	49.26
J-108	21.00	Demand	0.00	Fixed	0.00	136.01	49.74
J-109	23.00	Demand	50.19	Fixed	50.19	138.93	50.13
J-110	23.00	Demand	182.83	Fixed	182.84	138.90	50.12
J-111	23.00	Demand	173.51	Fixed	173.51	140.44	50.78
J-112	23.00	Demand	119.02	Fixed	119.02	136.91	49.26
J-113	25.00	Demand	0.00	Fixed	0.00	140.40	49.90

Steady State Analysis
Junction Report

Node Label	Elevation (ft)	Demand Type	Demand (gpm)	Demand Pattern	Calculated Demand (gpm)	Hydraulic Grade (ft)	Pressure (psi)
J-114	24.00	Demand	162.04	Fixed	162.04	144.04	51.91
J-115	23.00	Demand	0.00	Fixed	0.00	140.40	50.77
J-116	25.00	Demand	306.88	Fixed	306.88	140.40	49.90
J-117	24.00	Demand	0.00	Fixed	0.00	141.86	50.97
J-118	24.00	Demand	9.32	Fixed	9.32	141.91	50.99
J-119	24.00	Demand	10.76	Fixed	10.76	142.46	51.23
J-120	23.00	Demand	58.79	Fixed	58.79	142.89	51.85
J-121	23.00	Demand	0.00	Fixed	0.00	147.32	53.76
J-122	23.00	Demand	88.91	Fixed	88.91	143.90	52.28
J-123	23.00	Demand	193.59	Fixed	193.59	146.56	53.43
J-124	23.00	Demand	0.00	Fixed	0.00	147.46	53.82
J-125	22.00	Demand	5.02	Fixed	5.02	147.52	54.28
J-126	23.00	Demand	5.02	Fixed	5.02	147.54	53.86
J-127	22.00	Demand	5.02	Fixed	5.02	147.62	54.32
J-128	22.00	Demand	0.00	Fixed	0.00	151.01	55.79
J-129	22.00	Demand	36.57	Fixed	36.57	150.28	55.47
J-130	22.00	Demand	24.38	Fixed	24.38	150.04	55.37
J-131	22.00	Demand	40.15	Fixed	40.15	149.54	55.15
J-132	23.00	Demand	26.53	Fixed	26.53	149.29	54.61
J-133	21.00	Demand	14.34	Fixed	14.34	148.47	55.12
J-134	23.00	Demand	21.51	Fixed	21.51	148.01	54.06
J-135	21.00	Demand	29.40	Fixed	29.40	147.87	54.86
J-136	22.00	Demand	26.53	Fixed	26.53	148.36	54.64
J-137	23.00	Demand	27.25	Fixed	27.25	149.51	54.71
J-138	21.00	Demand	19.36	Fixed	19.36	148.43	55.10
J-139	21.00	Demand	46.61	Fixed	46.60	148.34	55.06
J-140	21.00	Demand	12.19	Fixed	12.19	148.34	55.06
J-141	22.00	Demand	15.06	Fixed	15.06	147.91	54.45
J-142	22.00	Demand	15.06	Fixed	15.06	147.88	54.43
J-143	23.00	Demand	35.13	Fixed	35.13	147.86	53.99
J-144	23.00	Demand	0.00	Fixed	0.00	147.96	54.04
J-145	23.00	Demand	0.00	Fixed	0.00	148.34	54.20
J-146	23.00	Demand	44.45	Fixed	44.45	157.06	57.97
J-147	22.00	Demand	0.00	Fixed	0.00	163.48	61.18
J-148	23.00	Demand	76.00	Fixed	76.00	173.69	65.16
J-149	23.00	Demand	0.00	Fixed	0.00	168.85	63.07
J-150	23.00	Demand	43.02	Fixed	43.02	161.40	59.85
J-151	23.00	Demand	0.00	Fixed	0.00	157.44	58.13
J-152	23.00	Demand	27.25	Fixed	27.25	156.85	57.88
J-153	24.00	Demand	16.49	Fixed	16.49	156.83	57.44
J-154	22.00	Demand	7.17	Fixed	7.17	156.80	58.29
J-155	22.00	Demand	0.00	Fixed	0.00	168.24	63.24
J-156	21.00	Demand	0.00	Fixed	0.00	163.59	61.66
J-157	22.00	Demand	0.00	Fixed	0.00	163.13	61.03
J-158	22.00	Demand	0.00	Fixed	0.00	162.18	60.62
J-159	21.00	Demand	0.00	Fixed	0.00	161.14	60.60
J-160	21.00	Demand	0.00	Fixed	0.00	158.45	59.44
J-161	22.00	Demand	34.42	Fixed	34.42	159.12	59.29
J-162	21.00	Demand	58.79	Fixed	58.79	161.23	60.64
J-163	22.00	Demand	24.38	Fixed	24.38	161.13	60.16
J-164	22.00	Demand	10.04	Fixed	10.04	161.12	60.16
J-165	22.00	Demand	9.32	Fixed	9.32	161.12	60.16
J-166	22.00	Demand	22.94	Fixed	22.94	158.57	59.06

Steady State Analysis
Junction Report

Node Label	Elevation (ft)	Demand Type	Demand (gpm)	Demand Pattern	Calculated Demand (gpm)	Hydraulic Grade (ft)	Pressure (psi)
J-167	21.00	Demand	12.91	Fixed	12.91	158.74	59.56
J-168	21.00	Demand	0.00	Fixed	0.00	159.26	59.79
J-169	22.00	Demand	45.17	Fixed	45.17	161.23	60.21
J-170	22.00	Demand	17.93	Fixed	17.92	161.22	60.21
J-171	21.00	Demand	4.30	Fixed	4.30	161.22	60.63
J-172	22.00	Demand	35.13	Fixed	35.13	156.27	58.06
J-173	22.00	Demand	0.00	Fixed	0.00	154.84	57.44
J-174	23.00	Demand	71.70	Fixed	71.70	153.92	56.61
J-175	24.00	Demand	0.00	Fixed	0.00	153.91	56.18
J-176	23.00	Demand	24.38	Fixed	24.38	153.92	56.62
J-177	23.00	Demand	53.78	Fixed	53.78	154.13	56.70
J-178	24.00	Demand	30.11	Fixed	30.11	153.91	56.18
J-179	24.00	Demand	25.09	Fixed	25.09	153.86	56.15
J-180	24.00	Demand	0.00	Fixed	0.00	153.90	56.17
J-181	23.00	Demand	32.98	Fixed	32.98	155.02	57.09
J-182	24.00	Demand	19.36	Fixed	19.36	154.99	56.65
J-183	25.00	Demand	10.04	Fixed	10.04	154.95	56.20
J-184	26.00	Demand	10.04	Fixed	10.04	151.39	54.22
J-185	25.00	Demand	47.32	Fixed	47.32	150.09	54.09
J-186	25.00	Demand	14.34	Fixed	14.34	147.42	52.94
J-187	25.00	Demand	16.49	Fixed	16.49	146.02	52.33
J-188	25.00	Demand	19.36	Fixed	19.36	144.88	51.84
J-189	24.00	Demand	0.72	Fixed	0.72	144.36	52.05
J-190	25.00	Demand	22.23	Fixed	22.23	144.29	51.59
J-191	24.00	Demand	39.43	Fixed	39.44	144.28	52.01
J-192	24.00	Demand	14.34	Fixed	14.34	144.28	52.01
J-193	24.00	Demand	20.08	Fixed	20.08	144.28	52.01
J-194	25.00	Demand	17.93	Fixed	17.92	144.29	51.58
J-195	25.00	Demand	10.04	Fixed	10.04	144.27	51.58
J-196	25.00	Demand	19.36	Fixed	19.36	144.26	51.57
J-197	26.00	Demand	22.23	Fixed	22.23	144.47	51.23
J-198	25.00	Demand	17.21	Fixed	17.21	144.23	51.56
J-199	25.00	Demand	17.21	Fixed	17.21	144.15	51.52
J-200	26.00	Demand	25.09	Fixed	25.09	144.10	51.07
J-201	27.00	Demand	22.23	Fixed	22.23	144.10	50.64
J-202	26.00	Demand	27.96	Fixed	27.96	144.14	51.09
J-203	26.00	Demand	22.94	Fixed	22.94	144.11	51.07
J-204	25.00	Demand	24.38	Fixed	24.38	144.13	51.52
J-205	26.00	Demand	10.76	Fixed	10.76	144.16	51.10
J-206	25.00	Demand	14.34	Fixed	14.34	144.14	51.52
J-207	26.00	Demand	0.00	Fixed	0.00	144.14	51.09
J-208	26.00	Demand	9.32	Fixed	9.32	144.47	51.23
J-209	25.00	Demand	12.19	Fixed	12.19	144.22	51.55
J-210	26.00	Demand	10.04	Fixed	10.04	144.19	51.11
J-211	25.00	Demand	10.76	Fixed	10.76	144.16	51.53
J-212	33.00	Demand	0.00	Fixed	0.00	144.09	48.04
J-213	33.00	Demand	0.00	Fixed	0.00	144.07	48.03
J-214	33.00	Demand	0.00	Fixed	0.00	144.09	48.04
J-215	32.00	Demand	27.25	Fixed	27.25	144.04	48.45
J-216	32.00	Demand	10.04	Fixed	10.04	144.03	48.45
J-217	33.00	Demand	24.38	Fixed	24.38	144.06	48.03
J-218	33.00	Demand	30.11	Fixed	30.11	143.90	47.96
J-219	33.00	Demand	17.93	Fixed	17.92	143.86	47.94

Steady State Analysis
Junction Report

Node Label	Elevation (ft)	Demand Type	Demand (gpm)	Demand Pattern	Calculated Demand (gpm)	Hydraulic Grade (ft)	Pressure (psi)
J-220	34.00	Demand	9.32	Fixed	9.32	144.07	47.60
J-221	34.00	Demand	14.34	Fixed	14.34	144.01	47.57
J-222	35.00	Demand	13.62	Fixed	13.62	143.95	47.11
J-223	34.00	Demand	0.00	Fixed	0.00	144.07	47.60
J-224	34.00	Demand	36.57	Fixed	36.57	144.08	47.60
J-225	35.00	Demand	0.00	Fixed	0.00	144.08	47.17
J-226	35.00	Demand	10.76	Fixed	10.76	144.12	47.19
J-227	35.00	Demand	17.93	Fixed	17.92	144.01	47.14
J-228	34.00	Demand	13.62	Fixed	13.62	144.00	47.57
J-229	34.00	Demand	21.51	Fixed	21.51	144.06	47.59
J-230	35.00	Demand	11.47	Fixed	11.47	144.05	47.16
J-231	34.00	Demand	16.49	Fixed	16.49	144.06	47.59
J-232	35.00	Demand	9.32	Fixed	9.32	144.16	47.20
J-233	34.00	Demand	0.00	Fixed	0.00	144.17	47.64
J-234	34.00	Demand	10.76	Fixed	10.76	144.18	47.64
J-235	35.00	Demand	10.76	Fixed	10.76	144.19	47.22
J-236	34.00	Demand	3.59	Fixed	3.59	144.23	47.67
J-237	35.00	Demand	3.59	Fixed	3.59	144.31	47.27
J-238	34.00	Demand	0.00	Fixed	0.00	144.37	47.73
J-239	33.00	Demand	0.00	Fixed	0.00	144.70	48.30
J-240	34.00	Demand	20.79	Fixed	20.79	144.30	47.70
J-241	34.00	Demand	10.76	Fixed	10.76	144.28	47.69
J-242	34.00	Demand	25.81	Fixed	25.81	144.26	47.68
J-243	34.00	Demand	15.77	Fixed	15.77	144.35	47.72
J-244	35.00	Demand	17.93	Fixed	17.92	144.62	47.40
J-245	33.00	Demand	0.00	Fixed	0.00	144.52	48.23
J-246	35.00	Demand	0.00	Fixed	0.00	144.38	47.30
J-247	35.00	Demand	0.00	Fixed	0.00	144.33	47.28
J-248	35.00	Demand	21.51	Fixed	21.51	144.32	47.27
J-249	34.00	Demand	21.51	Fixed	21.51	144.39	47.73
J-250	33.00	Demand	15.77	Fixed	15.77	144.40	48.17
J-251	34.00	Demand	13.62	Fixed	13.62	144.43	47.75
J-252	33.00	Demand	15.77	Fixed	15.77	144.47	48.20
J-253	34.00	Demand	13.62	Fixed	13.62	144.29	47.69
J-254	33.00	Demand	12.91	Fixed	12.91	144.29	48.12
J-255	34.00	Demand	12.91	Fixed	12.91	144.29	47.69
J-256	33.00	Demand	24.38	Fixed	24.38	144.25	48.11
J-257	34.00	Demand	22.94	Fixed	22.94	144.26	47.68
J-258	34.00	Demand	9.32	Fixed	9.32	144.52	47.79
J-259	35.00	Demand	9.32	Fixed	9.32	144.52	47.36
J-260	35.00	Demand	20.79	Fixed	20.79	144.30	47.27
J-261	35.00	Demand	18.64	Fixed	18.64	144.29	47.26
J-262	34.00	Demand	0.00	Fixed	0.00	144.28	47.69
J-263	34.00	Demand	0.00	Fixed	0.00	144.27	47.68
J-264	35.00	Demand	25.81	Fixed	25.81	144.26	47.25
J-265	34.00	Demand	43.02	Fixed	43.02	144.27	47.69
J-266	35.00	Demand	17.93	Fixed	17.92	144.25	47.24
J-267	34.00	Demand	14.34	Fixed	14.34	144.25	47.67
J-268	34.00	Demand	4.30	Fixed	4.30	146.79	48.77
J-269	33.00	Demand	18.64	Fixed	18.64	148.20	49.82
J-270	33.00	Demand	31.55	Fixed	31.55	146.73	49.18
J-271	33.00	Demand	3.59	Fixed	3.59	146.73	49.18
J-272	34.00	Demand	10.04	Fixed	10.04	146.71	48.74

Steady State Analysis
Junction Report

Node Label	Elevation (ft)	Demand Type	Demand (gpm)	Demand Pattern	Calculated Demand (gpm)	Hydraulic Grade (ft)	Pressure (psi)
J-273	34.00	Demand	7.17	Fixed	7.17	146.71	48.74
J-274	35.00	Demand	0.00	Fixed	0.00	146.73	48.31
J-275	35.00	Demand	14.34	Fixed	14.34	146.70	48.30
J-276	33.00	Demand	14.34	Fixed	14.34	148.94	50.13
J-277	34.00	Demand	13.62	Fixed	13.62	149.65	50.01
J-278	34.00	Demand	6.45	Fixed	6.45	150.44	50.35
J-279	34.00	Demand	17.93	Fixed	17.92	151.69	50.89
J-280	34.00	Demand	24.38	Fixed	24.38	149.64	50.01
J-281	34.00	Demand	46.61	Fixed	46.60	150.35	50.31
J-282	33.00	Demand	21.51	Fixed	21.51	150.23	50.69
J-283	34.00	Demand	21.51	Fixed	21.51	152.58	51.28
J-284	34.00	Demand	22.94	Fixed	22.94	155.98	52.75
J-285	35.00	Demand	25.09	Fixed	25.09	157.51	52.98
J-286	36.00	Demand	15.77	Fixed	15.77	159.00	53.19
J-287	34.00	Demand	0.00	Fixed	0.00	155.96	52.74
J-288	34.00	Demand	18.64	Fixed	18.64	155.96	52.74
J-289	36.00	Demand	20.79	Fixed	20.79	160.73	53.94
J-290	37.00	Demand	30.83	Fixed	30.83	163.06	54.51
J-291	38.00	Demand	0.00	Fixed	0.00	164.06	54.51
J-292	38.00	Demand	0.00	Fixed	0.00	165.94	55.32
J-293	36.00	Demand	0.00	Fixed	0.00	160.73	53.94
J-294	38.00	Demand	0.00	Fixed	0.00	160.73	53.07
J-295	34.00	Demand	0.00	Fixed	0.00	157.51	53.41
J-296	34.00	Demand	10.76	Fixed	10.76	157.50	53.40
J-297	38.00	Demand	0.00	Fixed	0.00	173.85	58.74
J-298	38.00	Demand	0.00	Fixed	0.00	172.03	57.96
J-299	39.00	Demand	0.00	Fixed	0.00	172.08	57.55
J-300	39.00	Demand	24.38	Fixed	24.38	172.11	57.56
J-301	39.00	Demand	20.08	Fixed	20.08	172.97	57.93
J-302	40.00	Demand	0.00	Fixed	0.00	171.81	57.00
J-303	40.00	Demand	34.42	Fixed	34.42	171.78	56.98
J-304	40.00	Demand	12.91	Fixed	12.91	171.78	56.99
J-305	40.00	Demand	14.34	Fixed	14.34	171.82	57.00
J-306	40.00	Demand	24.38	Fixed	24.38	171.51	56.87
J-307	40.00	Demand	22.94	Fixed	22.94	171.52	56.88
J-308	40.00	Demand	7.89	Fixed	7.89	171.74	56.97
J-309	40.00	Demand	7.17	Fixed	7.17	171.81	57.00
J-310	40.00	Demand	0.00	Fixed	0.00	173.95	57.92
J-311	40.00	Demand	21.51	Fixed	21.51	173.76	57.84
J-312	40.00	Demand	1.43	Fixed	1.43	173.83	57.87
J-313	40.00	Demand	0.00	Fixed	0.00	173.87	57.89
J-314	40.00	Demand	65.96	Fixed	65.96	173.87	57.89
J-315	40.00	Demand	0.00	Fixed	0.00	174.70	58.25
J-316	40.00	Demand	12.19	Fixed	12.19	175.13	58.44
J-317	40.00	Demand	12.19	Fixed	12.19	175.15	58.45
J-318	39.00	Demand	0.00	Fixed	0.00	174.96	58.79
J-319	39.00	Demand	0.00	Fixed	0.00	174.87	58.76
J-320	40.00	Demand	0.00	Fixed	0.00	174.88	58.32
J-321	41.00	Demand	0.00	Fixed	0.00	174.83	57.87
J-322	39.00	Demand	0.00	Fixed	0.00	175.67	59.10
J-323	39.00	Demand	31.55	Fixed	31.55	174.96	58.79
J-324	39.00	Demand	0.00	Fixed	0.00	174.96	58.79
J-325	40.00	Demand	0.00	Fixed	0.00	174.91	58.34

Steady State Analysis
Junction Report

Node Label	Elevation (ft)	Demand Type	Demand (gpm)	Demand Pattern	Calculated Demand (gpm)	Hydraulic Grade (ft)	Pressure (psi)
J-326	39.00	Demand	0.00	Fixed	0.00	174.91	58.77
J-327	39.00	Demand	0.00	Fixed	0.00	174.91	58.77
J-328	44.00	Demand	2.87	Fixed	2.87	182.25	59.78
J-329	44.00	Demand	5.02	Fixed	5.02	182.25	59.78
J-330	44.00	Demand	2.87	Fixed	2.87	184.01	60.55
J-331	41.00	Demand	5.02	Fixed	5.02	178.31	59.38
J-332	42.00	Demand	2.87	Fixed	2.87	177.90	58.77
J-333	41.00	Demand	2.87	Fixed	2.87	177.11	58.86
J-334	39.00	Demand	0.00	Fixed	0.00	175.67	59.10
J-335	44.00	Demand	5.02	Fixed	5.02	177.21	57.61
J-336	43.00	Demand	5.02	Fixed	5.02	176.51	57.73
J-337	43.00	Demand	5.02	Fixed	5.02	176.51	57.73
J-338	40.00	Demand	0.00	Fixed	0.00	143.59	44.80
J-339	39.00	Demand	2.87	Fixed	2.87	143.59	45.23
J-340	25.00	Demand	2.15	Fixed	2.15	144.01	51.46
J-341	40.00	Demand	0.00	Fixed	0.00	143.59	44.80
J-342	24.00	Demand	0.00	Fixed	0.00	144.33	52.04
J-344	21.00	Demand	0.00	Fixed	0.00	135.92	49.69
J-345	20.00	Demand	61.66	Fixed	61.66	135.84	50.09
J-346	20.00	Demand	36.57	Fixed	36.57	135.84	50.09
J-347	22.00	Demand	25.09	Fixed	25.09	135.92	49.26
J-348	22.00	Demand	22.23	Fixed	22.23	135.99	49.29
J-349	23.00	Demand	68.83	Fixed	68.83	136.05	48.88
J-350	21.00	Demand	0.00	Fixed	0.00	135.95	49.71
J-360	24.00	Demand	42.30	Fixed	42.30	131.65	46.55
J-361	24.00	Demand	0.00	Fixed	0.00	131.64	46.55
J-362	24.00	Demand	17.93	Fixed	17.92	144.16	51.96
J-363	25.00	Demand	2.87	Fixed	2.87	144.26	51.57
J-364	26.00	Demand	5.02	Fixed	5.02	144.24	51.13
J-365	26.00	Demand	41.59	Fixed	41.59	144.11	51.08
J-366	25.00	Demand	0.72	Fixed	0.72	144.30	51.59
J-367	40.00	Demand	60.95	Fixed	60.94	144.03	44.99
J-368	26.00	Demand	0.00	Fixed	0.00	144.11	51.08
J-369	34.00	Demand	0.00	Fixed	0.00	144.07	47.60
J-370	37.00	Demand	16.49	Fixed	16.49	142.46	45.61
J-371	38.00	Demand	16.49	Fixed	16.49	142.08	45.01
J-372	38.00	Demand	14.34	Fixed	14.34	141.86	44.91
J-373	39.00	Demand	0.00	Fixed	0.00	141.43	44.29
J-374	22.00	Demand	0.00	Fixed	0.00	134.02	48.44
J-375	23.00	Demand	5.74	Fixed	5.74	135.55	48.67
J-376	24.00	Demand	24.38	Fixed	24.38	119.00	41.08
J-377	24.00	Demand	12.19	Fixed	12.19	119.03	41.10
J-378	23.00	Demand	9.32	Fixed	9.32	118.86	41.45
J-379	22.00	Demand	12.19	Fixed	12.19	118.86	41.88
J-380	23.00	Demand	27.96	Fixed	27.96	118.86	41.45
J-381	23.00	Demand	5.74	Fixed	5.74	118.89	41.47
J-382	25.00	Demand	9.32	Fixed	9.32	118.92	40.61
J-383	24.00	Demand	0.72	Fixed	0.72	118.92	41.05
J-384	23.00	Demand	5.74	Fixed	5.74	118.85	41.45
J-385	26.00	Demand	0.00	Fixed	0.00	151.66	54.34
J-386	34.00	Demand	57.36	Fixed	57.36	144.07	47.60
J-387	34.00	Demand	0.00	Fixed	0.00	145.20	48.09
J-388	34.00	Demand	189.29	Fixed	189.29	144.09	47.60

Steady State Analysis
Junction Report

Node Label	Elevation (ft)	Demand Type	Demand (gpm)	Demand Pattern	Calculated Demand (gpm)	Hydraulic Grade (ft)	Pressure (psi)
J-389	34.00	Demand	124.76	Fixed	124.76	144.28	47.69
J-390	24.00	Demand	20.79	Fixed	20.79	144.14	51.95
J-391	26.00	Demand	169.21	Fixed	169.21	144.03	51.04
J-392	26.00	Demand	58.79	Fixed	58.79	144.04	51.05
J-393	26.00	Demand	7.17	Fixed	7.17	145.36	51.62
J-394	23.00	Demand	5.02	Fixed	5.02	158.11	58.43
J-395	23.00	Demand	145.55	Fixed	145.55	159.32	58.95
J-396	26.00	Demand	2.87	Fixed	2.87	144.33	51.17
J-397	24.00	Demand	7.17	Fixed	7.17	146.43	52.94
J-398	24.00	Demand	58.79	Fixed	58.79	144.61	52.16
J-399	25.00	Demand	115.44	Fixed	115.44	144.31	51.59
J-400	24.00	Demand	5.02	Fixed	5.02	144.18	51.97
J-401	25.00	Demand	0.00	Fixed	0.00	144.11	51.51
J-402	26.00	Demand	5.02	Fixed	5.02	144.22	51.12
J-403	25.00	Demand	0.00	Fixed	0.00	144.16	51.53
J-404	25.00	Demand	41.59	Fixed	41.59	144.11	51.51
J-405	26.00	Demand	3.59	Fixed	3.59	144.09	51.07
J-406	26.00	Demand	0.00	Fixed	0.00	144.08	51.06
J-407	26.00	Demand	65.25	Fixed	65.25	144.07	51.06
J-408	26.00	Demand	22.94	Fixed	22.94	147.67	52.61
J-409	26.00	Demand	22.94	Fixed	22.94	147.80	52.67
J-410	26.00	Demand	22.94	Fixed	22.94	147.91	52.72
J-411	26.00	Demand	116.87	Fixed	116.87	144.16	51.10
J-412	26.00	Demand	25.09	Fixed	25.09	144.25	51.14
J-413	26.00	Demand	0.00	Fixed	0.00	144.16	51.10
J-416	25.00	Demand	0.00	Fixed	0.00	144.16	51.53
J-417	25.00	Demand	35.13	Fixed	35.13	140.42	49.91
J-418	26.00	Demand	0.00	Fixed	0.00	143.79	50.94
J-419	40.00	Demand	150.57	Fixed	150.57	139.47	43.01
J-420	40.00	Demand	5.74	Fixed	5.74	136.87	41.89
J-421	23.00	Demand	12.19	Fixed	12.19	129.61	46.10
J-425	22.00	Demand	15.06	Fixed	15.06	131.07	47.16
J-428	22.00	Demand	17.21	Fixed	17.21	130.87	47.08
J-429	22.00	Demand	0.00	Fixed	0.00	121.99	43.24
J-430	20.00	Demand	127.63	Fixed	127.63	120.15	43.31
J-431	24.00	Demand	72.42	Fixed	72.42	120.15	41.58
J-433	38.00	Demand	55.93	Fixed	55.93	166.82	55.70
J-434	20.00	Demand	0.00	Fixed	0.00	127.84	46.63
J-435	20.00	Demand	0.00	Fixed	0.00	129.83	47.50
J-436	20.00	Demand	0.00	Fixed	0.00	130.80	47.91
J-437	20.00	Demand	0.00	Fixed	0.00	119.93	43.21
J-438	25.00	Demand	0.00	Fixed	0.00	119.55	40.89
J-439	24.00	Demand	0.00	Fixed	0.00	119.98	41.51
J-440	24.00	Demand	0.00	Fixed	0.00	181.11	67.94
J-450	24.00	Demand	0.00	Fixed	0.00	132.31	46.83

Steady State Analysis
Pipe Report

Link Label	Length (ft)	Diameter (in)	Material	Roughness	Current Status	Discharge (gpm)	Start Hydraulic Grade (ft)	End Hydraulic Grade (ft)	Headloss (ft)	Friction Slope (ft/1000ft)
P-2	540.00	8	PVC	140.0	Open	12.87	119.20	119.20	0.28e-2	0.01
P-3	1,364.00	8	PVC	140.0	Open	-172.12	119.20	120.04	0.84	0.62
P-4	1,503.00	8	PVC	140.0	Open	-262.91	120.04	122.08	2.03	1.35
P-5	511.00	8	PVC	140.0	Open	-475.47	122.08	124.15	2.07	4.05
P-6	490.00	8	PVC	140.0	Open	-519.64	124.15	126.49	2.34	4.77
P-8	475.00	8	PVC	140.0	Open	-230.75	122.54	123.04	0.51	1.06
P-9	831.00	8	PVC	140.0	Open	-497.33	123.04	126.70	3.66	4.40
P-10	2,274.00	6	PVC	140.0	Open	-111.41	124.15	126.70	2.55	1.12
P-11	341.00	8	PVC	140.0	Open	-381.27	126.70	127.62	0.92	2.69
P-12	977.00	8	PVC	140.0	Open	-39.83	122.08	122.12	0.04	0.04
P-13	463.00	8	PVC	140.0	Open	-211.39	122.12	122.54	0.42	0.90
P-14	1,346.00	8	PVC	140.0	Open	148.62	122.12	121.49	0.63	0.47
P-15	942.00	8	PVC	140.0	Open	-207.96	121.49	122.31	0.83	0.88
P-16	629.00	8	PVC	140.0	Open	-242.21	122.31	123.04	0.73	1.16
P-19	270.00	8	PVC	140.0	Open	-273.35	122.70	123.09	0.39	1.45
P-20	903.00	8	PVC	140.0	Open	-322.10	123.09	124.87	1.78	1.97
P-21	340.00	8	PVC	140.0	Open	-386.63	124.87	125.81	0.94	2.76
P-22	617.00	8	PVC	140.0	Open	-560.15	125.81	129.20	3.38	5.48
P-23	251.00	8	PVC	140.0	Open	-848.56	129.20	132.16	2.97	11.83
P-24	304.00	8	PVC	140.0	Open	-284.11	126.70	127.18	0.47	1.56
P-25	1,275.00	8	PVC	140.0	Open	-286.27	127.18	129.20	2.02	1.58
P-26	2,257.00	12	PVC	140.0	Open	-446.74	126.49	127.62	1.13	0.50
P-28	292.00	8	PVC	140.0	Open	188.75	127.62	127.40	0.21	0.73
P-30	500.00	8	PVC	140.0	Open	61.68	127.17	127.13	0.05	0.09
P-32	413.00	12	PVC	140.0	Open	305.11	127.09	126.99	0.10	0.25
P-33	323.00	12	PVC	140.0	Open	248.18	126.99	126.93	0.05	0.17
P-34	251.00	8	PVC	140.0	Open	69.68	126.93	126.90	0.03	0.12
P-37	251.00	6	PVC	140.0	Open	77.93	128.01	127.86	0.15	0.58
P-38	1,016.00	8	PVC	140.0	Open	208.11	127.86	126.97	0.89	0.88
P-39	162.00	8	PVC	140.0	Open	152.90	126.97	126.89	0.08	0.50
P-40	556.00	8	PVC	140.0	Open	132.82	126.89	126.68	0.21	0.38
P-41	1,325.00	8	PVC	140.0	Open	51.76	126.68	126.59	0.09	0.07
P-42	547.00	8	PVC	140.0	Open	93.40	126.59	126.48	0.11	0.20
P-43	348.00	8	PVC	140.0	Open	68.30	126.48	126.44	0.04	0.11
P-44	218.00	8	PVC	140.0	Open	8.95	126.44	126.44	0.57e-3	0.26e-2
P-45	461.00	8	PVC	140.0	Open	-33.35	126.44	126.45	0.01	0.03
P-46	202.00	8	PVC	140.0	Open	4.82	126.45	126.45	0.17e-3	0.83e-3
P-47	784.00	8	PVC	140.0	Open	-110.78	126.45	126.67	0.21	0.27
P-48	194.00	8	PVC	140.0	Open	34.55	126.67	126.66	0.01	0.03
P-49	576.00	8	PVC	140.0	Open	-31.59	126.66	126.68	0.02	0.03
P-50	704.00	12	PVC	140.0	Open	146.66	126.90	126.86	0.04	0.06
P-51	236.00	12	PVC	140.0	Open	272.28	126.86	126.81	0.05	0.20
P-52	1,119.00	8	PVC	140.0	Open	101.06	126.81	126.55	0.26	0.23
P-53	200.00	8	PVC	140.0	Open	35.93	126.55	126.54	0.01	0.03
P-54	315.00	8	PVC	140.0	Open	35.93	126.54	126.53	0.01	0.03
P-55	534.00	10	PVC	140.0	Open	22.83	126.53	126.53	0.26e-2	0.5e-2
P-56	825.00	10	PVC	140.0	Open	72.90	126.53	126.50	0.04	0.04
P-57	196.00	10	PVC	140.0	Open	72.90	126.50	126.49	0.01	0.04
P-58	1,112.00	6	PVC	140.0	Open	-51.58	126.90	127.20	0.30	0.27
P-59	163.00	12	PVC	140.0	Open	-379.34	127.20	127.26	0.06	0.37
P-60	469.00	12	PVC	140.0	Open	-302.67	127.09	127.20	0.11	0.24
P-61	275.00	12	PVC	140.0	Open	-157.17	126.86	126.88	0.02	0.07

Steady State Analysis
Pipe Report

Link Label	Length (ft)	Diameter (in)	Material	Roughness	Current Status	Discharge (gpm)	Start Hydraulic Grade (ft)	End Hydraulic Grade (ft)	Headloss (ft)	Friction Slope (ft/1000ft)
P-62	245.00	8	PVC	140.0	Open	4.13	126.88	126.88	0.15e-3	0.62e-3
P-63	299.00	8	PVC	140.0	Open	31.71	126.88	126.87	0.01	0.03
P-64	477.00	6	PVC	140.0	Open	-44.16	126.87	126.97	0.10	0.20
P-65	214.00	8	PVC	140.0	Open	-67.15	126.97	126.99	0.02	0.11
P-66	516.00	6	PVC	140.0	Open	-60.26	126.99	127.17	0.19	0.36
P-67	711.00	12	PVC	140.0	Open	-161.29	126.88	126.93	0.05	0.08
P-68	1,043.00	6	PVC	140.0	Open	-27.58	126.88	126.97	0.09	0.08
P-69	253.00	6	PVC	140.0	Open	-26.81	126.97	126.99	0.02	0.08
P-70	846.00	6	PVC	140.0	Open	0.77	126.97	126.97	0.99e-4	0.12e-3
P-71	248.00	8	PVC	140.0	Open	61.68	127.13	127.11	0.02	0.09
P-72	828.00	8	PVC	140.0	Open	27.54	127.11	127.09	0.02	0.02
P-73	926.00	6	PVC	140.0	Open	-34.14	126.99	127.11	0.12	0.13
P-74	1,112.00	6	PVC	140.0	Open	-56.95	126.90	127.26	0.36	0.32
P-75	258.00	8	PVC	140.0	Open	-45.31	126.87	126.88	0.01	0.05
P-76	1,016.00	6	PVC	140.0	Open	-45.31	126.88	127.10	0.22	0.21
P-77	137.00	8	PVC	140.0	Open	188.75	127.40	127.30	0.10	0.73
P-78	294.00	8	PVC	140.0	Open	143.45	127.30	127.17	0.13	0.44
P-79	970.00	6	PVC	140.0	Open	-45.31	127.10	127.30	0.21	0.21
P-80	1,059.00	8	PVC	140.0	Open	-194.79	126.67	127.49	0.82	0.78
P-81	749.00	8	PVC	140.0	Open	-281.55	127.49	128.64	1.15	1.54
P-82	395.00	8	PVC	140.0	Open	209.04	128.64	128.29	0.35	0.89
P-83	785.00	6	PVC	140.0	Open	-51.08	126.45	126.66	0.21	0.27
P-84	198.00	8	PVC	140.0	Open	-68.17	126.59	126.61	0.02	0.11
P-85	965.00	10	PVC	140.0	Open	-171.22	126.61	126.81	0.20	0.21
P-86	204.00	8	PVC	140.0	Open	88.71	126.61	126.57	0.04	0.18
P-87	1,196.00	10	PVC	140.0	Open	63.62	126.57	126.53	0.04	0.03
P-88	585.00	10	PVC	140.0	Open	-65.12	126.53	126.55	0.02	0.03
P-89	597.00	6	PVC	140.0	Open	58.95	126.45	126.25	0.21	0.35
P-90	879.00	6	PVC	140.0	Open	-20.64	126.25	126.29	0.04	0.05
P-91	428.00	6	PVC	140.0	Open	-59.35	126.29	126.44	0.15	0.35
P-93	640.00	8	PVC	140.0	Open	-105.18	132.28	132.44	0.16	0.25
P-95	406.00	8	PVC	140.0	Open	-8.54	131.50	131.50	0.98e-3	0.24e-2
P-96	281.00	6	PVC	140.0	Open	-53.71	131.50	131.58	0.08	0.29
P-97	225.00	6	PVC	140.0	Open	-121.17	131.58	131.88	0.29	1.31
P-99	128.00	8	PVC	140.0	Open	77.66	132.19	132.17	0.02	0.14
P-100	506.00	10	PVC	140.0	Open	271.97	132.43	132.19	0.25	0.49
P-101	302.00	10	PVC	140.0	Open	266.25	132.58	132.43	0.14	0.47
P-102	714.00	8	PVC	140.0	Open	-5.72	132.43	132.44	0.82e-3	0.12e-2
P-103	426.00	8	PVC	140.0	Open	-105.18	132.17	132.28	0.11	0.25
P-104	810.00	8	PVC	140.0	Open	50.97	131.58	131.53	0.05	0.07
P-105	945.00	8	PVC	140.0	Open	33.05	131.53	131.50	0.03	0.03
P-106	656.00	8	PVC	140.0	Open	10.82	131.50	131.50	0.24e-2	0.37e-2
P-110	438.00	8	PVC	140.0	Open	9.18	131.90	131.90	0.11e-2	0.25e-2
P-111	207.00	8	PVC	140.0	Open	194.31	132.19	132.03	0.16	0.77
P-112	1,034.00	8	PVC	140.0	Open	-73.55	131.90	132.03	0.13	0.13
P-114	751.00	8	PVC	140.0	Open	-30.21	131.88	131.90	0.02	0.02
P-115	1,065.00	8	PVC	140.0	Open	17.92	131.88	131.87	0.01	0.01
P-116	775.00	6	PVC	140.0	Open	-10.48	131.89	131.90	0.01	0.01
P-117	391.00	10	PVC	140.0	Open	377.80	132.92	132.58	0.35	0.89
P-118	574.00	10	PVC	140.0	Open	-43.02	132.92	132.92	0.01	0.02
P-119	1,072.00	10	PVC	140.0	Open	-453.08	132.92	134.26	1.34	1.25
P-120	725.00	12	PVC	140.0	Open	931.47	134.26	132.85	1.41	1.95

Steady State Analysis
Pipe Report

Link Label	Length (ft)	Diameter (in)	Material	Roughness	Current Status	Discharge (gpm)	Start Hydraulic Grade (ft)	End Hydraulic Grade (ft)	Headloss (ft)	Friction Slope (ft/1000ft)
P-121	1,003.00	12	PVC	140.0	Open	785.85	132.85	131.42	1.43	1.42
P-122	614.00	8	PVC	140.0	Open	504.93	131.42	128.64	2.78	4.53
P-124	157.00	12	Ductile Iron	130.0	Open	-2,143.09	132.16	133.81	1.64	10.45
P-127	515.00	12	PVC	140.0	Open	-1,384.55	134.26	136.36	2.09	4.06
P-129	190.00	8	PVC	140.0	Open	309.50	144.47	144.12	0.35	1.83
P-130	1,006.00	8	PVC	140.0	Open	309.50	144.12	142.28	1.84	1.83
P-131	2,594.00	8	PVC	140.0	Open	263.05	142.28	138.76	3.51	1.35
P-132	291.00	8	PVC	140.0	Open	414.48	138.76	137.85	0.91	3.14
P-133	1,056.00	8	PVC	140.0	Open	305.60	137.85	135.96	1.89	1.79
P-134	540.00	8	PVC	140.0	Open	67.56	135.96	135.90	0.06	0.11
P-135	506.00	8	PVC	140.0	Open	5.90	135.90	135.90	0.61e-3	0.12e-2
P-137	649.00	6	PVC	140.0	Open	36.73	136.24	136.14	0.09	0.14
P-138	3,015.00	8	PVC	140.0	Open	-67.95	135.90	136.24	0.33	0.11
P-139	199.00	8	PVC	140.0	Open	169.11	136.36	136.24	0.12	0.60
P-142	247.00	8	PVC	140.0	Open	-284.79	138.76	139.15	0.39	1.57
P-143	1,276.00	6	PVC	140.0	Open	13.75	139.15	139.12	0.03	0.02
P-144	1,300.00	6	PVC	140.0	Open	-169.09	139.12	142.28	3.16	2.43
P-145	294.00	8	PVC	140.0	Open	562.18	142.28	140.66	1.62	5.52
P-146	742.00	6	PVC	140.0	Open	242.75	140.66	137.14	3.52	4.74
P-147	2,077.00	6	PVC	140.0	Open	-58.68	137.14	137.85	0.71	0.34
P-148	2,441.00	6	PVC	140.0	Open	-145.92	136.14	140.66	4.51	1.85
P-149	638.00	8	PVC	140.0	Open	-348.73	139.15	140.61	1.46	2.28
P-151	477.00	8	PVC	140.0	Open	0.00	140.61	140.61	0.00	0.00
P-152	728.00	8	PVC	140.0	Open	-325.27	140.61	142.07	1.46	2.01
P-153	728.00	8	PVC	140.0	Open	-330.33	140.61	142.11	1.50	2.06
P-154	490.00	8	PVC	140.0	Open	-493.52	142.11	144.24	2.13	4.34
P-155	83.00	8	PVC	140.0	Open	-153.86	142.07	142.11	0.04	0.50
P-156	969.00	8	PVC	140.0	Open	-171.41	142.07	142.66	0.59	0.61
P-157	623.00	8	PVC	140.0	Open	-182.16	142.66	143.09	0.43	0.69
P-158	67.00	8	PVC	140.0	Open	18.39	140.61	140.61	0.66e-3	0.01
P-159	3,213.00	12	PVC	140.0	Open	-655.56	144.24	147.51	3.27	1.02
P-160	871.00	8	PVC	140.0	Open	-240.96	143.09	144.10	1.00	1.15
P-161	1,288.00	8	PVC	140.0	Open	-329.87	144.10	146.75	2.65	2.06
P-162	186.00	8	PVC	140.0	Open	-523.46	146.75	147.65	0.90	4.84
P-163	163.00	12	PVC	140.0	Open	-591.87	147.51	147.65	0.14	0.84
P-164	2,102.00	8	PVC	140.0	Open	-63.68	147.51	147.72	0.21	0.10
P-165	621.00	8	PVC	140.0	Open	-34.35	147.72	147.74	0.02	0.03
P-166	631.00	8	PVC	140.0	Open	-73.72	147.74	147.82	0.08	0.13
P-167	621.00	8	PVC	140.0	Open	-34.35	147.72	147.74	0.02	0.03
P-168	1,298.00	12	PVC	140.0	Open	-1,115.33	147.65	151.18	3.53	2.72
P-169	436.00	10	PVC	140.0	Open	526.26	151.18	150.46	0.72	1.65
P-170	241.00	10	PVC	140.0	Open	399.76	150.46	150.22	0.24	0.99
P-171	827.00	10	PVC	140.0	Open	303.32	150.22	149.73	0.49	0.59
P-172	666.00	10	PVC	140.0	Open	237.90	149.73	149.48	0.25	0.38
P-173	517.00	8	PVC	140.0	Open	283.43	149.48	148.68	0.80	1.56
P-174	573.00	8	PVC	140.0	Open	198.82	148.68	148.21	0.46	0.81
P-175	1,119.00	6	PVC	140.0	Open	34.02	148.21	148.07	0.14	0.13
P-176	1,199.00	6	PVC	140.0	Open	-64.90	148.07	148.57	0.50	0.41
P-178	1,015.00	6	PVC	140.0	Open	89.94	150.46	149.70	0.77	0.76
P-179	495.00	6	PVC	140.0	Open	-25.27	149.70	149.73	0.04	0.07
P-180	1,486.00	6	PVC	140.0	Open	72.05	150.22	149.48	0.74	0.50
P-181	162.00	8	PVC	140.0	Open	-138.86	148.57	148.64	0.07	0.42

Steady State Analysis
Pipe Report

Link Label	Length (ft)	Diameter (in)	Material	Roughness	Current Status	Discharge (gpm)	Start Hydraulic Grade (ft)	End Hydraulic Grade (ft)	Headloss (ft)	Friction Slope (ft/1000ft)
P-182	339.00	8	PVC	140.0	Open	-70.26	148.64	148.68	0.04	0.12
P-183	1,464.00	6	PVC	140.0	Open	87.96	149.70	148.64	1.06	0.72
P-184	294.00	8	PVC	140.0	Open	47.43	148.57	148.55	0.02	0.06
P-185	406.00	8	PVC	140.0	Open	0.83	148.55	148.55	0.15e-4	0.38e-4
P-187	593.00	8	PVC	140.0	Open	50.19	148.12	148.08	0.04	0.06
P-188	920.00	8	PVC	140.0	Open	23.92	148.08	148.07	0.01	0.02
P-189	920.00	6	PVC	140.0	Open	11.22	148.08	148.07	0.01	0.02
P-190	107.00	8	PVC	140.0	Open	143.29	148.21	148.17	0.05	0.44
P-191	464.00	8	PVC	140.0	Open	65.25	148.17	148.12	0.05	0.10
P-192	1,319.00	8	PVC	140.0	Open	-11.36	148.55	148.56	0.01	0.4e-2
P-196	613.00	12	PVC	140.0	Open	1,977.25	173.73	168.92	4.81	7.85
P-197	1,072.00	12	PVC	150.0	Open	1,977.25	168.92	161.51	7.41	6.91
P-198	151.00	6	PVC	140.0	Open	-955.07	148.56	157.58	9.02	59.75
P-199	447.00	6	PVC	140.0	Open	95.36	157.58	157.20	0.38	0.84
P-200	1,613.00	12	PVC	140.0	Open	1,050.43	161.51	157.58	3.93	2.44
P-201	810.00	6	PVC	140.0	Open	50.91	157.20	156.99	0.21	0.26
P-202	299.00	6	PVC	140.0	Open	23.66	156.99	156.97	0.02	0.06
P-203	464.00	4	PVC	140.0	Open	7.17	156.97	156.95	0.02	0.05
P-204	161.00	8	PVC	140.0	Open	-1,387.36	163.58	168.31	4.73	29.37
P-205	717.00	12	PVC	140.0	Open	-1,936.89	168.31	173.73	5.42	7.56
P-206	873.00	8	PVC	140.0	Open	549.52	168.31	163.69	4.62	5.29
P-207	759.00	8	PVC	140.0	Open	170.43	163.69	163.23	0.46	0.61
P-208	862.00	12	PVC	140.0	Open	-401.35	163.23	163.58	0.35	0.41
P-209	1,195.00	12	PVC	140.0	Open	571.78	163.23	162.28	0.95	0.79
P-210	538.00	10	PVC	140.0	Open	571.78	162.28	161.25	1.03	1.92
P-212	391.00	8	PVC	140.0	Open	-296.15	158.59	159.25	0.66	1.69
P-213	1,013.00	8	PVC	140.0	Open	-330.56	159.25	161.34	2.09	2.07
P-214	882.00	8	PVC	140.0	Open	-379.10	161.34	163.69	2.35	2.66
P-215	134.00	8	PVC	140.0	Open	43.74	161.25	161.24	0.01	0.05
P-216	955.00	8	PVC	140.0	Open	19.36	161.24	161.23	0.01	0.01
P-217	183.00	6	PVC	140.0	Open	9.32	161.23	161.23	0.21e-2	0.01
P-218	579.00	8	PVC	140.0	Open	-94.86	158.59	158.71	0.12	0.21
P-219	527.00	8	PVC	140.0	Open	-117.81	158.71	158.87	0.16	0.31
P-220	1,123.00	10	PVC	140.0	Open	528.04	161.25	159.39	1.86	1.66
P-221	817.00	10	PVC	140.0	Open	397.32	159.39	158.59	0.80	0.98
P-222	345.00	6	PVC	140.0	Open	130.71	159.39	158.87	0.52	1.51
P-223	1,175.00	8	PVC	140.0	Open	77.66	161.51	161.34	0.17	0.14
P-224	1,170.00	8	PVC	140.0	Open	6.99	161.34	161.34	0.19e-2	0.17e-2
P-225	1,170.00	6	PVC	140.0	Open	3.28	161.34	161.34	0.19e-2	0.17e-2
P-226	415.00	8	PVC	140.0	Open	22.23	161.34	161.34	0.01	0.01
P-227	339.00	4	PVC	140.0	Open	4.30	161.34	161.33	0.01	0.02
P-228	623.00	10	PVC	140.0	Open	788.34	158.59	156.42	2.17	3.48
P-229	626.00	10	PVC	140.0	Open	625.55	156.42	155.00	1.42	2.27
P-230	453.00	10	PVC	140.0	Open	586.10	155.00	154.09	0.91	2.01
P-231	512.00	10	PVC	140.0	Open	28.64	154.09	154.08	0.39e-2	0.01
P-232	478.00	8	PVC	140.0	Open	-26.57	154.08	154.09	0.01	0.02
P-233	752.00	6	PVC	140.0	Open	-50.95	154.09	154.29	0.20	0.26
P-234	707.00	6	PVC	140.0	Open	-104.72	154.29	155.00	0.71	1.00
P-235	274.00	10	PVC	140.0	Open	55.21	154.08	154.07	0.01	0.03
P-237	567.00	10	PVC	140.0	Open	25.09	154.07	154.07	0.34e-2	0.01
P-238	651.00	6	PVC	140.0	Open	25.09	154.07	154.02	0.05	0.07
P-239	862.00	6	PVC	140.0	Open	127.65	156.42	155.17	1.24	1.44

Steady State Analysis
Pipe Report

Link Label	Length (ft)	Diameter (in)	Material	Roughness	Current Status	Discharge (gpm)	Start Hydraulic Grade (ft)	End Hydraulic Grade (ft)	Headloss (ft)	Friction Slope (ft/1000ft)
P-240	423.00	6	PVC	140.0	Open	65.27	155.17	155.00	0.18	0.42
P-241	234.00	6	PVC	140.0	Open	29.40	155.17	155.15	0.02	0.10
P-242	430.00	4	PVC	140.0	Open	10.04	155.15	155.11	0.04	0.09
P-243	594.00	8	PVC	140.0	Open	485.76	154.09	151.58	2.50	4.21
P-244	645.00	6	PVC	140.0	Open	151.87	151.58	150.30	1.28	1.99
P-245	787.00	8	PVC	140.0	Open	428.40	150.30	147.67	2.63	3.34
P-246	442.00	8	PVC	140.0	Open	414.06	147.67	146.28	1.39	3.14
P-247	386.00	8	PVC	140.0	Open	397.57	146.28	145.16	1.12	2.91
P-248	645.00	8	PVC	140.0	Open	323.86	151.58	150.30	1.28	1.99
P-250	712.00	12	PVC	140.0	Open	171.86	144.64	144.58	0.06	0.09
P-251	1,262.00	12	PVC	140.0	Open	56.86	144.58	144.57	0.01	0.01
P-252	429.00	12	PVC	140.0	Open	17.42	144.57	144.57	0.53e-3	0.12e-2
P-253	529.00	12	PVC	140.0	Open	-35.14	144.57	144.57	0.24e-2	0.45e-2
P-254	802.00	12	PVC	140.0	Open	-55.22	144.57	144.58	0.01	0.01
P-255	236.00	12	PVC	140.0	Open	155.83	144.58	144.56	0.02	0.07
P-256	736.00	12	PVC	140.0	Open	49.82	144.56	144.56	0.01	0.01
P-257	658.00	8	PVC	140.0	Open	-117.69	144.56	144.76	0.20	0.31
P-258	848.00	8	PVC	140.0	Open	-149.23	144.76	145.16	0.40	0.47
P-259	317.00	8	PVC	140.0	Open	92.78	144.58	144.52	0.06	0.20
P-260	577.00	8	PVC	140.0	Open	75.57	144.52	144.44	0.08	0.13
P-261	547.00	8	PVC	140.0	Open	58.36	144.44	144.40	0.05	0.08
P-262	415.00	8	PVC	140.0	Open	-11.60	144.40	144.40	0.18e-2	0.42e-2
P-263	769.00	6	PVC	140.0	Open	-19.36	144.40	144.43	0.03	0.04
P-264	876.00	6	PVC	140.0	Open	-38.23	144.43	144.57	0.14	0.16
P-265	468.00	8	PVC	140.0	Open	-14.46	144.40	144.40	0.3e-2	0.01
P-266	688.00	8	PVC	140.0	Open	-37.41	144.40	144.43	0.03	0.04
P-267	327.00	8	PVC	140.0	Open	-61.78	144.43	144.46	0.03	0.09
P-268	501.00	8	PVC	140.0	Open	-95.98	144.46	144.56	0.11	0.21
P-269	383.00	6	PVC	140.0	Open	-9.10	144.43	144.44	0.42e-2	0.01
P-270	327.00	6	PVC	140.0	Open	-23.44	144.44	144.46	0.02	0.06
P-271	302.00	8	PVC	140.0	Open	0.00	144.44	144.44	0.00	0.00
P-272	565.00	8	PVC	140.0	Open	9.32	144.76	144.76	0.16e-2	0.28e-2
P-273	627.00	12	PVC	140.0	Open	148.14	144.56	144.52	0.04	0.07
P-274	583.00	12	PVC	140.0	Open	125.20	144.52	144.49	0.03	0.05
P-275	568.00	4	PVC	140.0	Open	10.76	144.52	144.46	0.06	0.11
P-276	554.00	8	PVC	140.0	Open	-228.98	144.58	145.16	0.58	1.05
P-277	2,295.00	12	PVC	140.0	Open	115.16	144.49	144.39	0.09	0.04
P-279	159.00	12	PVC	140.0	Open	65.76	144.39	144.39	0.23e-2	0.01
P-280	340.00	6	PVC	140.0	Open	37.28	144.39	144.34	0.05	0.15
P-281	488.00	6	PVC	140.0	Open	10.04	144.34	144.34	0.01	0.01
P-282	781.00	8	PVC	140.0	Open	28.48	144.39	144.38	0.02	0.02
P-283	705.00	6	PVC	140.0	Open	48.04	144.38	144.21	0.17	0.24
P-284	991.00	6	PVC	140.0	Open	17.92	144.21	144.17	0.04	0.04
P-286	587.00	6	PVC	140.0	Open	27.96	144.38	144.33	0.05	0.09
P-287	408.00	4	PVC	140.0	Open	13.62	144.33	144.26	0.07	0.17
P-288	229.00	12	PVC	140.0	Open	-55.75	144.38	144.38	0.24e-2	0.01
P-289	410.00	12	PVC	140.0	Open	-79.92	144.38	144.39	0.01	0.02
P-290	208.00	12	PVC	140.0	Open	-116.48	144.39	144.40	0.01	0.04
P-291	603.00	12	PVC	140.0	Open	-141.79	144.40	144.43	0.04	0.06
P-292	987.00	6	PVC	140.0	Open	31.55	144.43	144.33	0.11	0.11
P-293	518.00	6	PVC	140.0	Open	13.62	144.33	144.31	0.01	0.02
P-294	174.00	6	PVC	140.0	Open	24.17	144.38	144.37	0.01	0.07

Steady State Analysis
Pipe Report

Link Label	Length (ft)	Diameter (in)	Material	Roughness	Current Status	Discharge (gpm)	Start Hydraulic Grade (ft)	End Hydraulic Grade (ft)	Headloss (ft)	Friction Slope (ft/1000ft)
P-295	499.00	6	PVC	140.0	Open	4.68	144.37	144.37	0.15e-2	0.3e-2
P-296	270.00	6	PVC	140.0	Open	-6.79	144.37	144.37	0.17e-2	0.01
P-297	395.00	6	PVC	140.0	Open	-25.31	144.37	144.40	0.03	0.07
P-298	403.00	6	PVC	140.0	Open	2.03	144.37	144.37	0.15e-3	0.38e-3
P-299	233.00	4	PVC	140.0	Open	-9.32	144.48	144.50	0.02	0.08
P-300	189.00	6	PVC	140.0	Open	-9.32	144.50	144.50	0.22e-2	0.01
P-301	337.00	6	PVC	140.0	Open	-20.08	144.50	144.52	0.02	0.05
P-302	402.00	6	PVC	140.0	Open	-30.83	144.52	144.56	0.04	0.10
P-303	1,310.00	12	PVC	140.0	Open	184.09	144.56	144.43	0.13	0.10
P-304	594.00	12	PVC	140.0	Open	-218.51	144.56	144.64	0.08	0.13
P-305	447.00	12	PVC	140.0	Open	-234.43	144.64	144.71	0.07	0.15
P-306	1,327.00	12	PVC	140.0	Open	-310.03	144.71	145.05	0.34	0.25
P-307	505.00	6	PVC	140.0	Open	12.34	144.64	144.63	0.01	0.02
P-308	292.00	8	PVC	140.0	Open	51.37	144.63	144.61	0.02	0.07
P-309	285.00	8	PVC	140.0	Open	40.62	144.61	144.60	0.01	0.04
P-310	623.00	8	PVC	140.0	Open	-59.83	144.63	144.69	0.05	0.09
P-311	171.00	8	PVC	140.0	Open	-75.60	144.69	144.71	0.02	0.13
P-312	290.00	12	PVC	140.0	Open	337.24	145.05	144.96	0.09	0.30
P-313	348.00	12	PVC	140.0	Open	319.32	144.96	144.87	0.09	0.27
P-314	1,008.00	12	PVC	140.0	Open	223.59	144.87	144.73	0.14	0.14
P-315	336.00	12	PVC	140.0	Open	233.99	144.73	144.68	0.05	0.15
P-316	227.00	12	PVC	140.0	Open	168.75	144.68	144.66	0.02	0.08
P-317	518.00	8	PVC	140.0	Open	-10.40	144.73	144.73	0.18e-2	0.34e-2
P-318	671.00	8	PVC	140.0	Open	-31.91	144.73	144.75	0.02	0.03
P-319	440.00	8	PVC	140.0	Open	-47.68	144.75	144.77	0.03	0.06
P-320	409.00	8	PVC	140.0	Open	-61.31	144.77	144.81	0.04	0.09
P-321	411.00	8	PVC	140.0	Open	-77.08	144.81	144.87	0.06	0.14
P-322	933.00	12	PVC	140.0	Open	100.50	144.66	144.63	0.03	0.03
P-323	375.00	8	PVC	140.0	Open	11.59	144.63	144.63	0.16e-2	0.42e-2
P-324	910.00	8	PVC	140.0	Open	-1.32	144.63	144.63	0.61e-4	0.67e-4
P-325	561.00	8	PVC	140.0	Open	-46.74	144.63	144.66	0.03	0.06
P-326	1,296.00	8	PVC	140.0	Open	14.81	144.60	144.59	0.01	0.01
P-327	1,049.00	8	PVC	140.0	Open	-9.57	144.59	144.59	0.31e-2	0.3e-2
P-328	1,116.00	8	PVC	140.0	Open	-32.52	144.59	144.63	0.03	0.03
P-329	546.00	8	PVC	140.0	Open	18.64	144.87	144.86	0.01	0.01
P-330	331.00	8	PVC	140.0	Open	9.32	144.86	144.86	0.93e-3	0.28e-2
P-331	299.00	8	PVC	140.0	Open	65.25	144.68	144.64	0.03	0.10
P-332	259.00	8	PVC	140.0	Open	44.45	144.64	144.63	0.01	0.05
P-333	320.00	8	PVC	140.0	Open	25.81	144.63	144.63	0.01	0.02
P-334	808.00	8	PVC	140.0	Open	25.81	144.63	144.61	0.01	0.02
P-335	331.00	8	PVC	140.0	Open	25.81	144.61	144.60	0.01	0.02
P-336	783.00	12	PVC	140.0	Open	75.28	144.63	144.61	0.01	0.02
P-337	674.00	8	PVC	140.0	Open	32.27	144.61	144.59	0.02	0.03
P-338	1,249.00	8	PVC	140.0	Open	14.34	144.59	144.59	0.01	0.01
P-340	566.00	12	PVC	140.0	Open	-1,076.18	147.18	148.62	1.44	2.55
P-341	520.00	8	PVC	140.0	Open	66.68	147.18	147.12	0.06	0.11
P-342	465.00	8	PVC	140.0	Open	20.79	147.12	147.12	0.01	0.01
P-343	477.00	6	PVC	140.0	Open	17.21	147.12	147.10	0.02	0.04
P-344	221.00	6	PVC	140.0	Open	7.17	147.10	147.10	0.15e-2	0.01
P-345	682.00	8	PVC	140.0	Open	14.34	147.12	147.12	0.43e-2	0.01
P-346	140.00	4	PVC	140.0	Open	14.34	147.12	147.10	0.03	0.18
P-347	287.00	12	PVC	140.0	Open	-1,094.82	148.62	149.38	0.75	2.63

Steady State Analysis
Pipe Report

Link Label	Length (ft)	Diameter (in)	Material	Roughness	Current Status	Discharge (gpm)	Start Hydraulic Grade (ft)	End Hydraulic Grade (ft)	Headloss (ft)	Friction Slope (ft/1000ft)
P-348	271.00	12	PVC	140.0	Open	-1,109.16	149.38	150.11	0.73	2.69
P-349	282.00	12	PVC	140.0	Open	-1,147.17	150.11	150.92	0.81	2.87
P-350	394.00	12	PVC	140.0	Open	-1,221.73	150.92	152.19	1.27	3.22
P-351	856.00	8	PVC	140.0	Open	24.38	150.11	150.09	0.01	0.02
P-352	843.00	8	PVC	140.0	Open	68.11	150.92	150.82	0.09	0.11
P-353	311.00	4	PVC	140.0	Open	21.51	150.82	150.70	0.12	0.39
P-354	276.00	12	PVC	140.0	Open	-1,239.66	152.19	153.10	0.91	3.31
P-355	1,014.00	12	PVC	140.0	Open	-1,261.17	153.10	156.57	3.47	3.42
P-356	429.00	12	PVC	140.0	Open	-1,302.75	156.57	158.12	1.56	3.63
P-357	398.00	12	PVC	140.0	Open	-1,338.60	158.12	159.64	1.52	3.82
P-358	652.00	6	PVC	140.0	Open	18.64	156.57	156.54	0.03	0.04
P-359	112.00	8	PVC	140.0	Open	18.64	156.54	156.54	0.11e-2	0.01
P-360	452.00	12	PVC	140.0	Open	-1,354.38	159.64	161.40	1.76	3.90
P-361	590.00	12	PVC	140.0	Open	-1,375.17	161.40	163.77	2.37	4.01
P-362	244.00	12	PVC	140.0	Open	-1,406.00	163.77	164.79	1.02	4.18
P-363	456.00	12	PVC	140.0	Open	-1,406.00	164.79	166.69	1.91	4.18
P-364	162.00	8	PVC	140.0	Open	0.00	161.40	161.40	0.00	0.00
P-365	669.00	6	PVC	140.0	Open	0.00	161.40	161.40	0.00	0.00
P-367	113.00	4	PVC	140.0	Open	10.76	158.12	158.11	0.01	0.11
P-368	1,926.00	12	PVC	140.0	Open	-1,406.00	166.69	174.74	8.05	4.18
P-369	764.00	16	Ductile Iron	130.0	Open	2,108.70	174.74	172.83	1.91	2.50
P-370	438.00	10	PVC	140.0	Open	-117.61	172.83	172.88	0.05	0.10
P-371	167.00	10	PVC	140.0	Open	-179.27	172.88	172.92	0.04	0.22
P-372	1,172.00	6	PVC	140.0	Open	-89.85	172.92	173.80	0.88	0.75
P-374	555.00	6	PVC	140.0	Open	22.79	172.61	172.58	0.03	0.06
P-375	184.00	6	PVC	140.0	Open	-11.62	172.58	172.58	0.31e-2	0.02
P-376	680.00	6	PVC	140.0	Open	61.66	172.88	172.62	0.26	0.38
P-377	198.00	6	PVC	140.0	Open	22.79	172.62	172.61	0.01	0.06
P-378	611.00	6	PVC	140.0	Open	-24.53	172.58	172.62	0.04	0.07
P-379	186.00	6	PVC	140.0	Open	-24.38	172.32	172.33	0.01	0.07
P-380	948.00	6	PVC	140.0	Open	-47.32	172.33	172.55	0.22	0.23
P-381	231.00	6	PVC	140.0	Open	-55.21	172.55	172.62	0.07	0.31
P-382	778.00	6	PVC	140.0	Open	-62.38	172.62	172.92	0.30	0.38
P-383	918.00	6	PVC	140.0	Open	-109.93	173.80	174.80	1.00	1.09
P-385	647.00	6	PVC	140.0	Open	176.18	174.61	172.92	1.70	2.62
P-386	609.00	6	PVC	140.0	Open	-31.62	174.61	174.68	0.06	0.11
P-387	357.00	6	PVC	140.0	Open	-33.05	174.68	174.72	0.04	0.12
P-388	170.00	10	PVC	140.0	Open	265.09	174.80	174.72	0.08	0.46
P-389	573.00	10	PVC	140.0	Open	166.07	174.72	174.61	0.11	0.19
P-390	570.00	10	PVC	140.0	Open	-33.05	174.72	174.72	0.01	0.01
P-391	292.00	8	PVC	140.0	Open	-375.02	174.80	175.56	0.76	2.61
P-392	915.00	6	PVC	140.0	Open	-73.57	175.56	176.04	0.47	0.52
P-393	149.00	8	PVC	140.0	Open	-85.76	176.04	176.06	0.03	0.17
P-394	632.00	8	PVC	140.0	Open	127.30	176.06	175.84	0.22	0.35
P-395	278.00	8	PVC	140.0	Open	127.30	175.84	175.74	0.10	0.35
P-396	465.00	8	PVC	140.0	Open	-11.00	175.74	175.74	0.18e-2	0.38e-2
P-397	146.00	6	PVC	140.0	Open	53.96	175.74	175.70	0.04	0.29
P-398	462.00	6	PVC	140.0	Open	53.96	175.70	175.56	0.14	0.29
P-399	871.00	20	Ductile Iron	130.0	Open	-3,514.70	174.74	176.63	1.89	2.17
P-401	291.00	8	PVC	140.0	Open	-109.18	175.74	175.82	0.08	0.27
P-402	289.00	6	PVC	140.0	Open	0.00	175.82	175.82	0.00	0.00
P-403	457.00	8	PVC	140.0	Open	64.96	175.82	175.77	0.05	0.10

Steady State Analysis
Pipe Report

Link Label	Length (ft)	Diameter (in)	Material	Roughness	Current Status	Discharge (gpm)	Start Hydraulic Grade (ft)	End Hydraulic Grade (ft)	Headloss (ft)	Friction Slope (ft/1000ft)
P-404	776.00	8	PVC	140.0	Open	0.00	175.77	175.77	0.00	0.00
P-405	127.00	8	PVC	140.0	Open	0.00	175.77	175.77	0.00	0.00
P-406	286.00	8	PVC	140.0	Open	-64.96	175.74	175.77	0.03	0.10
P-407	1,674.00	8	PVC	140.0	Open	-205.69	175.82	177.26	1.44	0.86
P-408	337.00	8	PVC	140.0	Open	-2.87	182.50	182.50	0.11e-3	0.32e-3
P-409	427.00	8	PVC	140.0	Open	-456.18	182.50	184.10	1.60	3.75
P-410	981.00	8	PVC	140.0	Open	448.29	182.50	178.94	3.56	3.63
P-411	364.00	8	PVC	140.0	Open	222.52	178.94	178.58	0.36	0.99
P-412	708.00	8	PVC	140.0	Open	219.65	178.58	177.89	0.69	0.97
P-413	105.00	8	PVC	140.0	Open	8.46	176.63	176.63	0.2e-3	0.19e-2
P-414	560.00	8	PVC	140.0	Open	225.25	176.63	176.06	0.57	1.02
P-415	1,329.00	8	PVC	140.0	Open	216.78	177.89	176.63	1.26	0.95
P-416	1,043.00	8	PVC	140.0	Open	220.75	178.94	177.92	1.02	0.98
P-417	865.00	16	Ductile Iron	130.0	Open	-2,116.05	141.76	143.94	2.18	2.52
P-418	704.00	8	PVC	140.0	Open	215.73	177.92	177.26	0.66	0.94
P-419	562.00	8	PVC	140.0	Open	5.02	177.26	177.26	0.5e-3	0.9e-3
P-426	248.00	12	PVC	140.0	Open	27.59	143.94	143.93	0.73e-3	0.3e-2
P-427	984.00	12	PVC	140.0	Open	27.59	143.93	143.93	0.29e-2	0.29e-2
P-430	113.00	12	PVC	140.0	Open	510.48	144.54	144.47	0.07	0.64
P-436	2,758.00	8	PVC	140.0	Open	401.90	144.54	136.36	8.19	2.97
P-437	278.00	12	Ductile Iron	130.0	Open	3,013.53	150.00	144.54	5.46	19.64
P-439	683.00	6	PVC	140.0	Open	31.97	136.14	136.07	0.08	0.11
P-440	249.00	6	PVC	140.0	Open	9.00	136.07	136.06	0.27e-2	0.01
P-441	910.00	6	PVC	140.0	Open	-27.57	136.06	136.14	0.08	0.08
P-442	249.00	6	PVC	140.0	Open	-52.66	136.14	136.21	0.07	0.28
P-443	204.00	8	PVC	140.0	Open	-113.58	136.21	136.27	0.06	0.29
P-444	1,262.00	8	PVC	140.0	Open	-182.41	136.27	137.14	0.87	0.69
P-445	910.00	6	PVC	140.0	Open	-38.69	136.07	136.21	0.14	0.16
P-446	242.00	6	PVC	140.0	Open	-32.46	136.14	136.17	0.03	0.11
P-447	247.00	6	PVC	140.0	Open	31.97	136.17	136.14	0.03	0.11
P-448	655.00	8	PVC	140.0	Open	64.43	136.24	136.17	0.07	0.10
P-449	146.00	8	PVC	140.0	Open	-247.49	175.56	175.74	0.18	1.21
P-450	672.00	8	PVC	140.0	Open	-37.70	132.55	132.58	0.03	0.04
P-451	166.00	8	PVC	140.0	Open	-183.31	132.44	132.55	0.12	0.69
P-453	189.00	6	PVC	140.0	Open	-20.70	131.88	131.89	0.01	0.05
P-454	725.00	6	PVC	140.0	Open	-10.21	131.89	131.90	0.01	0.01
P-455	429.00	12	PVC	140.0	Open	200.98	144.47	144.42	0.05	0.11
P-456	980.00	12	PVC	140.0	Open	222.44	144.42	144.28	0.14	0.14
P-460	660.00	8	PVC	140.0	Open	-145.61	132.55	132.85	0.30	0.45
P-462	691.00	8	PVC	140.0	Open	-140.53	131.88	132.17	0.29	0.42
P-464	622.00	8	PVC	140.0	Open	96.38	132.03	131.90	0.13	0.21
P-477	1,115.00	12	PVC	140.0	Open	-82.35	144.52	144.54	0.02	0.02
P-479	519.00	12	PVC	140.0	Open	-168.68	144.54	144.59	0.04	0.08
P-483	197.00	12	PVC	140.0	Open	-1,002.06	143.94	144.38	0.44	2.23
P-485	879.00	12	PVC	140.0	Open	7.10	144.42	144.42	0.21e-3	0.24e-3
P-488	400.00	12	PVC	140.0	Open	-43.94	144.38	144.38	0.27e-2	0.01
P-489	331.00	12	PVC	140.0	Open	-18.47	144.38	144.38	0.46e-3	0.14e-2
P-490	455.00	12	PVC	140.0	Open	25.47	144.38	144.38	0.11e-2	0.25e-2
P-491	952.00	8	PVC	140.0	Open	245.01	143.93	142.80	1.13	1.19
P-492	372.00	8	PVC	140.0	Open	228.52	142.80	142.41	0.39	1.04
P-493	239.00	8	PVC	140.0	Open	212.03	142.41	142.19	0.22	0.91
P-494	545.00	8	PVC	140.0	Open	197.69	142.19	141.76	0.44	0.80

Steady State Analysis
Pipe Report

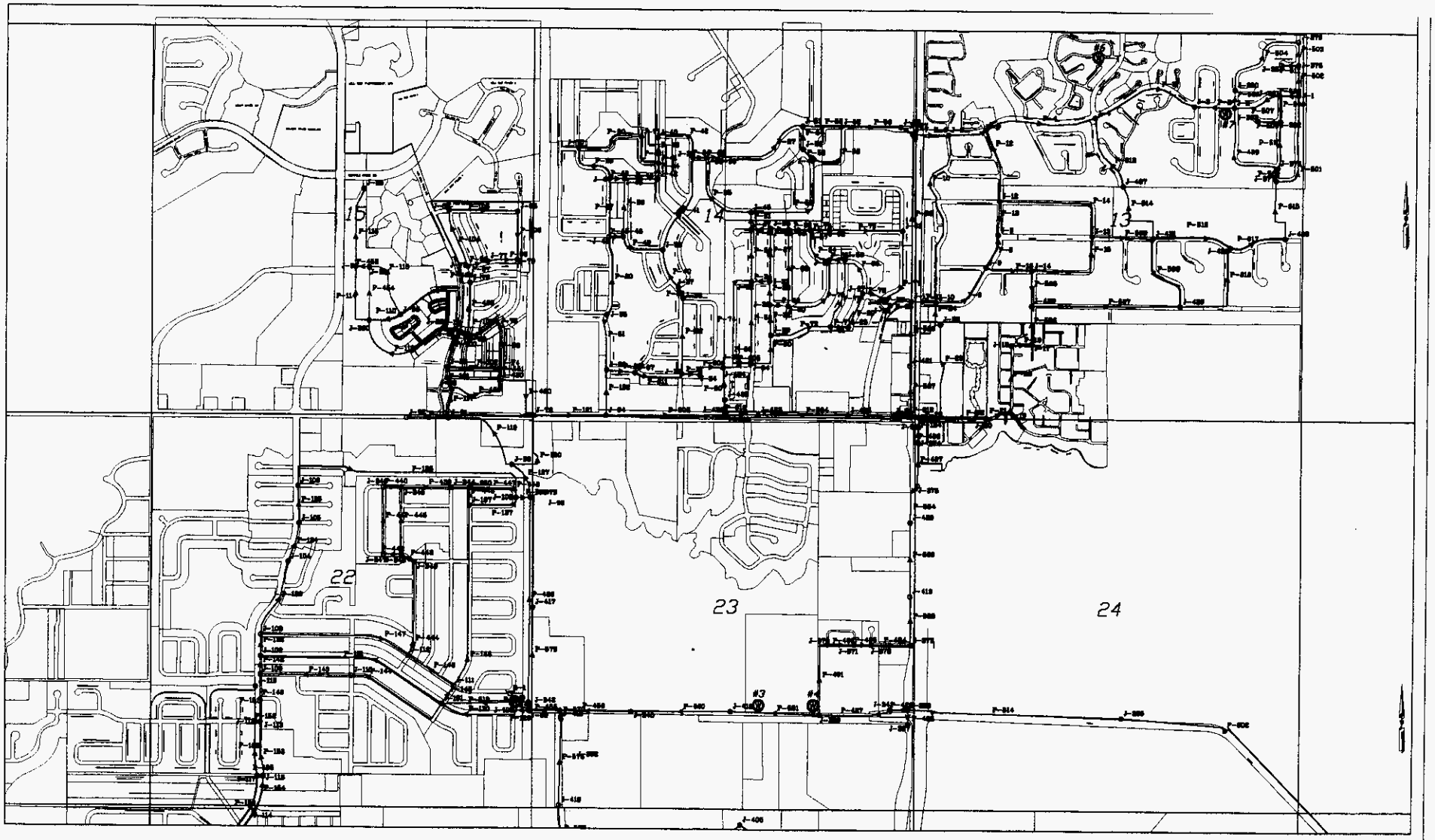
Link Label	Length (ft)	Diameter (in)	Material	Roughness	Current Status	Discharge (gpm)	Start Hydraulic Grade (ft)	End Hydraulic Grade (ft)	Headloss (ft)	Friction Slope (ft/1000ft)
P-496	202.00	16	Ductile Iron	130.0	Open	-2,151.69	133.81	134.33	0.52	2.59
P-497	592.00	16	Ductile Iron	130.0	Open	-2,151.69	134.33	135.86	1.54	2.59
P-499	1,340.00	6	PVC	140.0	Open	-28.50	119.20	119.32	0.12	0.09
P-500	170.00	8	PVC	140.0	Open	-87.40	119.32	119.35	0.03	0.18
P-501	1,406.00	8	PVC	140.0	Open	63.13	119.35	119.22	0.14	0.10
P-502	415.00	6	PVC	140.0	Open	26.33	119.22	119.19	0.03	0.08
P-503	317.00	6	PVC	140.0	Open	11.28	119.19	119.18	0.01	0.02
P-504	1,092.00	6	PVC	140.0	Open	-0.91	119.18	119.18	0.17e-3	0.15e-3
P-505	243.00	6	PVC	140.0	Open	-28.87	119.18	119.20	0.02	0.09
P-506	253.00	8	PVC	140.0	Open	9.54	119.22	119.22	0.74e-3	0.29e-2
P-507	644.00	8	PVC	140.0	Open	28.30	119.22	119.20	0.01	0.02
P-508	351.00	6	PVC	140.0	Open	-24.49	119.22	119.24	0.02	0.07
P-509	307.00	4	PVC	140.0	Open	0.72	119.24	119.24	0.22e-3	0.72e-3
P-510	644.00	6	PVC	140.0	Open	-34.53	119.24	119.32	0.08	0.13
P-511	233.00	4	PVC	140.0	Open	5.74	119.19	119.18	0.01	0.03
P-513	771.00	16	Ductile Iron	130.0	Open	3,990.14	180.00	173.73	6.27	8.13
P-514	2,929.00	12	PVC	140.0	Open	-1,141.58	143.94	152.26	8.32	2.84
P-516	1,904.00	12	PVC	140.0	Open	75.00	144.42	144.38	0.04	0.02
P-517	2,328.00	12	PVC	140.0	Open	25.47	144.38	144.38	0.01	0.25e-2
P-518	508.00	12	PVC	140.0	Open	-647.28	145.05	145.55	0.51	0.99
P-519	725.00	12	PVC	140.0	Open	-1,005.20	145.55	147.18	1.63	2.25
P-521	2,326.00	12	PVC	140.0	Open	-43.88	144.38	144.40	0.02	0.01
P-523	1,353.00	12	PVC	140.0	Open	-233.17	144.40	144.60	0.20	0.15
P-524	2,851.00	12	PVC	140.0	Open	-357.92	144.60	145.55	0.95	0.33
P-525	1,344.00	12	PVC	140.0	Open	-67.90	144.42	144.44	0.02	0.02
P-526	2,053.00	12	PVC	140.0	Open	-186.38	144.44	144.64	0.20	0.10
P-527	1,405.00	10	PVC	140.0	Open	97.69	144.44	144.34	0.10	0.07
P-528	1,371.00	8	PVC	140.0	Open	-36.05	144.34	144.38	0.05	0.03
P-529	1,010.00	8	PVC	140.0	Open	44.87	144.40	144.35	0.05	0.05
P-530	718.00	10	PVC	140.0	Open	35.47	144.35	144.34	0.01	0.01
P-531	2,357.00	10	PVC	140.0	Open	-49.40	144.35	144.39	0.05	0.02
P-533	1,465.00	12	PVC	140.0	Open	524.35	145.63	144.64	0.99	0.67
P-534	1,268.00	12	PVC	140.0	Open	-1,641.59	151.18	158.24	7.06	5.57
P-535	2,466.00	12	PVC	140.0	Open	-986.02	158.24	163.58	5.34	2.17
P-536	1,171.00	12	PVC	140.0	Open	-660.59	158.24	159.45	1.21	1.03
P-537	1,380.00	12	PVC	140.0	Open	-806.14	159.45	161.51	2.06	1.49
P-538	1,858.00	8	PVC	140.0	Open	-36.30	144.54	144.61	0.06	0.03
P-539	937.00	12	PVC	140.0	Open	943.70	148.56	146.68	1.87	2.00
P-540	892.00	12	PVC	140.0	Open	709.77	146.68	145.63	1.05	1.18
P-541	2,017.00	8	PVC	140.0	Open	-226.77	144.61	146.68	2.08	1.03
P-542	962.00	8	PVC	140.0	Open	-119.45	144.59	144.89	0.30	0.31
P-543	1,127.00	8	PVC	140.0	Open	-178.25	144.89	145.63	0.74	0.66
P-544	659.00	12	PVC	140.0	Open	-49.95	144.59	144.59	0.01	0.01
P-545	664.00	12	PVC	140.0	Open	-165.38	144.59	144.64	0.05	0.08
P-546	1,518.00	12	PVC	140.0	Open	119.77	144.54	144.48	0.07	0.04
P-547	2,414.00	12	PVC	140.0	Open	85.20	144.48	144.42	0.06	0.02
P-549	1,297.00	12	PVC	140.0	Open	-36.50	144.41	144.42	0.01	0.49e-2
P-550	2,642.00	8	PVC	140.0	Open	29.55	144.48	144.41	0.06	0.02
P-552	649.00	12	PVC	140.0	Open	-118.08	144.49	144.52	0.03	0.04
P-554	1,512.00	12	PVC	140.0	Open	-113.06	144.43	144.49	0.06	0.04
P-555	1,676.00	12	PVC	140.0	Open	78.56	144.43	144.40	0.03	0.02
P-556	814.00	12	PVC	140.0	Open	36.97	144.40	144.39	0.41e-2	0.5e-2

Steady State Analysis
Pipe Report

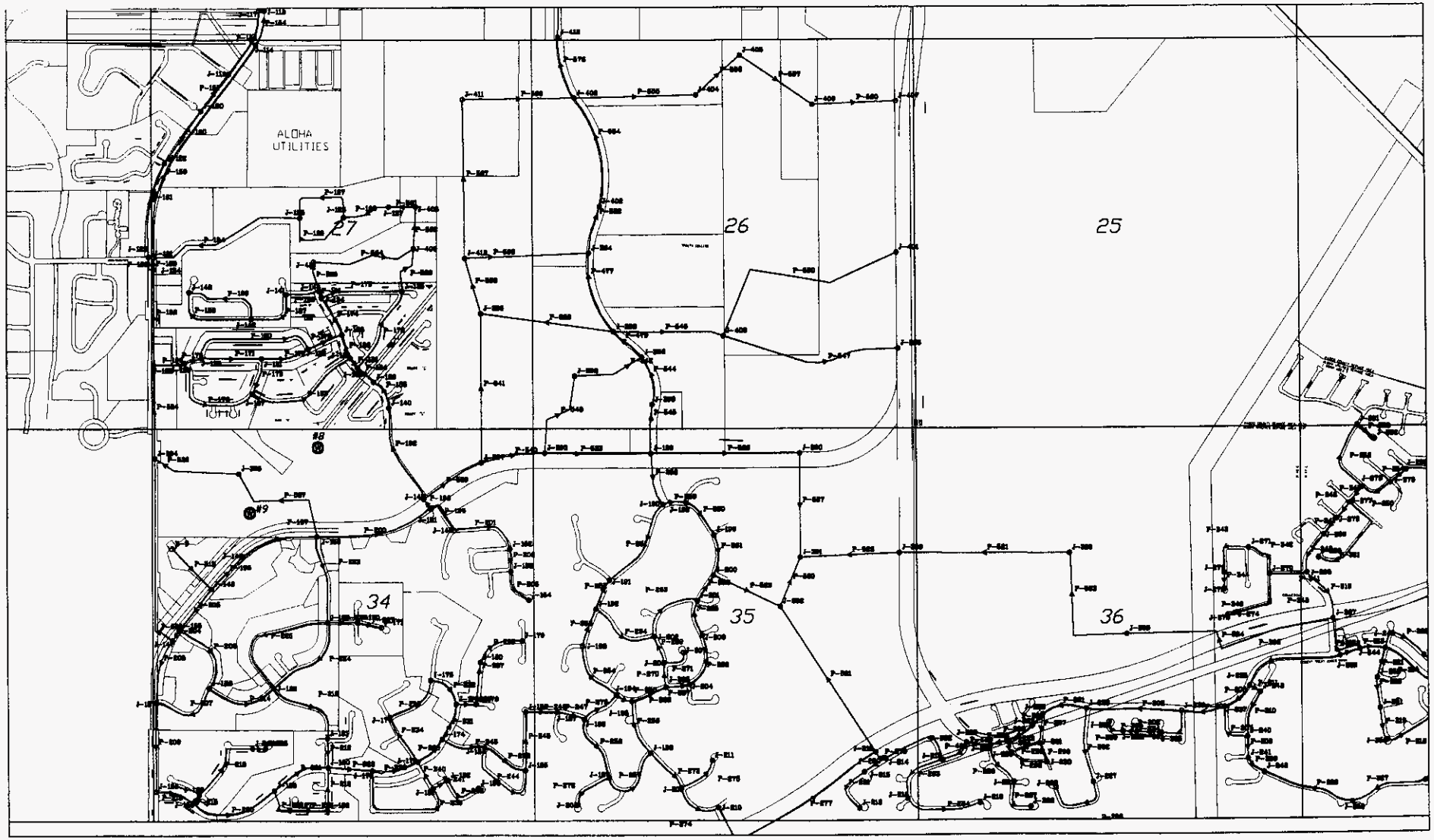
Link Label	Length (ft)	Diameter (in)	Material	Roughness	Current Status	Discharge (gpm)	Start Hydraulic Grade (ft)	End Hydraulic Grade (ft)	Headloss (ft)	Friction Slope (ft/1000ft)
P-557	1,208.00	12	PVC	140.0	Open	33.39	144.39	144.39	0.5e-2	0.41e-2
P-558	1,997.00	12	PVC	140.0	Open	-34.20	144.38	144.38	0.01	0.43e-2
P-559	2,056.00	12	PVC	140.0	Open	-66.06	144.38	144.41	0.03	0.01
P-560	1,150.00	12	PVC	140.0	Open	33.39	144.39	144.38	0.47e-2	0.41e-2
P-561	367.00	8	PVC	140.0	Open	-78.74	147.82	147.87	0.05	0.15
P-562	566.00	8	PVC	140.0	Open	-101.69	147.87	148.00	0.13	0.23
P-563	601.00	8	PVC	140.0	Open	-69.53	148.00	148.07	0.07	0.12
P-564	1,399.00	8	PVC	140.0	Open	-55.10	148.00	148.11	0.11	0.08
P-565	399.00	8	PVC	140.0	Open	-78.05	148.11	148.17	0.06	0.14
P-566	1,560.00	12	PVC	140.0	Open	-4.88	144.43	144.43	0.18e-3	0.12e-3
P-567	2,155.00	12	PVC	140.0	Open	-121.75	144.43	144.53	0.10	0.05
P-568	1,723.00	12	PVC	140.0	Open	40.75	144.53	144.52	0.01	0.01
P-569	782.00	12	PVC	140.0	Open	-187.60	144.53	144.61	0.08	0.10
P-570	117.00	12	PVC	140.0	Open	-39.39	144.42	144.42	0.66e-3	0.01
P-575	1,159.00	12	PVC	140.0	Open	-39.39	144.42	144.43	0.01	0.01
P-576	862.00	12	PVC	140.0	Open	-39.39	144.43	144.43	0.48e-2	0.01
P-577	4,208.00	12	PVC	140.0	Closed	0.00	144.43	144.24	0.00	0.00
P-578	1,482.00	12	PVC	140.0	Open	-1,151.76	136.36	140.64	4.28	2.89
P-579	1,278.00	12	PVC	140.0	Open	-1,186.89	140.64	144.54	3.90	3.05
P-580	1,376.00	12	PVC	140.0	Open	220.29	144.28	144.10	0.19	0.14
P-581	1,226.00	12	PVC	140.0	Open	220.29	144.10	143.93	0.17	0.14
P-583	661.00	16	Ductile Iron	130.0	Open	-2,313.74	139.80	141.76	1.96	2.97
P-584	506.00	16	Ductile Iron	130.0	Open	-2,157.43	135.86	137.18	1.32	2.61
P-585	998.00	16	Ductile Iron	130.0	Open	-2,163.17	137.18	139.80	2.61	2.62
P-586	874.00	12	Ductile Iron	130.0	Open	-1,016.77	127.62	129.92	2.30	2.63
P-587	684.00	12	Ductile Iron	140.0	Open	-1,028.96	129.92	131.52	1.60	2.35
P-592	880.00	12	PVC	140.0	Open	-265.56	131.35	131.52	0.17	0.19
P-594	1,230.00	12	PVC	140.0	Open	-250.51	131.14	131.35	0.21	0.17
P-595	478.00	8	PVC	140.0	Open	19.91	122.31	122.31	0.01	0.01
P-596	519.00	8	PVC	140.0	Open	-192.33	122.31	122.70	0.39	0.76
P-597	2,036.00	8	PVC	140.0	Open	212.23	122.31	120.45	1.85	0.91
P-598	995.00	8	PVC	140.0	Open	3.03	120.45	120.45	0.34e-3	0.35e-3
P-599	840.00	8	PVC	140.0	Open	-249.75	120.45	121.49	1.03	1.23
P-602	5,720.00	16	Ductile Iron	130.0	Open	-2,170.38	152.26	167.34	15.08	2.64
P-603	1,989.00	16	Ductile Iron	130.0	Open	-2,226.31	167.34	172.83	5.50	2.76
P-604	2,932.00	12	Ductile Iron	130.0	Open	-1,028.81	144.38	152.26	7.88	2.69
P-605	230.00	8	PVC	140.0	Open	-436.29	127.26	128.06	0.79	3.45
P-606	343.00	8	PVC	140.0	Open	77.93	128.06	128.01	0.05	0.14
P-607	434.00	8	PVC	140.0	Open	-514.22	128.06	130.09	2.03	4.68
P-608	1,642.00	12	PVC	140.0	Open	280.92	131.42	131.07	0.35	0.21
P-609	467.00	12	PVC	140.0	Open	-233.30	131.07	131.14	0.07	0.15
P-610	210.00	8	PVC	140.0	Open	-514.22	130.09	131.07	0.98	4.68
P-611	646.00	8	PVC	140.0	Open	178.93	128.29	127.86	0.43	0.66
P-612	156.00	12	Ductile Iron	130.0	Open	-1,294.53	131.52	132.16	0.64	4.11
P-613	1,006.00	8	PVC	140.0	Open	-99.22	120.04	120.27	0.22	0.22
P-614	816.00	8	PVC	140.0	Open	-99.22	120.27	120.45	0.18	0.22
P-615	919.00	8	PVC	140.0	Open	-162.72	119.35	119.87	0.51	0.56
P-616	1,056.00	8	PVC	140.0	Open	81.14	120.45	120.29	0.16	0.15
P-617	757.00	8	PVC	140.0	Open	162.72	120.29	119.87	0.42	0.56
P-618	1,048.00	8	PVC	140.0	Open	-81.57	120.29	120.45	0.16	0.16
P-619	1,200.00	12	PVC	140.0	Open	914.26	144.54	142.28	2.26	1.88
P-620	1,209.00	20	Ductile Iron	130.0	Open	3,523.16	185.00	182.37	2.63	2.18

Steady State Analysis
Pipe Report

Link Label	Length (ft)	Diameter (in)	Material	Roughness	Current Status	Discharge (gpm)	Start Hydraulic Grade (ft)	End Hydraulic Grade (ft)	Headloss (ft)	Friction Slope (ft/1000ft)
P-621	2,632.00	20	Ductile Iron	130.0	Open	3,523.16	182.37	176.63	5.73	2.18
P-622	236.00	8	PVC	140.0	Open	459.04	185.00	184.10	0.90	3.80
P-657	658.00	8	PVC	140.0	Open	10.76	158.12	158.12	0.24e-2	0.37e-2



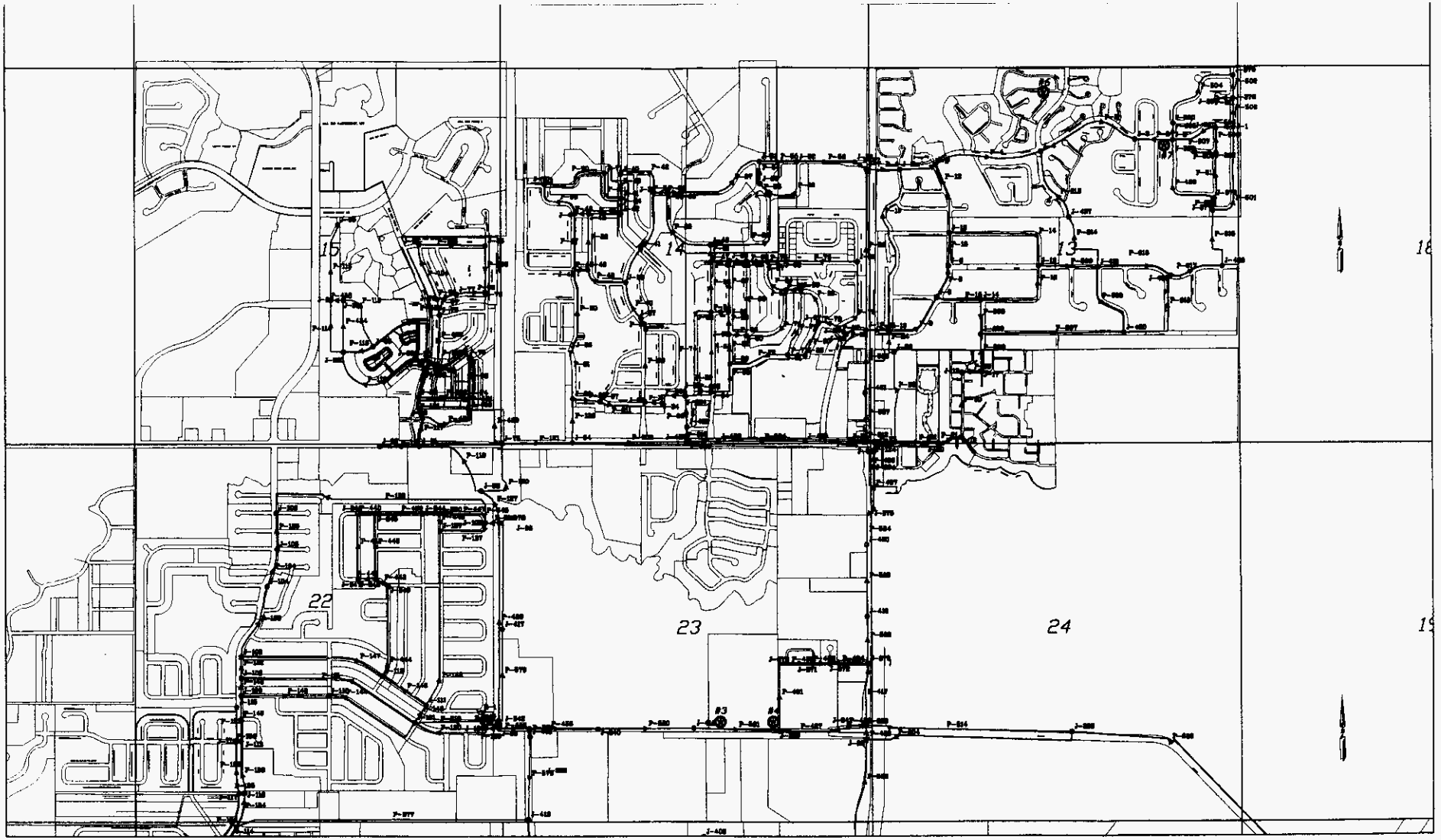
Civil Engineering Associates Inc. 720 E. FLETCHER AVE. TAMPA ,FL	SEVEN SPRINGS WATER SYSTEM 2015 INITIAL NODE MAP, PT.1	FIGURE E-1



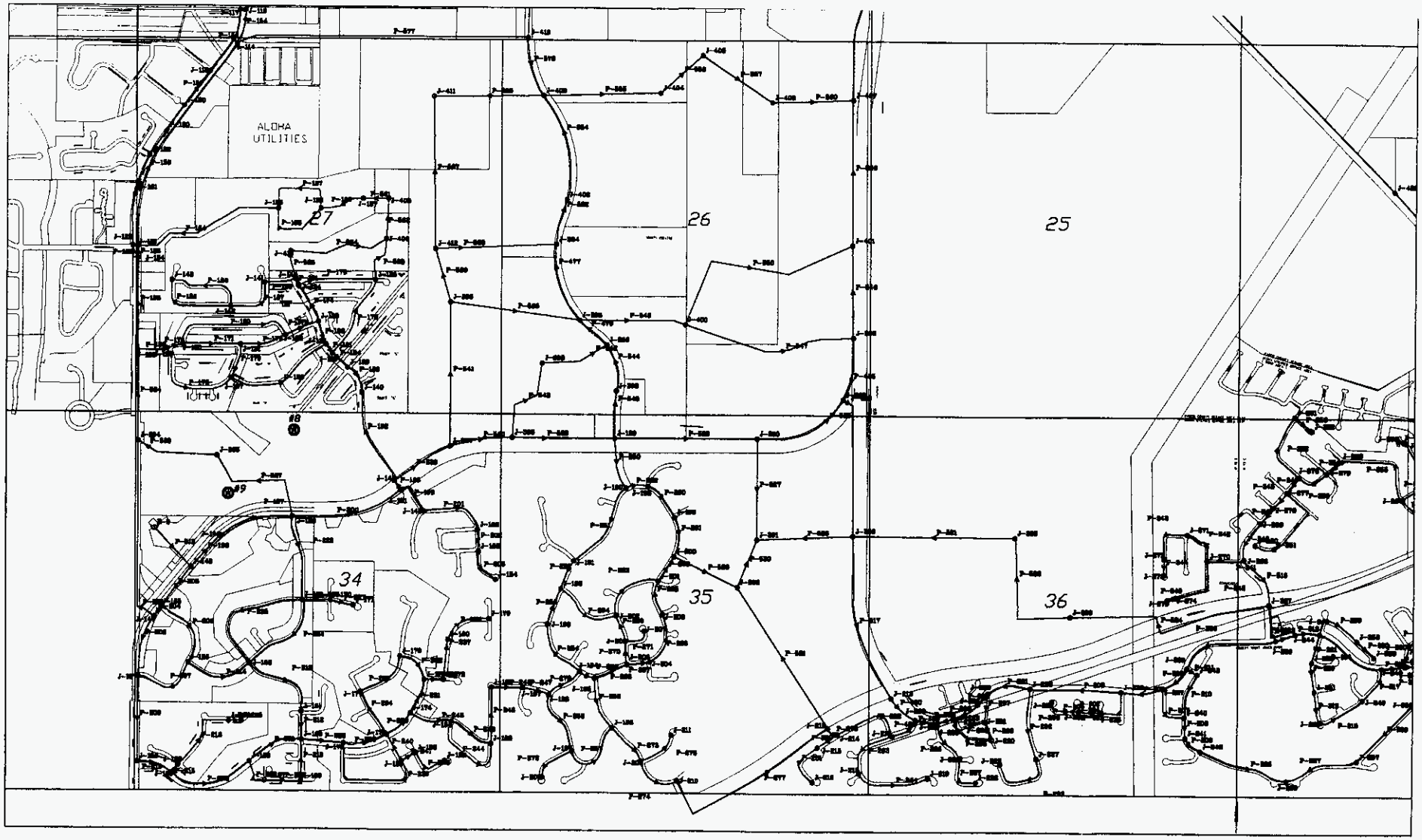
Civil Engineering Associates Inc. 720 E. FLETCHER AVE. TAMPA ,FL	SEVEN SPRINGS WATER SYSTEM 2015 INITIAL NODE MAP, PT.2	FIGURE E-2



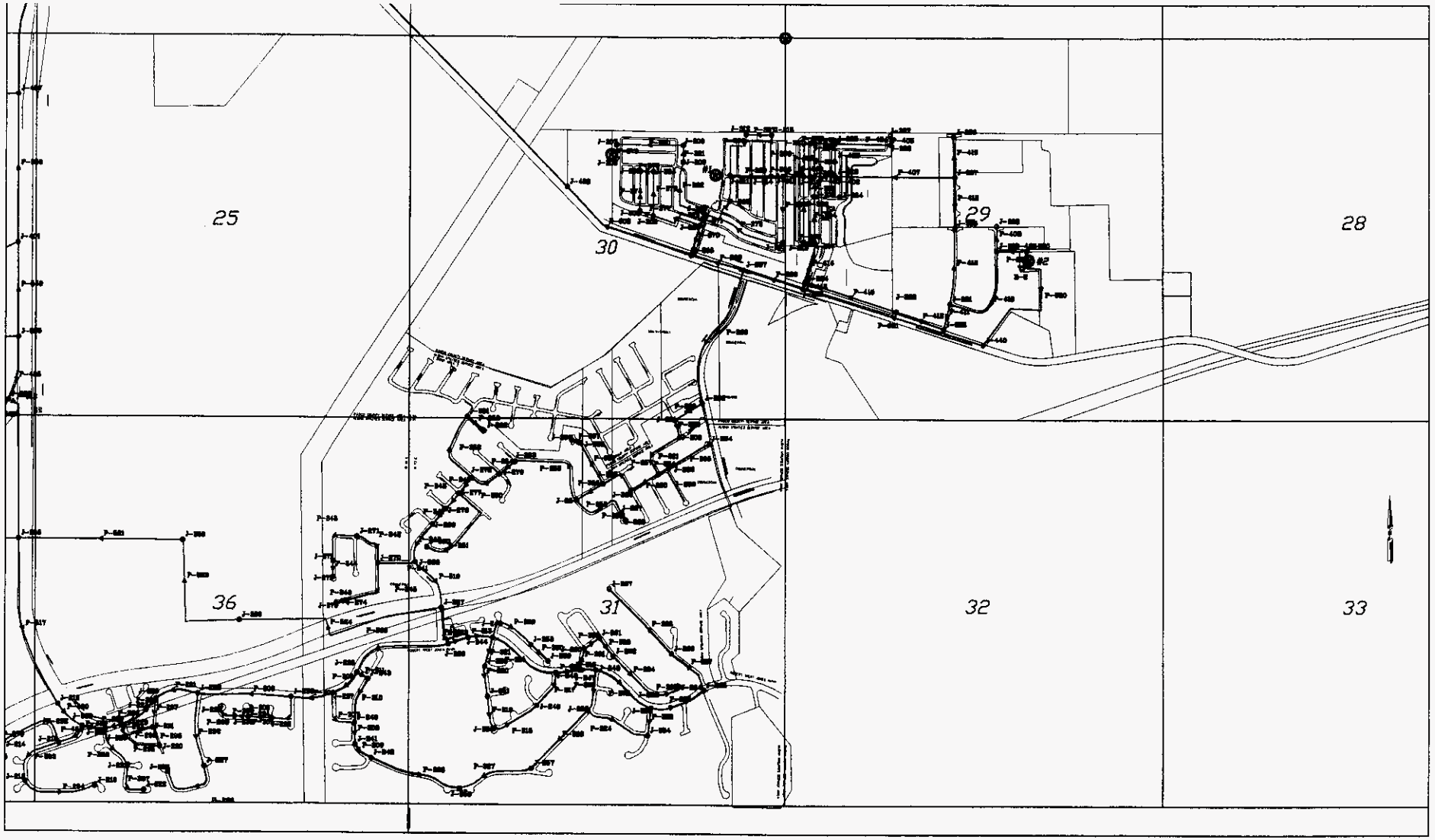
Civil Engineering Associates Inc. 720 E. FLETCHER AVE. TAMPA ,FL	SEVEN SPRINGS WATER SYSTEM 2015 INITIAL NODE MAP, PT.3	FIGURE E-3



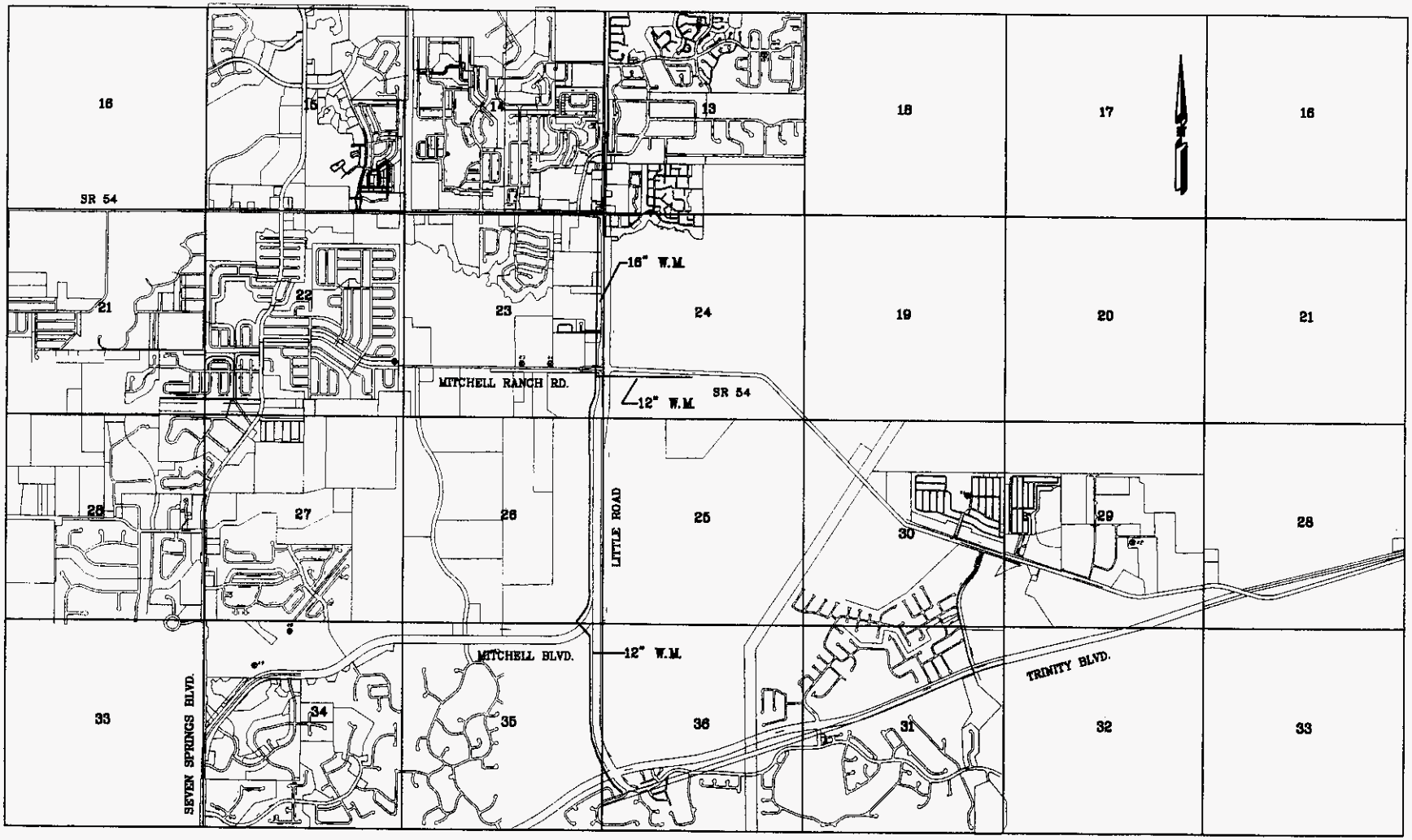
Civil Engineering Associates Inc. 720 E. FLETCHER AVE. TAMPA ,FL	SEVEN SPRINGS WATER SYSTEM 2015 FINAL NODE MAP, PT.1	FIGURE E-4



Civil Engineering Associates Inc. 720 E. FLETCHER AVE. TAMPA ,FL	SEVEN SPRINGS WATER SYSTEM 2015 FINAL NODE MAP, PT.2	FIGURE E-5



Civil Engineering Associates Inc. 720 E. FLETCHER AVE. TAMPA ,FL	SEVEN SPRINGS WATER SYSTEM 2015 FINAL NODE MAP, PT.3	FIGURE E-6



Civil Engineering Associates Inc. 720 E. FLETCHER AVE. TAMPA FLORIDA	SEVEN SPRINGS WATER SYSTEM 2015 PIPING IMPROVEMENTS	FIGURE E-7