980214-WS

ORIGINAL

Response to Question 14 in staff's data requests

Jacksonville Suburban Utilities Corporation

Water Use Management Plan

Submitted to:
St Johns River Water Management District
October 1994

Jacksonville Suburban Utilities Corporation

Water Use Management Plan

SYSTEM	C.U.P. #
Arlington	2-031-0028
Forest Brook	2-031-0040
Holly Oaks	2-031-0015
Hyde Grove	2-031-0038
Jacksonville Heights	2-031-0034
Lake Forest	2-031-0042
Magnolia Gardens	2-031-0039
Ortega Hills	2-031-0025
Ponce de Leon	2-109-0209
Ponte Vedra North	2-109-0118
Ponte Vedra South	2-109-0110
Royal Lakes	2-031-0036
San Jose	2-031-0033
San Pablo	2-031-0165
St. Johns North	2-109-0071
Venetia Terrace	2-031-0041

OCTOBER 1994

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A. INTRODUCTION

JACKSONVILLE SUBURBAN UTILITIES CORPORATION

WATER USE MANAGEMENT PLAN

INTRODUCTION

Jacksonville Suburban Utilities Corporation (JSUC) is submitting this Water Use Management Plan to the St. Johns River Water Management District (SJRWMD) as a supplement to the sixteen Consumptive Use Permits (C.U.P.s) listed on the title page.

JSUC is a wholly owned subsidiary of General Waterworks Corporation (GWC), a group of investor-owned companies whose corporate office is located in Harrington Park, New Jersey. GWC began in Arkansas in 1942, and has since expanded to 14 states. Each GWC company is a separate corporate entity operating under the laws of its respective state. GWC has recently merged with United Water Resources, thereby forming the second largest investor-owned utility in the country.

JSUC strongly encourages water use management and has implemented several procedures to achieve this goal, including annual replacement of old water mains and old meters, annual testing of production and City intertie meters, annual testing of all large meters (3" and above), monthly unaccounted-for-water reporting, corrosion control studies, on-site reuse at wastewater treatment plants, leak detection surveys, and public education.

This Water Use Management Plan is divided into sections concerning unaccounted-for-water losses, reuse, conservation rate structure, and public education on a company-wide basis. These are followed by sections that specifically address each individual system. The last section of this Plan contains a summary of our proposed additional conservation activities and timeframes.

In addition to the other water use management activities described in this Plan, our company has contracted the University of Florida to conduct a study concerning hydrogen sulfide removal in the treatment process. Hydrogen sulfide is believed to cause pipe corrosion, so finding an effective removal process should subsequently decrease water losses due to leakage. This study was completed on August 31, 1994, and the University's final report has been included as Attachment 1.

ATTACHMENT 1

HYDROGEN SULFIDE AND CORROSION CONTROL STUDY JACKSONVILLE SUBURBAN UTILITIES

FINAL REPORT

August 31, 1994

prepared by:

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Department of Environmental Engineering Sciences
University of Florida

INTRODUCTION

Jacksonville Suburban Utilities (JSU) is a private utility company operating both water and wastewater facilities in ten noncontiguous areas in and around Jacksonville, Florida. In each of these service areas, water is pumped from deep wells in the Floridan Aquifer, aerated in small cascade aerators, chlorinated and stored in water storage tanks at the well sites before being pumped into the distribution system. Some service areas have a number of wells and treatment facilities that feed into a common distribution system, e.g. the Holly Oaks area is served by three treatment plants (Monument Road, Ft. Caroline Road, and Queen Akers).

In June 1991 JSU requested a study of a portion of its water supply system be performed by the University of Florida. The focus of the study was hydrogen sulfide control and its effect on disinfection residuals and corrosion in the distribution system. Phase I of this study was completed in October 1991 and is described in a report dated October 31, 1991 entitled Hydrogen Sulfide Study for Jacksonville Suburban Utilities Phase I: Water Quality Assessment.

The Phase I study focused on the Holly Oaks service area and the three water treatment plants that serve this area: Ft. Caroline Rd., Monument Rd., and Queen Akers. Sulfide concentrations in untreated well water pumped from the Floridan Aquifer ranged from 2.7 to 3.8 mg/L. Although these sulfide concentrations were reduced by only 14% to 30% by cascade aeration,

chlorination was effective in oxidizing the remaining sulfide to below detection levels (0.1 mg/L) before the water entered the distribution system. Dissolved oxygen concentrations increased from virtually zero in the untreated well water to 5 mg/L before distribution. Free chlorine residuals leaving the treatment plants were found to vary from trace levels to greater than 3.5 mg/L. Free chlorine residuals in the distribution system were found to vary from below detection levels to 0.9 mg/L. First draw samples in the distribution system were found to contain copper concentrations as high as 2.8 mg/L.

In order to address the hydrogen sulfide problem as well as the excessive copper corrosion in the interior plumbing of residential homes, JSU commissioned the University of Florida to investigate various control technologies with laboratory and pilot plant studies. Three separate studies were conducted by graduate students at the University of Florida under the direction and supervision of the principal investigator. Project reports in partial fulfillment of the requirements for the Master of Engineering Degree were published. These graduate students and their report titles are listed below, and the reports are submitted as part of this final report of the project.

1. "Removal of Hydrogen Sulfide from Drinking Water by Packed-tower and Slatted-tray Aerators: A Pilot Study," by Ronald Olsen.
2. "Oxidation of Sulfide with Chlorine and Hydrogen Peroxide," by Michael Delate.

3. "Report on the Investigation of Copper Corrosion Control: A Flow-through Test Study," by Craig Langley.

This final report summarizes the results of these investigations and reports.

METHODS

The research project included both laboratory and pilot plant investigations. Laboratory bench-scale studies, conducted at the University of Florida Department of Environmental Engineering Sciences, focused on the oxidation of sulfide. Laboratory analytical measurements for all phases of the research were also performed at the University of Florida facilities. A pilot plant for hydrogen sulfide control (both by air stripping and chemical oxidation) and copper corrosion control was constructed by JSU at their Monument Road Water Treatment Plant. A schematic diagram of the plant is provided in Figure 1.

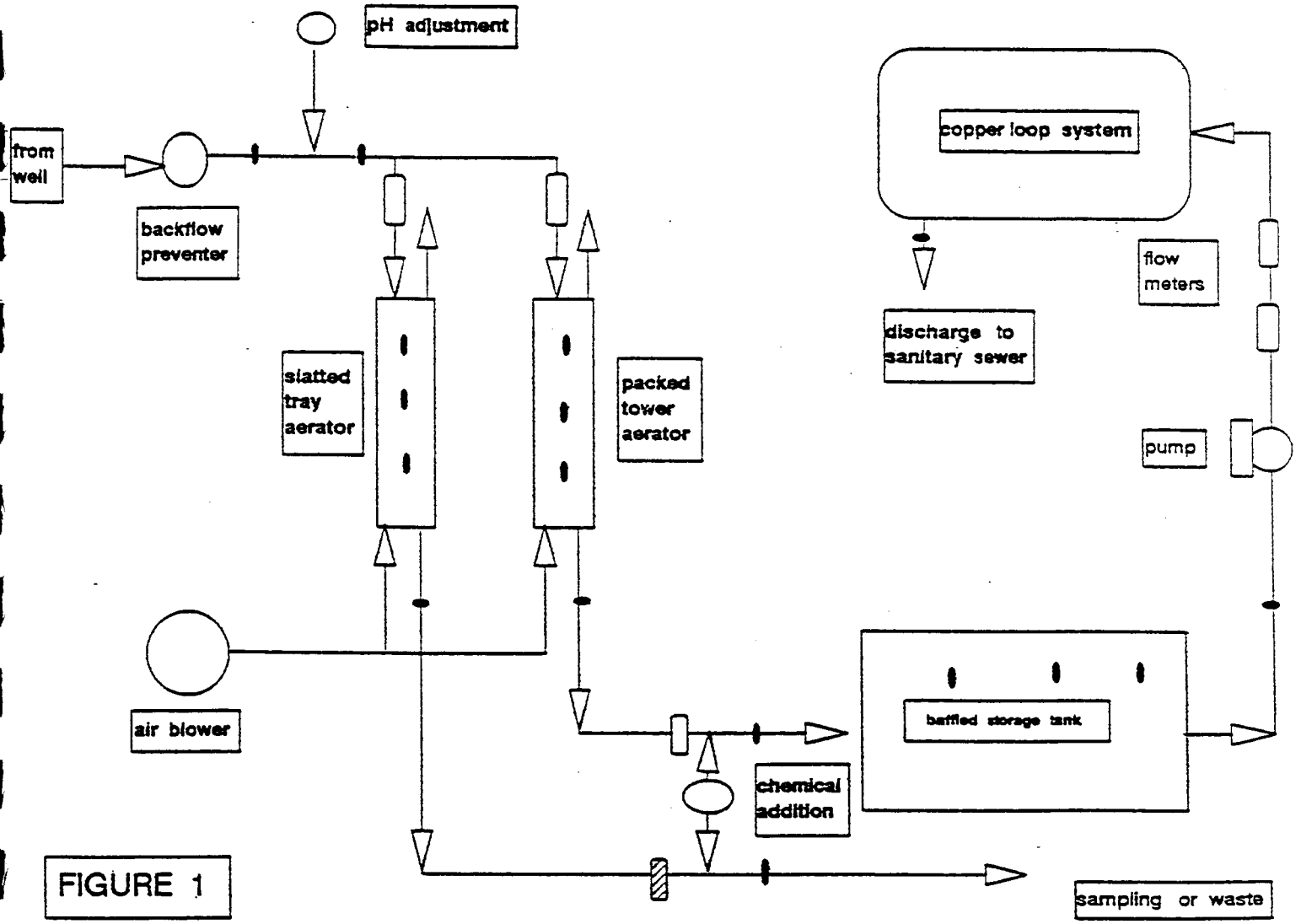

pH adjustment
from well
backflow preventer
slatted tray aerator
packed tower aerator
copper loop system
discharge to sanitary sewer
flow meters
pump
air blower
baffled storage tank
chemical addition
sampling or waste

FIGURE 1

Data from the pilot plant were collected intermittently (during specific experimental runs) from May, 1993 to August, 1993. Regular (weekly) monitoring of the corrosion loop portion of the pilot plant was performed from February, 1994 to August, 1994. During this latter period, the packed-tower aerator and oxidation/storage tank were also monitored with respect to selected water quality parameters.

Throughout the course of the project strict attention was given to accuracy and precision of results. All field and laboratory measurements were made according to either equipment instruction manuals or procedures outlined in Standard Methods. Field and laboratory instrumentation was calibrated daily or more often, and laboratory protocols included the development and validation of calibration curves, replicate analysis and blank analysis. Details of the monitoring method and analytical protocols can be found in the three reports that have been previously cited.

RESULTS

AERATION STUDY

The results of the aeration study indicated that hydrogen sulfide may be partially removed in a packed tower aerator (PTA) or

a slatted-tray aerator (STA). The PTA provided better sulfide removal efficiencies than the STA particularly at the ambient pH (Table 1). The improved removal efficiency of the PTA as compared to the STA was in spite of the higher loading rate (Q/A) and the slightly higher pH in the PTA experimental run. Both of these factors would tend to decrease the sulfide removal efficiency. The results shown in Table 1 are representative; more detail may be found in the Olsen report.

Table 1. PTA and STA total sulfide removal efficiency at ambient pH

	G/L	Q/A	pH	Removal eff.
	ft^3/ft^3	gpm/ft^2		%
PTA	17	21.5	7.56	72
STA	19	9.0	7.40	40

As theory would predict, lowering the pH prior to aeration allowed better removal efficiencies in both the STA and the PTA under all air-to-water ratios. Because the alkalinity of the raw water is relatively high (135 mg/L as $CaCO_3$), about 50 mg/L of concentrated sulfuric acid or about 95 mg/L of concentrated hydrochloric acid would be required to lower the pH by one pH unit. Such a sulfuric acid dosage would appreciably increase the already substantial sulfate concentration of the raw water and the cost of either acid dosage would be significant. In addition, the pH would

likely have to be increased with strong base addition for corrosion control purposes. Special facilities would be required to house the acid on site, and special handling would be required.

The PTA, STA and diffused aeration system increased the dissolved oxygen concentration of the water from near zero to between 5 and 6 mg/L. Increasing the dissolved oxygen concentration may exacerbate corrosion problems in the distribution system; however, low dissolved oxygen levels in the distribution system may lead to reversion of oxidized sulfur species to sulfide, thereby causing taste and odor problems and chlorine demand. Moreover, oxidation of the non-aerated raw water with chlorine produced high levels of turbidity as will be discussed in the oxidation portion of this report. It should be noted that the Phase 1 study found dissolved oxygen concentrations of between 5 and 6 mg/L as a result of the existing cascade aeration device which was found to remove between 23 and 30% of the total sulfide concentration at the Monument Rd. plant.

The PTA was operated intermittently during the initial phases of the research when volatilization and chemical oxidation were studied. During this initial period, the PTA and other appropriate processes were allowed to come to steady-state before samples were collected, but the systems were shut down for up to one week between certain sampling runs. During these shut-down periods, the packing dried, presumably inhibiting the growth of sulfide oxidizing bacteria. Accordingly, in the first phase of the research bacterial growth and fouling of the packing in the PTA was

not observed.

During the second phase of the research, the corrosion control study, the PTA and the chlorination/storage processes were operated continuously. After approximately 4 months of operation considerable turbidity was found developing in the storage tank. Water was also found to be backing-up in the tower a few feet above the normal operating head. This latter hydraulic problem was subsequently found to be the result of a flow restriction in the static mixer between the PTA and the storage tank and unrelated to the bacterial growth in the PTA. At that time the PTA was temporarily taken out of service. Some packing was removed from the top of the PTA and from some of the sampling ports positioned at various depths in the PTA. A white slime was observed on most of the packing. Some of the packing contained a combination of white and dark slime. It should be noted that the PTA was originally constructed with a transparent window which was covered with an opaque plastic during the initial phase of the study. This plastic film was torn during an inspection of the packing at some time during the second phase and was not repaired. A luxuriant growth of green and brown material could be seen through the window after several months of continuous operation. This green and brown colored growth likely was a photosynthetic microorganism and should not be a problem with full-scale operation if light is excluded from the packing.

Samples were collected of the white slime on the packing and of the turbidity in the storage tank. Under microscopic

examination, these appeared to be filamentous bacteria, perhaps *Beggiatoa* or *Thiothrix*. Granules of what appeared to be elemental sulfur appeared inside the filaments. Apparently, these bacteria began to grow on the packing using carbon dioxide as a carbon source and oxygen as an electron acceptor while oxidizing sulfide to sulfur in the PTA. During the initial phase of the study, the sulfide removal efficiency under ambient pH conditions was typically 65 to 75 %. In the second phase of the study when the bacterial growth developed, the sulfide concentration in the PTA effluent has been consistently below detection limits (0.1 mg/L) or essentially 100% removal efficiency.

Although the development of this bacteria enhances the sulfide removal in the PTA by catalyzing the oxidation of sulfide to sulfur, the resulting turbidity may prove to be a problem. Chlorine oxidation of sulfide also produces an elemental sulfur precipitate which results in an increase in turbidity in the effluent water. Apparently, the storage tanks have been retaining most of this turbidity in the past, but it is possible that colloidal sulfur is routinely leaving cascade aeration and chlorination facilities throughout Florida.

The turbidity (in the form of filamentous growth) appeared to be controlled if a chlorine residual was maintained in the storage tank. In the last two weeks of the study the microbial growth in the PTA increased above levels that were previously observed. Effluent from the PTA to the storage tank was highly turbid causing visibility in the storage tank to be reduced to only a few feet on

the last site visit. Prior to this time, the bottom of the storage tank was always visible.

The formation of this turbidity is a cause for concern with regard to using PTA for hydrogen sulfide control at a full-scale treatment plant. Other plants in Florida have been using PTAs and other air stripping devices for hydrogen sulfide control. These utilities have also reported microbial growth but have not indicated that it has caused excessive turbidity problems. A central Florida utility tested the PTA concept with a pilot system but did not observe the growth to be a problem. This pilot system was not operated continuously for an extended period, so sufficient time for growth may not have been provided. The City of Cocoa observed the development of bacterial growth in their pilot PTAs and superchlorinated them with a recirculating chlorine solution every 6 months to control bacterial growth.

Measures to control the growth of the bacteria in the PTA may consist of allowing a drying period during normal operation. Providing two PTAs, each capable of handling the plant flow, would allow for alternate tower operation so that one PTA may be drying while the other is operating. Another option may be the continuous operation of the blower while water flow may be intermittent particularly during low flow conditions. Of course, routine cleaning of the packing will also control bacterial growth.

OXIDATION

A portion of the oxidation study focused on the removal of

sulfide during storage without the addition of chlorine or hydrogen peroxide as oxidants. Water was allowed to flow through the pilot baffled storage tank with a mean hydraulic detention time of 4 hours. Removal of sulfide may have been by volatilization or oxidation by the dissolved oxygen present in the water, but the individual effect of each of these mechanisms was not determined. Sulfide removal efficiency without the addition of chlorine or peroxide was 69% (2.62 mg/L to 0.82 mg/L) using non-aerated well water and 90% (0.72 mg/L to 0.07 mg/L) using aerated water (passed through the PTA). There was evidence of significant oxygen consumption in the aerated water experiment which indicates that oxidation by oxygen was a factor in sulfide removal. A small increase in turbidity was found during these experiments but the final turbidity did not exceed 1 NTU.

Sulfide removal by chlorination was rapid. In both non-aerated and aerated water at mole ratios of chlorine to sulfide of greater than one, sulfide removal occurred within one minute of contact time. Turbidity formation was substantial (15 to 22 NTU) after chlorination of non-aerated water. Turbidity was found to increase above raw water turbidity levels when aerated water with a sulfide concentration of 0.7 mg/L was chlorinated, but the turbidity remained below 2.3 NTU for all chlorine doses (up to a mole ratio of chlorine to sulfide of 3.8 or a chlorine dose of 5.1 mg/L.) It should be noted that a chlorine residual could not be maintained for the four hour detention time at the chlorine doses employed in the field experiments.

Sulfide removal by oxidation with hydrogen peroxide was slower than chlorine oxidation in aerated water. Hydrogen peroxide oxidation of sulfide in non-aerated water caused excessive turbidity formation (30 to 40 NTU) after four hours of detention time in the storage tank.

Because hydrogen peroxide is twice as expensive as chlorine by weight, and the dosage of hydrogen peroxide required to remove sulfide remaining after packed tower aeration is twice the required dosage of chlorine, chlorine is clearly the less expensive of the two oxidants.

CORROSION CONTROL

The copper corrosion control loop study was performed using a cooper loop system shown in the schematic in Figure 2.

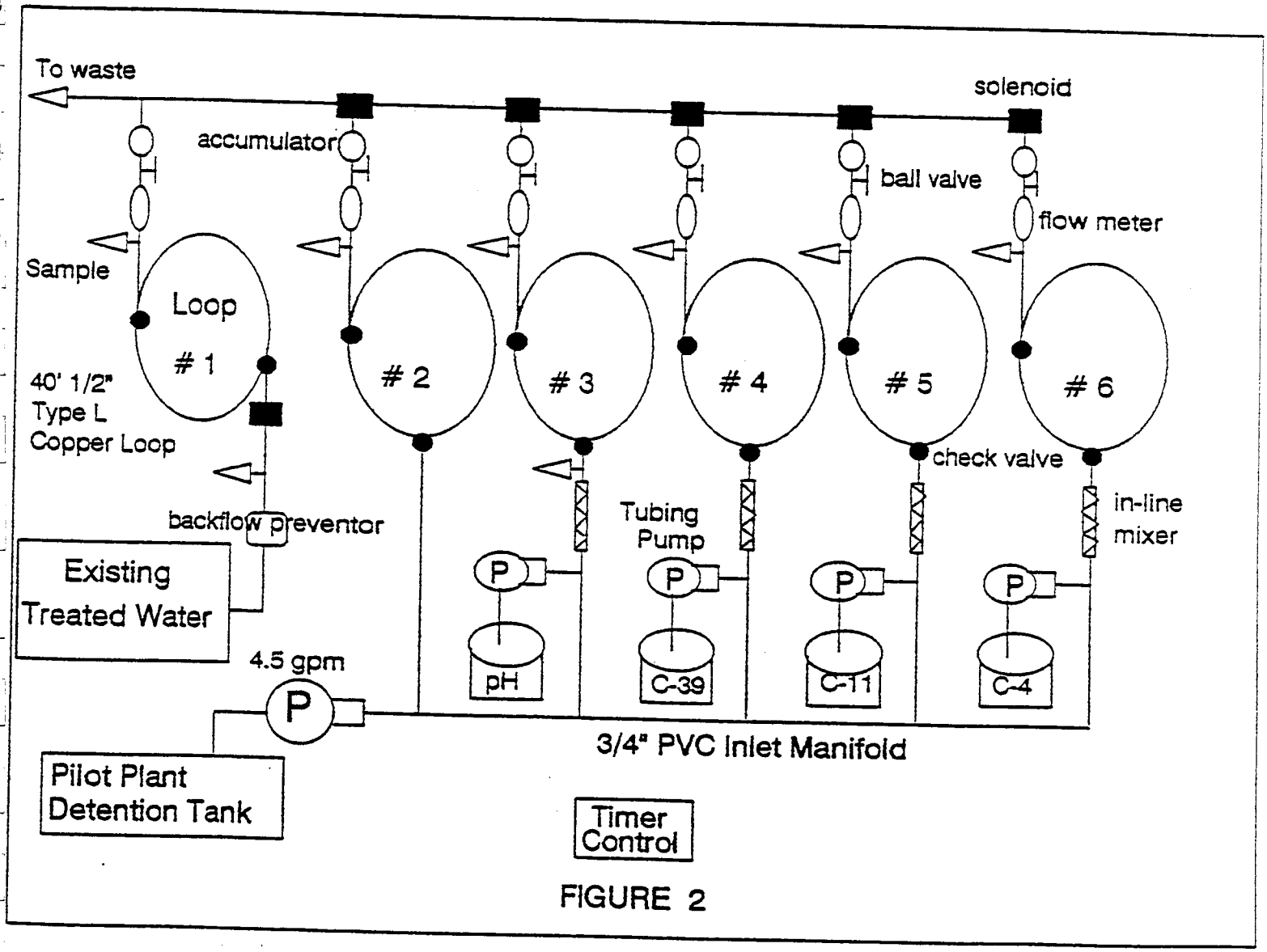

To waste
solenoid
accumulator
ball valve
flow meter
Sample
Loop
1
2
3
4
5
6
40' 1/2"
Type L
Copper Loop
check valve
in-line
mixer
backflow preventor
Tubing
Pump
Existing
Treated Water
P
pH
C-39
C-11
C-4
4.5 gpm
3/4" PVC Inlet Manifold
Pilot Plant
Detention Tank
Timer
Control

FIGURE 2

The loops were exposed to different water conditions:

Loop 1 - Water from the existing treatment system at the Monument Rd. Plant.

Loop 2 - Water from the pilot plant (stripped of hydrogen sulfide and carbon dioxide in the PTA, chlorinated, and stored for nominally 4 hours).

Loop 3 - Same as Loop 2. This loop was intended as a pH adjustment loop; however, the pH increased through the PTA to a value that provided a positive Langlier Index. Accordingly, the pH was not further adjusted.

Loop 4 - Pilot plant water with the addition of a polyphosphate inhibitor.

Loop 5 - Pilot plant water with the addition of an orthophosphate inhibitor.

Loop 6 - Pilot Plant water with the addition of a blended phosphate inhibitor.

The corrosion control study was conducted from February 6, 1994 to July 28, 1994, allowing the collection of data over a twenty-six week period.

The first draw, copper concentrations for the six loops are plotted versus time in Figure 3. The aberrant values obtained during weeks 9 through 11 were the result of a PTA malfunction. The copper concentration in Loop 1, the Monument Rd. plant control averaged about 1.5 mg/L over the last few weeks of the study. This value exceeds the action level of 1.3 mg/L in the Lead and Copper

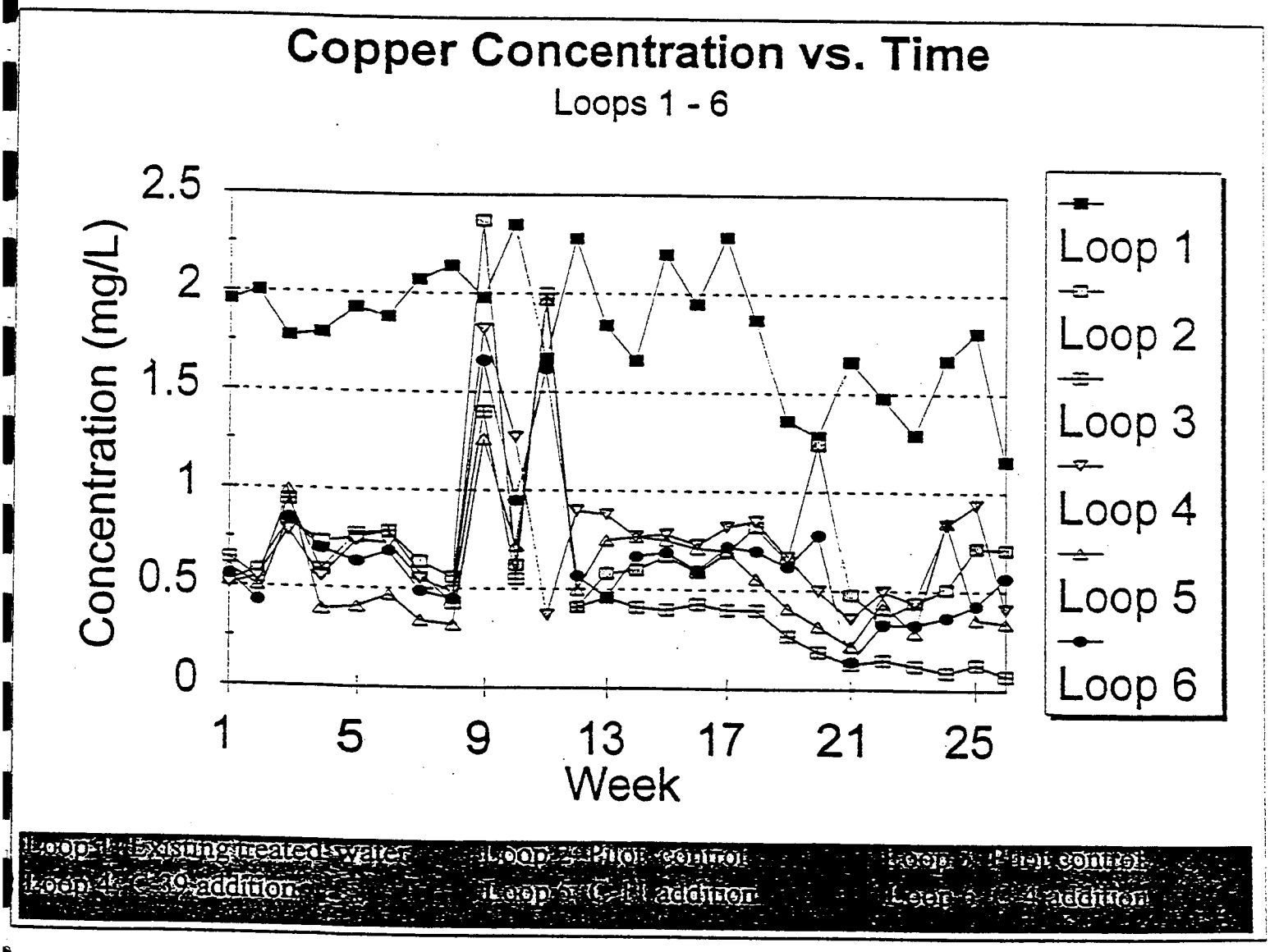


Figure 3. First draw copper concentrations for loops 1 - 6 vs time

Rule, and is near the average copper concentration found in the JSU Lead and Copper Rule Monitoring of 1.57 mg/L. With the exception of weeks 9 through 11, the average concentration for the loops 2 and 3, those receiving pilot plant water without any further chemical addition, was about 0.65 mg/L and 0.40 mg/L, respectively. The pilot plant water was considerably less corrosive to copper than the water treated in the existing Monument Rd. treatment plant.

Excluding, the three-week period when the PTA was inoperative, the average pH of the water treated in the pilot plant was 8.22 as compared to the existing treatment plant pH of 7.15. The increase in pH is the result of carbon dioxide removal, and, to a lesser extent, hydrogen sulfide removal in the PTA. The increase in pH was sufficient to alter the Langlier Index (LI) from -0.44 to +0.65 and change the calcium carbonate precipitation potential (CCPP) from -323 mg/L to 10 mg/L. This CCPP falls within the range recommended by EPA for producing a water that will inhibit corrosion through a protective coating of calcium carbonate. However, it is unlikely that the difference in the copper concentrations between loop 1 and loops 2 and 3, found from the beginning of this study, was the result of calcium carbonate deposition because some time is required before the deposition of the calcium carbonate scale can become effective. It is more likely, that the pH affected the electrochemical nature of corrosion by reducing the corrosion potential.

The trend of copper concentration decrease in Loop 3 from week 13 through week 26 was likely the result of a leaking solenoid on loop 3 that was only discovered in the final week of the study. The leakage was insufficient to produce a reading on the instantaneous flow meter but could be observed on the accumulator.

All inhibitors were fed at 1 mg/L as inhibitor in accordance with the manufacturer's recommendation. No one inhibitor caused a dramatic change in corrosion. As shown in Figure 3, there is little difference between these concentrations and those found in loops 2 and 3. Overall, of the three inhibitors, the zinc orthophosphate (C-11) produced the lowest copper concentrations in the test loops.

The dosage of C-11 was increased ten-fold and the concentrations of C-4 and C-39 were doubled during the last four weeks of the study. No significant difference in first-draw copper concentrations was noted when concentrations of copper before the increase in inhibitor dosage were compared to copper concentrations after the increase in dosage.

It should be noted that the three inhibitors in loops 4, 5 and 6 were used above the recommended pH range. The range of pH in the test loops fed by pilot plant water was 8.00 to 8.46. The optimum pH range for phosphate inhibitors is below 8.0. Operating outside the optimum pH range for the phosphate inhibitors may have had an adverse effect on their performance. On the other hand, the Monument Rd. Treatment Plant water in loop 1 was dosed with zinc polyphosphate inhibitor and had a pH range of 7.04 to 7.52 (a more

favorable pH range for corrosion inhibition), yet copper concentrations in this loop were higher than all other loop copper concentrations.

SUMMARY AND RECOMMENDATIONS

In order to produce a potable water of high quality which satisfies federal and state regulations, an integrated design approach should be implemented, taking into consideration the effect of the treatment process on each important water quality parameter. The JSU supply, drawn from the Floridan Aquifer, contains elevated levels of hydrogen sulfide and carbon dioxide. It is desirable to reduce the concentrations of both of these compounds prior to distribution. The hydrogen sulfide produces offensive odor in water, exerts a chlorine demand and may cause pipe corrosion. Carbon dioxide is a weak acid and lowers the pH of water. Copper corrosion has been associated with low pH in this study as well as in previous research. JSU has been experiencing low chlorine residuals in the distribution system and elevated copper concentrations in first-draw samples from residences in their distribution system.

Hydrogen sulfide and carbon dioxide can be removed in an air stripping process. Total sulfide (the sum of hydrogen sulfide, H_2S, and bisulfide, HS^-) can be transformed to elemental sulfur and other oxidized forms of sulfur (such as sulfate, SO_4^{2-}) by using oxidants such as chlorine, hydrogen peroxide, ozone and even oxygen. Microbes may catalyze the oxidation when oxygen is the

oxidant.

Air stripping has the advantage of removing the hydrogen sulfide from the water, but only the hydrogen sulfide portion of the total sulfide can be removed in this manner. Because carbon dioxide removal, as well as hydrogen sulfide removal, causes the pH to increase, the air stripping process causes the sulfide species distribution to shift to the non-volatile bisulfide. Accordingly, all of the sulfide may not be removed in the air stripping process. In the subject research only about 70% of the total sulfide was removed in the PTA. Adjustment of the pH prior to air stripping enables greater sulfide removal efficiencies, but, with the high alkalinity of the Floridan Aquifer water in the JSU service area, high dosages of acid would be required to substantially lower the pH. In addition, the lower pH would exacerbate copper corrosion in the distribution system. Accordingly, pH adjustment is not recommended since good hydrogen sulfide removal efficiencies may be obtained with the PTA at ambient pH and oxidation techniques are available to remove the remaining amount of sulfide.

Packed tower aeration achieves the greatest removal efficiencies for all volatile species as compared to other methods of air stripping. In this study the slatted tray aerator was found to be far less efficient at removing hydrogen sulfide. If PTAs replace the low efficiency cascade aerators at the JSU plants, increased concentrations of hydrogen sulfide in the air may be expected concomitant with increased efficiencies of hydrogen sulfide removal from the water. The total sulfide concentration of

2.0 to 2.5 mg/L at Monument Rd. Treatment Plant during the course of this study may not be high enough to produce severe odor problems, but the potential for neighborhood complaints exists. PTAs may be retrofitted with scrubbers or biofilters to remove hydrogen sulfide odors.

Oxidation of sulfides by chlorine, hydrogen peroxide and oxygen produce an insoluble colloidal elemental sulfur. This sulfur may increase turbidity levels in the distributed water but the turbidity may be reduced by removing some of the sulfide (in an air stripping process, for example) prior to the oxidation process. In this study both chlorine and hydrogen peroxide rapidly oxidized the sulfide, but caused excessive turbidity if the water was not subjected to air stripping before the oxidation step. Oxidation using chlorine was faster than hydrogen peroxide and chlorine, already in use at JSU facilities, is less costly than hydrogen peroxide.

Oxygen also oxidized the sulfide but at a much slower rate. Microbes may catalyze the oxidation of sulfide by oxygen, if microbial growth is allowed to develop. This catalytic effect was observed in the latter part of the research when microbial growth was observed in the pilot PTA and the sulfide removal efficiencies in the PTA approached 100% with a contact time of less than a minute. While microbial growth allows for greater sulfide removal efficiency, the growth produces turbidity in the form of string-like solids in the PTA and the storage tank. This solid is commonly found in all storage tanks and cascade aerators and

presents a maintenance problem. In the last two weeks of the research, the microbial growth was extensive and the resulting turbidity was excessive. Although control of this microbial growth was not studied in this research, methods of control are available, such as periodic cleaning.

It appears that two sulfide removal mechanisms were active in sulfide removal in the PTA--volatile loss of hydrogen sulfide and oxidation of sulfide with oxygen catalyzed by microbial growth. Removal efficiencies are excellent but excessive turbidity may be produced. The turbidity may be controlled by controlling the microbial growth. This control may be achieved by cleaning the packing at regular intervals or, perhaps, by alternately loading two PTA systems and allowing the media to dry in between loadings. JSU personnel report that the cascade aerator at Monument Rd. develops more microbial growth than other aerators because the aerator surface is wet more often. In addition, during the initial testing of the PTA and oxidation system, when the PTA dried in between experimental runs, no microbial growth was noted.

In light of the above findings and the desire of JSU to lower the hydrogen sulfide concentration, the use of a PTA to enhance the hydrogen sulfide removal efficiency is recommended. Special consideration should be given to microbial growth and turbidity control in the full-scale implementation. Careful monitoring of the full-scale operation is important to gain further understanding of the process and to identify the best methods to minimize the problems described above.

The PTA effluent should be chlorinated to oxidize the sulfide remaining after air stripping and directed to a storage tank prior to distribution. Observations in the pilot plant operation indicated that microbial growth and turbidity formation in the storage tank were reduced if a free chlorine residual was maintained.

Consideration should be given to the Disinfection-disinfection by-product (D-DBP) Rule that will soon be promulgated by USEPA and enforced by the FDEP. The proposed rule will reduce the allowable concentration of trihalomethanes (THMs) to 80 ug/L and set the allowable concentration for haloacetic acids (HAAs) at 60 ug/L. A second phase of this regulation may reduce these concentrations by 50%. JSU has not had problems in the past meeting the current THM standard of 100 ug/L. THM formation increases as the pH increases. Since the PTA will increase the pH of the water, additional THM formation can be expected. It does not appear that the increase in pH will cause any problem with meeting the first phase of the new D-DBP rule. The lower concentration limits that may be required by the second phase of the rule may be difficult to achieve.

The copper test loop demonstration study indicated that the increase in pH provided by the PTA reduced the copper concentrations in the first-draw samples from the loop to an average value of 0.65 mg/L over the duration of the test. This concentration may be compared with the existing treatment plant water loop which maintained a copper concentration of about 2.0 mg/L during the first half of the study and 1.5 mg/L over the

second half of the study. Accordingly, it appears that no additional corrosion control treatment of the aerated and chlorinated water is required to satisfy the Lead and Copper Rule action level for copper (1.3 mg/L).

Phosphate inhibitors used in this study included an orthophosphate, a polyphosphate and a blended phosphate product. At dosages of 1 mg/L as product they did not substantially reduce first-draw copper concentrations below copper concentrations achieved by simply increasing the pH as a result of carbon dioxide stripping in the PTA. Doubling the concentrations of the polyphosphate and blended phosphate inhibitors and increasing the concentration of the orthophosphate inhibitor by 10-fold did not substantially reduce the copper concentrations from these loops. It should be noted that the pH range (> 8.0) was above the normal recommended pH range for these inhibitors; use of the inhibitors at a lower pH may have provided better copper corrosion control. In light of these findings, the use of a phosphate corrosion control inhibitor at this time is not recommended if PTA stripping at ambient pH is employed.

B. UFW

UNACCOUNTED-FOR-WATER (UFW) LOSSES

a. Comprehensive Water Audit

JSUC conducts an audit of UFW losses for each system on a monthly basis. Attachment 2 shows the service area of each JSUC system. These monthly reports calculate an UFW percentage by comparing metered production flows with actual customer billings. Service connections and interconnections with other utilities are metered. Water production and customer use values are adjusted on a monthly basis to account for meter inaccuracies, meter changes, and detected leaks, as shown on the customer listings (Attachment 3). Attachment 4 shows the total water production from each of our systems for 1993.

Our UFW reports also express lost water in terms of water lost per length of main (gpm/mile). This provides our company with a more meaningful guide in determining which systems have greater UFW problems. We realize that zero UFW is not achievable. Various researchers have estimated minimum UFW levels ranging from 1,000 to 3,000 gallons per day per mile of main (0.69 to 2.08 gpm/mile). For our purposes, the assumption is that 2 gpm/mile represents the minimum level of UFW achievable in most water systems. UFW amounts higher than this are considered to be "recoverable", and computations are made to determine the revenues that could be saved if actual UFW were reduced to 2 gpm/mile.

b. System Betterments

JSUC, through an annual replacement program, replaces old water mains and water services with PVC. The present focus of the program is the replacement of 2" galvanized steel (G.S.) water mains. JSUC experienced a 100% increase in 2" G.S. mains through recent acquisitions. The program greatly reduces leakage and improves service (see Attachment 5).

c. Fire Flows

Upon the SJRWMD's approval of this Plan, we propose to begin estimating monthly fire flows. The fire department presently records the address, flow rate, and duration of each fire run. With this information, we can closely estimate the volume of water used for every fire that occurs within our service areas. These estimates will be included in the monthly UFW reports as they occur.

d. Water Theft

Hydrant piracy is a problem for water suppliers, and catching unauthorized users is very difficult. JSUC crews have stopped companies from making illegal withdrawals on occasion, but it is uncommon to catch someone in the act.

e. Meter Replacments

Our twenty-three (23) water treatment plant production meters and fourteen (14) City intertie meters are tested on a yearly basis and recalibrated as necessary. Customer meters sized 3" and above are also tested annually. The large customer meters are comprised of eighty-five (85) commercial meters and five (5) fire line meters. Meter tests are conducted by Metro Meter Services of Owensboro, Kentucky.

JSUC replaces approximately 2,500 customer meters each year. A meter may be changed out for various reasons, some of which are the age of the meter, damage to the meter, the meter is not operating, or it is not operating within prescribed accuracy limits. JSUC began this program in 1974. Also, in 1973 when JSUC computerized its billing system it included a built-in check of each customer's water usage. If the usage is above or below the range established a work order is written for the meter to be checked. If there is no obvious reason for the meter to under-register, a field accuracy test is performed. If the meter is not within prescribed accuracy limits it is changed out.

f. Indoor Audits

No indoor audits are currently being conducted. In the first quarter of 1995 we propose to print a message concerning water conservation kits at the bottom of our customer bills. This message will explain how the customers can order conservation kits directly from our supplier. Different water conservation kits are available, and commonly include such items as flow-conserving showerheads, toilet displacement bags, leak dye tablets, faucet aerators, and information on other household conservation measures. After running this message, we will return to printing water conservation tips at the bottom of our bills.

Since January 1994 water conservation kits containing displacement bags and leak dye tablets have been provided to our customers at the main office.

g. Leak Detection and Repair Program

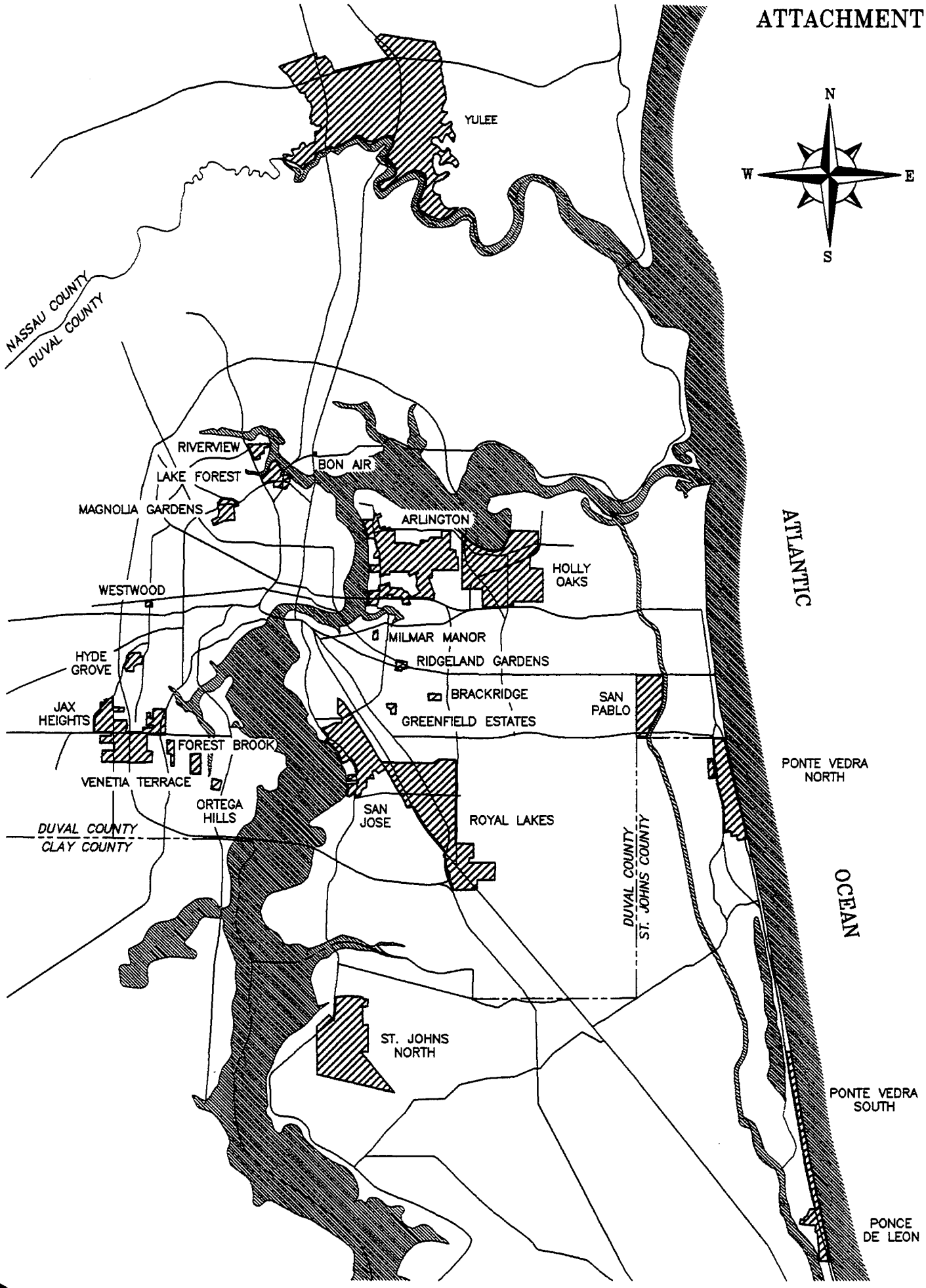
JSUC has implemented a program whereby a leak detection contractor will perform leak surveys on all of our systems by 1996. This leak location survey consists of sonic detection, where ground microphones listen directly above the water main, on valves, and on fire hydrants. The survey has begun according to the following schedule, with priority given to systems with the greatest UFW losses.

System	Year of survey	1993 UFW%
Arlington	1993	8%
Hyde Grove	1993	18%
Lake Forest	1993	27%
St. Johns N.	1993	16%
Greenfield	1993	43%
Baywood	1993	(part of Royal Lakes)
Riverview	1994	28%
Ridgeland	1994	25%
Brackridge	1994	24%
Milmar Manor	1994	36%
Ortega Hills	1994	1%
Westwood	1994	42%
Ponte Vedra	1994	4%
Ponce de Leon	1994	34%
San Pablo	1994	14%
Jax Heights	1994	14%
Mag. Gardens	1994	17%
Holly Oaks	1995	13%
Forest Brook	1995	0
Royal Lakes	1995	6%
San Jose	1995	13%
Ven. Terrace	1995	12%
Bon Air	1995	0

All leaks have been repaired at the time of discovery, and the 1995 portion of the survey will continue in this manner. Attachment 6 shows the results of the 1993 portion of this survey, and Attachment 7 shows the 1994 portion. At the end of this initial leak detection survey, we will review and analyze the results of this detection program to determine how or if it should continue. At that time, a report will be submitted to the SJRWMD (the second quarter of 1996).

This survey is also being used to correct our system maps as errors are found.

ATTACHMENT 2



JACKSONVILLE SUBURBAN UTILITIES CORPORATION
(A SUBSIDIARY OF GENERAL WATERWORKS)

ATTACHMENT 3

JACKSONVILLE SUBURBAN UTILITIES CORPORATION
CUSTOMERS
DECEMBER 1993

SYSTEM	RES WATER	COM WATER	PUBLIC WATER	PRIV FIRE	TOTAL WATER	RES SEWER	COM SEWER	PUBLIC SEWER	TOTAL SEWER CUST	KGS BILLED	CCF ADJUSTED	KGS ADJUSTED	NET KGS BILLED
ARL	5895	417	10	16	6338	4609	616	11	5236	44547	1,181	883	45,431
BA	12	1	0	0	13	0	0	0	0	10		0	10
BR	170	2	0	0	172	0	0	0	0	3		13	16
FB	183	0	0	0	183	0	0	0	0	2829	16	12	2,841
GR	115	0	0	0	115	0	0	0	0	0		0	0
HG	343	3	1	0	347	330	5	1	336	729	113	85	814
HO	2768	141	6	9	2924	2037	80	1	2118	7817	(91)	(68)	7,749
JH	3290	234	8	10	3542	3190	215	4	3409	20624	277	207	20,831
LF	784	24	1	0	809	0	0	0	0	761	25	19	780
MG	682	16	2	0	700	677	17	2	696	11683	(116)	(87)	11,596
MM	113	1	0	0	114	0	0	0	0	0		13	13
OH	431	5	0	0	436	431	2	0	433	6841		764	7,605
PDL	143	10	0	0	153	102	2	0	104	3923		97	4,020
PV	0	0	0	0	0	0	0	0	0	0		0	0
RI	146	32	0	0	178	0	0	0	0	226		(8)	218
RL	991	946	1	100	2038	962	771	1	1734	79301	(35)	(26)	79,275
RV	282	0	0	0	282	0	0	0	0	0		0	0
SJ	3687	309	6	5	4007	3281	328	5	3614	110012	(296)	(221)	109,791
SJN	636	6	0	0	642	518	0	0	518	18958		93	19,051
SP	860	25	1	6	892	693	21	1	715	4468		307	4,775
TC	0	33	0	2	35	0	32	0	32	2035	0	0	2,035
VT	239	0	0	0	239	122	0	0	122	3495	46	34	3,530
WW	49	7	0	0	56	0	0	0	0	99		49	148
YUL	0	1	0	0	1	0	1	0	1	428	0	0	428
TOTAL	21819	2213	36	148	24216	16952	2090	26	19068	318791	1,120	2,166	320,957

LEGEND

ARL	ARLINGTON	MG	MAGNOLIA GARDENS	SJN	ST JOHNS NORTH
BA	BON AIR	MM	MILMAR MANOR	SP	SAN PABLO
BR	BRACKRIDGE	OH	ORTEGA HILLS	TC	TOWN & COUNTRY
FB	FOREST BROOK	PDL	PONCE DE LEON	VT	VENETIA TERRACE
GR	GREENFIELD	PV	PONTE VEDRA	WW	WESTWOOD
HG	HYDE GROVE	RI	RIDGELAND GARDENS	YUL	YULEE
HO	HOLLY OAKS	RL	ROYAL LAKES		
JH	JAX HEIGHTS	RV	RIVERVIEW		
LF	LAKE FOREST	SJ	SAN JOSE		

PONTE VEDRA
CUSTOMERS
DECEMBER 1993

SYSTEM	RES WATER	COM WATER	PUBLIC WATER	PRIV FIRE	TOTAL WATER	RES SEWER	COM SEWER	PUBLIC SEWER	TOTAL SEWER CUST	KGS BILLED	CCF ADJUSTED	KGS ADJUSTED	NET KGS BILLED
PV	1555	160	1	0	1716	722	89	1	812	80,949		126	81,075

ATTACHMENT 4

JACKSONVILLE SUBURBAN UTILITIES WATER PLANT WORKSHEET (1993 SUMMARY)
(IN 1000 GALLONS)

	ARLINGTON SYSTEM								HOLLY OAKS SYSTEM					JAX HEIGHTS SYSTEM							SAN PABLO SYSTEM					PONTE VEDRA N			PONTE VEDRA S			
MTH/YR		ALDRICH PARK	COLUMB.	ELVIA	GREEN PERR PURCH	LAKE LUCINA	UNIV. PARK	TOWN & COUNTRY PUR.	SYSTEM SUB TOTAL	HOLLY OAKS	QUEEN ANNES	MON'T ROAD	KILCO RD PURCH	SYSTEM SUB TOTAL	OAK HILL	GREEN FOREST	WHEAT PUMP	ROAD PUR.	103rd ST PURCH	SYSTEM SUB TOTAL	MARSH VIEW	PALM ISLAND	PURCH	SYSTEM SUB TOTAL	PONTE VEDRA N	CORONA RD	SYSTEM SUB TOTAL	A1A N	A1A S	PONCE DE LEON	PURCH	SYSTEM SUB TOTAL
01/93		18455	0	0	18269	22324	11172	1892	72112	12331	10415	0	5009	22746	7056	5459	21706	33		34254	11652	1610	6	13268	10270	11986	22256	1741	170	1204	0	3115
02/93		16682	0	0	16927	20405	9798	2151	65963	5546	3344	16224	1670	25114	6279	4046	18721	109	123	29955	10898	2084	7481	20463	9851	14200	23251	1604	128	1166	0	2898
03/93		22011	16301	0	637	24356	11681	2835	77821	3135	2356	25616	0	31107	7616	8417	20422	95	141	36550	12527	3617	571	16715	10264	16586	26850	1695	992	566	0	3253
04/93		20262	22361	0	3	24585	11443	2683	81337	3906	5480	24425	425	33811	8710	8139	22281	97	188	39227	14181	52	3906	18139	10849	18499	29348	1245	2538	0	0	3783
05/93		22449	26761	0	31	28108	13564	2606	93519	1323	7732	31567	2302	40622	9595	8800	26943	66	301	45404	13920	0	6950	20870	14476	25883	39559	1896	3038	0	0	4934
06/93		23214	25743	0	0	27846	13341	2650	92794	212	7126	33913	1561	42812	9809	8535	28037	80	312	46773	13234	0	6889	20123	17062	23433	40495	880	1420	4194	0	6414
07/93		21299	23219	18	0	27599	12503	2410	87048	110	7019	31324	3071	41524	9640	8034	25363	67	344	43448	12137	0	6900	19037	17010	23749	40759	916	1325	4701	0	6942
08/93		21405	25314	0	0	29256	13119	3014	92108	109	6918	33292	2028	42347	9854	7933	26031	8	299	44125	11585	0	7084	18669	17556	24705	42261	1777	0	5095	5049	6872
09/93		19873	21484	0	0	25583	12077	2998	82015	153	6174	27847	1967	36141	15504	8717	23372	13	162	47768	8910	0	7011	15921	16051	20254	36305	1332	0	4287	2098	5619
10/93		21179	19013	0	0	25058	12641	1322	79213	85	4979	25821	1952	32437	9386	8104	23014	3	198	40705	10033	0	4248	14281	14001	17820	31821	499	0	4336	2522	4835
11/93		16429	23255	0	0	20571	11415	1	71671	399	3792	25083	0	29274	7879	7190	20590	19	170	35848	13384	0	3	13387	12325	16845	29170	188	0	3761	1995	3949
12/93		22155	15323	0	0	24583	11939	840	74840	145	4126	26076	0	30347	8260	7472	20756	0	282	36770	13993	0	74	14067	24608	1817	26425	112	0	4137	821	4249
12 MTHS. TOTAL		245413	218774	18	35867	300276	144693	25402	970441	27454	69461	300788	19985	408282	109588	91646	277236	590	2520	480827	146454	7363	51123	204940	173523	214977	388500	13805	9611	33447	12485	56863
AVG OF 12 MTHS.		20451	18231	2	2989	25023	12058	2117	80870	2288	5788	25066	1665	34024	9132	7637	23103	49	210	40069	12205	614	4260	17078	14460	17915	32375	1150	801	2787	1040	4739
AVG. DAY		672	599	0	98	823	396	70	2659	75	190	824	55	1119	300	251	760	2	7	1317	401	20	140	561	475	589	1064	38	26	92	34	156

INDEPENDENT SYSTEMS

FOREST BROOK PUMPED	FOREST BROOK PURCH	HYDE GROVE PUMPED	HYDE GROVE PURCH	MAGNOLIA GARDENS PUMPED	MAGNOLIA GARDENS PURCH	ROYAL LAKES	SAN JOSE	VENETIA TERRACE PUMPED	VENETIA TERRACE PURCH	LAKE FOREST PUMP	LAKE FOREST PURCH	ST JOHNS NORTH	TULEE (NCCI)	BON AIR	BRACK RIDGE PUMP	BRACK RIDGE PUR.	GREEN FIELD PUMP	GREEN FIELD PUR.	MILMAR PURCH	ORTEGA HILLS	RIDGE LAND PURCH	RIVERVIEW PUMP	RIVERVIEW PUR	WEST WOOD	COMPANY TOTALS PUMPED	COMPANY TOTALS PURCH	COMPANY TOTALS PUMPED + PURCHASED	
1233	0	3901	1	4617	0	83708	52066	711	730	0	6639	4308	537	68	1262	0	858	0	737	3237	1267	2441	0	350	301839	34583	336422	
1103	0	3297	0	4170	7	76582	47798	0	1341	0	5838	4916	497	64	1151	0	967	224	735	2925	1216	1743	0	343	284739	37822	322561	
1313	0	4010	10	4401	210	89045	54668	329	1226	0	6504	6025	590	67	1210	260	1028	0	936	3360	1564	1649	873	396	356108	15862	371970	
1557	0	4020	2	5140	2	88974	63250	1647	1	0	8144	8760	595	72	1216	0	1166	0	799	3606	1595	2405	0	403	381154	17845	398999	
1961	0	4822	1	6188	3	100299	81335	1928	1	0	10049	11107	601	113	1409	0	1716	0	1359	3964	1897	2578	0	531	451204	25566	476770	
1874	0	5153	66	6038	0	99965	83524	1820	0	0	9623	11595	548	160	1341	0	1831	0	1474	3647	1896	2567	59	778	458760	24610	483370	
1682	0	4096	1	5613	1	94901	77972	1691	58	1832	7927	11537	534	115	1348	13	1690	86	1196	3729	1867	2581	0	580	435867	23941	459808	
1678	0	4165	1	5859	9	103604	83645	1734	1	9629	754	13443	490	110	1334	36	1540	99	1234	3706	1789	2603	0	885	463325	16356	479681	
1377	0	3832	0	4913	1	91783	72350	1516	15	7994	952	8085	553	90	1191	0	546	572	1035	3548	1615	2540	0	356	412292	16341	428633	
1285	0	3418	73	5161	9	89662	65621	1520	15	7512	761	7045	496	117	1075	0	0	962	1120	3447	1500	2673	91	330	384931	12254	397185	
1195	1	3238	78	4608	13	85853	59179	1379	2	7006	715	6857	497	112	1093	0	0	1121	942	3044	1468	750	1425	323	358240	5958	364198	
1286	322	3424	2	5005	4	90209	61749	1513	1	8328	322	7023	484	72	1047	0	0	996	871	3487	1454	0	2177	324	369453	7345	376798	
17544	323	47376	235	61713	259	1094585	803157	15788	3391	42301	58228	100701	6422	1160	14677	309	11342	4060	12438	41700	19128	24530	4625	5599	4657912	231047	4888959	12 MONT
1462	27	3948	20	5143	22	91215	66930	1316	283	3525	4852	8392	535	97	1223	26	945	338	1037	3475	1594	2044	385	467	388159	19254	407413	AVG OF
48	1	130	1	169	1	2999	2200	43	9	116	160	276	18	3	40	1	31	11	34	114	52	67	13	15	12761	633	13394	AVG DAY

Replacement of 2" Mains

JSUC has approximately 85,000 feet of 2" galvanized steel main in its distribution systems which includes 48,000 feet in the recently acquired Atlantic Utilities System. Continuing with past practice, the following projects address a continuing effort to replace the corroding mains with PVC, to improve service, reduce maintenance and improve fire flows. A maintenance history is shown for each project.

95-E-101	Replace 740 Feet of 2" G.S. with 8" PVC On San Bernado, San Jose 5 Year History (1) Very corroded (2) Numerous complaints	25,000
95-E-102	Replace 850' of 2" G.S. With 8" PVC on Middleton Lane, Arlington 5 Year History (1) 2 main breaks per year - average (2) Very corroded (3) Numerous complaints	30,000
95-E-103	Replace 1000' of 2" G.S. With 8" PVC on Lagoon Drive, San Pablo History since system was aquired (1) Very corroded (2) Very poor service lines (3) Numerous complaints	35,000
95-E-104	Replace 650' of 2" G.S. and 300' of 4" G.S. with 8" PVC on San Pedro Road, San Jose 5 Year History (1) 2 main breaks per year - average (2) Very corroded	35,000

95-E-105 Replace 700' of 2" G.S. With 8" PVC on Carlotta Road West, Arlington — 25,000

5 Year History
(1) 2 main breaks per year - average
(2) Very corroded
(3) Numerous complaints

95-E-106 Replace 800' of 2" G.S. with 8" PVC on Grissom and Schirra Drives, Arlington — 35,000

5 Year History
(1) 2 main breaks per year - average
(2) Very corroded
(3) Numerous complaints

95-E-107 Replace 1200' of 2" G.S. with 8" PVC on Almira Street, Arlington — 45,000

5 Year History
(1) 2 main breaks per year - average
(2) Very corroded
(3) Numerous complaints

95-E-108 Replace 650' of 2" G.S. with 8" PVC on Cesperdes Avenue, San Jose — 25,000

5 Year History
(1) 2 main breaks per year - average
(2) Very corroded
(3) Numerous complaints

95-E-109 Replace 650' of 2" G.S. with 8" PVC on Tiston Road, Jax Heights — 25,000

5 Year History
(1) 2 main breaks per year - average
(2) Very corroded
(3) Numerous complaints

95-E-110 Replace 750' of 2" G.S. with 8" PVC on Adele Court, Arlington — 25,000

5 Year History
(1) 2 main breaks per year - average
(2) Very corroded
(3) Numerous complaints

Other Main Replacements

95-E-111 Replace 450' of 4" G.S. With 8" PVC on Parr Court, Brackridge — 15,000

This project is a continuation of improvements to better connect the Brackridge distribution system to the City of Jacksonville Intertie.

95-E-112 Replace 600' of 4" G.S. With 8" PVC on Almours Drive, San Jose — 25,000

This existing 4" main had a fire hydrant which was removed. This main replacement is proposed in order to provide adequate fire flow for a new hydrant.

95-E-201 Old Baymeadows Road 12" PVC Water Main Installation — 90,000

The City of Jacksonville is widening this section of roadway between Southside Boulevard and Baymeadow Road. JSUC has an 12" supply main which will need to be relocated to the limits of right-of-way. This is the installation of approximately 2,100 ft of 12" PVC.

2100 lf 12" PVC @ $43.00/lf 90,000

95-E-202 Monument Road 12" PVC Water Main Installation — 400,000

Jacksonville Transportation Authority is widening the corridor along Monument Road from State Road 9A to McCormick Road. JSUC has a 12" supply main from the Monument Road WTP along this corridor which will need to be relocated to the limits of right-of-way. This is the installation of approximately 12,000 ft of 12" PVC.

12001f 12" PVC @ $33.00/lf 400,000

95-E-203 Lane Avenue 8" PVC Water Main Installation 60,000

The City of Jacksonville is widening a section of roadway through the Westwood Service Area. JSUC has 4" G.S. and 4" A.C. supply mains which are located within the limits of the proposed pavement. Approximately 1300 feet of 8" and 250' of 4" replacement main is proposed outside the proposed pavement.

1300 lf 8" PVC @ $40.00/lf	52,000
250 lf 4" PVC @ $32.00/lf	8,000
Total	60,000

ATTACHMENT 6

FINAL REPORT

Annual Leak Detection Survey

prepared for:

JACKSONVILLE SUBURBAN UTILITIES CORPORATION
A SUBSIDIARY OF GENERAL WATERWORKS CORPORATION

Jacksonville Suburban Utilities Corporation
Jacksonville, Florida
October 1993

Table of Contents

CHAPTER I

CHAPTER I. GENERAL

INTRODUCTION

C/P Utility Services Corporation (C/P) was invited by Jacksonville Suburban Utilities Corporation (JSU), Jacksonville, Florida, to conduct a Water Distribution System Leak Detection Survey. The purpose of conducting the water leak detection survey was to identify underground leakage in the system that could be contributing to unaccounted water, comply with District requirements and provide valuable information on the condition of the distribution system. C/P, located in Orlando, Florida, has been providing leak detection and other water conservation services to utilities companies for the past ten years. C/P was selected to conduct this survey and is pleased to submit our Final Report on the survey performed during the Summer of 1993.

SCOPE OF SERVICES

JSU contracted with C/P in May 1993, to conduct a leak detection survey on approximately 94 miles of water distribution system in the following service areas: St. Johns North, Hyde Grove, Lake Forest and Arlington. The subsequent inclusion of Greenridge and Baywood added approximately four miles to the survey totalling close to 98 miles. On July 12, 1993, C/P met with JSU staff to commence the leak survey. The scope of services agreed upon consisted of the following:

1.C/P would furnish a survey vehicle, a technician, and equipment necessary to conduct the leak detection survey as specified.

2.JSU would furnish an employee knowledgeable in the layout and operation of the system to assist our technician, as well as maps showing the size, length and material of the mains.

3.The method of survey to be in direct contact with available fire hydrants, valves and service connections using electronic sound amplification equipment.

4.Ground microphones would be utilized for listening above the mains, hydrant branches and service lines in areas of poor sound transmission and to assist in pinpointing leaks found with FCS C2000 computer correlator.

5.Indications of leaks found during the general survey would be verified a second time with the correlator to pinpoint locations.

6.C/P will make an estimate of the size of each leak located and submit weekly reports to JSU including a sketch of leak locations.

7. A final report would be submitted to JSU and would include a listing and summary of all leaks discovered during the survey. Leaks would be listed according to type (main, service, valve, hydrant), and copies of all original leak reports to be included.

CHAPTER II

CHAPTER II. FIELD INVESTIGATIONS

LEAK LOCATION

The leak location survey for JSU's water distribution system was completed using electronically amplified sonic detection methods, where specialized direct contact equipment was used to listen on valves, service connections and fire hydrants and ground microphones were used on the surfaces above the mains.

This "general survey" was designed to locate areas where leak sounds were occurring. To pinpoint the leaks, a detailed location survey was conducted in those areas of the distribution system where leaks may be present. A computerized leak correlator, the most sophisticated equipment in the leak detection field today, in conjunction with the ground microphone was used to pinpoint leaks. These devices are extremely accurate in determining leak locations. The location of all leaks identified during the field investigations are shown in Table II-1. All leak reports are presented in Appendix A.

Thirty-two leaks were located during the survey for an approximate total of 122,100 gallons per day (gpd) in underground leakage.

Seven leaks occurred directly on water mains and accounted for leakage estimated to be 47,500 gpd (see Table II-2). Causes of main breaks can include surges from improper operation of hydrants or valves, pump surges, soil conditions causing movement of the main, poor backfill or bedding, water mains weakened from corrosion, and aging or faulty joint material. JSU should continue to review main repair records to look for common causes and to locate those areas of the system which may require main replacement due to reoccurring breaks.

Fifteen service line related leaks accounted for an estimated 62,100 gpd of total leakage. Service leaks usually occur on old plastic services, which are susceptible to failure. Service leaks that occur at the main are generally a result of corroded corporation stops or tapping saddles. The cause for service leaks should be investigated to determine if the areas of the distribution system are experiencing an inordinate amount of leaks.

Six leaks occurred on valves and accounted for approximately 17,200 gpd of the total identified leakage.

Three leaks, which were on blow-offs or flushing hydrants, contributed approximately 2,400 gpd of the total leakage. Corrosion and loose or worn fittings can cause small, yet significant leaks in blow-offs.

One hydrant leak also added approximately 100 gpd to the total identified leakage found in this survey.

Photo shows a service leak at 7141 Hanson Drive North under repair at Hyde Grove in Jacksonville. See Leak Report #5.

Photo shows a main line leak at the corner of Grandview Drive and Lone Star Road.
See Leak Report #34.

AREAS NOT SURVEYED

Four portions of the Arlington system were not surveyed due to factors which could not be avoided during the time the survey was conducted. These specific locations and factors are listed below:

1. Map #8 - main line between Gaillardia Road South and Fontainbleau Crescent.

The valve on the north end wasn't located. The existing line is polyethylene plastic and it is not accessible for direct contact at any point along its 400 ft. length. This includes where it crosses the drainage ditch. The valve on the south end was located and no leak indications were found there.

2. Map #9 - The main lines around the perimeter of Elvia Water Treatment Plant on Merrill Road.

These lines were not in use and therefore, not under pressure due to repairs underway at this facility. Leaks could not be determined without pressurized water in these lines.

3. Map #11 - The galvanized steel main line at Town & Country Shopping Center extending from AMOCO station to the point of the tie-in with 6" air conditioning main on the east side of property.

The correct location of this main could not be established during the survey.

4. Map #13 - 8" P.V.C. main from the tie-in along Commerce Road across Arlington Expressway to Charleston Square Apartments.

The valve on the north end of this line wasn't located and heavy woods extending from Commerce Road to Arlington Expressway (approximately 500 ft.) prevented both direct contact and ground microphone use. The valve at Charleston Square Apartments was accessible and no leak indications were found there.

These areas were discussed with JSU staff and a verbal approval was given to delete them from the survey.

TABLE II-1
Leak by Location

1.	1479 Mallard Landing Blvd.	Service	*
2.	7069 Delaware Ave.	Valve	1,400
3.	Corner Stark St. & Lk. Forest Blvd.	Hydrant	100
4.	944 Ethan Allen St.	Service	100
5.	7141 Hanson Dr. North	Service	2,900
6.	Corner Calvin St. and Edgewood Ave.	Blow-off	1,400
7.	Corner Kennard St. and Cornwallis Dr.	Main	7,200
8.	895 Cornwallis Dr.	Service	1,000
9.	747 Valley Forge Rd.	Service	1,400
10.	874 Kennard St.	Valve	**
10a.	874 Kennard St.	Main	4,300
11.	Corner Saratoga Blvd. and Concord Blvd. East	Valve	1,400
12.	Corner Caribbean Dr. and El Morro Dr.	Blow-off	500
13.	3245 El Morro Dr.	Service	7,200
14.	3048 Cesery Blvd.	Service	7,200
15.	2940 Justina Plaza	Service	500
16.	Shetland Rd. and Peeler Rd.	Blow-off	500
17.	Lk. Forest Blvd. opposite W.T. Plant	Valve	7,200
18.	1242 Ribault River Dr.	Main	4,300
19.	Corner Concord Cir. East and Meade St.	Valve	1,400
20.	1256 Wainwright Ct.	Service	2,900
21.	1248 Edgewood Ave.	Service	100
22.	Corner Lexington Dr. and Saratoga Blvd.	Valve	2,900
23.	Corner Greenfern Ln. and Heritage Rd.	Main	11,500
24.	7227 Stonehurst Rd.	Main	2,900
25.	2439 Green Oak Dr.	Service	1,400
26.	Expressway Shopping Mall, C.J.'s	Main	4,300
27.	Expressway Shopping Mall east side	Valve	2,900
28.	2615 Herrick Dr.	Service	1,400
29.	Town & Country, Sherwin Williams store	Service	21,600
30	Town & Country next to Sherwin Williams	Service	2,900
31.	Corner Overlook Dr. and Wildwood Rd.	Valve	2,900
32.	942 Overlook Dr.	Service	4,300
33.	1889 Parkcrest Dr.	Service	4,300
34.	Grandview Dr. and Lone Star Rd.	Main	7,200
		ESTIMATED SURVEY TOTAL:	**129,300**

* - Determined not to be a leak

** - Reinvestigated and leak report as 10a

Leakage by Type
Table II-2

Leak Type	Number of Leaks	Leakage Total	Percent of Total Leakage
Valves	6	17,200	13.0
Service	15	62,100	48.0
Main	8	47,500	37.0
Hydrant	1	100	1.0
Blow-Off	3	2,400	1.0
Survey Total	33	129,300 gpd	100%

A model for evaluating the cost/benefit ratio of a leak detection survey is included in Chapter III. Potential benefits from recovered leakage on Line 2 of the table can be compared with estimated leak detection costs to aid in determining the frequency of leak surveys.

Below in Table II-3 is an explanation of how much water could be lost on a daily, monthly, and yearly basis from undetected leakage found in this survey.

Leakage Accumulation
Table II-3

Daily	Monthly	Yearly
129,300 gallons (estimated)	3,879,000 gallons (estimated)	46,548,000 gallons (estimated)

CHAPTER III

CHAPTER III. FINDINGS AND RECOMMENDATIONS

FINDINGS

1. In 35 days of the survey, completing approximately 104 miles of water main, C/P located 32 leaks totaling an estimated 129,300 gpd of leakage.

2. During the survey, 15 leaks were located on services and accounted for 62,100 gpd or 48.0 percent of the total estimated leakage.

3. Six leaks were found on valves accounting for 17,200 gpd of the total estimated leakage or 13.3 percent of the total.

4. Eight main line leaks were found accounting for 47,500 gpd or 36.7 percent of total estimated leakage.

5. Three blow-offs or flushing hydrants contributed approximately 2,400 gpd or less than 1.0 percent of the total leakage.

6. One hydrant leaking from its caps produced approximately 100 gpd of estimated leakage or less than 1.0 percent of the total.

7. C/P found the existing maps of the water distribution system somewhat inaccurate with location errors and numerous appurtenances not shown. In particular, most blow-offs or flushing hydrants were not indicated on the maps. The location and type of mains shown was fairly accurate and the maps generally easy to work with.

RECOMMENDATIONS

1. We foremost recommend repairing all remaining leaks not restored during this survey.

2. The cause of main leaks should be investigated. A thorough review of main break records may reveal areas of the system with frequently recurring main breaks.

3. The cause for service leaks should also be investigated. Older services are more susceptible to leakage. Replacing old materials with newer services may be warranted. Meter fittings may need to be adjusted or replaced.

4. An evaluation of valve leaks may disclose a pattern of damaged or worn valves needing replacement in areas within the system.

5. Close attention should continue to be paid to water pumpage records as well as water consumption figures. A sudden increase in either the amount of unaccounted water may indicate underground leakage has developed and should be identified immediately.

6. A meter testing and replacement program could be reviewed based on the frequency of damaged and nonregistering or underregistering meters found during this survey.

Attachment 6 shows the results of the 1993 leak detection survey, which covered the following systems: Arlington, Hyde Grove, Lake Forest, St. Johns North, Greenfield, and Baywood (a subdivision of Royal Lakes). A total of 33 leaks were located for a total leakage of approximately 129,300 gpd. JSUC crews repaired these leaks at a cost of approximately $13,550.

ATTACHMENT 7

FINAL REPORT

Annual Leak Detection Survey

prepared for:

JACKSONVILLE SUBURBAN UTILITIES CORPORATION
A SUBSIDIARY OF GENERAL WATERWORKS CORPORATION

Jacksonville Suburban Utilities Corporation
Jacksonville, Florida
August 1994

Table of Contents

CHAPTER I. GENERAL

INTRODUCTION

C/P Utility Services Corporation (C/P) was selected by Jacksonville Suburban Utilities Corporation (JSU), Jacksonville, Florida, to perform a Water Distribution System Leak Detection Survey on selected areas of their water systems. The purpose of conducting the leak detection survey was to identify underground leakage in the system that was contributing to unaccounted water and provide valuable information on the condition of the distribution system. C/P, located in Orlando, Florida, has been providing leak detection and other water conservation services including leak detection to utilities for the past 10 years and was responsible for the Leak Detection Survey completed in 1993 for JSU. C/P is pleased to submit this Final Report on the survey performed during the months of May, June, and July 1994.

SCOPE OF SERVICES

Jacksonville Suburban Utilities contracted with C/P in April 1994, to conduct a leak detection survey on approximatly 125 miles of the water distribution systems in the following areas: Riverview, Ridgeland, Greenfield, Brackridge, Milmar, Ortega Hills, Westwood, Ponte Vedra, Ponce DeLeon, San Pablo, Jacksonville Heights, and Magnolia Gardens. During the survey, C/P was also requested to include the Oaks IV Apartments in it's investigations. The management of the Oaks IV were concerned about a history of leaks and accuracy of water consumption figures in their approximately 3/4 of a mile, distribution system.

On May 2, 1994, C/P met with JSU staff to commence the leak survey. The scope of services agreed upon consisted of the following:

1. C/P to furnish transportation, a technician, and all equipment necessary to conduct the leak detection survey as specified.

2. JSU to furnish an employee knowledgeable in the layout and operation of the system as well as maps showing the size, length and material of the mains to work with C/P's technician during the survey.

3. Method of survey was to be direct contact with available fire hydrants, valves and service connections surveyed using electronic sound amplification equipment.

4. Ground microphones are to be utilized for listening above the mains, hydrant branches and service lines in areas of poor sound transmission and to assist in pinpointing leaks found with the FCS C2000 computer correlator.

5. Indications of leaks found during the general survey to be verified a second time with correlator to pinpoint locations.

6. C/P to make an estimate of the size of each leak located and submit weekly reports to JSU including a sketch of leak locations.

7. A final report will be submitted to JSU and include a listing and summary of all leaks discovered during the survey. Leaks would be listed according to type (main, service, valve, hydrant), and copies of all original leak reports be included.

CHAPTER II. FIELD INVESTIGATIONS

LEAK LOCATION

The leak location survey for JSU's water distribution system was based on electronically amplified sonic detection, where specialized direct contact equipment was used to listen on valves, service connections and fire hydrants. A ground microphone was used on the surfaces above the mains.

This general survey was designed to locate areas where leak sounds were occurring. To pinpoint the leaks, a detailed location survey was conducted in those areas of the distribution system where leak sounds were present. A computer correlator, the most sophisticated equipment in the the leak detection field today, in conjunction with a ground microphone, was used to pinpoint leaks. These devices are extremely accurate in determining leak locations. The location of all leaks identified during the field investigations are shown in Table II-1. All leak reports are presented in Appendix A.

Forty-one leaks were located during the survey for a total of approximately 94,492 gallons per day (GPD) of water leakage. Five of these leaks were pinpointed on customer service lines. This was estimated at 7,224 GPD in leakage since they occurred downstream from their respective meters. The remaining thirty-six leaks total approximately 87,268 GPD of unaccounted for water throughout the various distribution systems we surveyed.

TABLE II-1
LEAKS BY LOCATION

	LOCATION	LEAK TYPE	AMOUNT/GPD
1.	9040 Jackson Ave.	Main	4320
2.	Between 7934 & 7942 Blank Dr.	Hydrant	2880
3.	Intersection Tintern Circle & Tintern Cove	Hydrant	2880
4.	7794 Hunter's Lake Circle	Service	2880
5.	4248 Sharbeth Dr. East	Service	2880(1)
6.	7449 Proxima Rd.	Service	2880
7.	7475 LaVentura Dr. South	Service	720
8.	Behind "BIG C" Carwash	Service	1440(1)
9.	4946 Avent Dr.	Service	24(1)
10.	Corner St. Andrews St. & Highway Ave.	Valve	120
11.	Corner Julia St. & Barbara Ave.	Blow-Off/Valve	24
12.	Corner Anne Ave. & Canadian Ave.	Blow-Off/Valve	100
13.	3116 Greenfield Circle	Service	4320
14.	6562 Oriole Ave.	Service	2880
15.	6757 Yvonne Lane	Blow-Off/Valve	24
16.	Corner Newton Rd. & Brackridge Blvd. East	Blow-Off/Valve	24
17.	1701 West Rd.	Main	7200
18.	4544 Grassy Cay Lane	Service	24
19.	Bldg. 4-B, Oaks IV	Valve	24
20.	303 Pablo Rd.	Service	1440
21.	324 San Juan Dr.	Service	1440(1)
22.	Intersection Pablo Ter. & Pablo Rd.	Hydrant	1440
23.	570 Ponte Vedra Blvd.	Service	48
24.	Corner Solana Rd. & Ponte Vedra Blvd.	Valve	2880
25.	183 Seawalk Dr.	Service	480
26.	322 Pablo Rd.	Service	1440
27.	153 Seawalk Dr.	Service	2880
28.	321 San Juan Dr.	Hydrant	2880
29.	Corner Gull Cir. & Tide's Edge Pl.	Main	4320
30.	3507 Ardisia Rd.	Service	1440
31.	2504 Iris Blvd.	Service	720
32.	5558 Verbena Rd.	Service	1440(1)

TABLE II-1
LEAKS BY LOCATION (cont'd)

	LOCATION	LEAK TYPE	AMOUNT/GPD
33.	Corner Phlox & Abelia Rd.	Hydrant	4320
34.	2968 Exora Ct.	Main	14,400
35.	2989 Snowdrop Ct.	Service	1440
36.	5720 Abelia Rd.	Main	1440
37.	Beach Blvd., West of Palm Island Dr.	Main	1440
38.	Corner Hazelhurst Dr. & Pottsburg Dr.	Main	2880
39.	Hart Bridge Expressway, North of West Rd.	Main	4320
40.	Corner Colima Pl. & Delisle Dr.	Main	4320
41.	4629 Burgundy Rd.	Service	1440

ESTIMATED SURVEY TOTAL LEAKAGE	**94,492 GPD**
METERED CUSTOMER LEAKS(1)	**-7,224 GPD**
ESTIMATED UNACCOUNTED TOTAL LEAKAGE	**87,268 GPD**

(1) Metered Customer Leaks

TABLE II-2

LEAKAGE BY TYPE

LEAK TYPE	NUMBER OF LEAKS	LEAKAGE TOTAL/GPD	PERCENTAGE OF TOTAL LEAKAGE
Service	15	25,032	28.7
Main	9	44,640	51.2
Valve	3	3,024	3.5
Hydrant	5	14,400	16.5
Blow-off	4	172	0.2
Survey Total*	**36**	**87,268**	**100.1**

* Does not include five metered customer leaks.

Potential benefits from recovered leakage can be compared with leak detection costs to aid in determining the frequency of leak surveys.

Below in Table II-3 is a projection of how much water could be lost on a daily, monthly, and yearly basis from leakage found in this survey.

TABLE II-3

POTENTIAL WATER LEAKAGE ACCUMULATION

DAILY	MONTHLY	YEARLY
87,268 gallons (estimated)	2,618,040 gallons (estimated)	31,416,480 gallons (estimated)

AREAS NOT SURVEYED

During the course of this survey, some sections of water mains in various systems were not investigated. These sections have terrain features that prevented access to the water main locations or the water lines were abandoned. These specific locations and reasons for not surveying them are listed below:

1. Ponte Vedra North - Map # 2, 8" AC line where it crosses waterway between Ponte Vedra Blvd. and San Juan Dr. The water line is submerged and contact points for correlating were not available.

2. Ponte Vedra North - Map # 3, 6" AC line where it crosses waterway between Valencia Way and Lake Rd. The water line is submerged and contact points for correlating were not available.

3. Ponte Vedra North - Map # 4, 10" PVC line where it crosses canal between Seawalk at Ponte Vedra and L'Atrium. The water line is submerged and contact points for correlating were not available.

4. Riverview - Map # 1, 2" GS line in woods and marsh for approximately 200-300 feet. Starting at Monroe Ave. and Broom St. and extending to Lot 16 on Monroe Ave. Line location unclear and unable to use equipment in this terrain.

5. Ridgeland Gardens - Map # 1, 3" GS line crossing Hart Bridge Expressway from Marion Ct. N. to Pottsburg Dr. 1.25" GS line where it connects to 3" GS line above to Marion Ct. N. Both lines under Expressway and enclosed in outer casing. No contact points available.

6. Jacksonville Heights - Map # 7, 8" AC line where it crosses I-295 from Lot 23 on Sonora Dr. N. to Firestone Rd. Line extends under Interstate highway and is enclosed in casing with no contact points available.

7. Westwood - Map # 1, 2" PVC line on Anne Ave. from Highway Ave. to Julia St. C/P was advised this line was either abandoned, did not exist, or its location was unknown.

8. Jacksonville Heights - Map # 2, 6" AC line starting at Sharbeth Dr. S., extending South to connection with 6" AC line running between Melvin Cir. W. and Jade Dr. E. C/P was advised this line is abandoned.

9. Jacksonville Heights - Map # 6, Water main on Golden Grove Rd. from Deepwood Dr. S. to Deepwood Dr. E. C/P was advised this line was recently replaced and didn't need to be surveyed.

CHAPTER III FINDINGS AND RECOMMENDATIONS

FINDINGS

1. In 39 days of survey time, covering approximately 122 miles of water main, and surveying numerous appurtenances, C/P located 41 leaks totaling an estimated 94,492 GPD of leakage.

2. During the survey, 15 leaks were located on services and accounted for 25,032 GPD or 28.7 percent of the total estimated leakage.

3. Three leaks were found on valves accounting for 3,024 GPD of total estimated leakage or 3.5 percent of the total.

4. Nine main line leaks were found accounting for 44,640 GPD or 51.2 percent of total estimated leakage.

5. Four blow-offs or flushing hydrants contributed approximately 172 GPD or 0.2 percent of the total leakage.

6. Five hydrants produced approximately 14,400 GPD of estimated leakage or 16.5 percent of the total.

7. Map Corrections - Maps of the twelve distribution systems involved in this survey vary in terms of accuracy. Recent changes, line locations, and appurtenance locations are not correct in all instances. The following are discrepancies found on the maps.

a. Westwood - Map # 1, 2" PVC line on Anne Ave. may not exist.

b. Westwood - Map # 1, Changes around Westwood W.T.P.

c. San Pablo - Map # 1, Along Beach Blvd. at Silver Palm Dr. Location of 6" PVC uncertain, and valves were found that aren't shown on the map.

d. Brackridge - Map # 1, 3" PVC at W.T.P. found to be both PVC and metal pipe.

e. Magnolia Gardens - Map # 1, Anther Ct. 2" GS line location uncertain. Valve found in resident's yard that wasn't as shown on map.

f. Riverview - Map # 1, Northern end of 2" GS line between Lem Turner Rd. and Washington Ave. - location uncertain and it runs beneath buildings.

g. Riverview - Map # 1, Lot 9146 and 2" GS line on Jackson Ave. not located as shown.

h. Ponte Vedra North - Map # 1, Elevated tank no longer on golf course.

i. Ponte Vedra North - Map # 1, Second 8" DI line found at bridge to The Pointe At Ponte Vedra. Only one line is shown.

j. Jacksonville Heights - Map # 2, 6" AC line from Sharbeth Dr. S. to 6" line between Melvin Cir. W. and Jade Dr. E. Line is abandoned.

k. Numerous valves and hydrants were not shown on these system maps. Also, several valves and hydrants were not found although drawn on the maps.

RECOMMENDATIONS

1. Repair all remaining leakage not repaired during the survey.

2. The cause of main leaks should be investigated. A thorough review of main break records may reveal areas of the system with frequent or recurring main breaks. Areas such as this could be considered for main replacement. Likewise, water main lines located between privately owned properties where access is limited and leaks are frequent should be evaluated for replacement along public right of way.

3. The cause for service leaks should also be investigated. Older services are more susceptible to leakage. Replacing old materials with newer copper services may be warranted. Meter fittings may need to be adjusted or replaced. Approximately half of the service leaks pinpointed were found at meter couplings and curb stops. The other leaks were from holes in the service lines on the customer or JSU side of the meter.

4. An evaluation of valve leaks may disclose a pattern of damaged or worn valves needing replacement in areas within the system.

5. Close attention should continue to be paid to water pumpage records as well as sewer flow rates. A sudden increase in either of these may indicate underground leakage has developed and should be repaired immediately.

Attachment 7 shows the results of the 1994 leak detection survey, which covered the following systems: Riverview, Ridgeland, Brackridge, Milmar Manor, Ortega Hills, Westwood, Ponte Vedra, Ponce de Leon, San Pablo, Jacksonville Heights, and Magnolia Gardens. A total of 41 leaks were located for a total leakage of approximately 94,492 gpd. JSUC crews repaired these leaks at a cost of approximately $5,800.

C. REUSE

REUSE

JSUC currently has on-site reuse at our five major WWTPs for chemical feeds and plant washdown, as shown on last month's sewage treatment plant summary (Attachment 8). In 1995 we plan to construct on-site reuse systems at San Pablo and Ortega Hills. In addition, we propose improvements to the reuse system at Monterey in 1994 to allow for chlorination of the weir troughs.

Attachment 9 includes our May 31, 1991 Reuse Feasibility Study, which identifies the following golf courses as potential users of reclaimed water:

McCumber Golf Course (from Royal Lakes WWTP)
Mill Cove Golf Club (from Holly Oaks WWTP)
San Jose Country Club (from San Jose WWTP)

We have held initial discussions with these golf courses, and the correspondence has been included as part of Attachment 9.

JSUC has provided draft agreements to the three aforementioned golf courses. If negotiations result in JSUC securing an agreement with one or more acceptors of reclaimed water, JSUC shall comply with the following schedule:

(1) JSUC shall submit a written request to the Florida Public Service Commission (PSC) for a limited proceeding to establish rates to cover the costs of a reclaimed water reuse program.

(2) Immediately following approval by the PSC, JSUC shall begin designing the reclaimed water reuse system and no later than 120 days following commencement of the reclaimed water reuse system design, JSUC shall submit a construction application in accordance with the Department of Environmental Protection's (DEP's) Administrative Procedures.

JSUC's Reuse Feasibility Study was updated in September 1994 to consider three WWTPs located in St. Johns County (see Attachment 9). This update has identified the Ponte Vedra Inn & Club as a feasible recipient of reclaimed reuse water from JSUC's Ponte Vedra WWTP. With JSUC's concurrence, the Ponte Vedra Inn & Club has submitted a conceptual reuse plan to the DEP for review. Attachment 9 includes this proposal.

No later than sixty (60) days following the DEP's acceptance of this plan, JSUC will proceed with implementing a reclaimed water reuse system in accordance with the schedule listed above for the other golf courses.

Attachment 9 also includes a letter from JSUC to the City of Jacksonville. This letter is a request for the City to consider supplying reuse water to the Mill Cove Golf Course from their Arlington East WWTP, and to consider receiving reuse water at the Deerwood Golf Course from our Royal Lakes WWTP. Any agreements and implementation schedules resulting from these negotiations will be forwarded to the SJRWMD, DEP, and Department of Regulatory and Environmental Services (RESD).

In the event a contract cannot be negotiated with one or more of the referenced parties, JSUC shall provide a written explanation of the reasons to the SJRWMD, DEP, and RESD. The DEP will make the final decision whether JSUC meets the reuse consideration requirements in accordance with WWTP operating permits. JSUC shall provide the SJRWMD, DEP, and RESD with written notification regarding the beginning and completion of each phase of the schedule and any delays in implementing the schedule.

Any delays in implementing the reclaimed water reuse program caused by other parties or events are beyond the control of JSUC.

WESTSIDE DISTRICT

December 1993

SEWAGE TREATMENT PLANT MONTHLY SUMMARY

PLANT NAME		TOTAL FLOW M.G.	AVERAGE FLOW M.G.D.	RE-USED FLOW M.G.	RAIN FALL INCH	TOTAL K.W.H. USED	K.W.H. PER M.G.	ACTUAL LOADS HAULED	GAL PER M.G.	POUNDS CL2 USED	LBSCL2 PER M.G.	POUNDS SO2 USED	LBS SO2 PER M.G.	POUNDS LIME USED	LBS PER M.G.	POLYMER GALLONS
JAX HEIGHTS	Dec 93	28.887	0.932	1.047	3.80	129840	4495	42	10178	1279	44	802	28	5255	182	
HYDE GROVE	Dec 93	4.989	0.158		2.30	1232	251									
MAG. GARDENS	Dec 93	6.668	0.215		2.50	2855	428									
N.C.C.I. JAIL	Dec 93	0.217	0.007		1.40					53.0	244					
ORTEGA HILLS	Dec 93	5.608	0.181		2.60	39848	7106	4	4993	208.0	37	153.0	27			

COMMENTS:

JHSTP:

HG L/S:

MG L/S:

NCCI STP:

OHSTP:

ATTACHMENT 8

SOUTHSIDE DISTRICT

December 1993

SEWAGE TREATMENT PLANT MONTHLY SUMMARY

PLANT NAME		TOTAL FLOW M.G.	AVERAGE FLOW M.G.D.	RE-USE FLOW M.G.	RAIN FALL INCH	TOTAL K.W.H. USED	K.W.H. PER M.G.	ACTUAL LOADS HAULED	GAL PER M.G.	POUNDS CHLORINE USED	LBSCL2 PER M.G.	POUNDS SO2 USED	LBS SO2 PER M.G.	POUNDS LIME USED	LBS PER M.G.	POLYMER GALLONS
ROYAL LAKES		73.996	2.387	3.098	2.15	261600	3535	42	3973	2880	39	1058	14			
MONTEREY																
SAN JOSE		61.173	1.973	1.933	2.60	125120	2045	35*	4005	1803	29	1388	23	6200	101	
JAX HEIGHTS																
HOLLY OAKS																
CUNNINGHAM	*	2.672	0.086		2.30	11728	4389	1	2620	280	105					
PONCE DE LEON		0.435	0.014		2.20	3285	7552			27	62					
SAN PABLO																
HYDE GROVE																
MAG. GARDENS																
PONTE VEDRA		9.401	0.303		2.90	28340	3015	9	5744	334	36					
N.C.C.I. Jail																
ORTEGA HILLS																

* St. Johns North STP ISCO flow recorder out of service 6/22/93

* San Jose STP 3 loads over sludge haul plan due to low supernate yeild

JACKSONVILLE SUBURBAN UTILITIES

December 1994

OPERATIONS DEPARTMENT

SEWAGE TREATMENT PLANT MONTHLY SUMMARY

PLANT NAME	DATE	TOTAL FLOW M.G.	AVERAGE FLOW M.G.D.	MAXIMUM FLOW M.G.	RAIN FALL INCH	TOTAL K.W.H. USED	K.W.H. PER M.G.	LOADS SLUDGE HAULED	GAL PER M.G.	POUNDS CHLORINE USED	LBSCL2 PER M.G.	POUNDS SO2 USED	LBS SO2 PER M.G.	POUNDS LIME USED	LBS PER M.G.	POLYMER GALLONS
ROYAL LAKES																
MONTEREY	Dec 1993	80.577	2.599	0.535	2.10	237200	2944	18	1564	2340	29	1351	17			110
SAN JOSE																
JAX HEIGHTS																
HOLLY OAKS	Dec 1993	18.925	0.610	0.769	2.70	75840	4007	29	10727	691	37	155	8			
CUNNINGHAM																
PONCE DE LEON																
SAN PABLO	Dec 1993	11.557	0.373		6.80	52240	4520	6	3634	425	37	253	22			
HYDE GROVE																
MAG. GARDENS																
PONTE VEDRA																
N.C.C.I. Jail																
ORTEGA HILLS																

COMMENTS:

MONTEREY WWTP: Flow meter inoperative due to contact chamber damage & repairs 10-20-93; flows estimated using effluent pump run-times.

HOLLY OAKS WWTP: Temporary sulfur dioxide feed installed as aid to dechlorination; poor supernatant yield creating need for additional sludge hauling.

SAN PABLO WWTP:

ATTACHMENT 9

JACKSONVILLE SUBURBAN UTILITIES CORPORATION

WATER REUSE FEASIBILITY STUDY

PREPARED FOR:

ST. JOHNS RIVER WATER MANAGEMENT DISTRICT

PREPARED BY:

GEORGE J. FLEGAL, P.E., AREA ENGINEER

MAY 31, 1991

JACKSONVILLE SUBURBAN UTILITIES CORPORATION
WATER REUSE FEASIBILITY STUDY

As part of the renewal process for the St. Johns River Water Management District (SJRWMD) Consumptive Use Permits (CUP), the SJRWMD has requested that Jacksonville Suburban Utilities Corporation (JSUC) prepare an update to its Water Reuse Feasibility Study. The original study, dated November 1986, does not reflect current situations and attitudes.

JSUC is supportive of efforts to reuse reclaimed water. Such programs will reduce the demands on potable water sources and will assist the State of Florida to properly manage its water resources. It is JSUC's intention to seek to serve economically and physically viable projects which protect the environment and the health, safety and welfare of the public.

Current Permit Conditions

The CUP for the Arlington Service Area, issued March 10, 1987, contained requirements for JSUC to implement reuse. One item directed us to implement in-plant reuse by using effluent in the chlorine injectors and in water-to-air heat pump systems at our Holly Oaks, Jacksonville Heights, University Park, Monterey and San Jose WWTP's within two years. With the exception of University Park WWTP which has been retired, this requirement has been met.

The second item involved providing reuse water to San Jose Golf Course near the San Jose WWTP. Through a series of meetings and discussions (Caroline Mitchell and Betty Levin of the SJRWMD were included) it was concluded that the project was not then feasible and the requirement was deleted.

Potential Reuse Sites

JSUC has three sites near its wastewater treatment facilities which could potentially utilize significant amounts of reclaimed water and which are most economically feasible. The three sites are the

Mill Cove Golf Course, San Jose Golf Course, and Baymeadows Golf Course. JSUC is currently attempting to obtain water usage data from the three golf courses. For purposes of completing the study and making cost estimates the reuse systems are based on 500 gallons per minute (gpm) flow rate or 0.240 million gallons per day (mgd) if operated 8 hours per day. The design of each of the reuse systems is based on pumping reuse water to an existing pond on the golf course property. The golf course will then be responsible for pumping the reuse water from the pond onto the golf course using their own irrigation system.

Reuse systems must comply with Chapter 17-610, Reuse of Reclaimed Water and Land Application, of the Florida Administrative Code. Specifically for golf course irrigation is Part III, Reuse; Slow-Rate Land Application Systems: Public Access Areas, Residential Irrigation, And Edible Crops. Below is a brief summary of the basic treatment requirements of the rule:

1. Minimum size of treatment facility is 0.10 mgd.
2. Minimum effluent BOD is 20 mg/l.
3. Minimum effluent TSS is 5 mg/l before disinfection.
4. High Level Disinfection (min. 1.0 mg/l after 30 minute detention time at average daily flow).
5. Filtration and chemical feed shall be provided.
6. Minimum Class I reliability.
7. Continuous on-line monitoring of total chlorine residual and turbidity.
8. Distribution system shall be designed at a minimum hydraulic capacity of 1.5 times average daily flow.

MILL COVE GOLF COURSE

Mill Cove Golf Course is an 18 hole golf course located at the Southeast corner of St. Johns Bluff Road and Monument Road on the property of Craig Air Field. Construction of Mill Cove Golf Course was completed in November 1990. An extensive history of water consumption and irrigation does not exist. The CUP for Mill Cove

states that ground water can only be utilized when surface water is not available. It also greatly reduces the allowable consumption of surface water for 1991 through 1997. Based on the conditions of their CUP, it appears that the need exists for an alternate source of irrigation for Mill Cove. In addition, the golf course is constructed on extremely sandy soil which will probably require more irrigation than many of the other golf courses in the Jacksonville area.

Holly Oaks WWTP, owned and operated by JSUC, is located at 10797 Ft. Caroline Road, Jacksonville, Florida, approximately three quarters of a mile from Mill Cove Golf Course. Holly Oaks WWTP is a 1.0 mgd activated sludge treatment plant designed to treat domestic wastewater to secondary standards. In 1990, Holly Oaks WWTP treated an average daily flow of 0.418 mgd. Holly Oaks currently discharges its effluent to Cowhead Creek, which then flows to Mill Cove and then the St. Johns River.

Approximately 2200 feet of 6 inch cast iron pipe already exist (currently unused) along Holly Oaks Ravine Drive. An additional 1500 feet of 8 inch PVC pipe would need to be installed to connect the Holly Oaks plant site to the Mill Cove Golf Course property. Approximately 2900 feet of 8 inch PVC pipe would have to be installed within the Mill Cove property to reach the nearest irrigation pond. Although the original design of the golf course included this pipe, it was not installed during construction. The cost to install the pipe within the Mill Cove property should be incurred by the golf course owner. The Holly Oaks WWTP would need the addition of a filter, chemical feed system, storage tank, high service pumps, monitoring and chlorine feed equipment. Total installation and operational costs are listed as follows. A location plan is also enclosed.

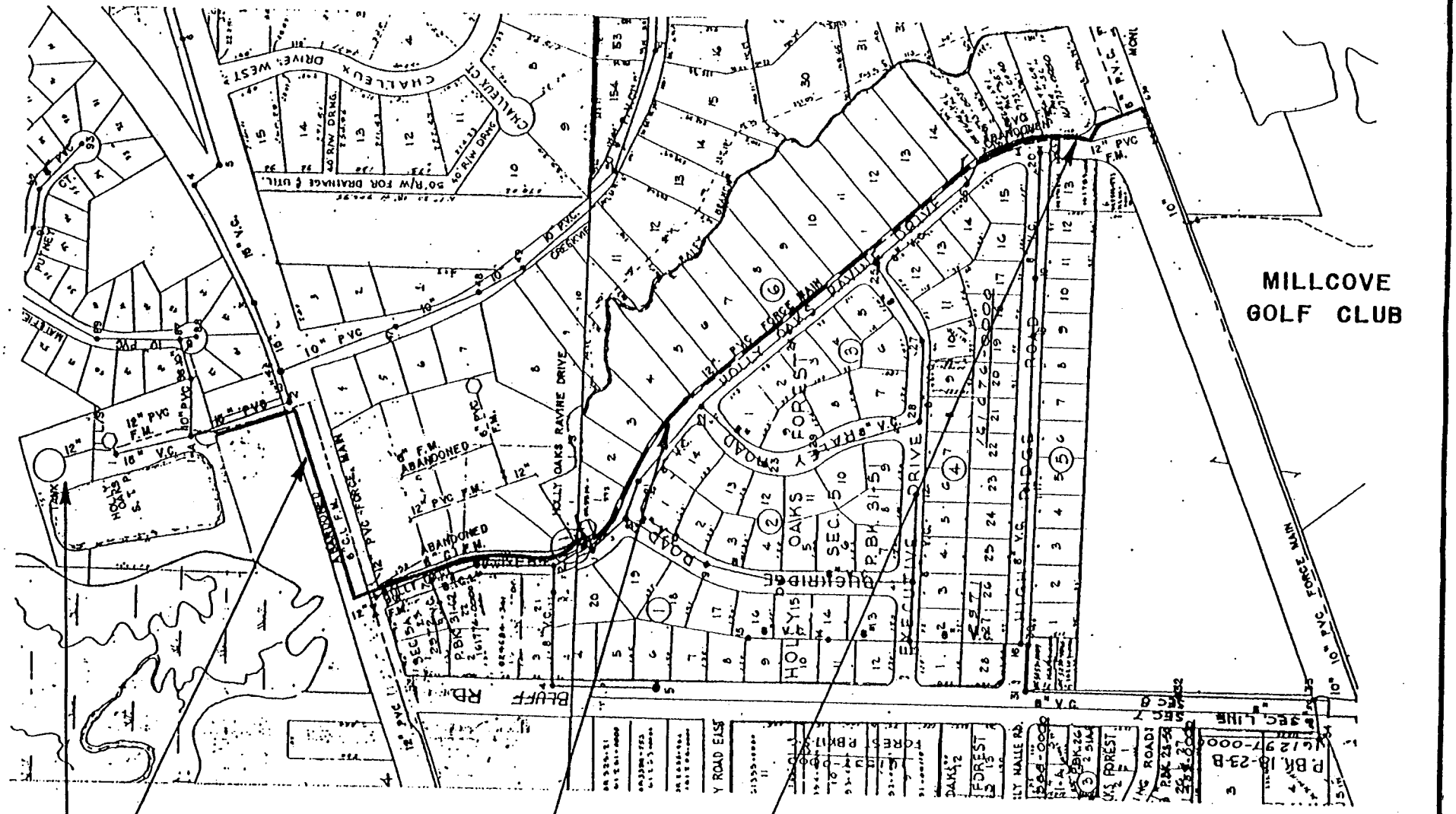
HOLLY OAKS REUSE SYSTEM INSTALLATION COSTS

Piping to Mill Cove Golf Course, 1500' x $30/ft.	=	$ 45,000
Piping within Mill Cove Property, 2900' x $20/ft.	=	$ 58,000
500 GPM Sand Filter	=	$100,000
15,000 GAL. Storage/C.C.C.	=	$ 20,000
2 - 500 gpm High Service Pumps, 2 x $2000	=	$ 4,000
Chemical (Polymer) Feed System	=	$ 1,000
Electronic Monitoring Equipment	=	$ 10,000
Piping & Valves	=	$ 5,000
Chlorination Equipment	=	$ 5,000
Electrical	=	$ 5,000
		$253,000
Less cost incurred by others	=	<$ 58,000>
Sub-Total	=	$195,000
Overhead (9%)	=	$ 17,550
Omissions (10%)	=	$ 21,255
TOTAL	**=**	**$233,805**

HOLLY OAKS REUSE OPERATIONAL COSTS

(Based on 500 gpm)

POWER	$1.35/hr x 8 hrs./day	=	$10.80/day
CHEMICAL:			
CHLORINE	6 lb/day x $0.15/lb	=	$0.90/day
POLYMER	(should not need)		
LABOR	1 hr/day x $20.00/hr	=	$20/day
	TOTAL	=	$31.70/day
		=	$0.13/1000 GAL
ANNUAL COST:			
= $31.70/day x 365 days		=	$11,571/year



HOLLY OAKS W.W.T.P.
TO
MILL COVE GOLF COURSE
REUSE MAIN

JACKSONVILLE SUBURBAN UTILITIES CORP.			
DATE	DRAWN	IWO	SHEET
5-30-1991	N. J. G.		1 OF 1

SAN JOSE GOLF COURSE

San Jose Golf Course is an 18 hole golf course located at the intersection of Old St. Augustine Road and San Jose Boulevard. San Jose Golf Course has been in existence for many years. Flow records have been maintained throughout its existence. However, the San Jose Golf Course was rebuilt and renovated in 1989. Much of the course contour, drainage, soil, and irrigation characteristics were altered during this reconstruction. Although irrigation data continues to be monitored, an extensive history of the data is not available for the reconstructed course. As was previously mentioned in this report, the San Jose Golf Course is one area in particular where the SJRWMD has urged the use of reclaimed water for irrigation.

The San Jose WWTP, owned and operated by JSUC, is located at 7128 Balboa Road, Jacksonville, Florida, approximately one third of a mile from the San Jose Golf Course. San Jose WWTP is a 2.25 MGD activated sludge treatment plant designed to treat domestic wastewater to secondary standards. In 1990, San Jose WWTP treated and average daily flow of 1.574 MGD. San Jose WWTP currently discharges its effluent to the St. Johns River.

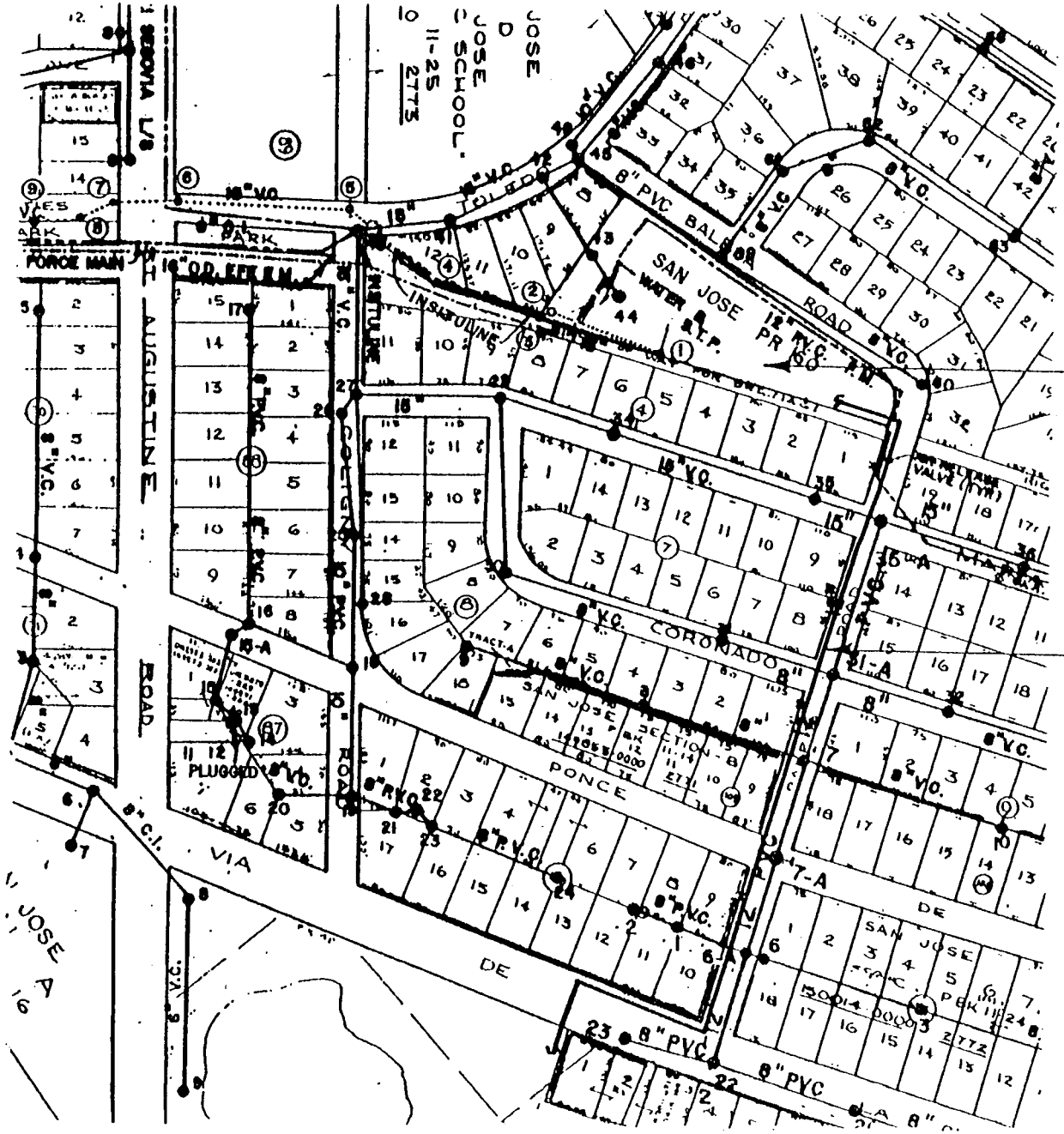
Approximately 1900 feet of 8 inch PVC pipe would have to be installed from the San Jose WWTP to the San Jose Golf Course property. An additional 2200 feet of 8 inch PVC pipe would have to installed within the golf course property. The San Jose WWTP would need the addition of a filter, chemical feed system, storage tank, high service pumps, monitoring and chlorine feed equipment. Total installation and operational costs are listed as follows. A location plan is also enclosed.

SAN JOSE REUSE SYSTEM INSTALLATION COSTS

Piping to San Jose Golf Course, 1900' x $30/ft.	=	$ 57,000
Piping within Golf Course Property, 2200' x $20/ft.	=	$ 44,000
500 GPM Sand Filter	=	$100,000
15,000 GAL. Storage/C.C.C.	=	$ 20,000
2 - 500 gpm High Service Pumps, 2 x $1,500	=	$ 3,000
Chemical (Polymer) Feed System	=	$ 1,000
Electronic Monitoring Equipment	=	$ 10,000
Piping & Valves	=	$ 5,000
Chlorination Equipment	=	$ 5,000
Electrical	=	$ 5,000
		$250,000
Less cost incurred by others	=	<$ 44,000>
Sub-Total	=	$206,000
Overhead (9%)	=	$ 18,540
Omissions (10%)	=	$ 22,454
TOTAL	=	**$246,994**

SAN JOSE REUSE OPERATIONAL COSTS

POWER	$0.20/hr x 8 hrs./day	=	$1.60/day
CHEMICAL:			
CHLORINE	6 lb/day x $0.15/lb	=	$0.90/day
POLYMER	(should not need)		
LABOR	1 hr/day x $20.00/hr	=	$20/day
	TOTAL	=	$22.50/day
		=	$0.09/1000 GAL
ANNUAL COST:			
= $22.50/day x 365 days		=	$8,213/year



SAN JOSE W.W.T.P. TO SAN JOSE GOLF COURSE REUSE MAIN

JACKSONVILLE SUBURBAN UTILITIES CORP.			
DATE	DRAWN	IWO	SHEET
5-30-1991	N. J. G.		1 OF 1

BAYMEADOWS GOLF COURSE

Baymeadows Golf Course is an 18 hole golf course located at the Northeast corner of the intersection of Interstate 95 and Baymeadows Road. Baymeadows Golf Course has been in operation for several years but has not metered their ground water consumption. The SJRWMD has ordered Baymeadows to install a meter and begin recording the quantity of ground water and surface water used for irrigation. It is believed that the majority of their irrigation comes from surface water. However, enough groundwater is probably used to warrant the installation of a water reuse system to the golf course.

Royal Lakes WWTP, owned and operated by JSUC, is located at 8509 Western Way, Jacksonville, Florida, approximately three quarters of a mile from Baymeadows Golf Course. Royal Lakes WWTP is a 3.0 MGD activated sludge treatment plant designed to treat domestic wastewater to secondary standards. In 1990, Royal Lakes WWTP treated an average daily flow of 1.905 MGD. Royal Lakes currently discharges its effluent to the Pottsburg Creek Swamp. However, construction and permit applications are now under way to discharge the plant effluent to the St. Johns River via a new 24 inch outfall.

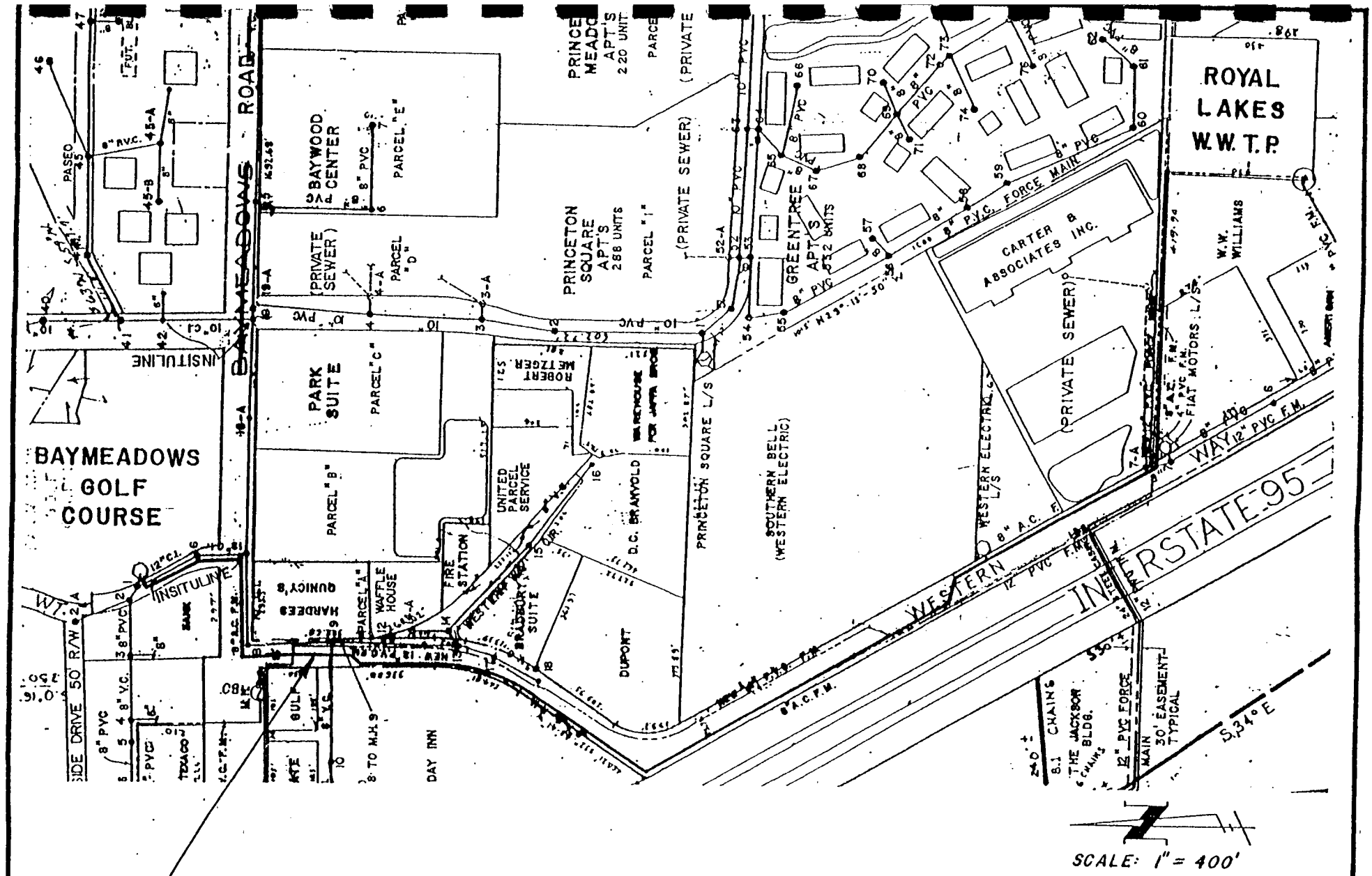
Approximately 3000 feet of 8 inch AC F.M. already exist between the Royal Lakes Plant site and Baymeadows Golf Course. An additional 500 feet of 8 inch PVC F.M. would be required to be installed to complete the connection. This is based on the assumption that the reuse water could be discharged into the pond closest to the golf course entrance along Baymeadows Road. Royal Lakes WWTP already has an existing sand filter which will be used strictly for reuse water once the effluent is discharged through the new outfall to the St. Johns River. Once construction of the new Chlorine Contact Chamber (CCC) is complete, the existing CCC will be available for reuse chlorination and storage. Total installation and operational costs for the reuse system are listed as follows. A location plan is also enclosed.

BAYMEADOWS REUSE SYSTEM INSTALLATION COSTS

Piping within R.L. WWTP property, 300' x $25/ft.	=	$ 7,500
Piping within Golf Course Property, 200' x $20/ft.	=	$ 4,000
2 - 500 gpm High Service Pumps, 2 x $1,500	=	$ 3,000
Chemical (Polymer) Feed System	=	$ 1,000
Electronic Monitoring Equipment	=	$10,000
Piping & Valves	=	$ 5,000
Chlorination Equipment	=	$ 5,000
Electrical	=	$ 5,000
		$40,500
Less cost incurred by others	=	<$ 4,000>
Sub-Total	=	$36,500
Overhead (9%)	=	$ 3,285
Omissions (10%)	=	$ 3,979
TOTAL	=	**$43,764**

BAYMEADOWS REUSE OPERATIONAL COSTS

POWER	$0.20/hr x 8 hrs./day	=	$1.60/day
CHEMICAL:			
CHLORINE	6 lb/day x $0.15/lb	=	$0.90/day
POLYMER	(should not need)		
LABOR	1 hr/day x $20.00/hr	=	$20/day
	TOTAL	=	$22.50/day
		=	$0.09/1000 GAL
ANNUAL COST:			
= $22.50/day x 365 days		=	$8,213/year



ROYAL LAKES W. W. T. P. TO BAYMEADOWS GOLF COURSE REUSE MAIN

JACKSONVILLE SUBURBAN UTILITIES CORP.			
DATE	DRAWN	IWO	SHEET
5-30-1991	N. J. G.		1 OF 1

Obstacles To Implementation

Although the implementation of reuse has been made more feasible by the DER through its Chapter 17-610, the subject has not been sufficiently addressed by the Public Service Commission (PSC) which regulates privately owned utilities. The PSC has not determined whether the user, in our case golf courses, should bear the entire cost of the reuse facilities. For example, if the three golf courses were considered together, the combined capital costs are about $525,000. The annual revenue requirement for this investment is approximately $100,000. Based on an average annual usage per golf course of 87.6 MG, this translates to $0.38/1000 gallons. Add to this the average operating cost of $0.10/1000 gallons, and the cost of reuse water would be $0.48/1000 gallons. Remember that these figures are based on liberal use reuse water. If the courses were to practice conservation of reuse water, the unit cost would need to be higher to obtain the necessary revenue. Also, the value of existing facilities (mains, filters, etc.) have not been included in the cost estimates.

A price of over $40,000/year for reuse water for each golf course would be difficult for these facilities to absorb considering that they are currently using groundwater to supplement stored storm runoff.

The PSC has indicated that they are prepared to address the cost-of-reuse situation if a proposal is made, but there is currently no precedent. Lacking the ability to earn on an investment, we are reluctant to commit to a significant reuse investment without PSC direction.

Another item that continues of concern is liability. A law was enacted several years ago that protects the end user from liability, but nothing similar applies to the generator. This exposure to potential liability will also add to the cost of reuse water.

Conclusion

In summary, Jacksonville Suburban Utilities Corporation (JSUC) is supportive of efforts to reuse reclaimed water. JSUC has already implemented reuse for in-plant use. JSUC has here identified three golf courses where reuse appears economically feasible. However, as a regulated utility, the concept of reuse must be addressed by the Public Service Commission with respect to rates. Also, the question of liability has not been fully addressed.

JACKSONVILLE SUBURBAN UTILITIES CORPORATION
A SUBSIDIARY OF GENERAL WATERWORKS CORPORATION

1400 MILLCOE ROAD, P.O. BOX 8004, JACKSONVILLE, FLORIDA 32239,(904) 725-2865

September 21, 1993

Mr. Donald E. Beaver, Jr., CCM
General Manager
San Jose Country Club
7529 San Jose Boulevard
Jacksonville, FL 32217

Mr. W. T. Coppedge, Jr.
Mill Cove Golf Club
1700 Monument Road
Jacksonville, FL 32225

Mr. J. Christopher Commins
Senior Vice President/ASLA
McCumber Golf
2301 Park Avenue, Suite 404
Orange Park, FL 32067

Gentlemen:

Enclosed please find a draft of a Spray Irrigation Agreement. We were unable to include a cost for treated effluent as we have not received historical usage data from the San Jose Country Club. After we receive their data, we will develop a cost and provide it to you.

Since we need to move forward on this, I would appreciate it if you would review the draft agreement and get back to me with your comments.

Please let me know if I can be of any other assistance.

Sincerely,

Philip Heil
Vice President

PH/ss

Enclosure

JACKSONVILLE SUBURBAN UTILITIES CORPORATION
A SUBSIDIARY OF GENERAL WATERWORKS CORPORATION

1400 MILLCOE ROAD, P.O. BOX 8004, JACKSONVILLE, FLORIDA 32239,(904) 725-2865

October 18, 1993

Mr. Donald E. Beaver, Jr., CCM
General Manager
San Jose Country Club
7529 San Jose Boulevard
Jacksonville, FL 32217

Mr. W. T. Coppedge, Jr.
Mill Cove Golf Club
1700 Monument Road
Jacksonville, FL 32225

Mr. J. Christopher Commins
Senior Vice President/ASLA
McCumber Golf Course
2301 Park Avenue, Suite 404
Orange Park, FL 32067

Gentlemen:

In my letter dated September 21, 1993 I sent you a draft Spray Irrigation Agreement. It was brought to my attention that I had omitted the Agreement Between Pasco County and Beacon Woods Golf Club for Disposal of Treated Effluent, a memorandum from Thomas Benefield regarding the water supply policy document and a fact sheet from the McCumber Golf Course. These documents are attached with this letter.

Sincerely,

Philip Heil
Vice President

PH/ss

Attachments

P. S. Please send me your irrigation usage figures so we can establish a charge for the treated effluent.

JACKSONVILLE SUBURBAN UTILITIES CORPORATION
WATER REUSE FEASIBILITY STUDY
UPDATE SEPTEMBER 1994

Jacksonville Suburban Utilities Corporation (JSUC) prepared a Water Reuse Feasibility in November 1986. The Plan was updated May 31, 1991 to reflect the current situations and attitudes. While JSUC is continuing to develop a reuse implementation plan as outline in the May 31, 1991 update,a second update has been prepared to add the JSUC facilities which have been acquired in St. Johns County for consideration of potential treated wastewater effluent reuse areas. St. Johns North WWTP was acquired in 1990 an currently serves approximately 548 residential customers. Ponte Vedra WWTP was acquired in 1993 and serves approximately 749 residential and 91 commercial customers. Ponce De Leon WWTP was acquired in 1990 and currently serves approximately 111 residential and 2 commercial customers.

As with it several service areas in Duval County JSUC will concentrate it efforts in reuse in St. Johns County in those areas which have a high potential for reuse.

ST. JOHNS NORTH (#2-109-0071)

The St. Johns North WWTP Service area is characterized as predominately suburban single family homes on large lots. Approximately 755 acres of the total 3729 acre service area is developed. Future development within the service area is projected to continue as single family homes. The rate of development is projected to be rapid. Sewer flows in 1994 average 0.092 MGD. The plant currently discharges treated effluent to a land application system consisting of two rapid infiltration basins. The proposed treatment plant expansion, currently under permit review, will include two additional rapid infiltration basins. On site reuse for landscape irrigation, chlorine feed and plant wash down water is also proposed in this expansion.

A review of proposed developments and the St. Johns County Land Use Map indicate that the potential for development of golf courses, cemeteries and other potential reuse sites is low. The Julington Creek golf course development to the north is provided reuse water for irrigation from the Julington Creek developments wastewater treatment plant.

Reuse of treated effluent from the St. Johns North WWTP for residential landscape irrigation is currently not feasible since new development is currently not required to construct separate reuse irrigation distribution systems.

PONTE VEDRA (#2-109-0118)

The 1,429 acre Ponte Vedra WWTP Service area is near full development with ocean front hotels and condominiums, apartment complexes, single family home, neighborhood commercial facilities and a golf and tennis club. The Ponte Vedra WWTP serves approximately 749 residential and 91 commercial customers. Current average daily flows are 0.318 MGD. Based on developments under design and undeveloped land within the service area approximately 220 additional ERCs could be added before the service area reaches build out. This growth is projected to continue at a moderately rapid rate as single family homes, apartments, condominiums and commercial facilities. The WWTP currently discharges treated effluent to a land application system consisting of a polishing pond and two rapid infiltration basins. On site reuse for landscape irrigation, chlorine feed and plant wash down water will be proposed in the plant upgrade required to produce reuse quality effluent.

The Ponte Vedra service area has a potential reuse site which could utilize significant amounts of reclaimed water. This site is the Ponte Vedra Golf Club in northern St. Johns County. JSUC is currently working with the owner of the Club and the Department of Environmental Protection to establish design and permitting criteria for delivered of reclaimed water to the lake system of the Club for withdrawal for subsequent land application. It is anticipated that the entire design flow (0.500 MGD) of JSUC's Ponte Vedra WWTP would be delivered to the golf course. A 12" PVC pipe has been installed under the right of way of State Road A1A for JSUC to deliver reuse water from the WWTP on the West side of A1A to the Ponte Vedra Club on the East of A1A. In order to deliver reuse quality effluent to the Ponte Vedra Club a WWTP upgrade to include high level disinfection, filtration, and plant redundancy would be required. JSUC has initiated a Performance Analysis of the existing WWTP as the first step in the permitting and design process.

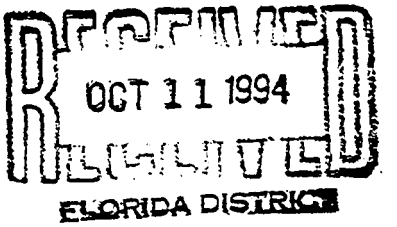
PONCE DE LEON (#2-109-0209)

The Ponce de Leon WWTP Service area is partially developed with ocean front single family homes located on the Atlantic Ocean and between A1A and the Intracoastal Waterway. Future development within the service area is projected to be continued as single family homes. The rate of development is projected to be slow. Wastewater flows in 1994 average 0.015 MGD. The plant currently discharges treated effluent to a land application system consisting of three rapid infiltration basins. On site reuse for landscape irrigation, chlorine feed and plant wash down water is also proposed in a operation permit renewal application currently being reviewed by the department.

Master plans for the undeveloped property within the service area indicate that the potential for development of golf courses, cemeteries and other reuse sites is low. This fact along with the low flow to the WWTP make reuse not feasible in the Ponce de Leon Service Area.

ENVIRONMENTAL SERVICES, INC.
8711 PERIMETER PARK BOULEVARD, SUITE 11
JACKSONVILLE, FLORIDA 32216

(904) 645-9900



6 October 1994

Mr. Jeff Martin
Florida Department of Environmental Protection
7825 Baymeadows Way, Suite B-200
Jacksonville, Florida 32257

RE: Ponte Vedra Wastewater Treatment Plant and Ponte Vedra Inn & Club

Dear Mr. Martin:

Thank you for your time and input during our meeting on 27 September 1994. As we discussed, the Ponte Vedra Inn & Club is in the process of redesigning the golf course irrigation system to utilize a lower water quality source for the irrigation system than the Floridan aquifer, which it is currently on. This redesign is required by a condition of their Consumptive Use Permit from the St. Johns River Water Management District (SJRWMD). The proposed approach is to use a combination of the stormwater lakes and reclaimed water from the Jacksonville Suburban Utilities Corporation's Ponte Vedra Wastewater Treatment Plant when the reclaimed water becomes available. Because the Ponte Vedra Inn & Club is an older development and has reached buildout, there is not any land available to construct a separate holding pond for the reclaimed water. Therefore, the proposed plan is to discharge the reclaimed water directly into the stormwater lake and pickup the irrigation water from the stormwater lake at two locations. The purpose of this submittal to you is to obtain preliminary approval of the discharge of the reclaimed water into the stormwater lake system, confirm that secondary treatment with high-level disinfection will be sufficient for discharge to the lake system for this reuse of reclaimed water and land application and to identify the permitting requirements of the treatment plant and of Ponte Vedra Inn & Club. The approval of the discharge point is critical in the irrigation system redesign. This information is imperative for the irrigation system redesign to continue. Without it, a complete system redesign could be required in the future in order to utilize the reclaimed water, which would be a duplication of considerable time and expense for Ponte Vedra Inn & Club.

By copy of this submittal to Ms. Wendy Elmore of SJRWMD, we respectfully request preliminary approval of this approach and the permitting requirements of SJRWMD in order to construct and operate this irrigation system at Ponte Vedra Inn & Club.

A map of the Ponte Vedra Inn & Club property is enclosed as requested which shows the proposed discharge point, proposed irrigation system pickup locations and proposed monitoring well locations. As shown on the map, Ponte Vedra golf course consists of 36 holes of golf that cover 190 acres of irrigated turf grass. The irrigation of this golf course requires a daily maximum of 1.2 million gallons. The current annual average output from the wastewater plant is 350,000 gallons per day with a projected annual average maximum of 0.5 million gallons per day.

The existing stormwater lake system, north of Solana Road, occupies 60 acres and was built in the 1920's prior to the stormwater regulations. This portion of the lake system is isolated from the southern portion by a weir type control structure with flashboard risers. Based on a master stormwater plan submitted to DEP in 1980, the Department determined that the lake system met the stormwater rule criteria and is an approved stormwater system (approval letter attached). As such the proposed discharge of reclaimed water into this system is not a discharge into "waters of the State".

The residential development in Ponte Vedra adjacent to the lake system and golf course are on septic tanks and public utility water supply. There are not any known shallow potable well locations in or around the project limits. The proposed monitoring well locations are based on this information, the proposed reclaimed water discharge point, the location of property owned by Ponte Vedra Inn & Club adjacent to the stormwater lake and information discussed during the meeting.

I trust that this information is sufficient for your review of this request. Your expedient written reply is greatly appreciated. If you have any questions, please call me at any time.

Sincerely,

ENVIRONMENTAL SERVICES, INC.

Gary K. Howalt

Gary K. Howalt
Senior Scientist

89-247DP.ltr

cc: Wendy Elmore
Paul Salmon
Z Mincek
Steve Manis

Attachments

JACKSONVILLE SUBURBAN UTILITIES CORPORATION
A SUBSIDIARY OF GENERAL WATERWORKS CORPORATION

1400 MILLCOE ROAD, P.O. BOX 8004, JACKSONVILLE, FLORIDA 32239,(904) 725-2865

October 31, 1994

Mr. Charles L. Logue, P.E.
Division Chief
Wastewater Division
Department of Public Utilities
City of Jacksonville
2221 Buckman Street
Jacksonville, Florida 32206

Re: Jacksonville Suburban Utilities Corporation (JSUC)
Wastewater Effluent Reuse

Dear Mr. Logue:

Over the past several month JSUC has been talking with the City of Jacksonville about the City's Master Plan and JSUC's plan for wastewater effluent disposal through reuse. It appears to be in the best interest of both parties to handle effluent reuse in Duval County through a basin wide approach. This letter is to summarize JSUC's conceptual plan for reuse and its understanding of the City's plan.

As understood, your preliminary plan has a major trunk line proposed for Monument Road to carry reuse quality effluent from the Arlington East WWTF to the East Arlington area of the City. Mill Cove Golf Course, located on Monument Road, is within JSUC's Holly Oaks Service Area. JSUC has identified this facility as a potential reuse customer. Since your major trunk is adjacent to Mill Cove Golf Course we propose that JSUC would obtain reuse water from the City for distribute to our customer, Mill Cove Golf Course.

You have indicated that the Deerwood Golf Course, within the City's service area, is also a potential reuse customer but is not located within the extent of your initial phases of a reuse effluent distribution system. This golf course is adjacent to our Royal Lakes WWTP Service Area. We have initiated conversation with the Baymeadows Golf Course for utilization of reuse effluent from the Royal Lakes WWTP. With the close proximity of these two golf courses, we would like to investigate the possibility of delivering reuse quality effluent to the City for distribution to the Deerwood Golf Course and other potential reuse customers.

We request that you provide confirmation that the City of Jacksonville is receptive to this basin wide approach to reuse and any preliminary schedules you may have on availability of reuse water to Mill Cove Golf Course and need for reuse water for Deerwood Golf Course and other potential reuse customers. We propose to present this information to the SJRWMD for as part of our Water Reuse Plan.

Should you have any question or require additional information please contact me at 721-4610.

Sincerely,

Stephen Manis, P.E.
Area Engineer

SVM/

cc: Philip Heil
Caroline Silvers, SJRWMD

D. RATE STRUCTURE

CONSERVATION RATE STRUCTURE

JSUC's current rate structure is defined as a base facility uniform volume rate, in which customers are charged a base rate according to meter size and a usage rate according to consumption. Attachment 10 shows an example of this rate structure.

The Florida Public Service Commission Order that established JSUC's present base facility–usage charge rate structure included the following statement: "For those customers who practice conservation, this structure will afford an opportunity to be recognized and compensated in the form of savings for their conservation efforts."

Customers generally feel that our rates are too high, and hence already have a financial incentive to conserve water. In addition, sewage rates are billed according to metered water usage, so customers who practice conservation would be reducing their sewer bills as well as their water bills. The water conservation plans prepared by Atlantic Utilities and Southern States Utilities, provided to us as examples by the SJRWMD, indicate that those companies also employ a uniform rate structure.

Should JSUC undergo a rate case in the future, a change to an inclining block rate would be considered and the SJRWMD would be notified of any rate case proceeding. However, we feel that it would be cost–prohibitive to initiate a rate case for the sole purpose of changing to such a structure.

JACKSONVILLE SUBURBAN UTILITIES CORPORATION

SECOND REVISED SHEET NO. 16.0
CANCELS FIRST REVISED SHEET NO. 16.0

WATER TARIFF

RATE SCHEDULE GW (1)
SCHEDULE OF RATES FOR GENERAL METERED WATER SERVICE

AVAILABILITY:
Available in the territory served by Jacksonville Suburban Utilities Corporation.

APPLICABILITY:
For water service to all customers in the territory served by Jacksonville Suburban Utilities Corporation., for which no other schedule applies, including Metered Commercial, Industrial, Municipal, Multiple Dwelling (Apartments) not individually metered and other Non-Residential Service customers.

LIMITATIONS:
The service required on the premises by the customer shall be supplied through one meter for each independent plumbing system. Stand-by or re-sale service not permitted hereunder. Subject to all of the Rules and Regulations of this Tariff and the General Rules and Regulations of the Commission.

BILLING PERIOD: Monthly

RATES:

Quantity Rates	Per Meter Per Month
All usage, per 1,000 gallons ..	$ 0.98
All usage, per 100 cubic feet .	$ 0.73

BASE FACILITY CHARGES:

Meter Size	Per Month
5/8"	$6.55
3/4"	8.44
1"	12.20
1½"	25.41
2"	48.02
3"	127.17
4"	327.00
6"	368.46
8"	4,104.53

Type of Filing: 1994 Price Index and Pass Through

(Continued to Sheet NO 16.1)

Effective: For Service Rendered On Or After July 19, 1994

Philip Heil
Vice President

Florida Public Service Commission

APPROVED

Authority No. WS-94-0115

Docket No. N/A

Order No. N/A

Effective July 19, 1994

Director
Division of Water and Wastewater

E. EDUCATION

PUBLIC EDUCATION

a. School Programs

JSUC has been active in instilling a water conservation ethic through participation in various school programs. These programs have been offered on request, and are listed below.

1. In 1993–1994, JSUC co–sponsored a play entitled "The Legend of the Lake" by Small Change Theater. This play was presented to approximately 20,000 students throughout the Duval County Public School System and received very favorable responses.

2. Plant tours have been conducted upon request.

3. Classroom lectures have been conducted upon request, and have featured a 22–minute video entitled "What Do You Know About H_2O?" and handout booklets entitled "The Story of Drinking Water", "Our World of Water", and several others (see Attachment 11). In 1994, JSUC visited thirty–eight classes in six elementary schools and distributed literature to approximately 1,050 students.

Our plant tours have been eliminated in order to comply with the Americans With Disabilities Act, as shown in Attachment 12. However, we propose to increase the frequency of the classroom lectures by submitting more invitations to the Duval County, St. Johns County, and Nassau County School Boards.

b. Customer Information

At the start of 1992, JSUC switched from a postcard billing system to an envelope billing system. Therefore, we propose to increase the frequency of conservation literature mailings. In addition to SJRWMD bill stuffers, we will be sending bill stuffers developed by other GWC companies.

In addition, our new bills have extra room at the bottom for conservation messages. The first list of messages ran in June 1992, and an example is shown in Attachment 13. These or similar water conservation tips will run continuously. Attachment 14 contains examples of our water conservation literature.

Splash!

Activity Book

Fred Fish and Sarah Seagull are great friends.

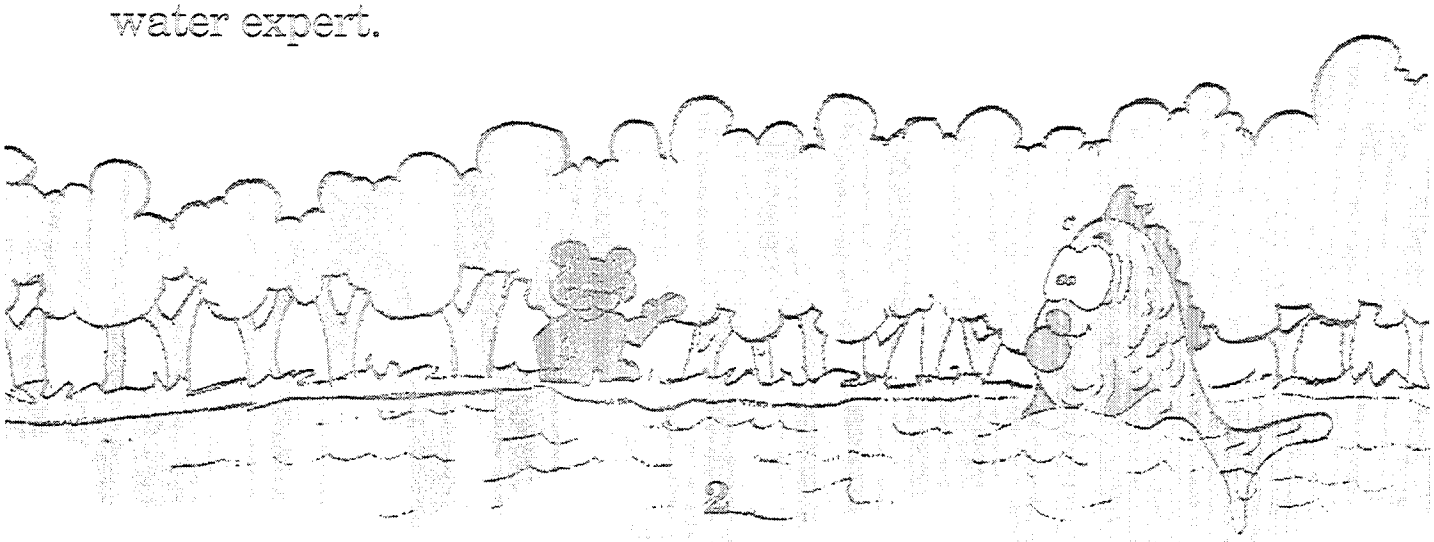
Sarah flies in the air. She watches the land and water below.

She sees the plants and animals that live on the land.

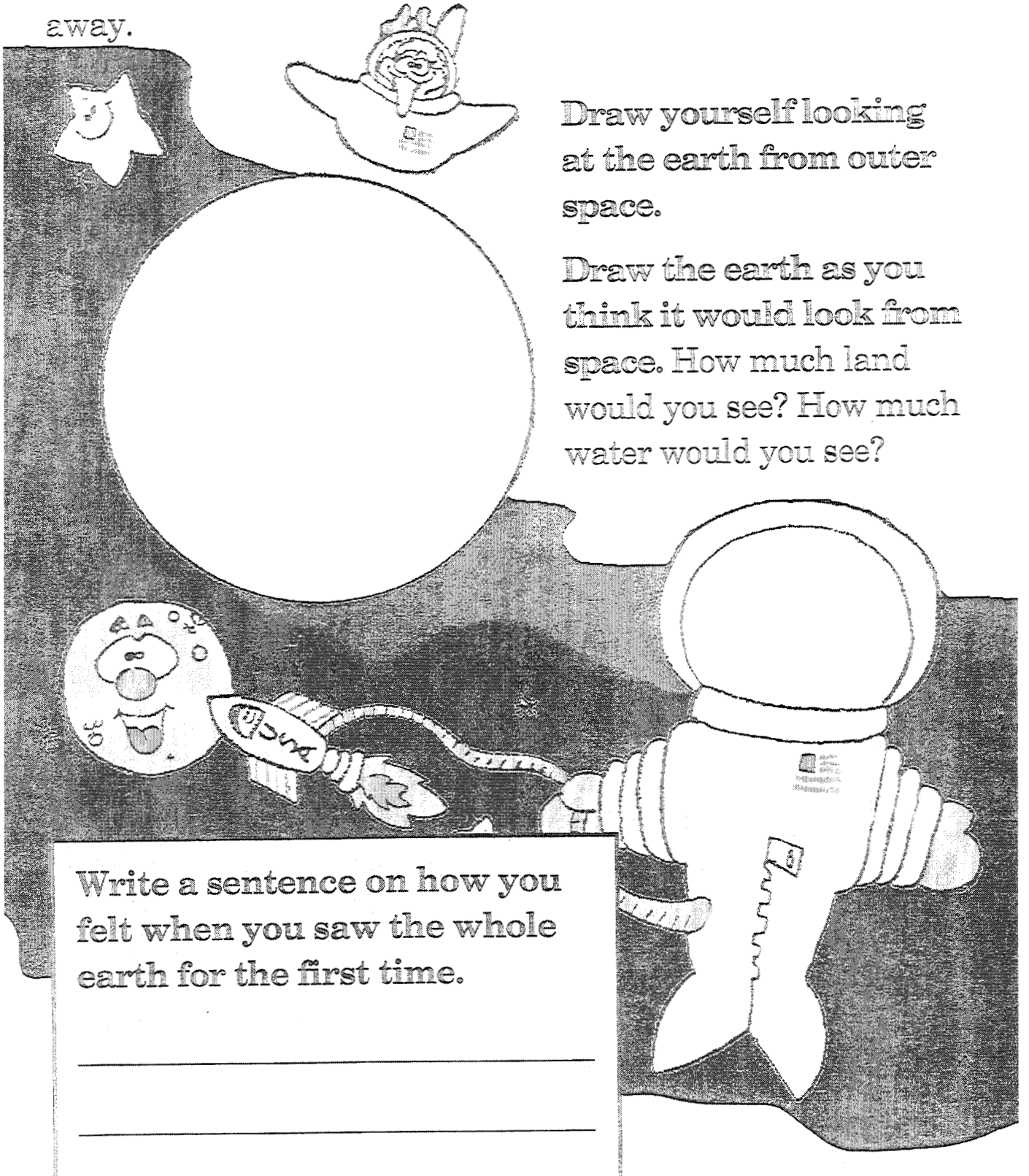
She dives down to the water for food.

Fred lives in the water. He is surrounded by water. He swims in it all the time.

He knows the plants and animals that live in water. He could not live out of water. Fred is a water expert.



Sarah can fly high into the sky. People can fly much higher than Sarah. They can see the whole earth at one time! The water on the earth makes it look blue from far away.



Draw yourself looking at the earth from outer space.

Draw the earth as you think it would look from space. How much land would you see? How much water would you see?

Write a sentence on how you felt when you saw the whole earth for the first time.

_____

_____

_____

Sarah knows that there is much more water than land on the earth.

Fred knows that many plants, fish and animals live in the water. They find plenty of food there. They can breathe in the water.

People and other plants and animals live on land. All living creatures on land breathe air. But they need water, too.

Match the word to the correct sentence.

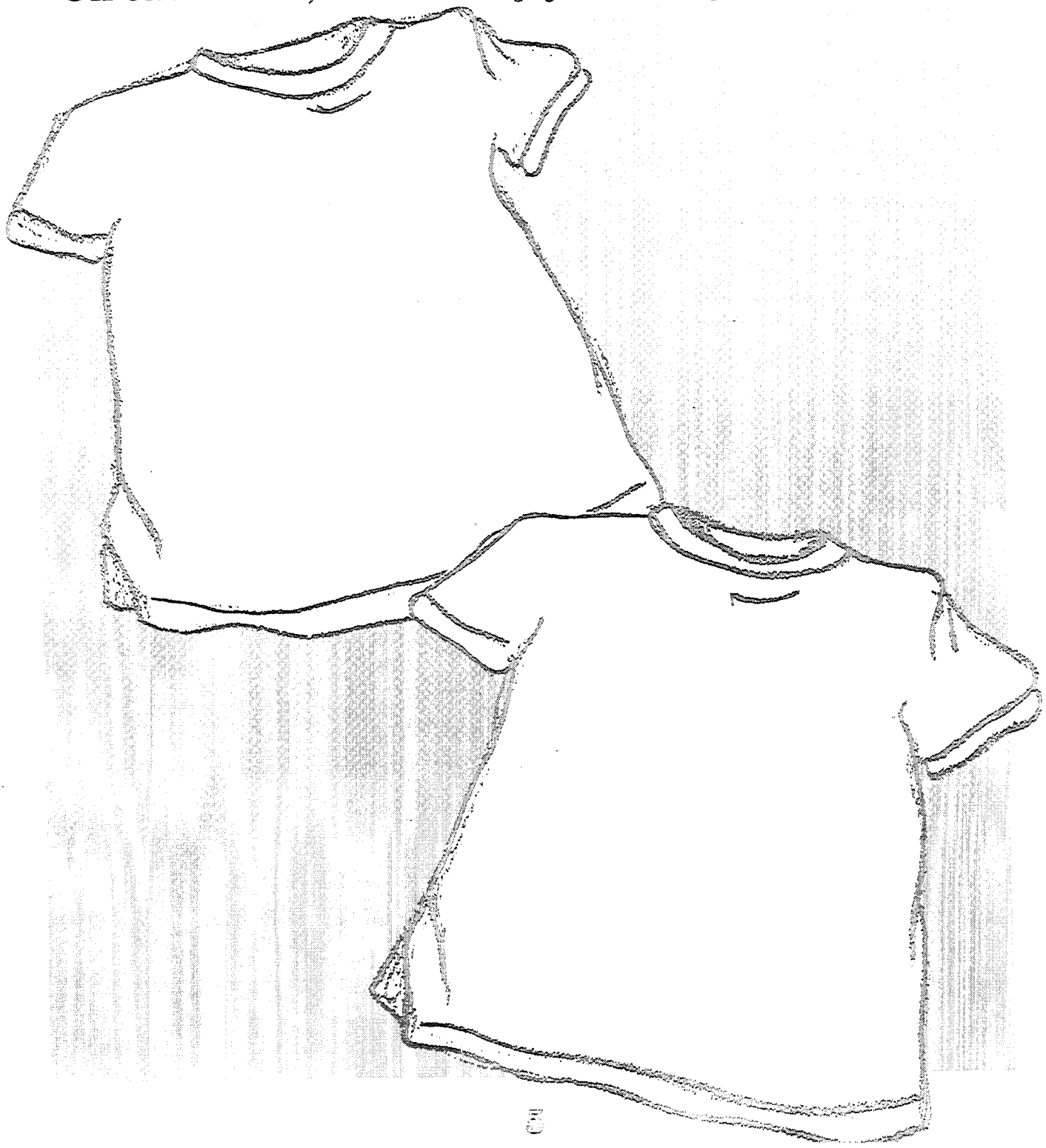
1. There is much more water than	air
2. Fred and other fish can breathe in the	people
3. People breathe	land
4. But water is important to	water

Without water, we would live only a few days.

Let's think of some ways our bodies get water.

- Drink water, milk, lemonade and fruit juices.
- Eat fruit and other foods. All foods have water in them.

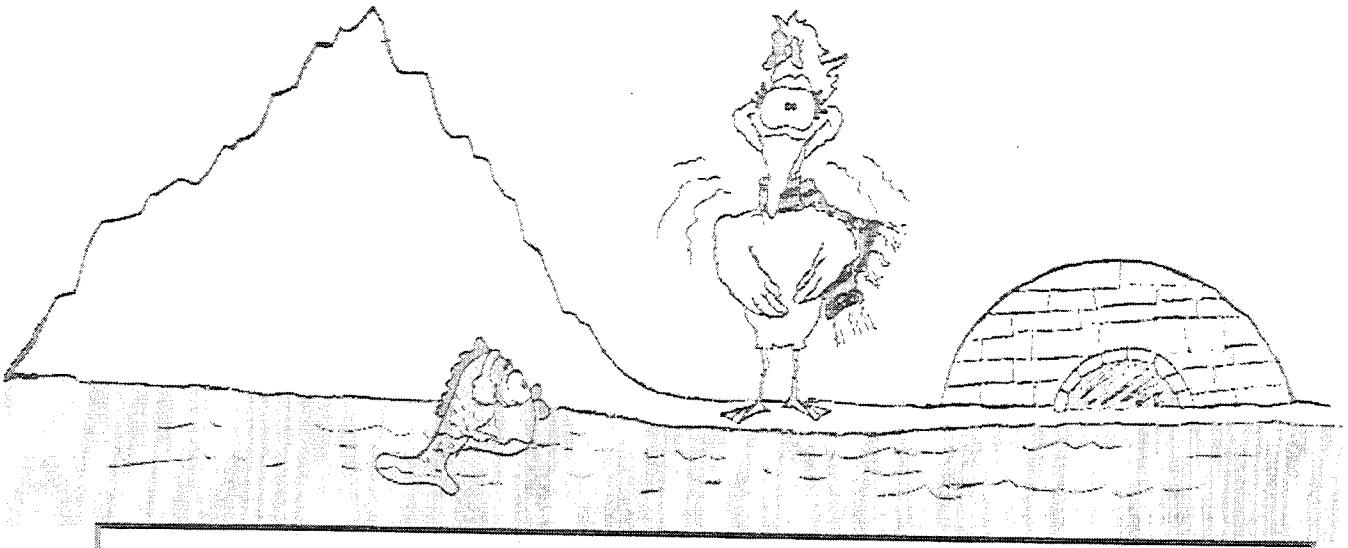
On each shirt, draw a way your body gets water.



When Sarah flies over the earth, she sees oceans. Almost all of the water on the earth is in oceans.

Ocean water contains salt. Salt water makes us more thirsty. We can drink only water without salt. This is called fresh water.

Almost all of the fresh water on earth is frozen. It is in huge blocks of ice called glaciers. Glaciers are at the North and South Poles of the earth.



Write a story about Fred or Sarah. Use some of these words in your story.

salt fresh ocean thirsty water ice

There is very, very little fresh water on earth. All people use this little bit of water. We use water from lakes, streams and rivers.

Sometimes fresh water is underground. We use pumps to bring it above ground. Then we can use it.

Find the numbers on the picture that the sentences tell about:

____ The ocean is very big.

____ Rivers have fresh water.

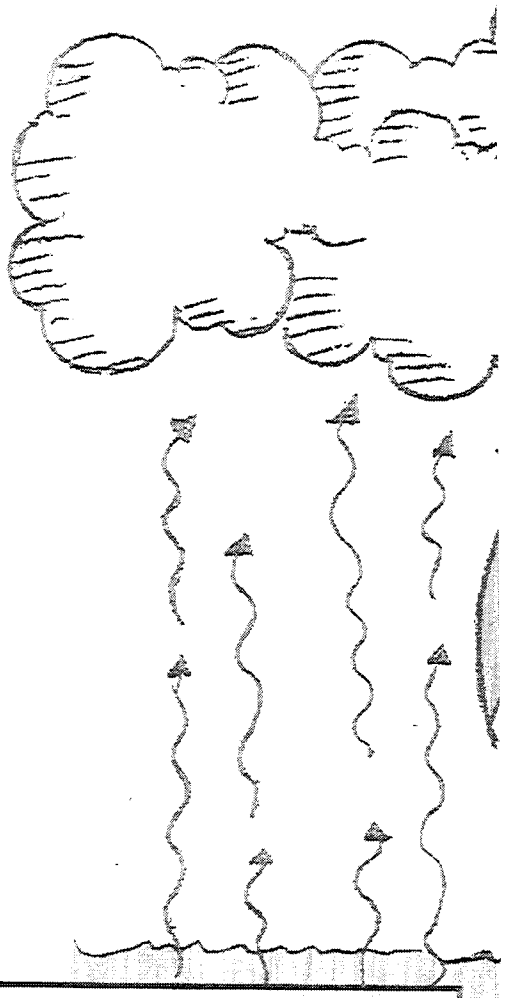
____ The glaciers are big.

____ Lakes have fresh water.

Most of the time we use water when it is a **liquid**. We drink liquid water. We swim in liquid water.

Water can also be a **solid**. Water is solid when it is ice. It is fun to eat ice in a snow cone.

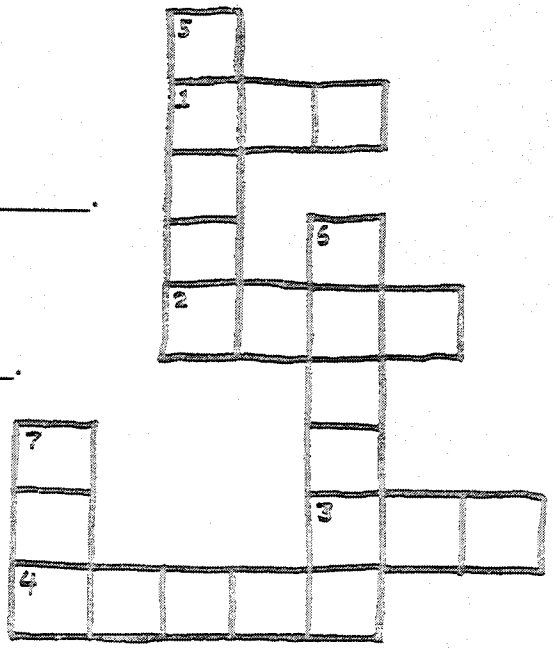
Water can also be a **gas**. It becomes a gas when it **evaporates**. We cannot see water when it is a gas. As your wet swimming suit dries the water becomes a gas. It moves into the air a tiny bit at a time. But you do not see it happen. You just notice when your suit is dry.



Find the words that make up the puzzle.

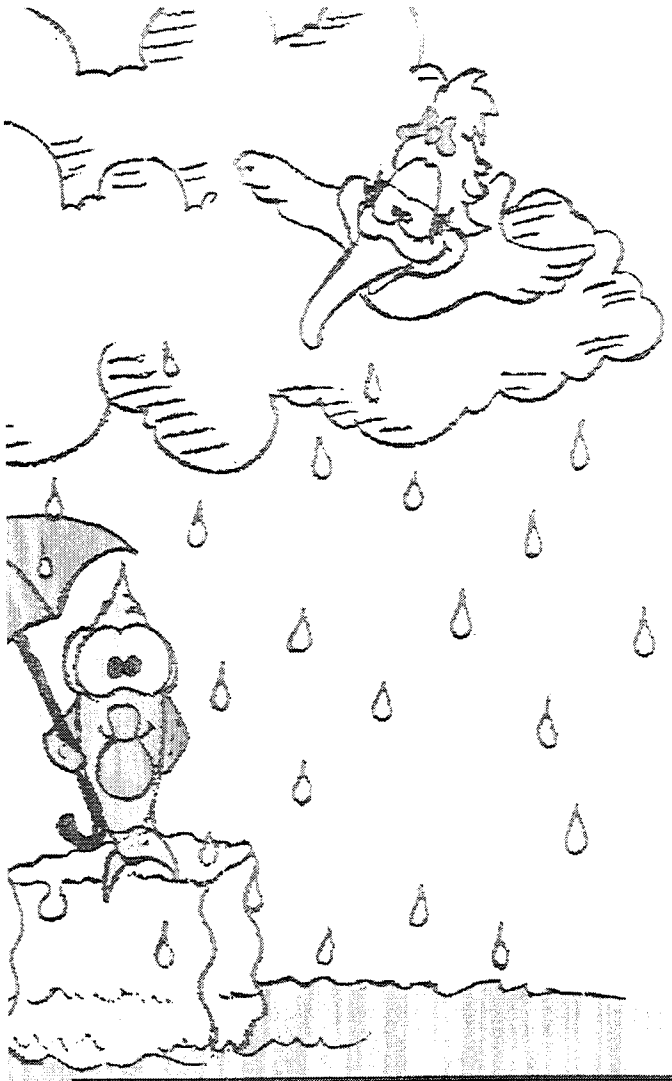
Across

1. Water as it becomes a gas can rise into the _____.
2. Water falling from the sky is _____.
3. Solid water is _____.
4. When water is ice, it is a _____.



Down

5. We drink liquid _____.
6. We swim in _____ water.
7. We cannot see water that is a _____.



Fred knows about evaporation. Most of the water that evaporates into the air comes from oceans, lakes and rivers. It also comes from plants, animals and the wet ground.

When the air moves high above the ground, it becomes very cold. Water that is a gas sticks to bits of dust in the cold air. It then becomes a raindrop.

Here is the secret code.

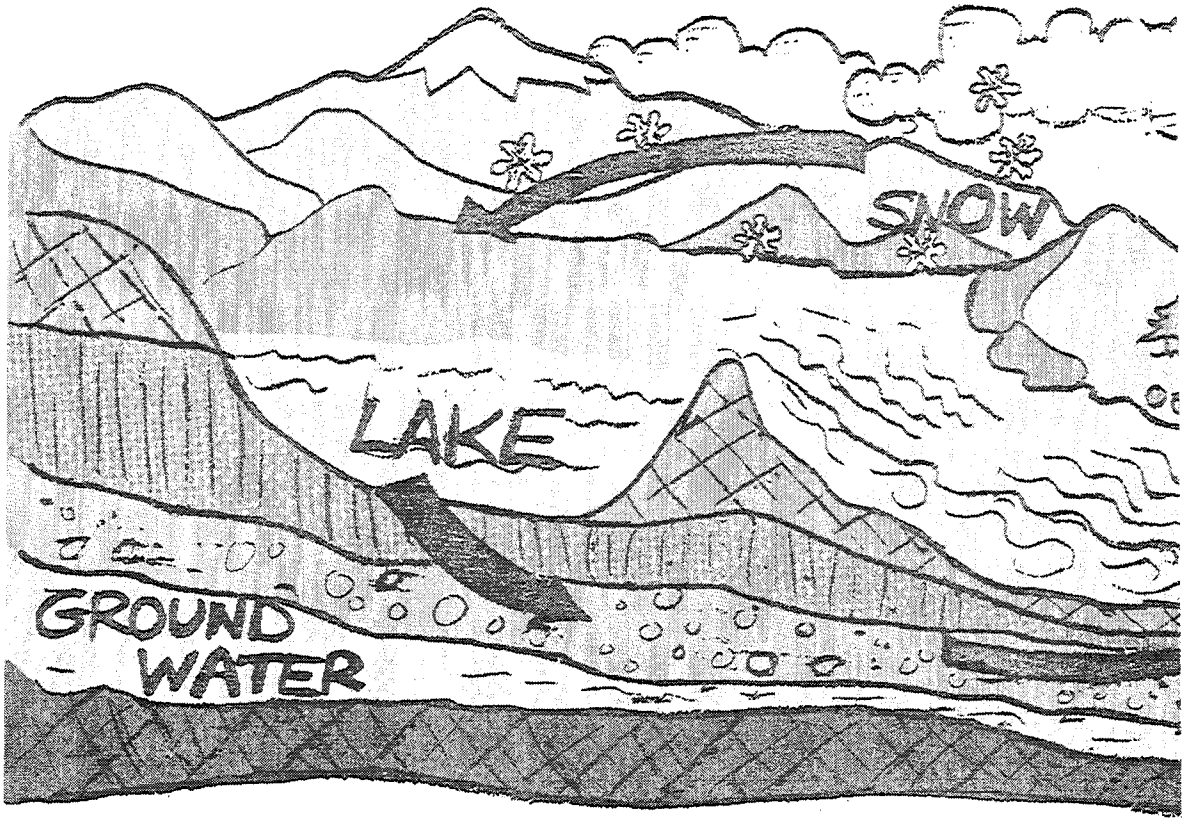
A	B	C	D	E	F	G	H	I	J	K	L	M
1	2	3	4	5	6	7	8	9	10	11	12	13
N	O	P	Q	R	S	T	U	V	W	X	Y	Z
14	15	16	17	18	19	20	21	22	23	24	25	26

Can you find the secret message?

$\overline{4}$ $\overline{18}$ $\overline{15}$ $\overline{16}$ $\overline{19}$ $\overline{13}$ $\overline{1}$ $\overline{11}$ $\overline{5}$

$\overline{3}$ $\overline{12}$ $\overline{15}$ $\overline{21}$ $\overline{4}$ $\overline{19}$

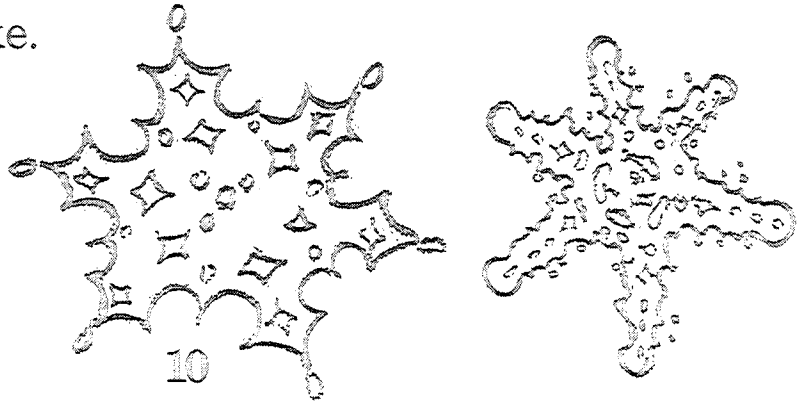
Up in the sky, water drops join together. They become bigger and bigger. Soon the drops become clouds. Some drops in the clouds get so heavy that they fall to earth. These are raindrops. If it is very cold, the drops become snowflakes.



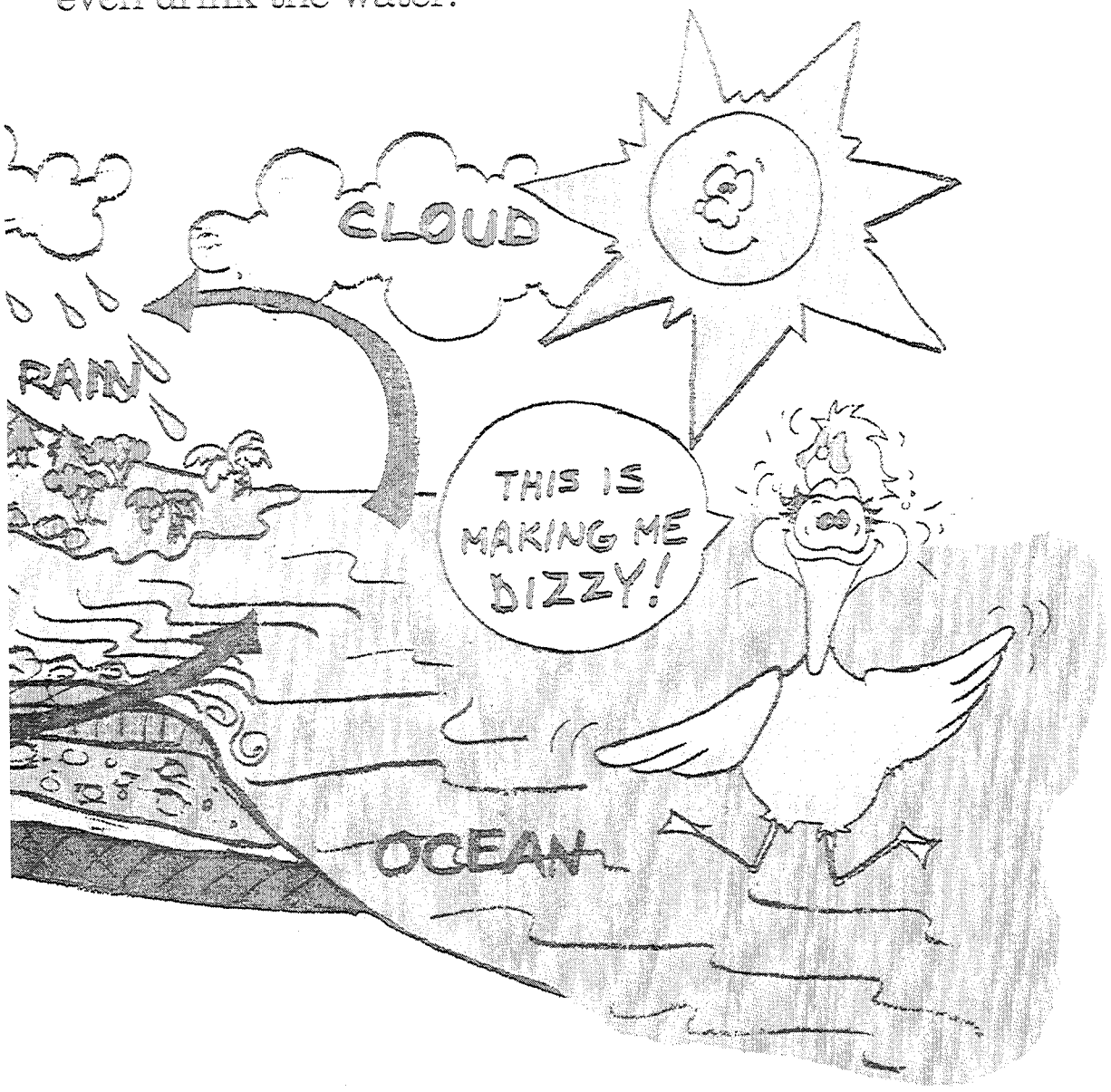
Count the number of snowflakes on this page. Count the number of raindrops on the next page. Are there more snowflakes or raindrops? How many more are there?

Did you know . . .

There are six points on every snowflake. But no two snowflakes are alike.



When the drops reach the earth, they may soak into the ground. They may run into a river or lake or ocean. We may even drink the water.



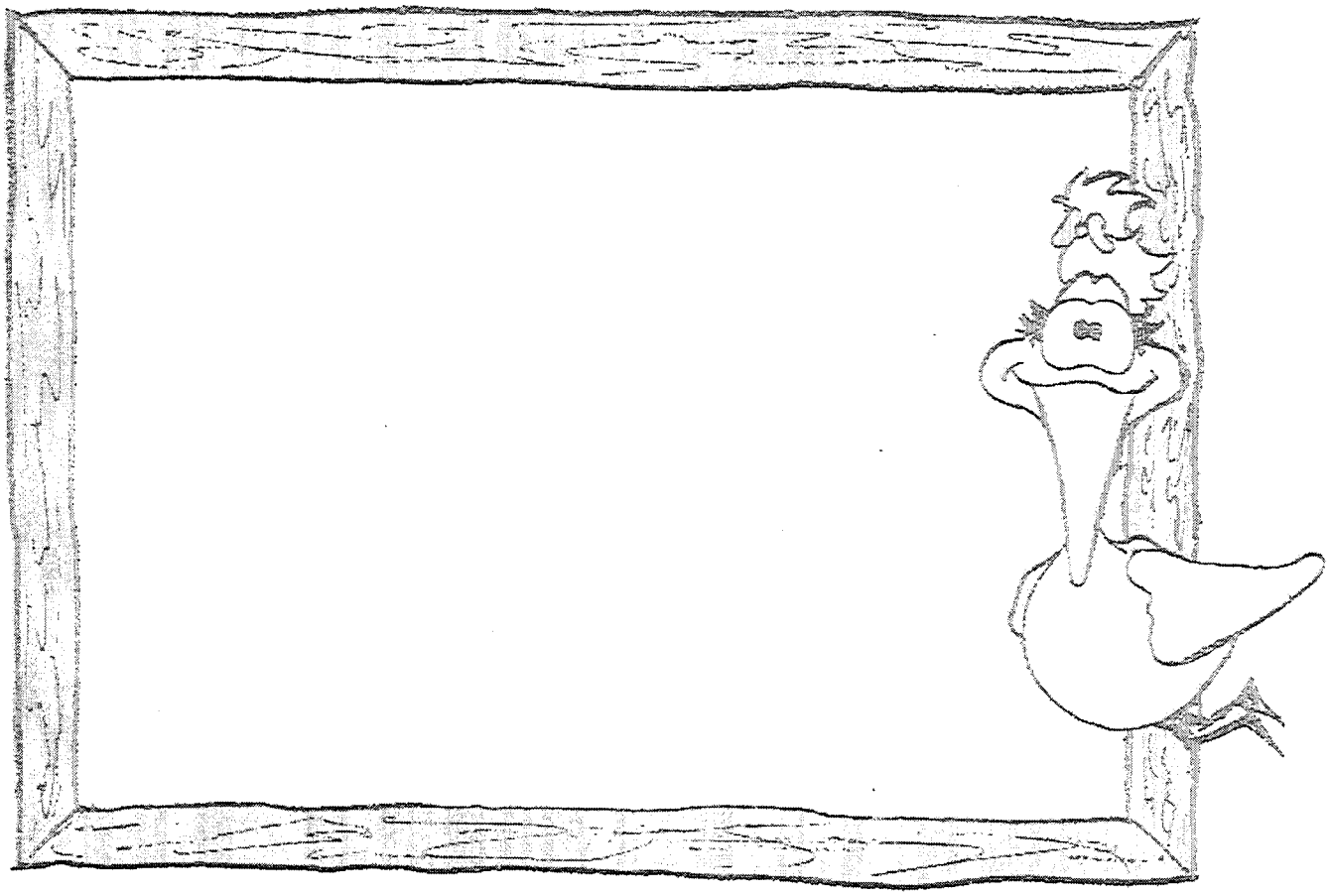
But guess what? The water will evaporate into the air again. Raindrops will form clouds again. It will rain or snow again. Over and over!

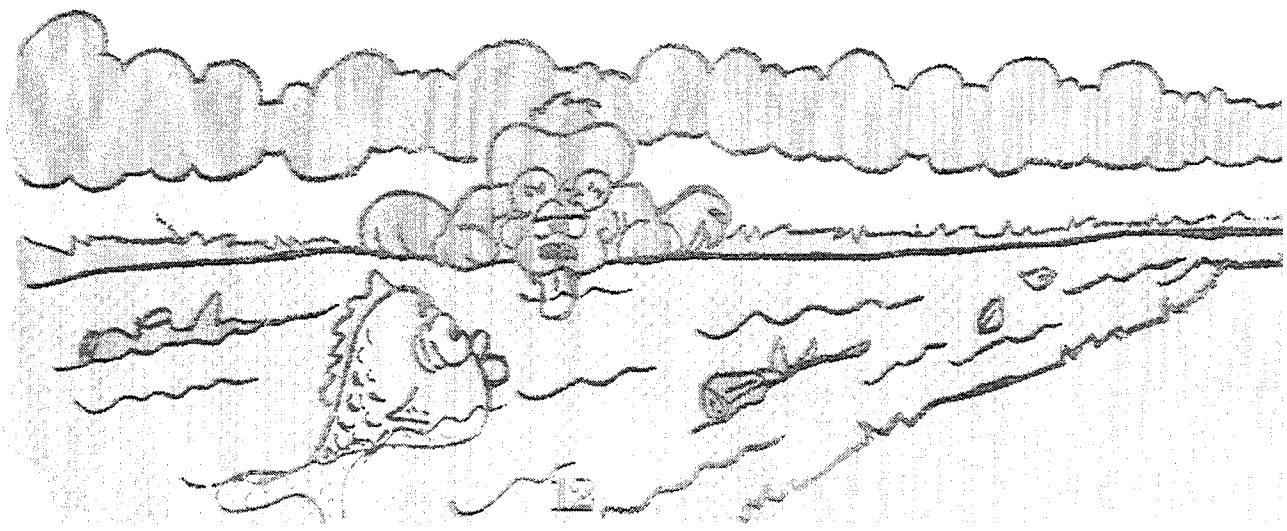
This water cycle will happen over and over again!

Fred knows that we need water. We need clean drinking water. Dirty water is called **polluted.** It is polluted by people who throw trash and chemicals into it. Polluted water is not good to drink.

Sarah works very hard to keep water clean. Can you help her?

Draw a picture of yourself helping Sarah keep our water clean.





Animals drink the water in rivers and lakes. The water may look nice and clean. But it may contain germs or pollution. YUK!! This water may make them or you very sick. We can help other creatures by trying not to pollute.

To help people, communities have water treatment plants. A water treatment plant is an interesting building. It has important equipment. People work there all day and all night to clean our water.

The treatment plant cleans our water in a special way. It gets rid of the germs and pollution. Water is then safe for us to drink.

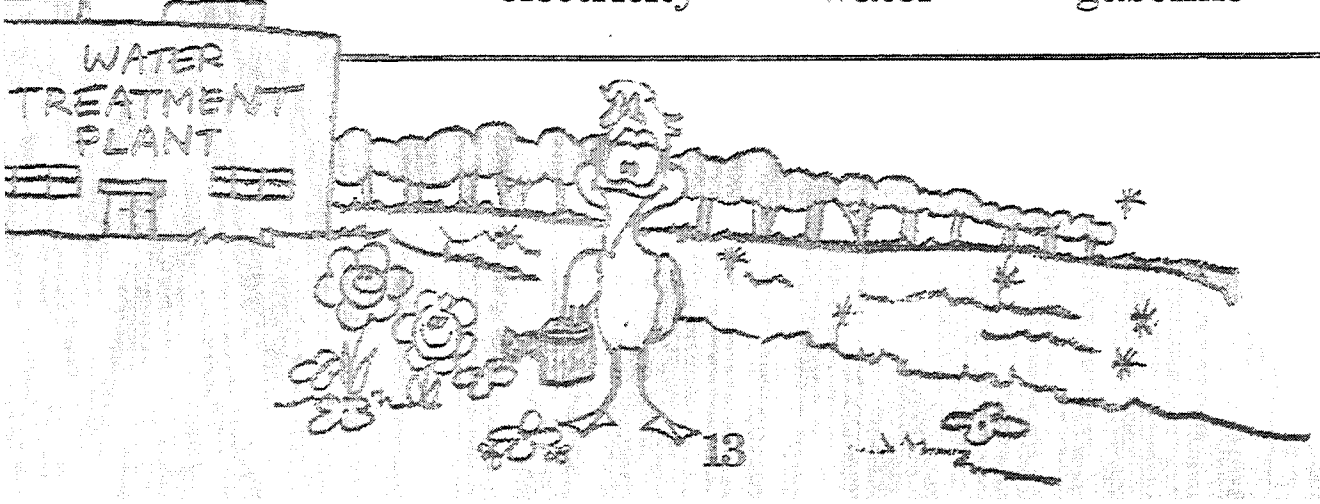
Circle the correct word to complete the sentence.

1. Water in rivers or lakes may look _____ when it is not.
   clean muddy dirty

2. People work all day and all night in the _____.
   treatment plant school river

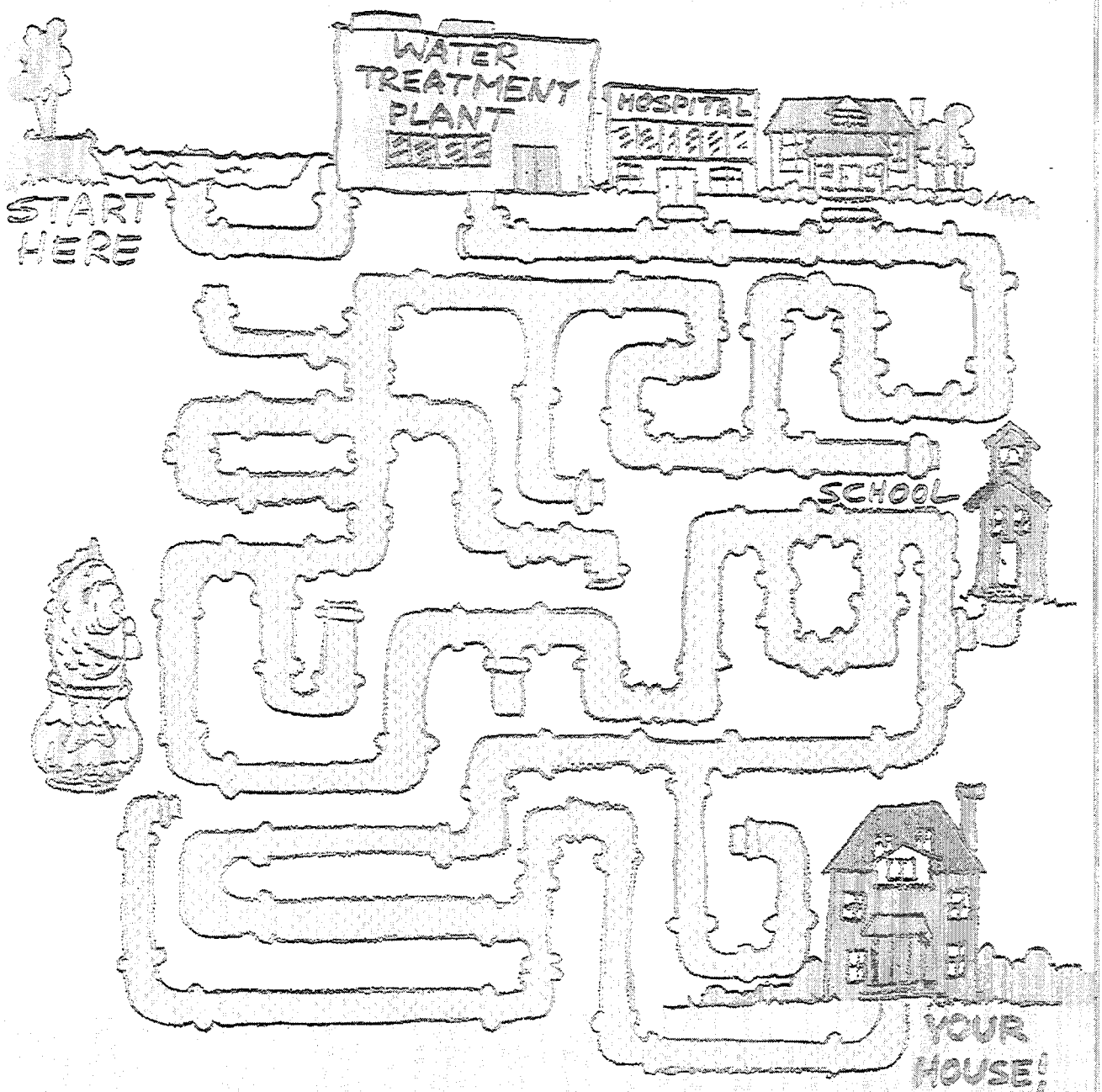
3. Germs can make us very _____.
   healthy sick wacky

4. Water treatment plants clean our _____ in a special way.
   electricity water gasoline



Fred and Sarah have found a river. From the river, the water goes into the water treatment plant. From the treatment plant, the clean water moves through large pipes under the street. Every house or school or store connects to the large pipes to get water.

Follow a drop of water from Bigfish Lake to your house!



Fred and Sarah know how important water is to us. They use water wisely. They want us to use water wisely too.

Fred and Sarah write down each time they use water.

Write down each time you use water today.

Fred's diary:

Get Up
1. Brush teeth
2. Shower

Breakfast
1. Milk
2. Juice
3. Oatmeal

YOUR DIARY:

Morning _____ _____

_____ _____

_____ _____

Afternoon _____ _____

_____ _____

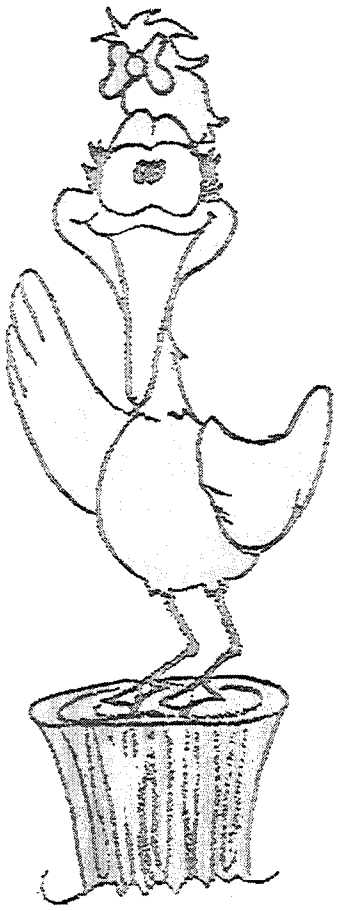
_____ _____

Night _____ _____

_____ _____

_____ _____

Fred and Sarah know some good ways to use water wisely. Can you think of other ways?



1. Take a 5 minute shower. This uses less water than a bath.
2. Turn off the water when you brush your teeth.
3. Use a bucket to wash your bike. Using a bucket uses less water than a hose.
4. Keep a jug of water in the refrigerator. Yo ys have cold water with g the faucet.

5. Carefully water your lawn and flowers.
6. Check your faucets for drips. A faucet with a little drip can waste lots of water.
7. _____
8. _____

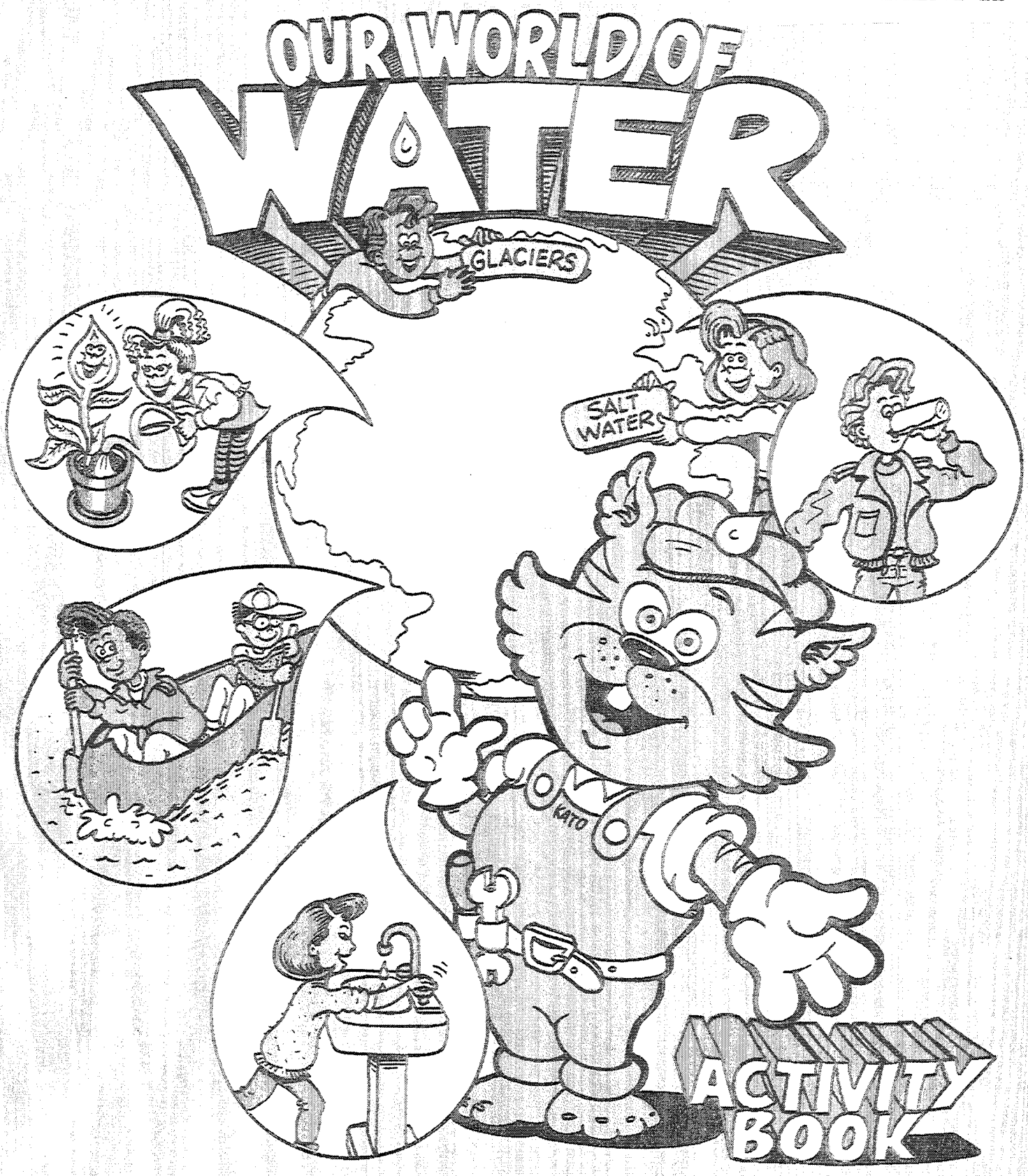
Use water only when you need it.
Always turn it off when you are finished.

American Water Works Association
6666 West Quincy Avenue, Denver, CO 80235

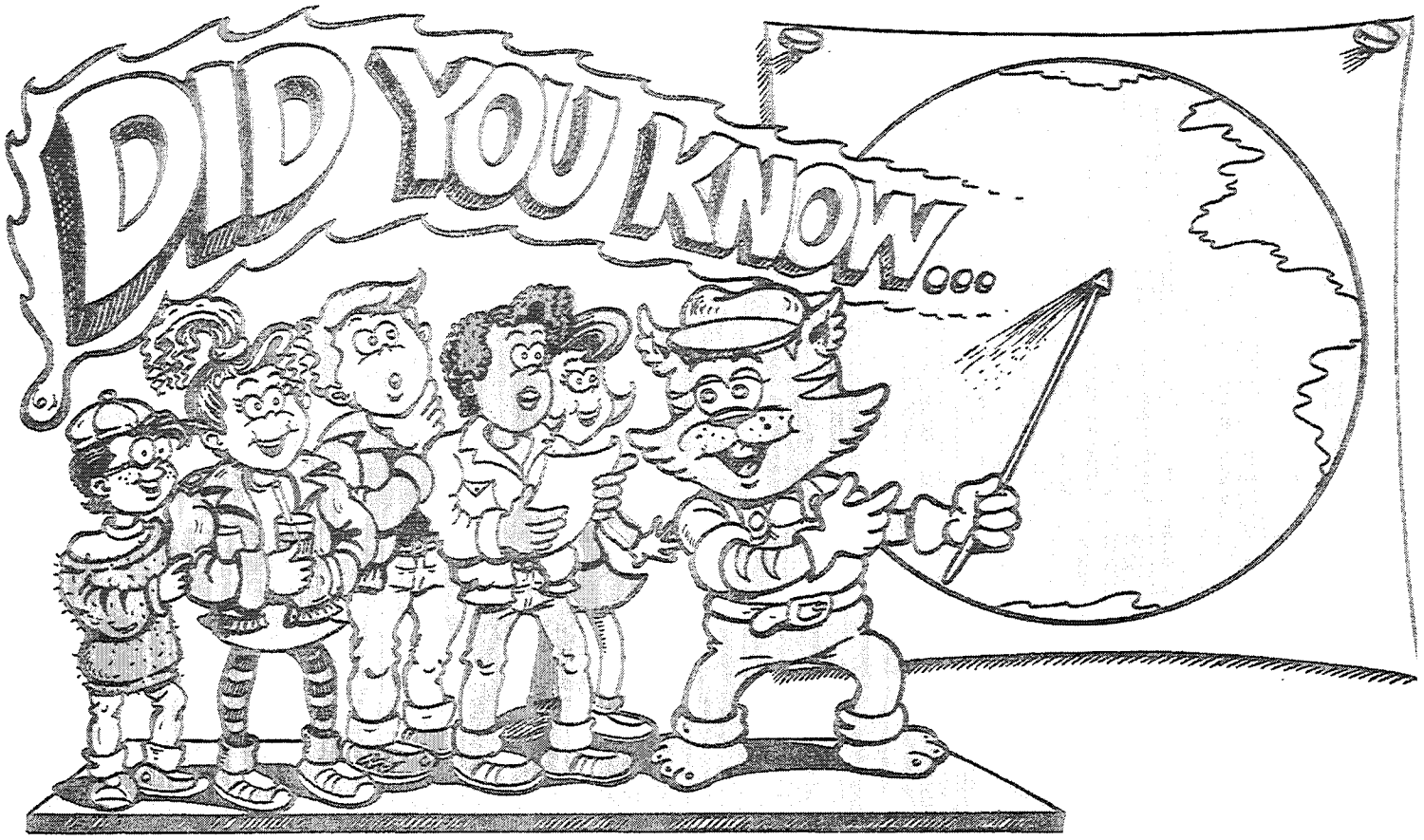
4P-200M-70054-5/93-PP

RECYCLABLE

ISBN 0-89867-517-0



Jacksonville Suburban Utilities Corp.



ALMOST 80% OF THE EARTH'S SURFACE IS COVERED BY

UNSCRAMBLE THE LETTERS TO FORM THE WORD THAT COMPLETES THE SENTENCE:

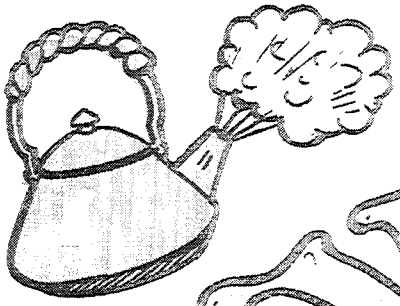
EAWTR

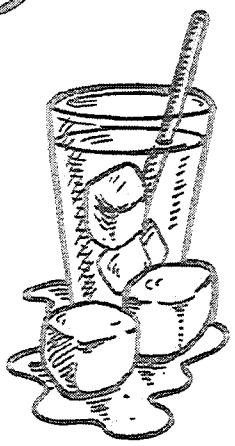
WHAT IS THE CHEMICAL FORMULA FOR WATER?

O2H

UNSCRAMBLE

WHAT IS WATER?





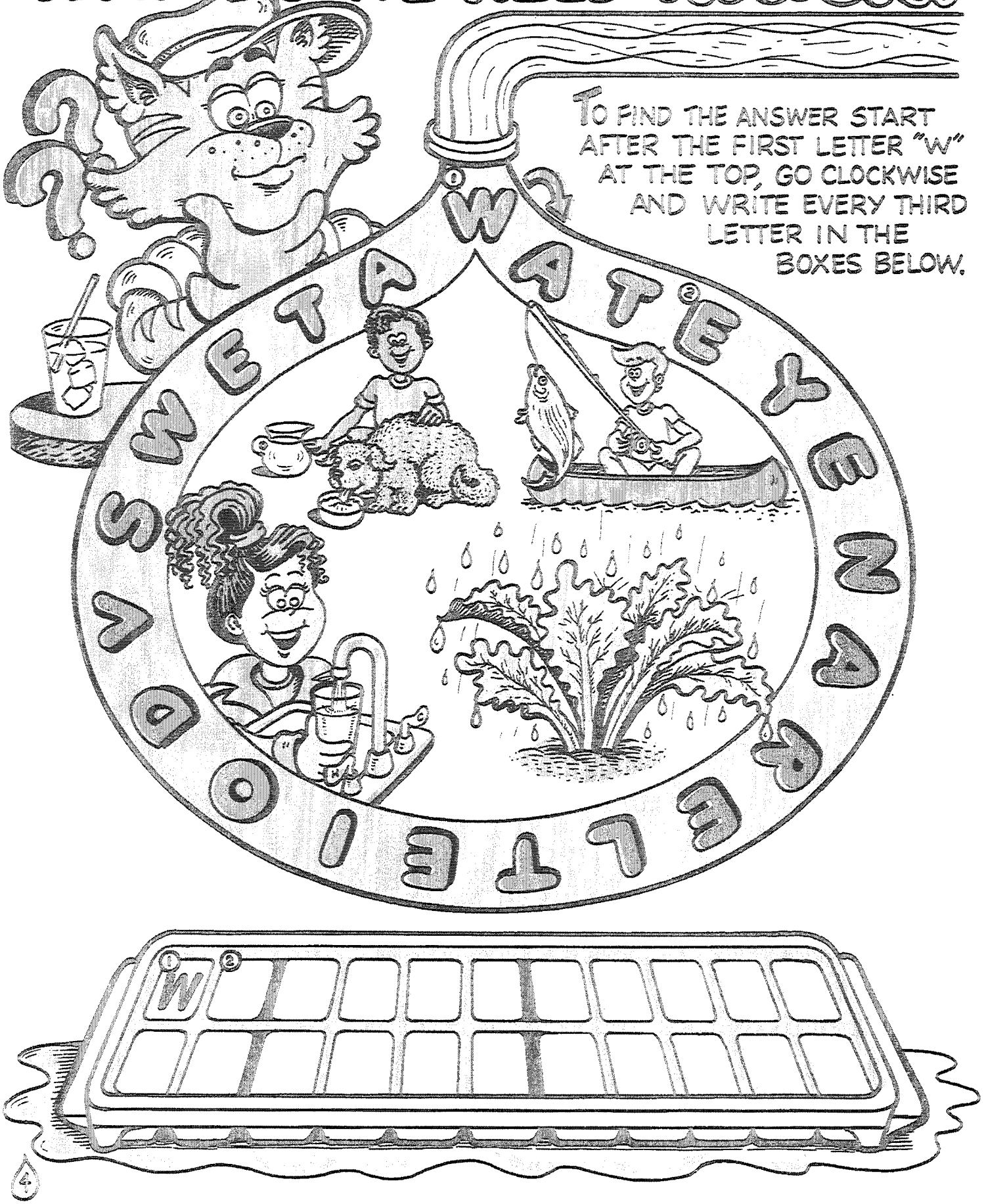
DIRECTIONS FILL IN THE MISSING VOWELS A,E,I,O,U SO YOU CAN READ THESE WATER FACTS.

W_T_R C_N B_ _ L_QU_D, S_L_D _R G_S.

W_T_R _S _D_RL_SS C_L_RL_SS, T_ST_L_SS _ND TR_NSP_R_NT.

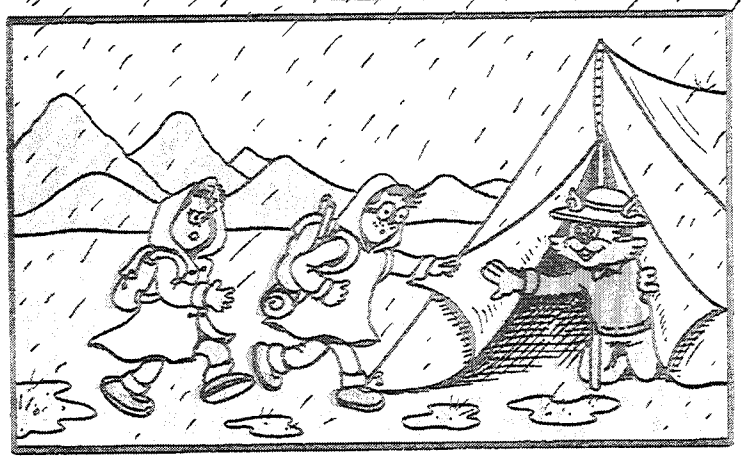
W_T_R _S _ L_QU_D F_ _ND _N _C_ _NS, L_K_S, R_V_RS _ND P_NDS.

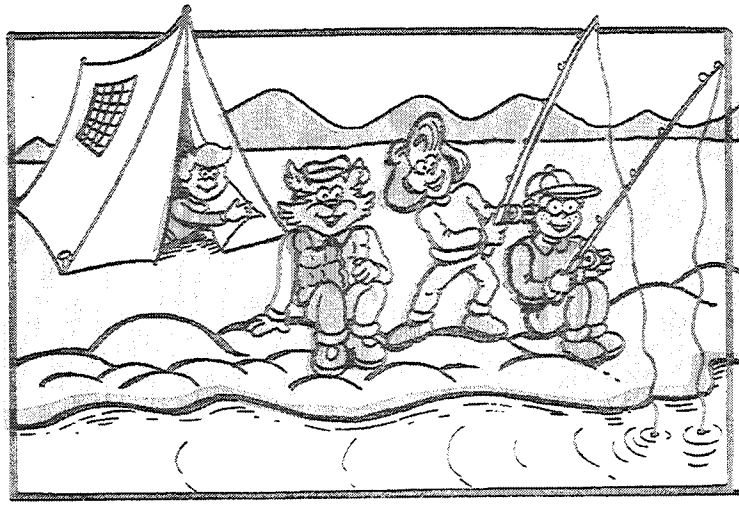
WHY DO WE NEED WATER?



WHERE DO WE GET WATER?

DRAW A LINE FROM THE DEFINITION TO THE PICTURE!





SURFACE WATER

LAKES, PONDS, RIVERS, OCEANS, STREAMS, PUDDLES.

GROUND WATER

WATER THAT COMES FROM BENEATH THE SURFACE OF THE GROUND.

PRECIPITATION

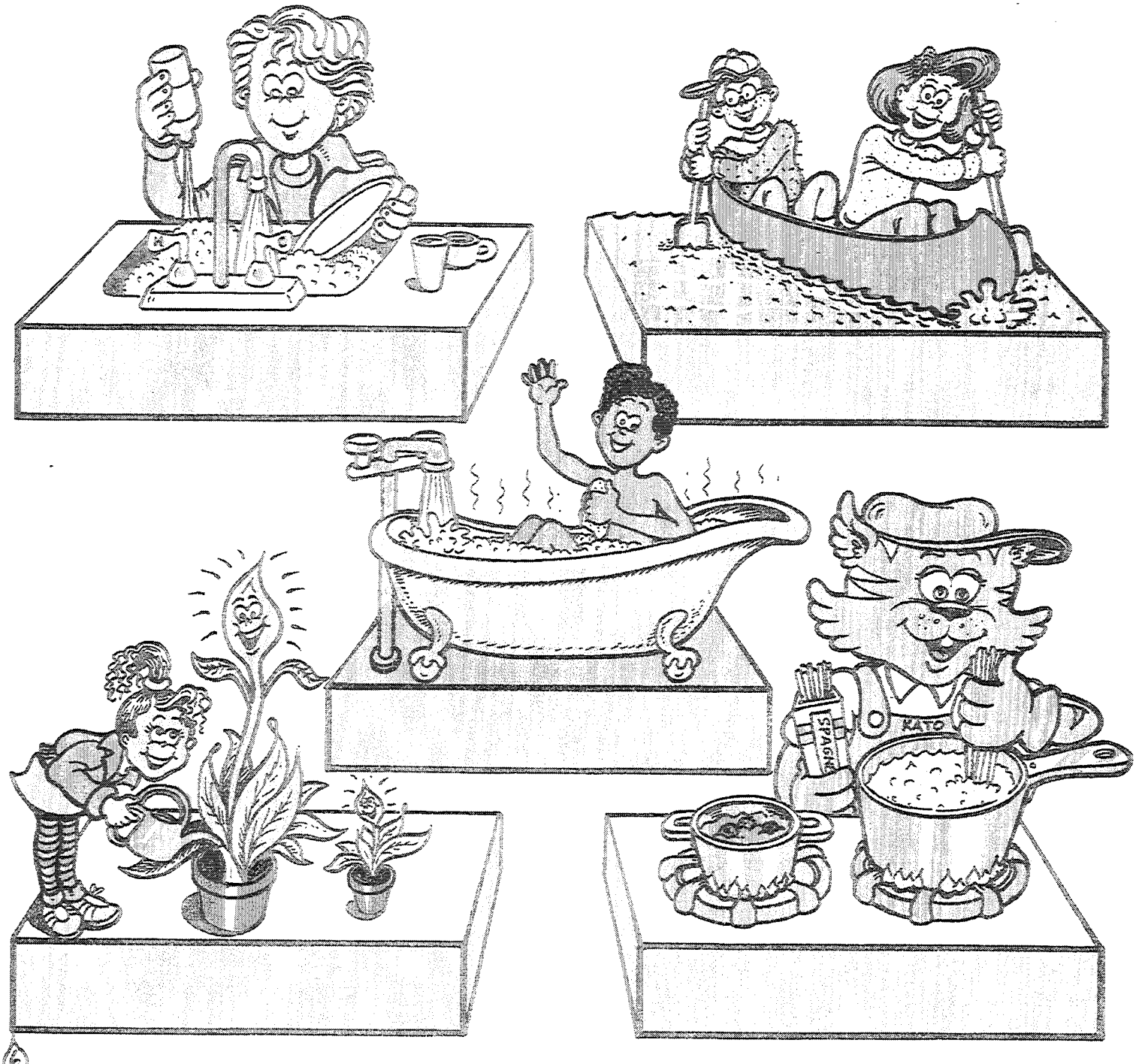
WATER RECEIVED ON EARTH DIRECTLY FROM CLOUDS AS RAIN, HAIL, SLEET OR SNOW.

HOW DO YOU USE WATER?

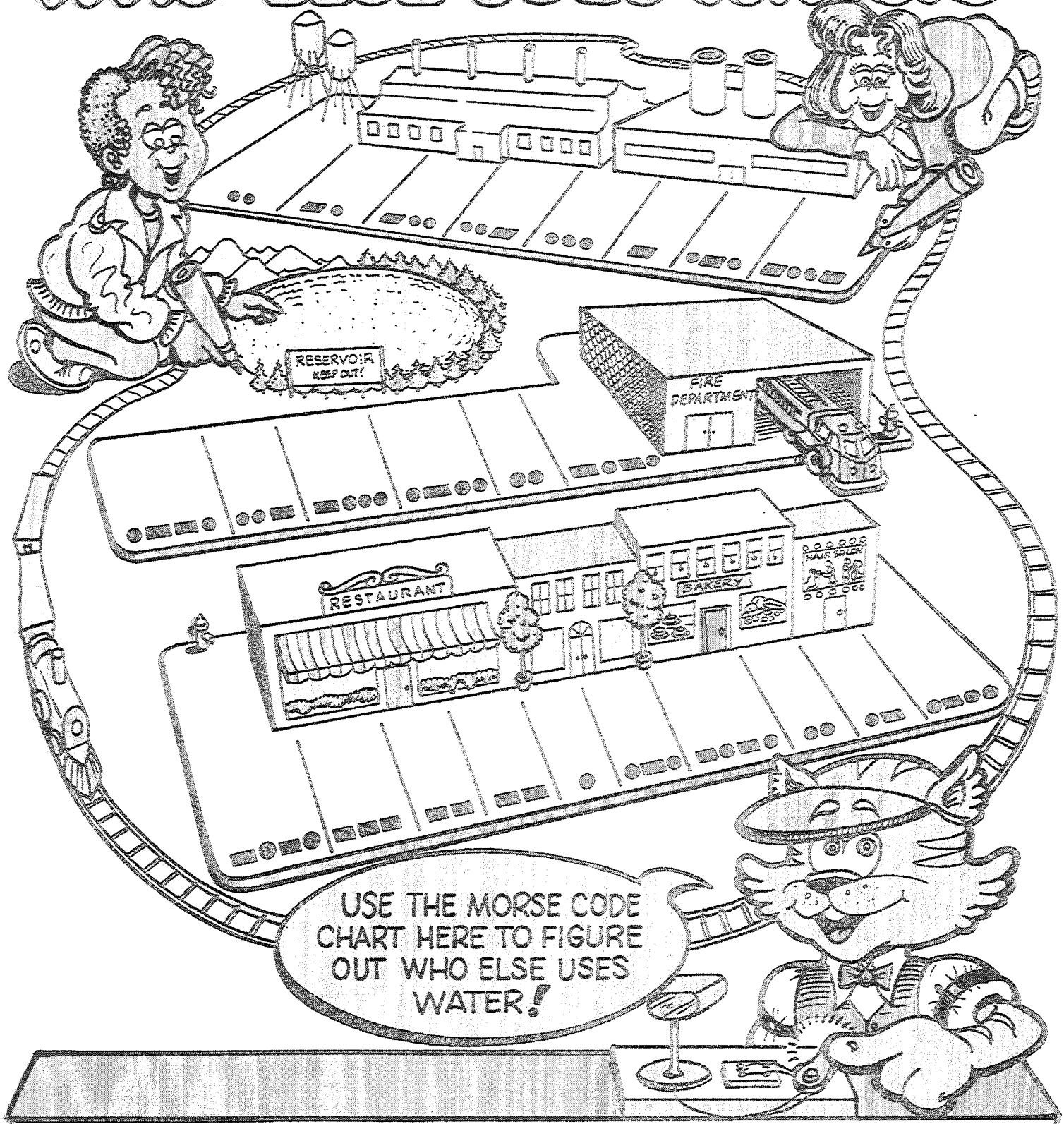
DIRECTIONS: UNSCRAMBLE THE WORDS IN THE PIPE AND...

BGINAHT ONICGOK
ITRWNAEG
IGATBNO WNGASIH

...THEN MATCH THEM TO THE PICTURES THEY EXPLAIN.



WHO ELSE USES WATER?

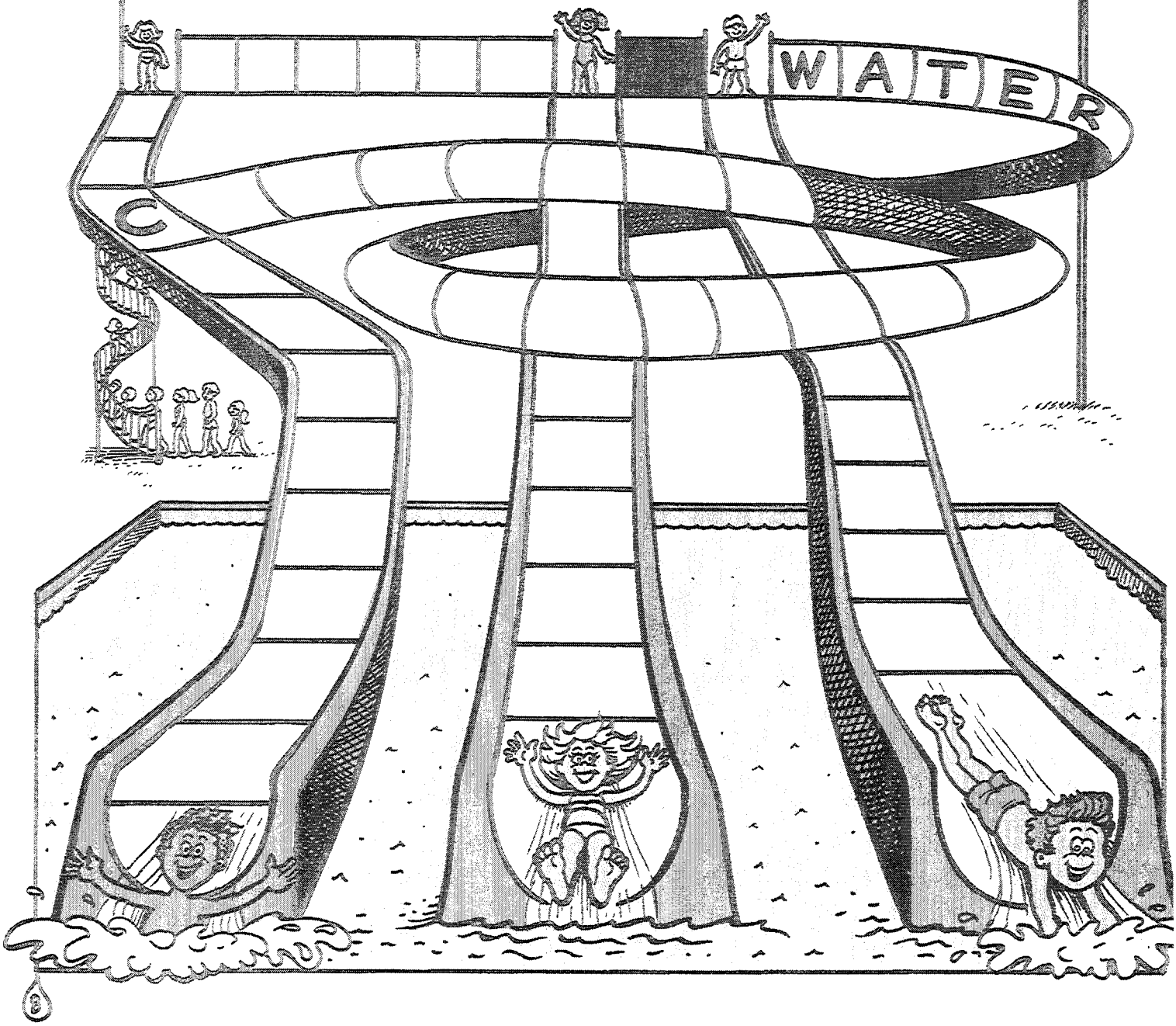


A ·−	E ·	I ··	M −−	Q −−·−	U ··−	Y −·−−
B −···	F ··−·	J ·−−−	N −·	R ·−·	V ···−	Z −−··
C −·−·	G −−·	K −·−	O −−−	S ···	W ·−−	
D −··	H ····	L ·−··	P ·−−·	T −	X −··−	

FILL IN THE SQUARES BELOW WITH THE FOLLOWING WORDS:

WATER VOCABULARY

CONSERVE - TO PROTECT OR PRESERVE NATURAL RESOURCES.
GLACIERS - LARGE MASSES OF ICE CONTAINING FRESH WATER.
RECLAMATION - RESTORING TO USEFUL GOOD CONDITION.
RESERVOIR - PLACE TO HOLD A SUPPLY OF WATER.
SEWAGE - WASTE MATERIAL CARRIED OFF BY SEWERS AND DRAINS.
TREATMENT - CONDITIONING OF WATER TO MAKE IT USABLE.



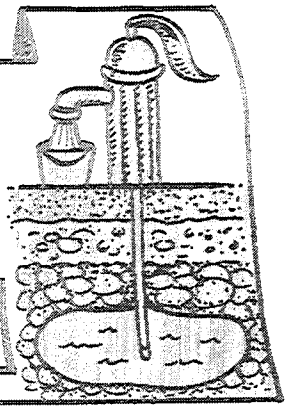
WHERE IS WATER STORED?

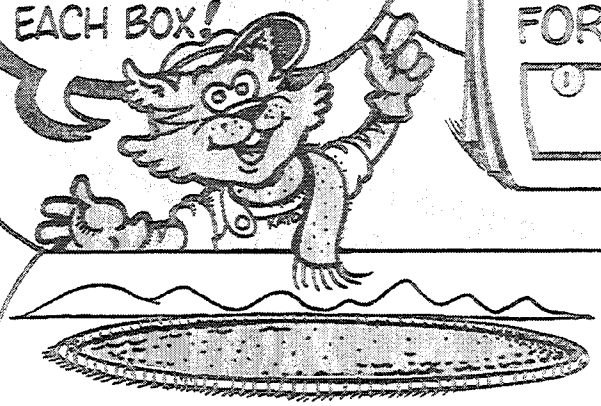
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26
A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z

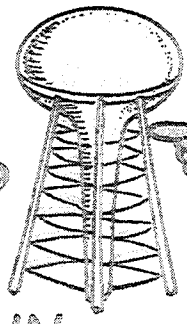
USE THE ALPHABET CODE ABOVE TO FIND THE SECRET MESSAGES BY WRITING THE CORRECT LETTER IN EACH BOX!

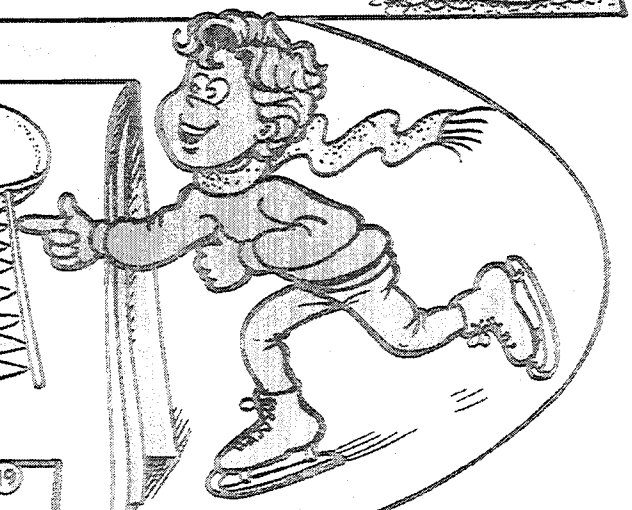
GROUNDWATER IS STORED IN LARGE UNDERGROUND FORMATIONS CALLED

1	17	21	9	6	5	18	19







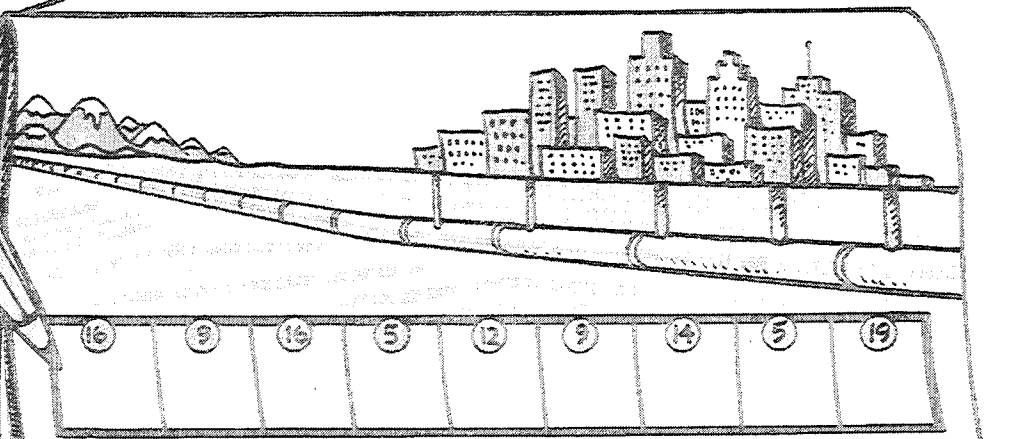


AFTER WATER IS CLEANED IT IS STORED IN

20	1	14	11	19

OR KEPT IN

18	5	19	5	18	22	15	9	13	19



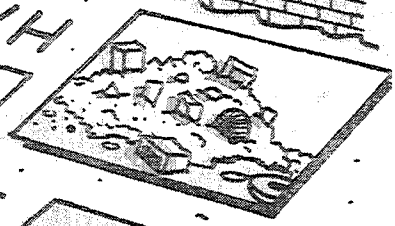
16	9	14	5	12	9	14	5	19

CARRY WATER GREAT DISTANCES TO THE PEOPLE.

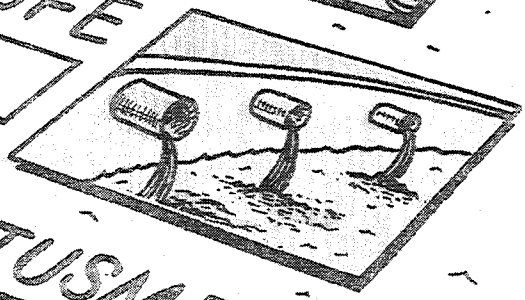
SPOT THE POLLUTANTS IN THE WATER BY CROSSING OUT THE FIRST LETTER AND THEN EVERY OTHER LETTER. WRITE THE REMAINING LETTERS IN THE BOX.

WATER POLLUTION

ΦTRRQARSVH



ASBECWDAEGFE



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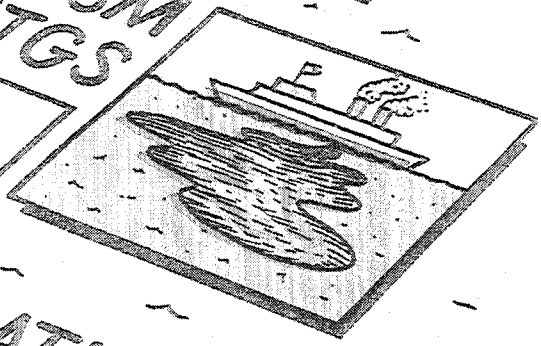
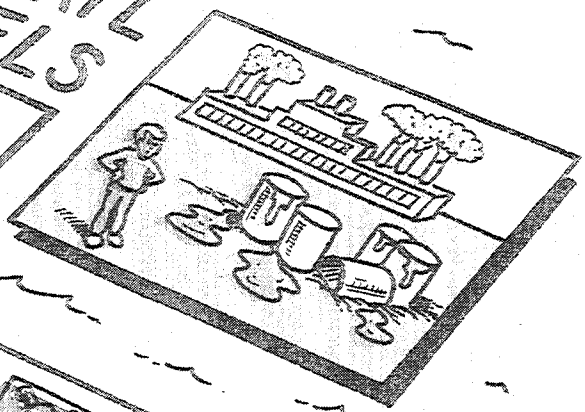
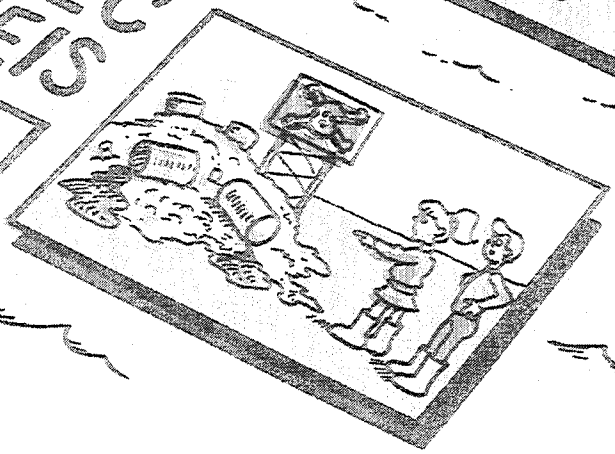
APBRCOEDFUICFTGS



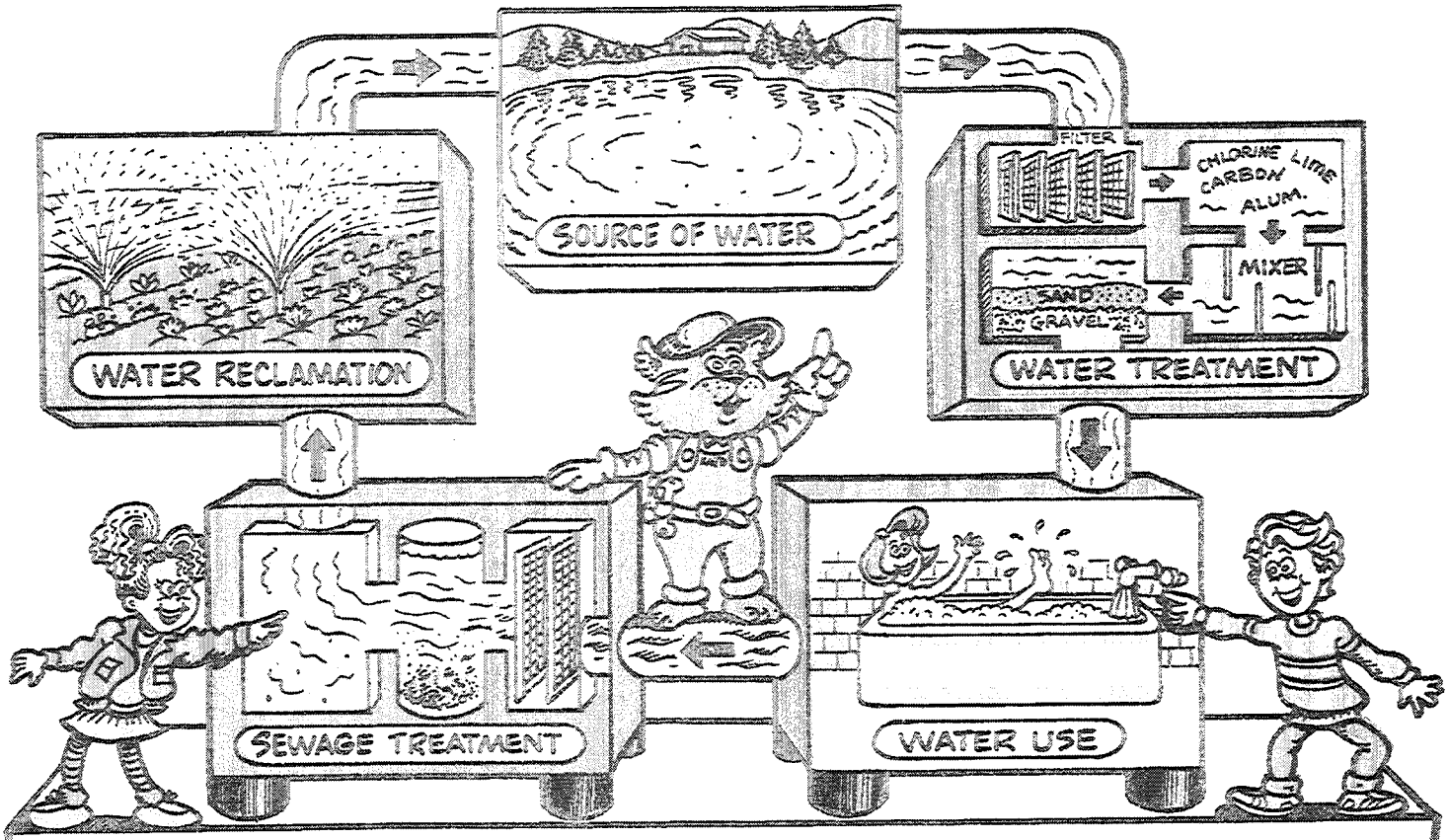
PITNODRUBSVTIRAISATL
CWXAZSITUELS



ATBOCXDIEC
PWQARSUTVEIS



WATER TREATMENT



USE THE CLUES BELOW TO FIND THE WORD MISSING FROM THE SENTENCE AT BOTTOM.

WHICH LETTER IS IN **WATER** BUT NOT IN **WEAR** → 1

WHICH LETTER IS IN **EARTH** BUT NOT IN **HEAT** → 2

WHICH LETTER IS IN **SAVE** BUT NOT IN **SERVE** → 3

WHICH LETTER IS IN **SERVE** BUT NOT IN **SCORE** → 4

WHICH LETTER IS IN **USE** BUT NOT IN **SUM** → 5

WHICH LETTER IS IN **INSTALL** BUT NOT IN **STAIN** → 6

WHICH LETTER IS IN **TANKS** BUT NOT IN **THANK** → 7

THE STORY OF THE

1	2	3	4	5	6	7

OF WATER!

WITH A GR-O-W-ING POPULATION...

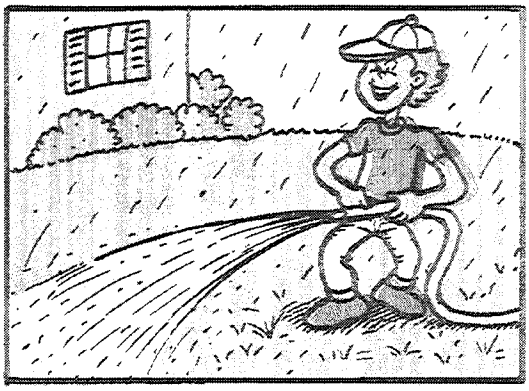
HOW MUCH IS LEFT TO DRINK?

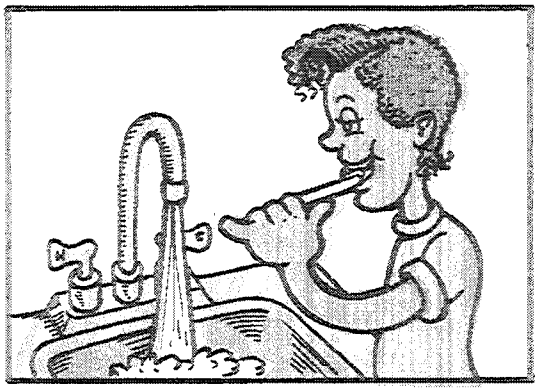
97% OF THE EARTH'S WATER IS SALTY + **2%** OF THE EARTH'S WATER IS IN GLACIERS + **[ ]%** IS FRESH WATER FOR US TO USE = **100%**

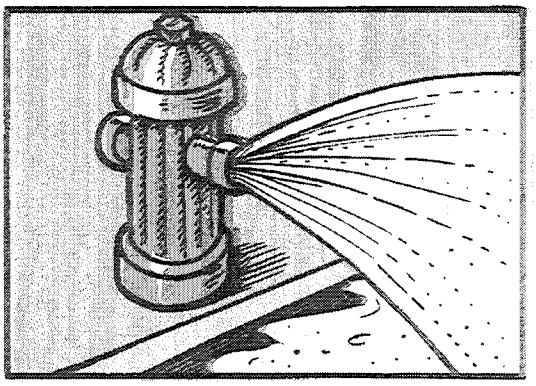
"WATER, WATER EVERYWHERE AND NOT A DROP TO DRINK"

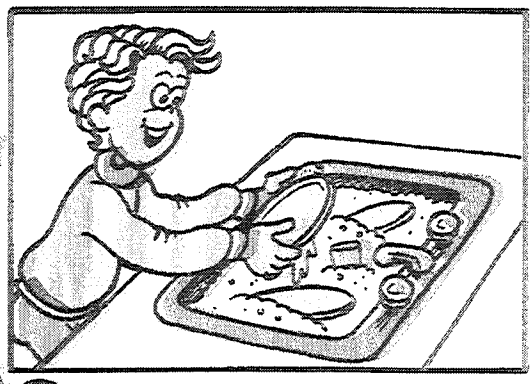
CAN YOU SPOT THE WATER WASTERS?

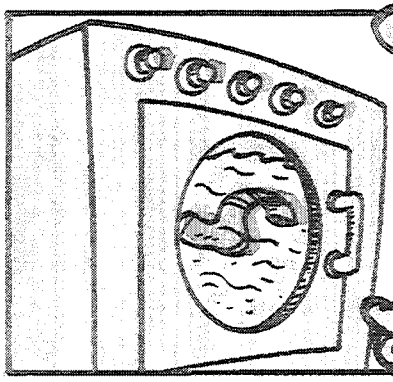
PUT AN X OVER EACH SCENE WHERE WATER IS BEING WASTED.

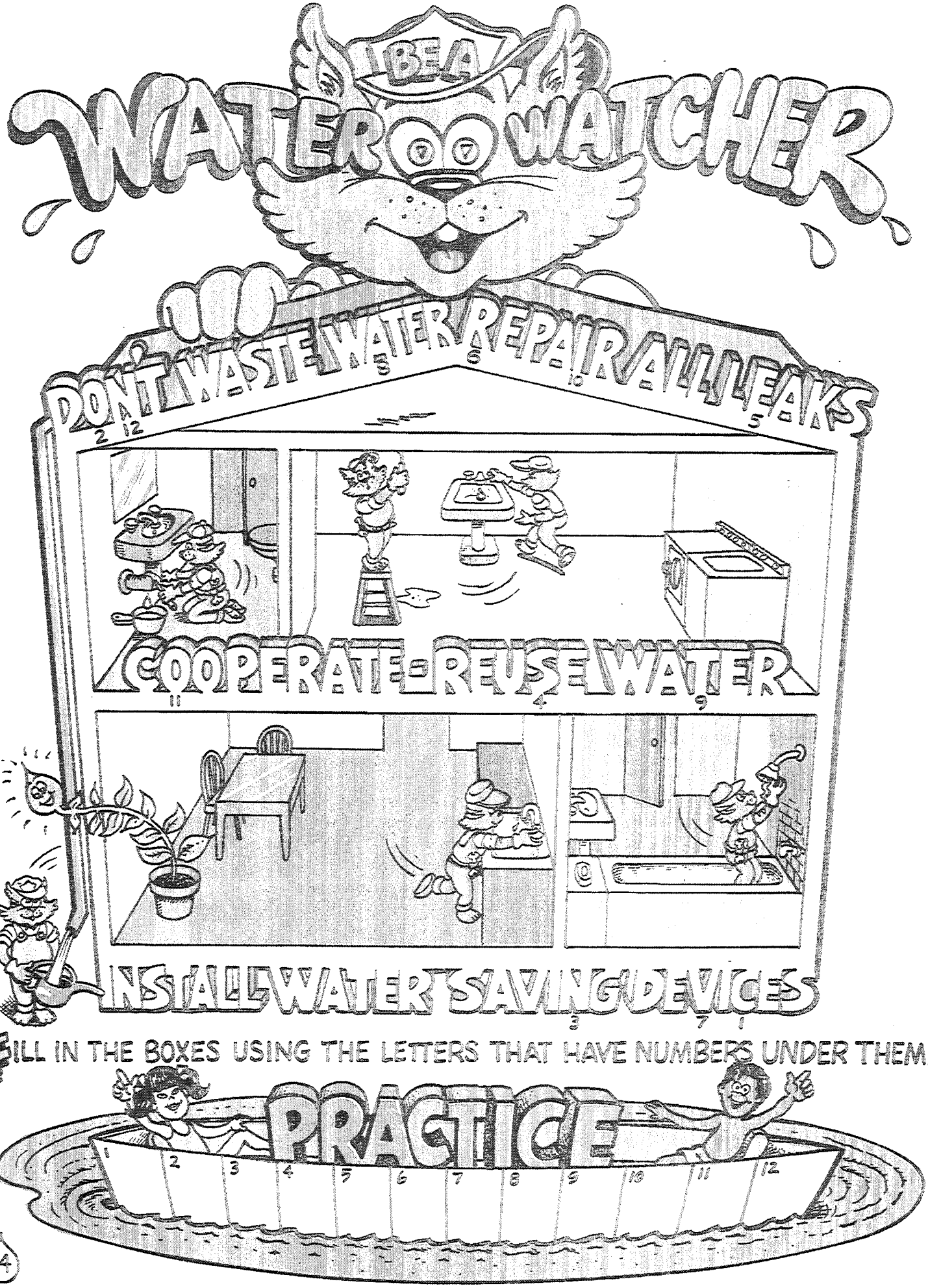








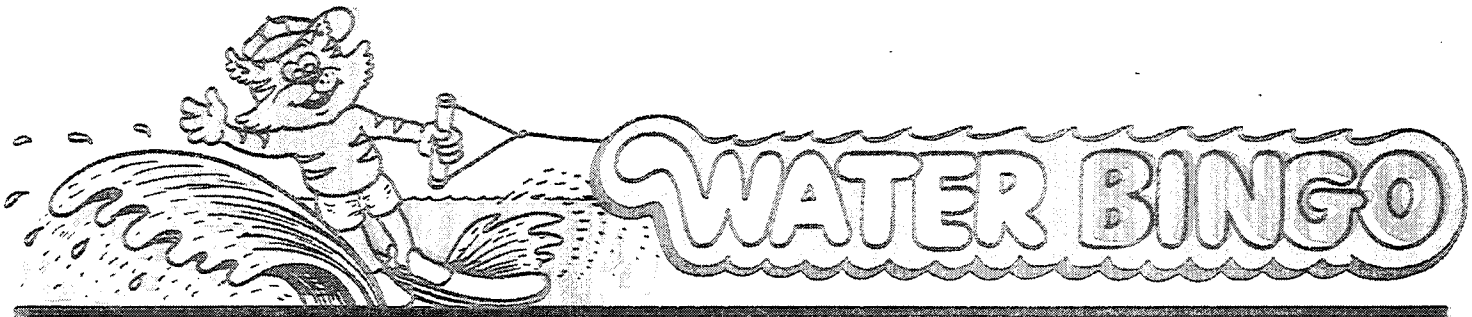




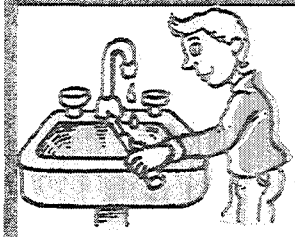
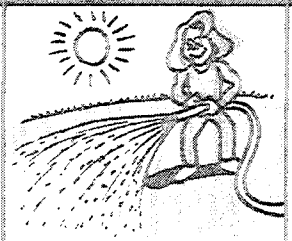
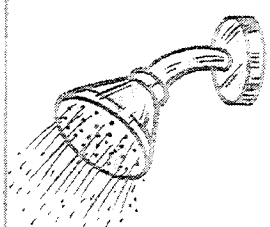
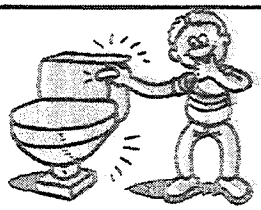
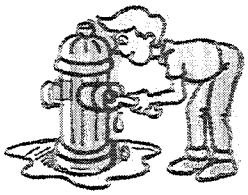
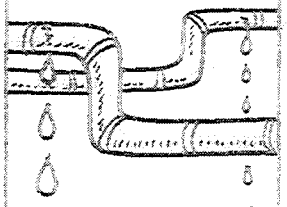
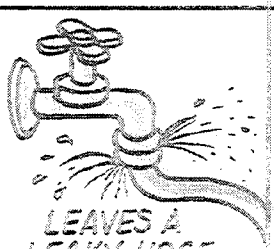
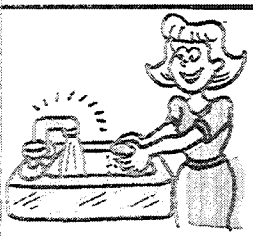
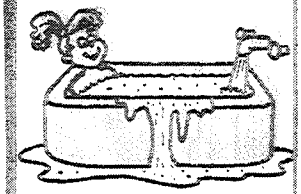
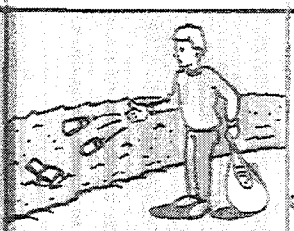
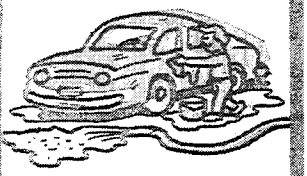
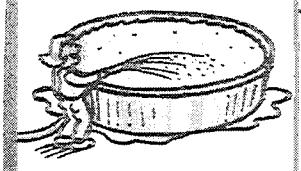
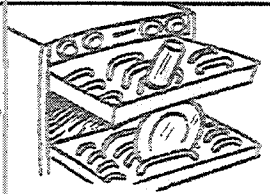
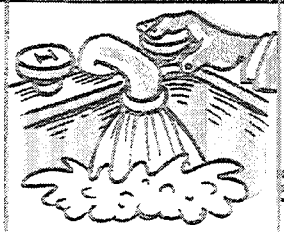
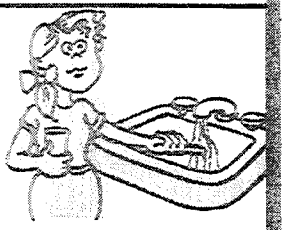
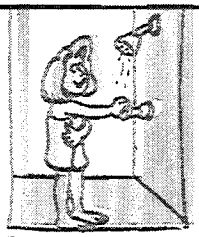
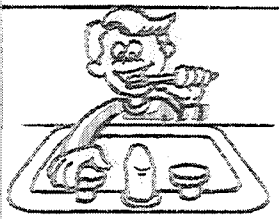
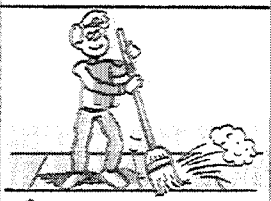
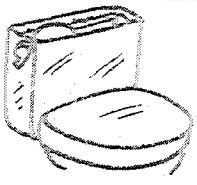
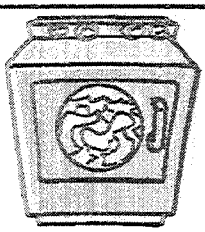
FILL IN THE BOXES USING THE LETTERS THAT HAVE NUMBERS UNDER THEM.

PRACTICE

1	2	3	4	5	6	7	8	9	10	11	12



CIRCLE THE RIGHT THINGS AND PUT AN "X" THROUGH THE WRONG ONES!

 FIXES LEAKY FAUCETS.	 ONLY WATERS LAWN WHEN NEEDED.	 DETECTS LEAKS IN TOILETS.	 USES SHOWER HEADS THAT SAVE WATER.	 KEEPS A BOTTLE OF DRINKING WATER IN THE REFRIGERATOR.
 FLUSHES TOILETS FOR FUN.	 CLOSES OPEN HYDRANTS.	 LETS LEAKY PIPES DRIP.	 LEAVES A LEAKY HOSE CONNECTION.	 LETS WATER RUN WHILE WASHING HANDS.
 FILLS UP TUB TOO FULL.	 USES RAINWATER TO WATER PLANTS.		 THROWS THINGS IN THE WATER.	 WASTES WATER WASHING CAR.
 OVERFILLS SWIMMING POOL.	 CLEANS 1 DISH AND 1 GLASS IN DISHWASHER.	 TURNS WATER ON FULL FORCE.	 PLANTS WATER-CONSERVING SHRUBS.	 LETS WATER RUN TO GET IT COLD.
 TAKES SHORT SHOWERS.	 TURNS WATER OFF WHILE BRUSHING TEETH.	 SWEEPS SIDEWALK INSTEAD OF HOSING IT DOWN.	 USES TOILET BAG TO REDUCE FLUSH VOLUME.	 USES FULL LOAD IN WASHING MACHINE.

WATER WORD SEARCH

FIND THE WORDS IN THE LETTER BOXES VERTICALLY ↕, HORIZONTALLY ↔, AND DIAGONALLY ↗.

C	O	N	S	E	R	V	A	T	I	O	N
T	R	A	G	N	E	M	U	L	B	G	T
P	E	T	N	P	C	S	E	W	A	G	E
I	O	N	E	K	L	G	J	E	R	R	Y
P	J	L	I	D	A	Q	U	I	F	E	R
E	R	G	L	I	M	V	D	G	W	S	G
L	Q	W	L	U	A	H	T	C	A	E	L
I	T	R	E	A	T	M	E	N	T	R	A
N	P	I	T	T	I	I	J	S	E	V	C
E	Z	S	I	U	O	L	O	A	R	O	I
S	H	I	R	A	N	Q	R	N	B	I	E
G	R	O	U	N	D	W	A	T	E	R	R

AQUIFER
CONSERVATION
GLACIER
GROUNDWATER
PIPELINES
POLLUTION
RECLAMATION
RESERVOIR
SEWAGE
TREATMENT
WATER

SOLUTIONS TO ACTIVITY PAGES

PAGE 2: WATER; H_2O.

PAGE 3: WATER CAN BE A LIQUID, SOLID OR GAS. WATER IS ODORLESS, COLORLESS, TASTELESS AND TRANSPARENT. WATER IS A LIQUID FOUND IN OCEANS, LAKES, RIVERS AND PONDS.

PAGE 4: WE NEED WATER TO STAY ALIVE.

PAGE 6: WASHING, BOATING, BATHING, WATERING, COOKING.

PAGE 7: INDUSTRY, PUBLIC, COMMERCIAL.

PAGE 8:

SEWAGE WATER
RECLAMATION
CONSERVATION
TREATMENT
RESERVOIR
GLACIERS

PAGE 9: AQUIFERS, TANKS, RESERVOIRS, PIPELINES.

PAGE 10: TRASH, SEWAGE, PETROLEUM, PRODUCTS, INDUSTRIAL WASTES, TOXIC WASTES.

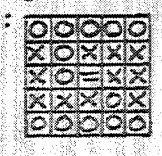
PAGE 11: TRAVELS.

PAGE 12: 1%; MOST OF THE WATER ON EARTH YOU CAN'T DRINK BECAUSE IT IS SALT WATER.

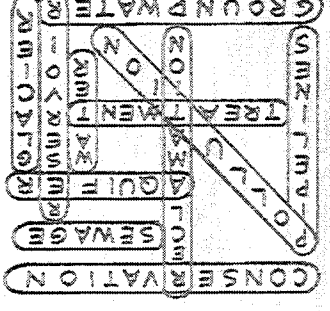
PAGE 13:

PAGE 14: CONSERVATION

PAGE 15:



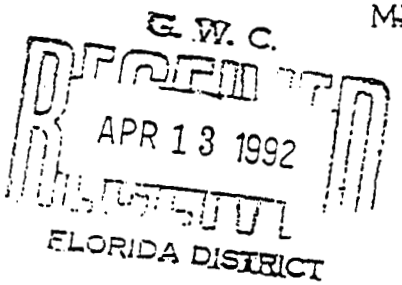
SOLUTION TO PG.16



ATTACHMENT 12

GENERAL WATERWORKS

MEMO



TO All Managers

FROM W. C. Linam

SUBJECT Americans With Disabilities Act

PROPERTY Atlantic Region

DATE April 9, 1992

It is my understanding that any building to which the public is invited or allowed to enter becomes a public building under the definition of the Americans With Disabilities Act. A public building must be accessible to a disabled individual. Therefore, unless our buildings such as treatment plants, pumping stations, etc., which you normally open to the public for tours, are accessible by the disabled, we must eliminate all public entry to these buildings.

Please eliminate any tours or other public access to any area that is not accessible to the disabled. If part of your plant is accessible but other parts are not, you can continue tours of the accessible portion, but you cannot allow access to the remainder of the building.

Bill

W. C. Linam

WCL:acl

JACKSONVILLE SUBURBAN
UTILITIES CORPORATION
1400 MILLCOE ROAD
JACKSONVILLE FL 32225

BILL DATE	PAST DUE DATE
08/31/93	

AMOUNT DUE
$.00

MAKE PAYMENTS TO:
JACKSONVILLE SUBURBAN
UTILITIES CORPORATION
P O BOX 15311
WILMINGTON DE 19886-5311

05281202000709239300000000002

MAIL TO:
JACKSONVILLE SUBURBAN
P O BOX 8004
JACKSONVILLE FL 32211

AMOUNT ENCLOSED

SERVICE ADDRESS	ACCOUNT NUMBER	AMOUNT DUE	FOR OFFICE USE ONLY
10797 FT CAROLINE RD	052-812-0200-07	$.00	*R PERM

Please return this portion of bill with payment

REGISTER ANY QUESTIONS OR COMPLAINTS ABOUT THIS BILL PRIOR TO THE DUE DATE TO:

JACKSONVILLE SUBURBAN
UTILITIES CORPORATION
1400 MILLCOE ROAD
P O BOX 8004
JACKSONVILLE FL 32239-0004
PHONE: 904-725-2865

METER READINGS

08/26/93	3989
07/26/93	3980
CONSUMPTION	9 -CCF

---------- BILLING SUMMARY ----------

CURRENT BILL CHARGES:

TOTAL CURRENT CHARGES:	$.00
TOTAL AMOUNT DUE	$.00
PAST DUE ON	

* * * * CUSTOMER MESSAGES FROM JACKSONVILLE SUBURBAN UTILITIES * * * *

WATER CONSERVATION TIPS

1. TURN IT OFF ... THE FAUCET, HOSE, SHOWER, WHEN NOT IN USE.

   TURN OFF THE TAP WHILE YOU SHAVE OR BRUSH YOUR TEETH. USE HOSE NOZZLES THAT CAN BE SHUT OFF WHEN NOT IN USE. A SINGLE HOSE LEFT ON USES NEARLY 300 GALLONS OF WATER AN HOUR. TAKE SHORTER SHOWERS, NOT MORE THAN 5 MINUTES.

2. CHECK TOILETS FOR HIDDEN LEAKS. TANK-TO-BOWL LEAKS CAN WASTE A QUART OF WATER WITH EACH FLUSH. PLACE A FEW DROPS OF FOOD COLORING IN THE TANK. WAIT 15 MINUTES AND SEE IF THE COLOR APPEARS IN THE BOWL. IF SO, YOU HAVE A LEAK, MAKE NECESSARY REPAIRS IMMEDIATELY.

3. INSPECT ALL PIPES FOR LEAKS, AS HUNDREDS OF GALLONS OF WATER A DAY COULD BE DRIPPING AWAY.

4. IN ACCORDANCE WITH GUIDELINES SET BY THE ST JOHN RIVER WATER MANAGEMENT DISTRICT, LAWN SPRINKLING IS RESTRICTED BETWEEN THE HOURS OF 10:00 A.M. - 4:00 P.M., 7 DAYS A WEEK.

OFFICE HOURS: 8:30 AM TO 4:30 PM MONDAY THROUGH FRIDAY.
FOR CUSTOMER INQUIRIES AND AFTER HOURS EMERGENCIES, CALL 725-2865.

BILL DATE	SERVICE ADDRESS	ACCOUNT NUMBER	AMOUNT DUE
08/31/93	10797 FT CAROLINE RD	052-812-0200-07	$.00

Please keep this portion of bill for your records

For more information write or call your Water Management District listed below.

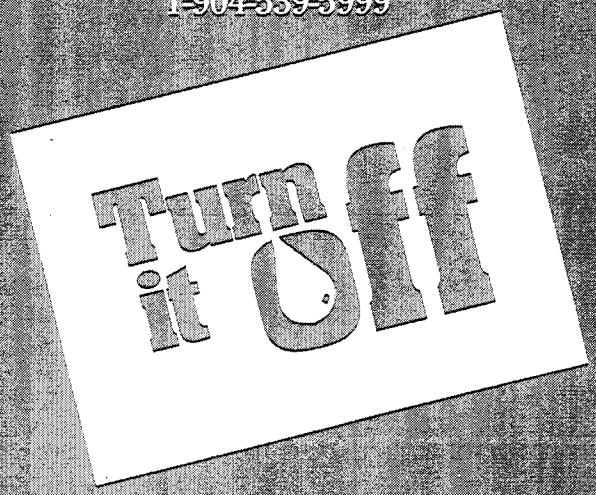
South Florida
Water Management District
P.O. Box 24680
West Palm Beach, FL 33416-4680
1-800-662-8876
1-407-686-8800

Southwest Florida
Water Management District
2379 Broad Street
Brooksville, FL 34609-6899
1-800-848-0499
1-904-796-7211

St. Johns River
Water Manage[illegible]District
P.O. Bo[illegible]
Palatka, Fl[illegible]29
1-90[illegible]

Suwannee River
Water Management District
Rt. 3, Box 64
Live Oak, FL 32060
1-904-362-1001

Northwest Florida
Water Management District
Rt.1, Box 3100
Havana, FL 32333
1-904-539-5999



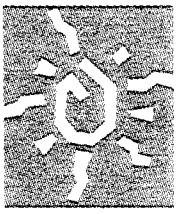
50 Ways To Turn it Off

How You Can Help Save Florida's Precious Water Supply

While this appears to be a straightforward brochure about water conservation, it is a lot more serious than that. It's about the very survival of our Florida lifestyle. It's not too late to save Florida's precious water supply. But we must act now to ensure the continued existence of our water supply for generations to come.

As you read through these 50 ways to save water you'll notice that some are simply common sense, while others utilize new technology. However, they are all equally important to you, your children and all future Florida generations.

Saving Water Indoors.



Saving Water Outdoors.

General Water-Saving Tips.

SAVING WATER INDOORS

1. Never put water down the drain when there may be another use for it such as watering a plant or garden, or cleaning.

2. Verify that your home is leak-free, because many homes have hidden water leaks. Read your water meter before and after a two-hour period when no water is being used. If the meter does not read exactly the same, there is a leak.

3. Repair dripping faucets by replacing washers. If your faucet is dripping at the rate of one drop per second, you can expect to waste 2,700 gallons per year, which will add to the cost of water and sewer utilities, or strain your septic system.

4. Check for toilet tank leaks by adding food coloring to the tank. If the toilet is leaking, color will appear within 30

minutes. Check the toilet for worn out, corroded or bent parts. Most replacement parts are inexpensive, readily available and easily installed. (Flush as soon as test is done, since food coloring may stain tank.)

5. Avoid flushing the toilet unnecessarily. Dispose of tissues, insects and other such waste in the trash rather than the toilet.

6. Install a toilet dam or displacement device such as a bag or bottle to cut down on the amount of water needed for each flushing. Be sure installation does not interfere with operating parts. When purchasing new or replacement toilets, consider low-volume units which use less than half the water of older models. In many areas, low-volume units are required by law.

7. Take shorter showers. Replace your showerhead with an ultra-low-flow version. Some units are available that allow you to cut off the flow without adjusting the water temperature knobs.

8. Use the minimum amount of water needed for a bath by closing the drain first and filling the tub only 1/3 full. Stopper tub before turning on water. The initial burst of cold water can be warmed by adding hot water later.

9. Don't let water run while shaving or washing your face. Brush your teeth first while waiting for water to get hot, then wash or shave after filling the basin.

10. Retrofit all wasteful household faucets by installing aerators with flow restrictors.

11. Operate automatic dishwashers and clothes washers only when they are fully loaded or properly set the water level for the size of load you are using.

12. When washing dishes by hand, fill one sink or basin with soapy water. Quickly rinse under a slow-moving stream from the faucet.

13. Store drinking water in the refrigerator rather than letting the tap run every time you want a cool glass of water.

14. Do not use running water to thaw meat or other frozen foods. Defrost food overnight in the refrigerator or by using the defrost setting on your microwave.

15. Kitchen sink disposals require lots of water to operate properly. Start a compost pile as an alternate method of disposing food waste instead of using a garbage disposal. Garbage disposals also can add 50% to the volume of solids in a septic tank which can lead to malfunctions and maintenance problems.

16. Consider installing an instant water heater on your kitchen sink so you don't have to let the water run while it heats up. This will reduce heating costs for your household.

17. Insulate your water pipes. You'll get hot water faster plus avoid wasting water while it heats up.

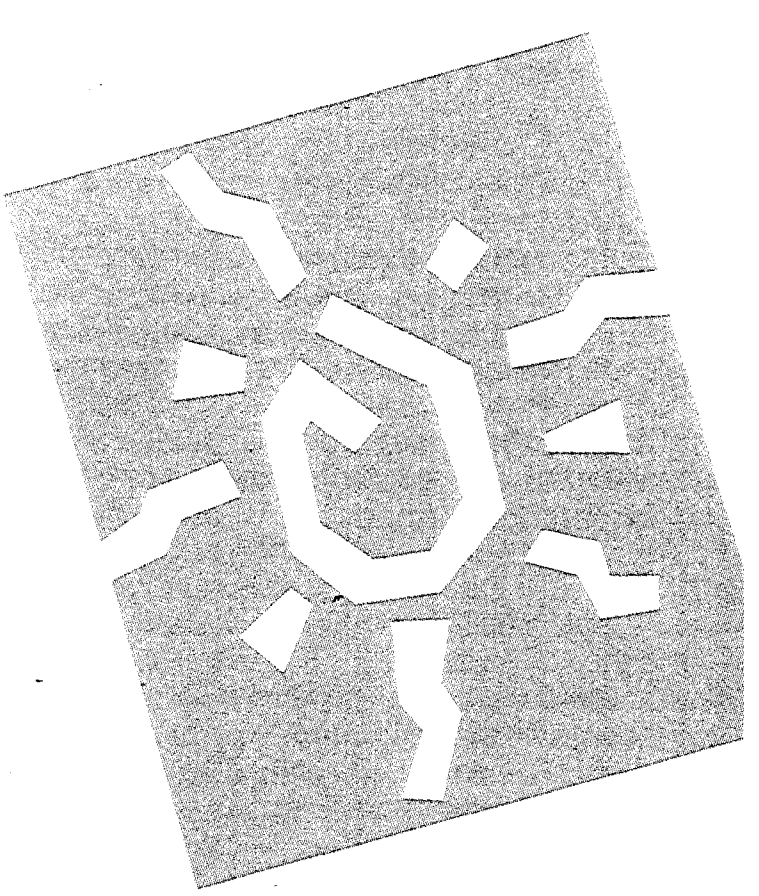
18. Never install a water-to-air heat pump or air-conditioning system. Newer air-to-air models are just as efficient and do not waste water.

19. Install water softening systems only when necessary. Save water and salt by running the minimum amount of regenerations necessary to maintain water softness. Turn softeners off while on vacation.

20. Check your pump. If you have a well at your home, listen to see if the pump kicks on and off while the water is not in use. If it does, you have a leak.

21. When adjusting water temperatures, instead of turning water flow up, try turning it down. If the water is too hot or cold, turn the offender down rather than increasing water flow to balance the temperature.

22. If the toilet flush handle frequently sticks in the flush position, letting water run constantly, replace or adjust it.



SAVING WATER OUTDOORS

23. Don't overwater your lawn. As a general rule, lawns only need watering every 5 to 7 days in the summer and every 10 to 14 days in the winter. A hearty rain eliminates the need for watering for as long as two weeks. Plant it smart, Xeriscape. Xeriscape landscaping is a great way to design, install and maintain both your plantings and irrigation system that will save you time, money and water. For your free copy of "Plant it Smart," an easy-to-use guide to Xeriscape landscaping, contact your Water Management District.

24. Water lawns during the early morning hours when temperatures and wind speed are the lowest. This reduces losses from evaporation.

25. Don't water your street, driveway or sidewalk. Position your sprinklers so that your water lands on the lawn and shrubs ... not the paved areas.

26. Install sprinklers that are the most water-efficient for each use. Micro and drip irrigation and soaker hoses are examples of water-efficient methods of irrigation.

27. Regularly check sprinkler systems and timing devices to be sure they are operating properly. It is now the law that "anyone who purchases and installs an automatic lawn sprinkler system MUST install a rain sensor device or switch which will override the irrigation cycle of the sprinkler system when adequate rainfall has occurred." To retrofit your existing system, contact an irrigation professional for more information.

28. Raise the lawn mower blade to at least three inches. A lawn cut higher encourages grass roots to grow deeper, shades the root system and holds soil moisture better than a closely-clipped lawn.

29. Avoid overfertilizing your lawn. The application of fertilizers increases the need for water. Apply fertilizers which contain slow-release, water-insoluble forms of nitrogen.

30. Mulch to retain moisture in the soil. Mulching also helps to control weeds that compete with plants for water.

31. Plant native and/or drought-tolerant grasses, ground covers, shrubs and trees. Once established, they do not need to be watered as frequently and they usually will survive a dry period without any watering. Group plants together based on similar water needs.

32. Do not hose down your driveway or sidewalk. Use a broom to clean leaves and other debris from these areas. Using a hose to clean a driveway can waste hundreds of gallons of water.

33. Outfit your hose with a shut-off nozzle which can be adjusted down to a fine spray so that water flows only as needed. When finished, "Turn it Off" at the faucet instead of at the nozzle to avoid leaks.

34. Use hose washers between spigots and water hoses to eliminate leaks.

35. Do not leave sprinklers or hoses unattended. Your garden hose can pour out 600 gallons or more in only a few hours, so don't leave the sprinkler running all day. Use a kitchen timer to remind yourself to turn it off.

36. Check all hoses, connectors and spigots regularly.

37. Consider using a commercial car wash that recycles water. If you wash your own car, park on the grass to do so.

38. Avoid the installation of ornamental water features (such as fountains) unless the water is recycled. Locate where there are minimal losses due to evaporation and wind drift.

39. If you have a swimming pool, consider a new water-saving pool filter. A single backflushing with a traditional filter.uses from 180 to 250 gallons or more of water.

GENERAL WATER SAVING TIPS

40. Create an awareness of the need for water conservation among your children. Avoid the purchase of recreational water toys which require a constant stream of water.

41. Be aware of and follow all water conservation and water shortage rules and restrictions which may be in effect in your area.

42. Encourage your employer to promote water conservation at the workplace. Suggest that water conservation be put in the employee orientation manual and training program.

43. Patronize businesses which practice and promote water conservation.

44. Report all significant water losses (broken pipes, open hydrants, errant sprinklers, abandoned free-flowing wells, etc.) to the property owner, local authorities or your Water Management District.

45. Encourage your school system and local government to help develop and promote a water conservation ethic among children and adults.

46. Support projects that will lead to an increased use of reclaimed waste water for irrigation and other uses.

47. Support efforts and programs to create a concern for water conservation among tourists and visitors to our state. Make sure your visitors understand the need for, and benefits of, water conservation.

48. Encourage your friends and neighbors to be part of a water-conscious community. Promote water conservation in community newsletters, on bulletin boards and by example.

49. Conserve water because it is the right thing to do. Don't waste water just because someone else is footing the bill such as when you are staying at a hotel.

50. Try to do one thing each day that will result in a savings of water. Don't worry if the savings is minimal. Every drop counts. And every person can make a difference. So tell your friends, neighbors and co-workers to "Turn it Off" and "Keep it Off." Water is the lifeblood of Florida. Don't bleed us dry.

This publication was printed on recycled paper at a cost of $2532.00 or $.084 per copy to encourage water conservation. 30M 392

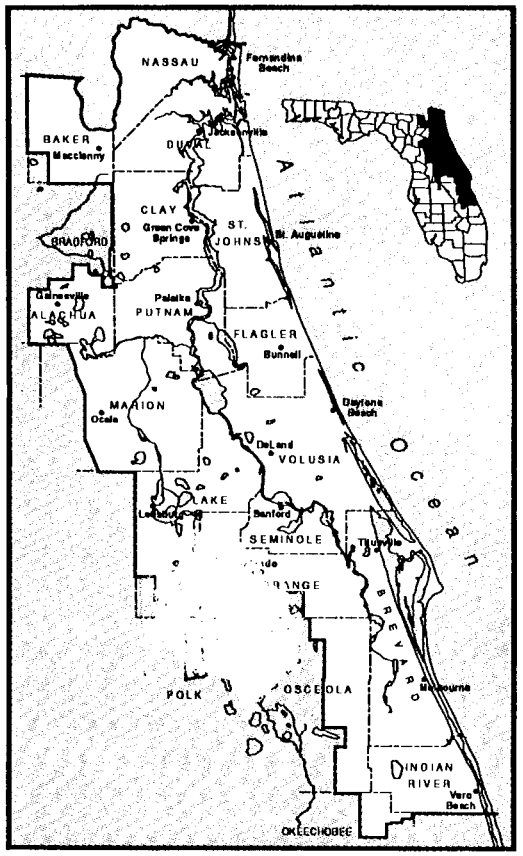
Water Conservation Tips

Indoors:

- Fix drips and leaks in faucets, pipes and toilets;
- Take shorter showers;
- Don't leave water running while brushing teeth, washing face, or shaving;
- Operate automatic dishwashers and clothes washers only when they are fully loaded;
- Install low-flow fixtures on shower-heads and toilets.

Outdoors:

- Use the principles of Xeriscape™ when landscaping your home or business. Xeriscape information is available at the SJRWMD, or through your local county extension agent.
- Don't leave water running freely while soaping or rinsing vehicles;
- Wash or rinse vehicles on a porous surface so the water will soak into the ground rather than becoming runoff;
- Use a hose equipped with an automatic shutoff nozzle;
- Sweep -- don't hose down -- your driveway or sidewalk.
- Consider using a water-saving filter on your swimming pool.



The SJRWMD includes Duval, Clay, Nassau, St. Johns, Flagler, Volusia, Seminole, Indian River, and Brevard counties, and portions of Baker, Bradford, Putnam, Alachua, Marion, Lake, Orange, Polk, Osceola and Okeechobee counties.

For more information concerning water restrictions, call the SJRWMD between 8 a.m. and 5 :30 p.m. Monday through Friday at:

ST. JOHNS RIVER WATER MANAGEMENT DISTRICT
P.O. Box 1429 • Palatka, Florida • 32178-1429

Printed on recycled paper

Water Conservation Rule

St. Johns River Water Management District

Why conserve water?

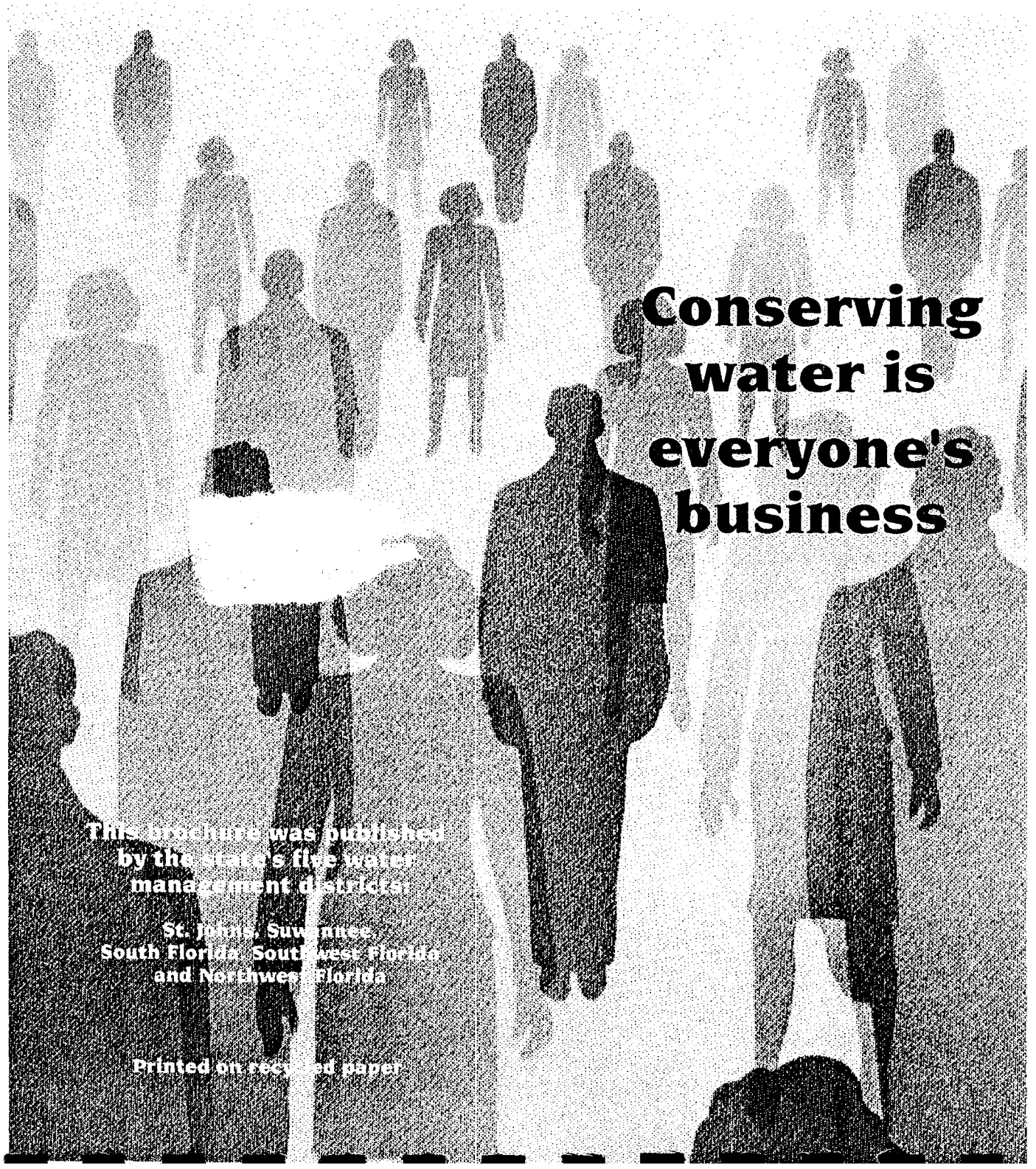
Florida's water supply is dependent upon fickle weather patterns -- periods of abundant rain followed by periods of drought. Although Florida receives an average of 55 inches of rain per year, about 65% of that evaporates. Only a relatively small percentage of total rainfall replenishes the ground and surface water supplies.

Rapid population growth, especially in coastal areas, has placed a great demand on our water resources. Never before has there been a greater need to manage and preserve our precious water resources. The state's five water management districts have been charged with that responsibility. But they can't do it alone...they need *your* support.

As a retail business man or woman, you have the unique opportunity to help reach and teach many visitors and residents who might not otherwise hear of the need to conserve water.

Enclosed in this brochure are tips on how *you* can help make a difference. By adopting any or all of these suggestions, you will help set the trend for the future of water conservation.

Thank you for your interest in the environment, and the protection and conservation of our precious water resources.



Conserving water is everyone's business

This brochure was published by the state's five water management districts:

St. Johns, Suwannee, South Florida, Southwest Florida and Northwest Florida

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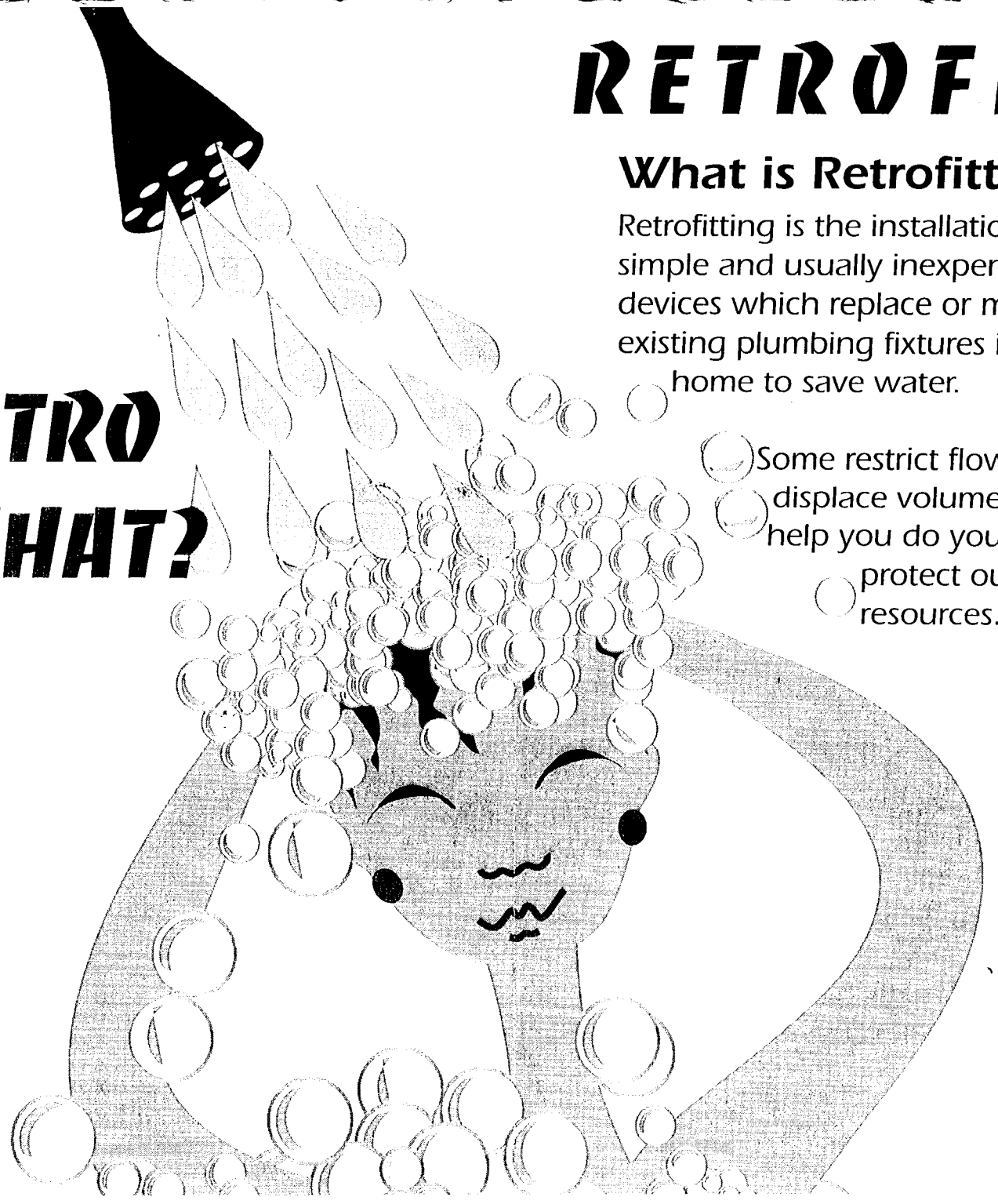
RETROFIT!

What is Retrofitting?

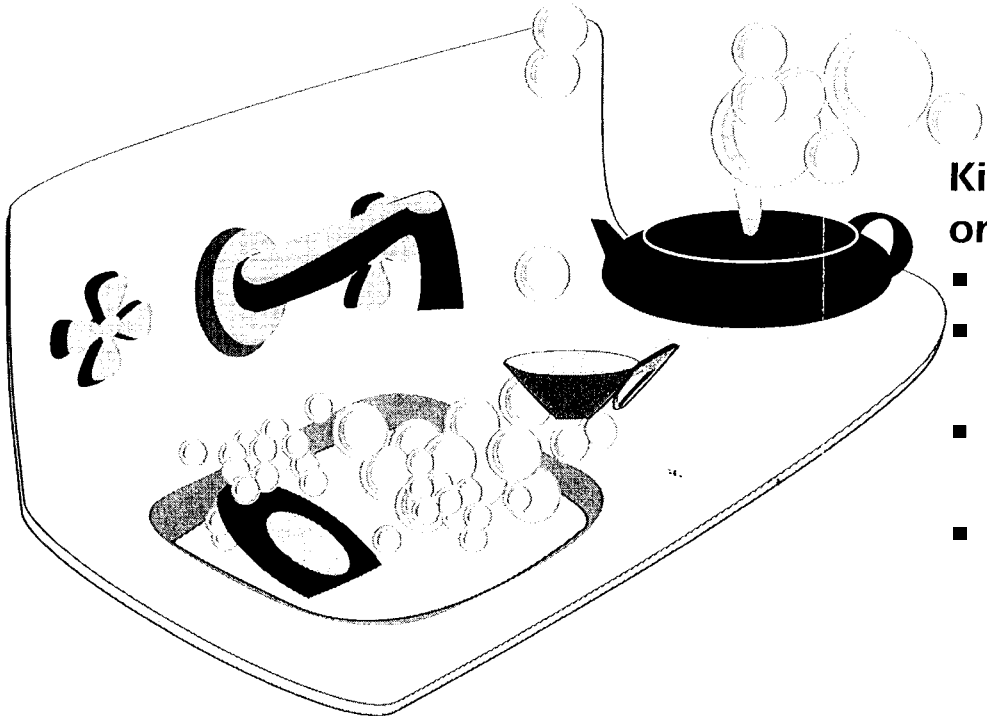
Retrofitting is the installation of simple and usually inexpensive devices which replace or modify existing plumbing fixtures in your home to save water.

Some restrict flow, others displace volume. They all help you do your part to protect our water resources.

RETRO WHAT?



Here are some easy suggestions to get you started!

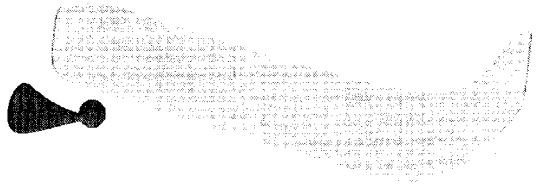


Kitchen faucet aerator with on-off control valve

- (Easy 5-minute installation)
- Water savings: 20-40% less than now using
- Energy savings: 30-45 kwh/yr
- Cost: $2-10

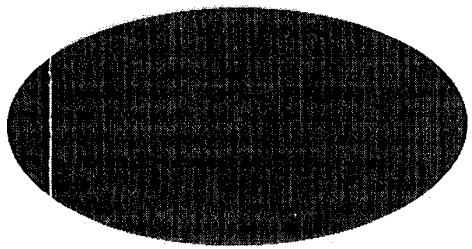
Ultra-low-flush toilets

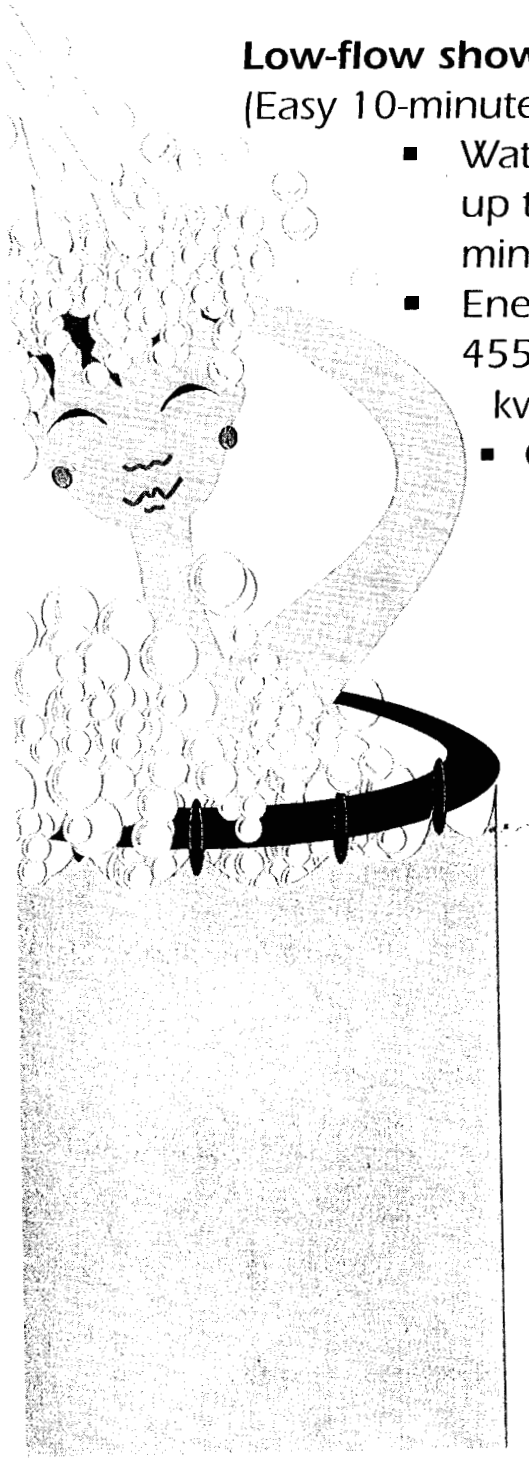
- (Installed by plumber 30-40 minutes)
- Water savings: uses 70-90% less than conventional toilets
- Cost: $80-775



Toilet dam (You install in minutes)

- Water savings: 20% less than now using
- Cost: $3-5





Low-flow showerheads
(Easy 10-minute installation)

- Water savings: up to 4.5 gal per minute (40-65%)
- Energy savings: 455-630 kwh/yr
- Cost: $6-30

Other Water Saving Tips

Make sure your home is leak-free. To find if you have hidden water leaks, read your meter before and after a two-hour period when no water is being used. Does the meter read the same? If not, you probably have a water leak.

Check for toilet leaks by adding food coloring to the tank. If the toilet is leaking, color will appear within 30 minutes. Check the toilet for worn out, corroded or bent parts. Most replacement parts are inexpensive, readily available and easily installed. (Flush as soon as test is done, since food coloring may stain tank.)

Don't let the water run while shaving or washing your face or brushing your teeth.

Operate automatic dishwashers and clothes washers only when they are fully loaded or properly set the water level for the size of load you are using.

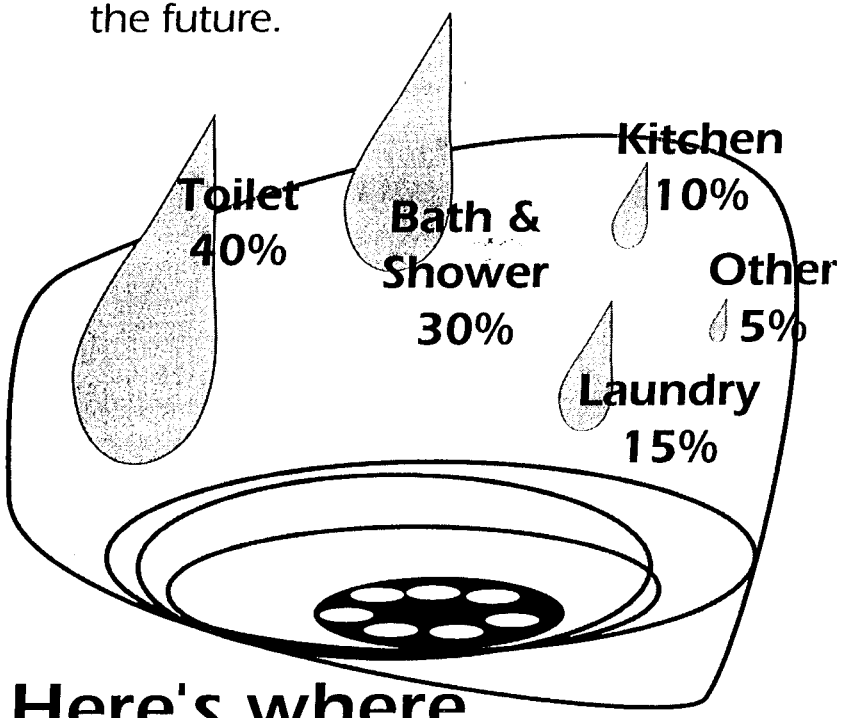
Kitchen sink disposals require lots of water to operate properly. Start a compost pile as an alternative method of disposing food waste instead of using a garbage disposal.

Insulate your water pipes. You'll get hot water faster plus avoid wasting water while it heats.

Why Retrofit?

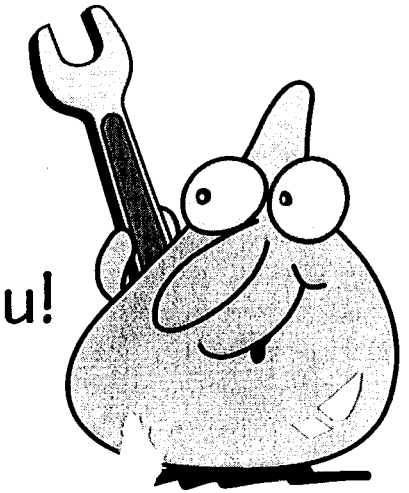
- Save water
- Save money
- Save Energy

Most retrofit devices will pay for themselves within six months, sooner for those that use hot water. Do your part to ensure our water supply for the future.



Here's where the water goes

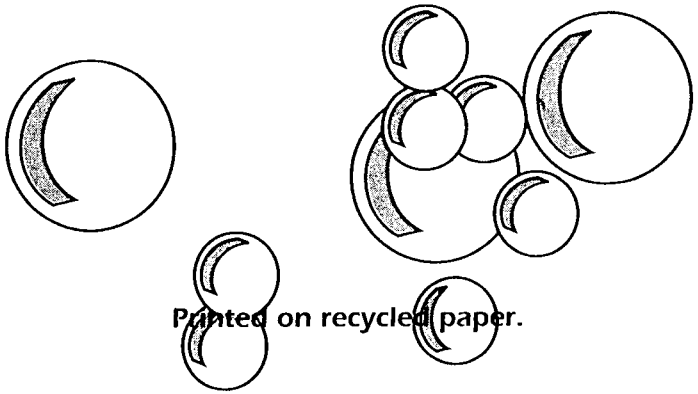
We can't manage without you!



This document was ...ced by the St. Johns River Water ...agement District, Division ...formation, as a public ser... ...e the public about the ... ...ofitting.

If you would like more information, contact your local utility, ask at your local home improvement or plumbing supply store, or write to

SJRWMD Division of Public Information
P.O. Box 1429
Palatka, FL 32178-1429



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THE STORY of DRINKING WATER

Text by: Rosalie Bock

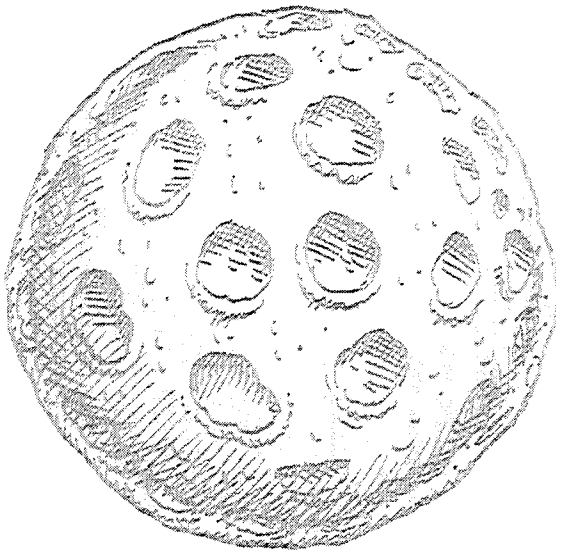
WHAT DO YOU KNOW ABOUT WATER?

What if there wasn't any water on earth?

There wouldn't be any trees...or animals...or humans.

All living things need water to live. Next to the air we breathe, water is our most important need.

Without water the earth would look like the moon:



The human body is 70% water. Every system in our body uses water.

- Water makes up 83% of our blood.
- Water transports body wastes.
- Water lubricates body joints.
- Water keeps our body's temperature stable.
- Water is a part of cells, which make up all living things.

Human beings can live several weeks without food, but only a few days without water. Each day, we must take in at least eight glasses of water. But drinking water or other liquids provide only half the water we need. The other half comes from the foods we eat.

List foods that have water in them.*

_____ _____

_____ _____

_____ _____

*All foods have water in them.

WHAT DO YOU KNOW ABOUT WATER...ON EARTH?

Almost 80% of the earth's surface is covered with water.

Ninety-seven percent of the water on earth is **salt water**. Salt water is filled with salt and other minerals. Humans cannot drink this water. It is too difficult and expensive to remove the salt.

Two percent of the water on earth is **glacier ice** at the North and South Poles. This ice is fresh water and could be melted down. It is too far away from where people live to be usable.

Less than 1% of all the water on earth is **fresh water** that we can actually use. We use this small amount of water for drinking, transportation, heating and cooling, industry, and many other purposes.

List some of the ways you use water in your life.
Which use do you think is the most important?

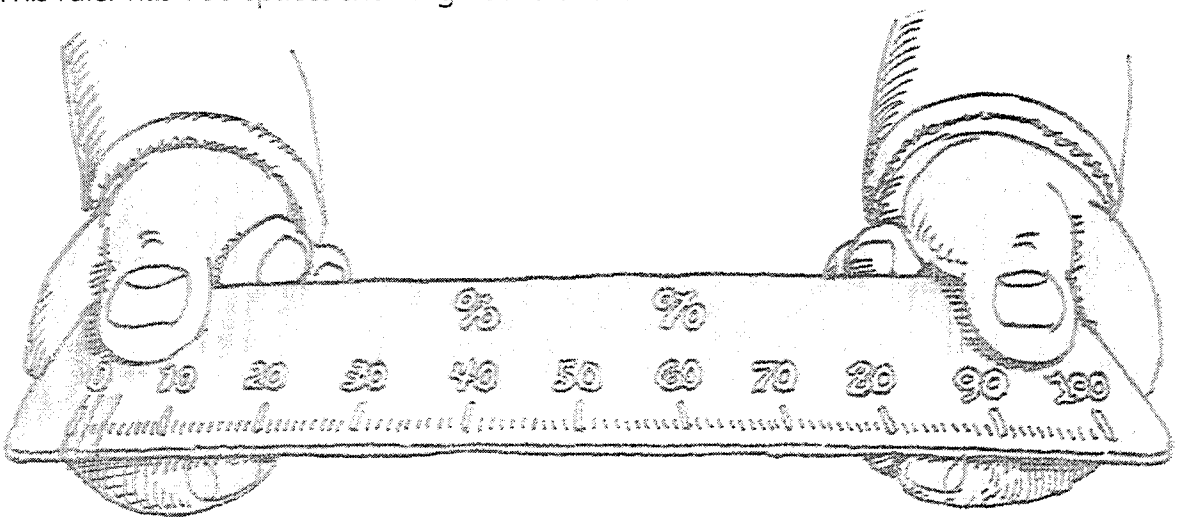
_____

_____

_____

Water on the earth

This ruler has 100 spaces showing 100% of the water on earth.



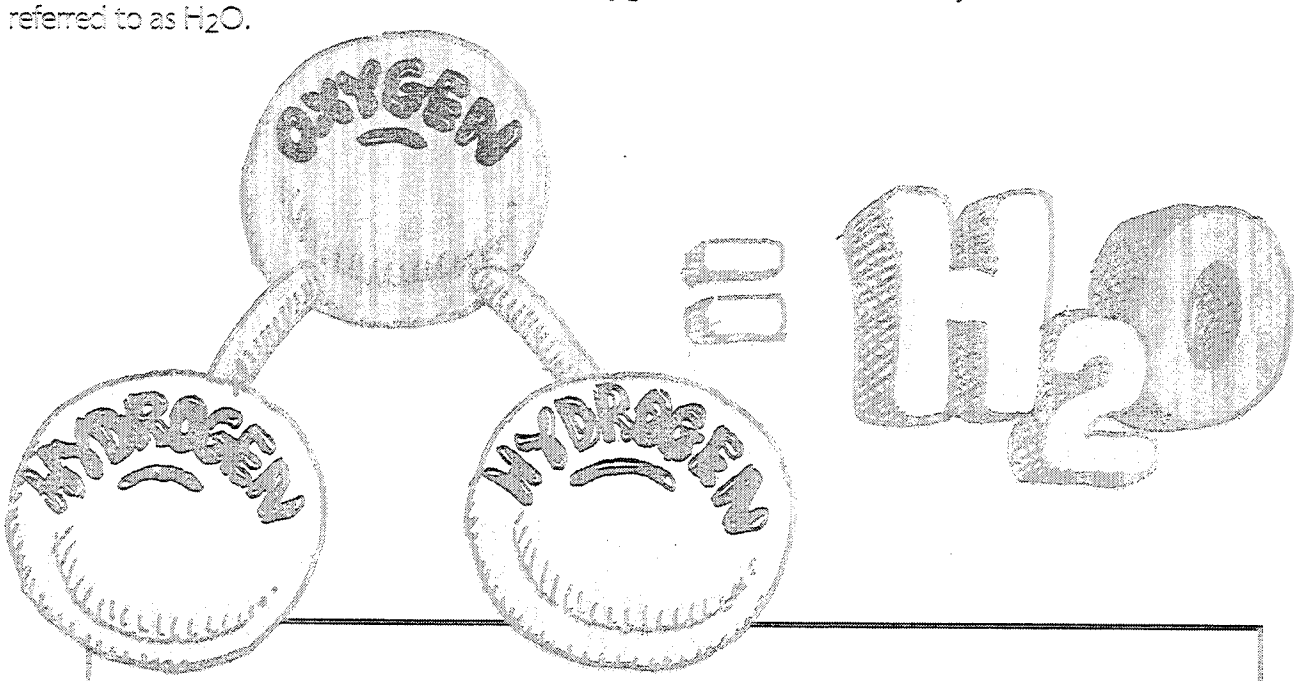
One space of **Blue** is 1% of the spaces on the ruler. This shows the fresh water we can use.

Two spaces of **Green** are 2% of the spaces on the ruler. This shows the water frozen in glaciers.

Ninety-seven spaces of **Yellow** are 97% of the spaces on the ruler. They show the amount of salt water on earth.

WHAT DO YOU KNOW ABOUT THE WATER MOLECULE?

Everything is made up of **atoms**. An atom is the smallest particle of an element, like oxygen or hydrogen. Atoms mix together to form **molecules**. A water molecule has three atoms: two hydrogen (H) atoms and one oxygen (O) atom. That's why water is sometimes referred to as H_2O.



What is a **solvent**?

A solvent is a liquid that can dissolve other substances. Water is the most common solvent in nature.This is why many minerals are found in water. How do we take advantage of this ability of water to dissolve almost anything?

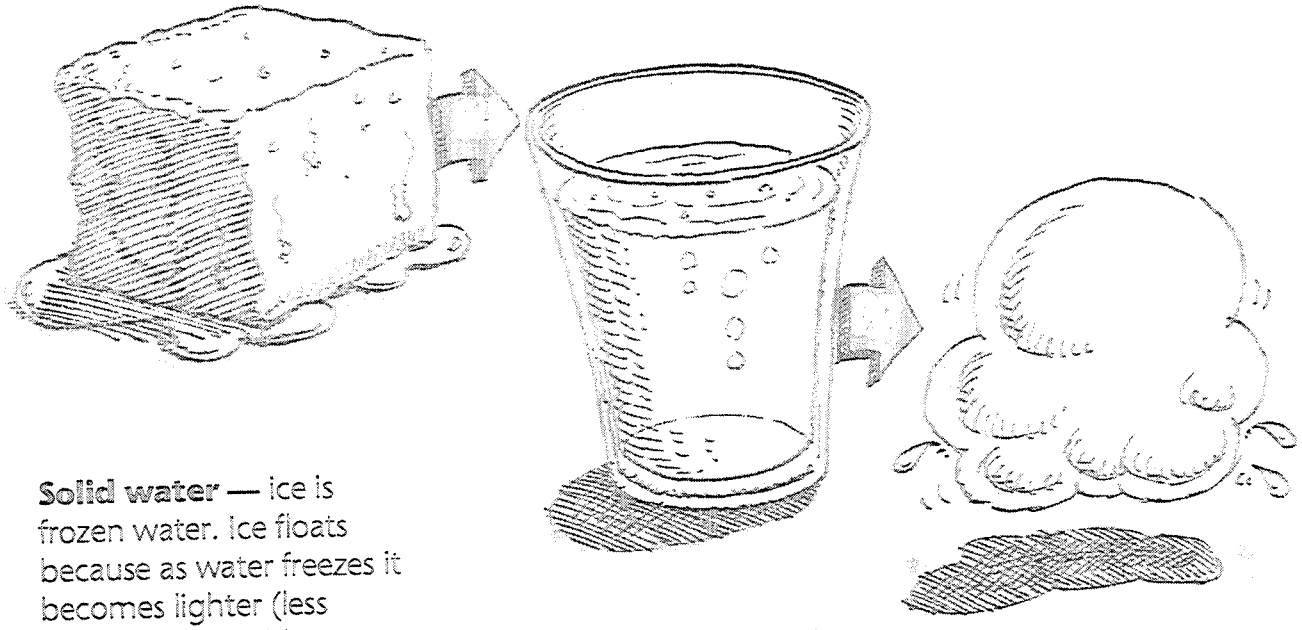
We use water to dissolve many things.

Even when we cook, we use water as a solvent.

What drinks or foods do you mix in water?

WHAT DO YOU KNOW ABOUT WATER AND ITS THREE FORMS?

Water is tasteless, odorless and colorless.
Water can occur in three states: **solid** (ice), **liquid**, or **gas** (vapor).



Solid water — ice is frozen water. Ice floats because as water freezes it becomes lighter (less dense) than liquid water. Water freezes at 0 degrees Celsius, 32 degrees Fahrenheit.

Liquid water is wet and fluid. This is the form of water that we are most familiar with. We wash with, drink, and use liquid water in many ways.

Water as a gas—vapor is always present in the air around us. You cannot see it. When you boil water, it changes from a liquid to a gas. Some of the water vapor cools and we see it as a small cloud called steam. This cloud of steam is a mini-version of the clouds we see in the sky. Steam is formed at 100 degrees Celsius, 212 degrees Fahrenheit.

The water vapor attaches to small bits of dust in the air. It forms raindrops in warm temperatures. In cold temperatures, it freezes and forms snow or hail.

What do you think would happen if ice did not float? What would happen to the fish and plants in the water? How does the ice on top of a lake help the fish and plants that live underneath?*

_____

_____

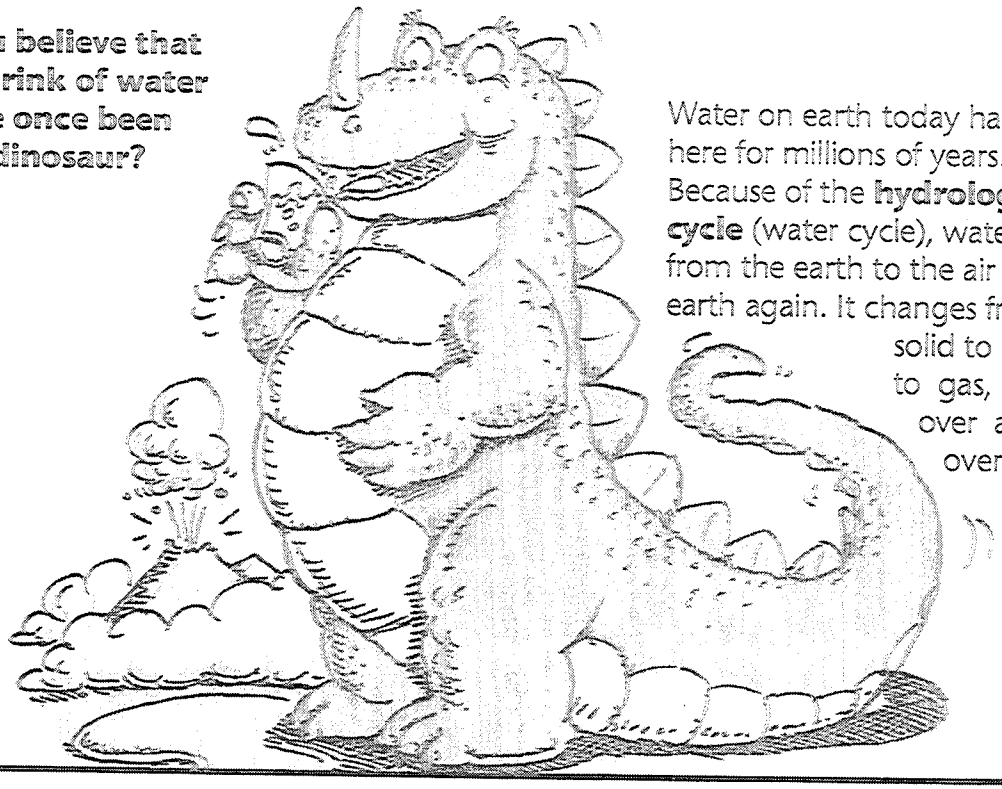
_____

_____

*If ice did not float, lakes would freeze from the bottom up. The plants and fish would also freeze. Most of them would die. But the ice on top keeps the water underneath protected from the cold. It is like a blanket that keeps the water at a safe temperature for the living things in the lake.

WHAT DO YOU KNOW ABOUT THE WATER CYCLE?

Would you believe that your last drink of water could have once been used by a dinosaur?



Water on earth today has been here for millions of years. Because of the **hydrologic cycle** (water cycle), water moves from the earth to the air to the earth again. It changes from solid to liquid to gas, over and over again.

Hydrologic cycle (water cycle) vocabulary

Hydrologic - relating to water
Evaporation - liquid water becoming a gas
Water vapor - water as a gas in the air
Condensation - water vapor becoming a liquid
Surface runoff - water that runs along the soil and goes into lakes and rivers
Precipitation - rain, snow, sleet or hail
Groundwater - water under the ground, as in a spring or well
Aquifer - a large water source under the ground
Percolation - water moving downward through openings in the soil.

It is not a secret...water is wonderful!

Use this code to fill in the message:*

_ _ _ _, _ _ _ _, _ _ _ _ and _ _ _ _ _
are forms of precipitation.

A B C D E F G H I J K L M N O P Q R S T U V W X Y Z

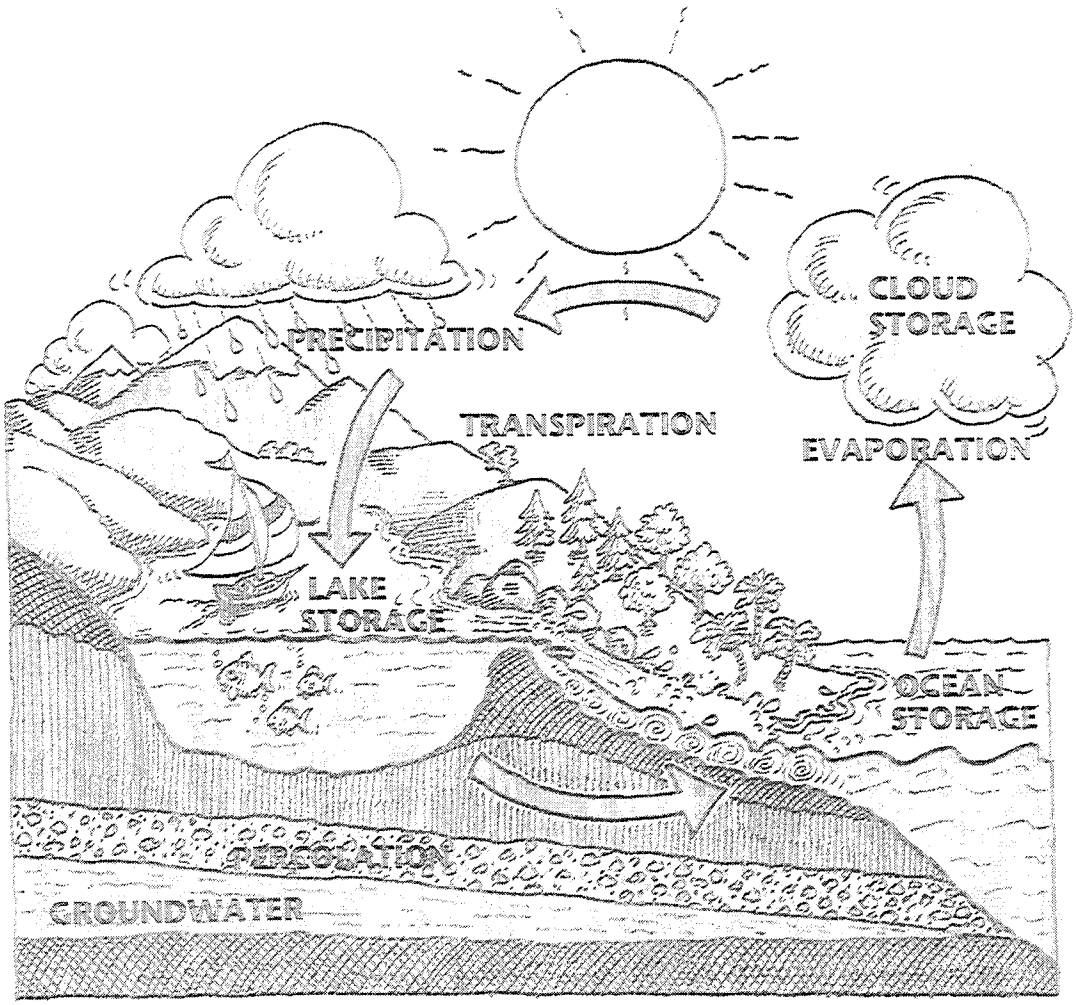
_ _ _ _, _ _ _ _, _ _ _ _ and _ _ _ _ _
are forms of precipitation.

*Rain, snow, hail and sleet are forms of precipitation.

THE HYDROLOGIC CYCLE

Water **evaporates.** It travels into the air and becomes part of a cloud. It falls down to earth as precipitation. Then it evaporates again. This repeats over and over again in a never-ending cycle. This **hydrologic cycle** never stops. Water keeps moving and changing from a solid to a liquid to a gas, over and over again.

Precipitation creates **runoff** that travels over the ground surface and helps to fill lakes and rivers. It also **percolates** or moves downward through openings in the soil to replenish **aquifers** under the ground. Some places receive more **precipitation** than others. These areas are usually close to oceans or large bodies of water that allow more water to **evaporate** and form clouds. Other areas receive less. Often these areas are far from water or near mountains. As clouds move up and over mountains, the water vapor condenses to form precipitation and freezes. Snow falls on the peaks.



What do you think would happen if the hydrologic cycle stopped?

*All life on earth would end. Without this never-ending cycle, plants would die. Underground sources would soon be emptied. Rivers, lakes and oceans would overflow and flood large areas of land. The whole ecological cycle would end.

How many inches of precipitation does the area you live in receive in one year?

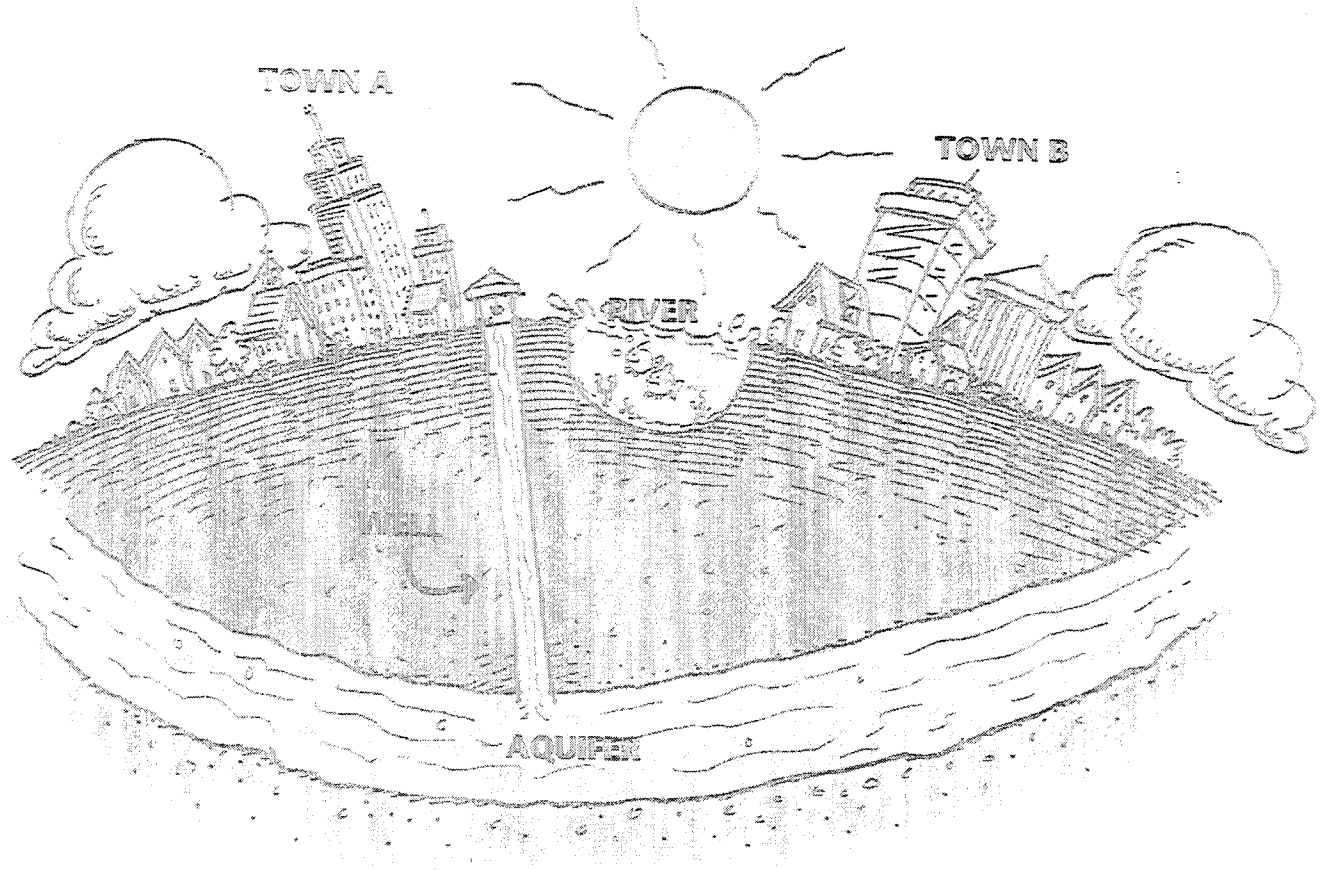
If you don't know, you can find the answer at your local library.

WHAT DO YOU KNOW ABOUT WATER SUPPLY?

There are three parts to water supply... **source — treatment — distribution**

More than two billion people on the earth do not have a good water supply. Water must be carried by hand. Their water might not even be clean. In some places, people spend most of their day carrying water for their family to use.

Most people in North America get their water from **public utilities**. Public utilities are companies or government agencies that supply basic needs such as electricity, gas or water to the public. These utilities get their water from a natural **source** (a river, lake or aquifer). Many also **treat** (clean) the water to remove impurities. The utility then **distributes** (sends) the water to homes and businesses for people to use.

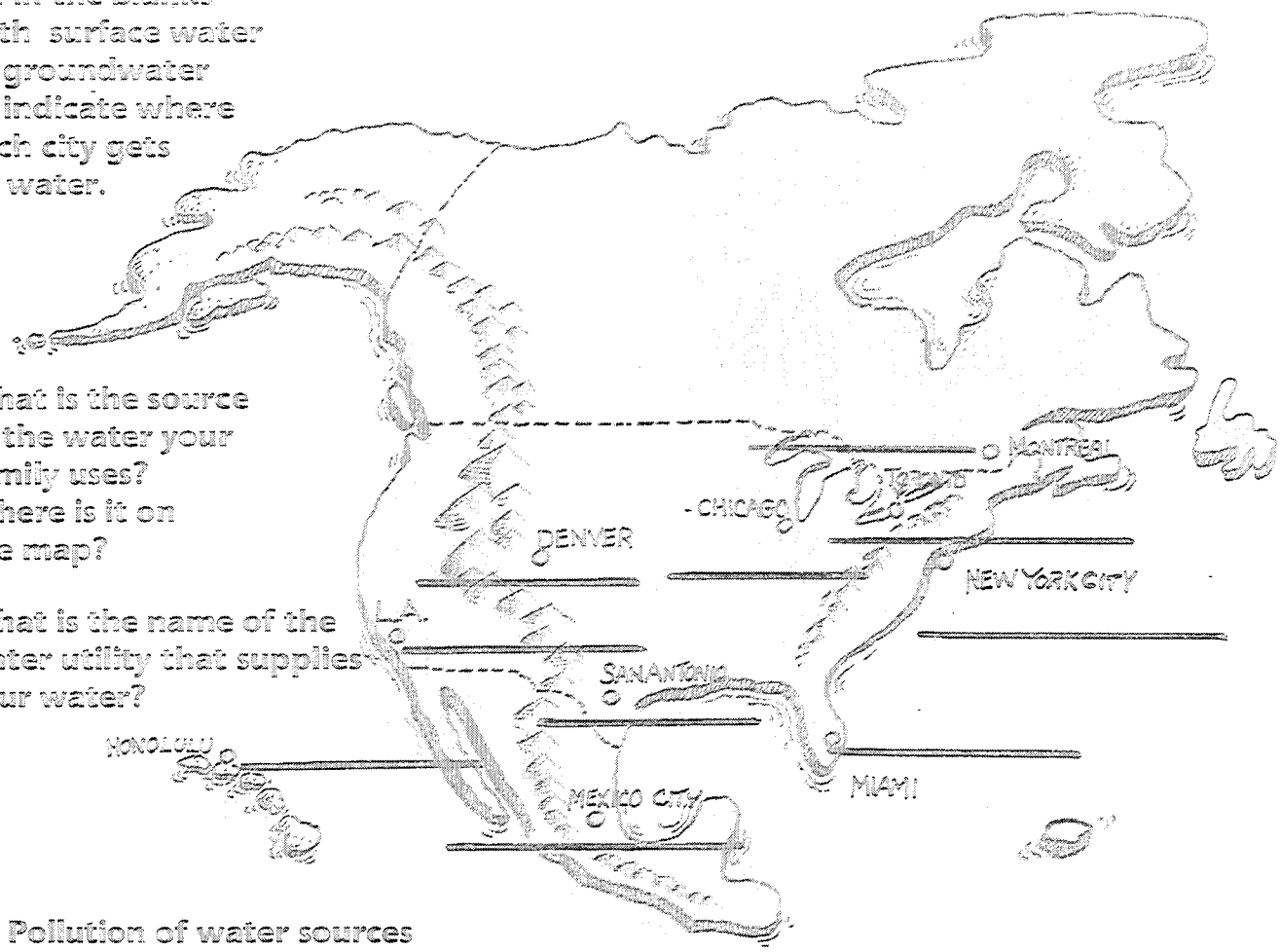


Some public utilities get water from **surface water sources** such as lakes and rivers. Other utilities get water from **groundwater** sources. The underground rock, clay, sand and gravel materials that store water are called **aquifers**. Some cities are fortunate enough to be near both a **surface water source** and a **groundwater aquifer**.

Miami, Honolulu, San Antonio and Mexico City depend mostly on groundwater sources. Chicago, Montreal, Quebec, Toronto, St. Louis, Pittsburgh and Guadalajara are on the shores of rivers or lakes, so they use surface water. Cities such as New York, Los Angeles and Denver have to bring surface water through pipes for many miles.

WHAT DO YOU KNOW ABOUT WATER SOURCES?

Fill in the blanks with surface water or groundwater to indicate where each city gets its water.



What is the source of the water your family uses? Where is it on the map?

What is the name of the water utility that supplies your water?

Pollution of water sources

Water can be polluted with human and/or chemical wastes. Even deep underground aquifers can be polluted from the surface. For example, oil thrown on the ground or in the sewer can pollute the water and is very hard to remove.

Everyone must do their part to keep our water sources clean.

Public utilities must clean water very carefully. They test water and measure pollutants to make sure the water is safe. They can measure very small amounts of pollutants in bodies of water—parts per million, parts per billion, and even parts per trillion. The water that the water companies deliver to people must meet strict rules of purity. It's hard to imagine but:

- One part per million would be equal to one drop in 10 gallons or a fish tank.
- One part per billion would be equal to one drop in 10,000 gallons.
- One part per trillion would be equal to one drop in 10,000,000 gallons.

Water that utilities send out must be safe for everyone to use.

After water is used, it goes down the drain. Then it goes through the sewer to a **wastewater treatment plant**. There it is treated (cleaned) again before the water is sent back to a natural water source. This protects everyone and everything that uses the water downstream.

WHAT DO YOU KNOW ABOUT WATER TREATMENT?

Water treatment is the process of cleaning water. Treatment makes the water safe for people to drink. Because it is a good solvent, water picks up all sorts of natural pollutants. In nature, water is not always clean enough for people to drink. When the microscope was invented in the 1850s, germs could be seen in water for the first time. In 1902, Belgium was the first country to use chlorine to clean or treat water in a public water supply. Today, almost every city in the world treats their drinking water. Treatment includes **disinfection** with chlorine or other chemicals to kill any germs in the water.

A Treatment Plant

1. **Intake:** Water is taken from the source. Logs, fish and plants are screened out at the intake and then the water is drawn into the treatment plant. If the source is groundwater, the "screening" is done by the soil as the water travels under the earth's surface. Sometimes very little treatment is required for groundwater.

2. **Chemical Addition:** Aluminum sulfate (alum), polymers and/or chlorine are added to the water. These kill germs, improve taste and odor, and they help settle solids still in the water. The water and these chemicals are then mixed together.

3. **Coagulation and Flocculation:** Here, the alum and other chemicals from the chemical addition step cling to particles in the water. This is called **coagulation**. It causes the particles to stick together and form larger particles called **floc.**

4. **Sedimentation:** The water and the floc particles flow into a sedimentation basin. Here the floc settles to the bottom and is removed from the water.

5. **Filtration:** From the sedimentation basin, the water flows through filters. Filters are made of layers of sand and gravel. The filters are used to remove any remaining particles left in the water.

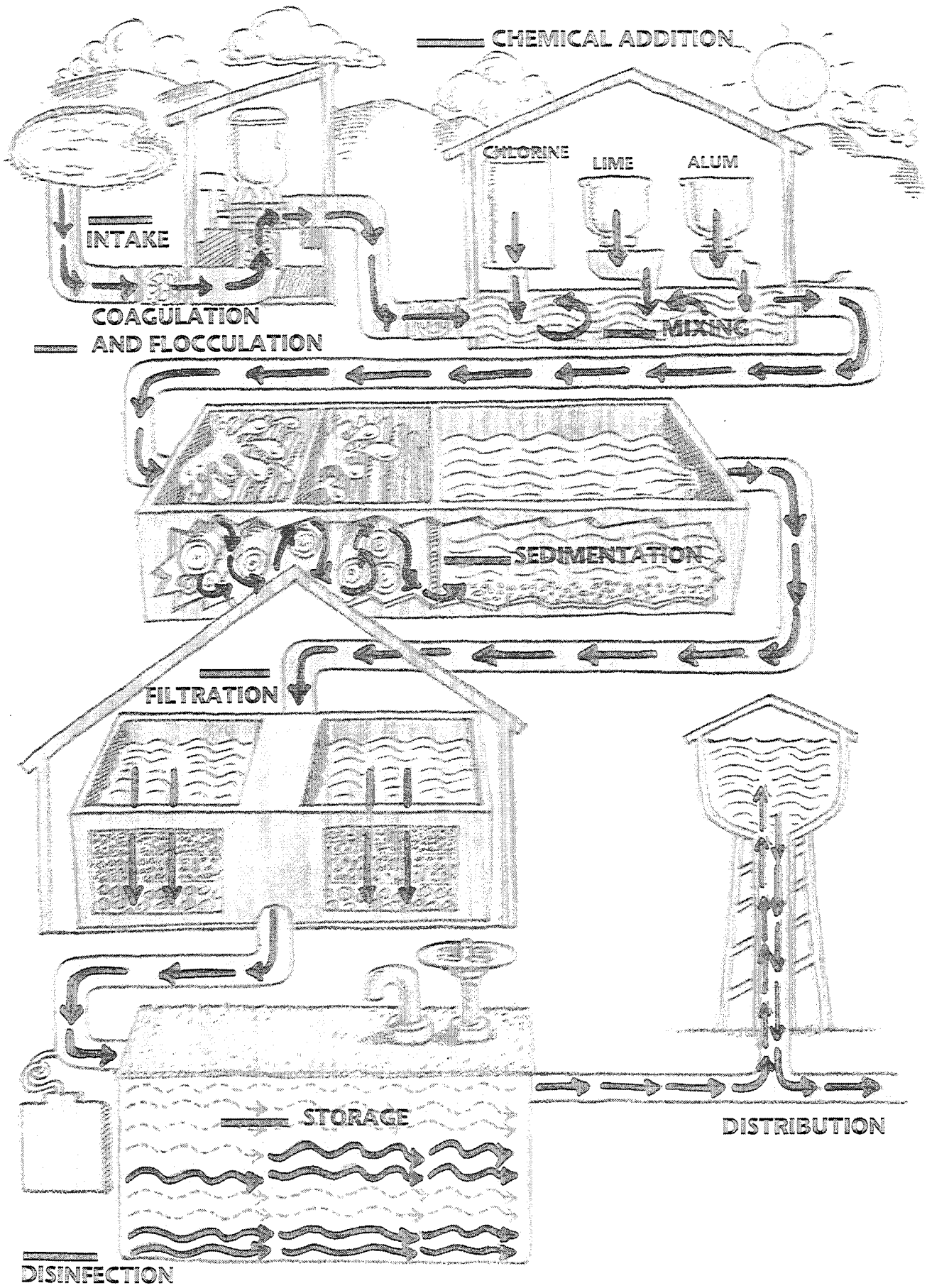
6. **Disinfection:** A small amount of chlorine, or other disinfecting chemicals, is added. This is used to kill any remaining germs and to keep the water safe as it travels to the public. In some water systems, especially those with groundwater sources, this is the only treatment provided.

7. **Storage:** The water is placed in a closed tank or reservoir called a clear well. This allows time for the chlorine to mix throughout the water in order for disinfection to take place. The water then flows into the distribution system.

The water is sampled and tested throughout the treatment plant. Sampling is performed to make sure the processes are working and that the water is safe before it leaves the plant. In North America, governments have set standards for drinking water. When water leaves a treatment plant, it is as clean or cleaner than required by these standards.

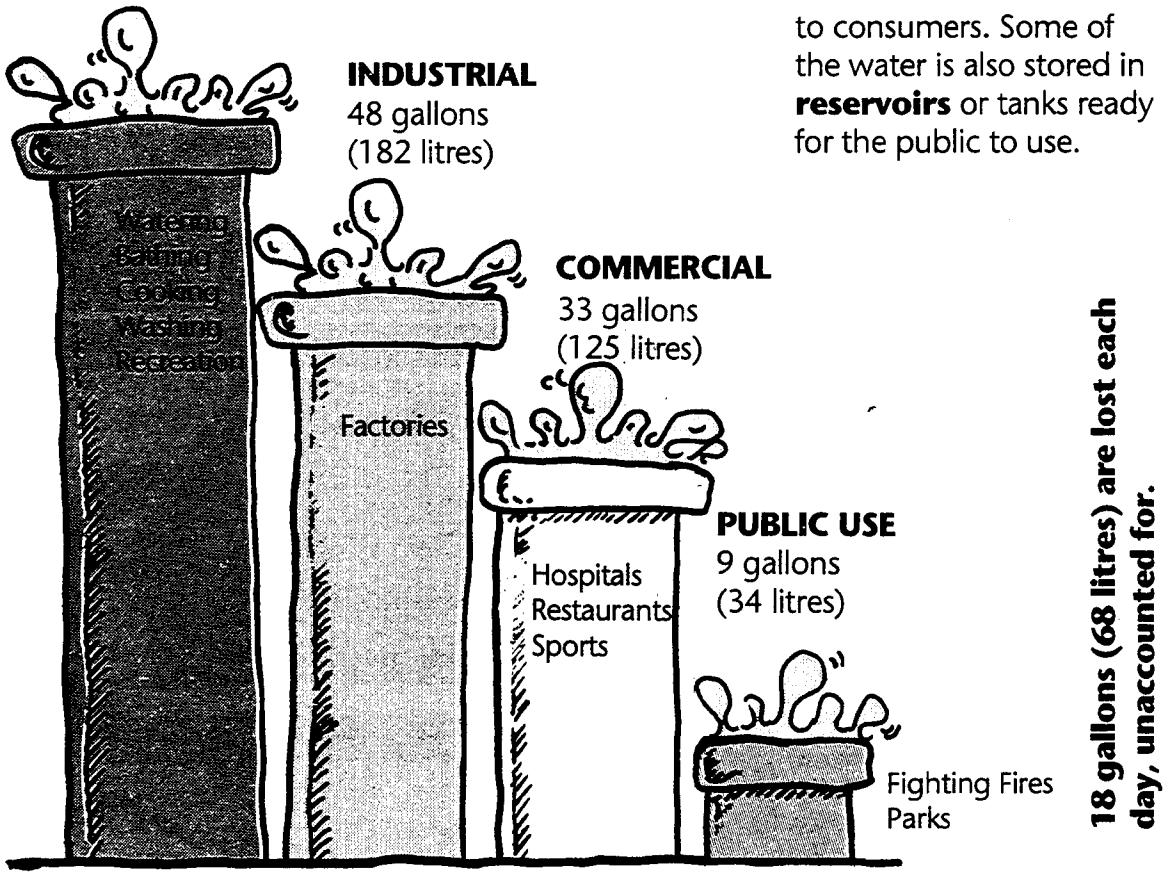
Water Treatment

Place the correct number of the step on the line.



WHAT DO YOU KNOW ABOUT WATER DISTRIBUTION?

The third part of a public water supply system is **distribution**. This is when water is sent from the treatment plant to homes and businesses. Each day, about **42 billion gallons** (159 billion litres) of clean drinking water are produced by public water systems in the United States and Canada. This water is then distributed to consumers. Some of the water is also stored in **reservoirs** or tanks ready for the public to use.



176 gallons (666 litres) are treated in the United States for each person every day.

To save energy, treatment plants, reservoirs and tanks are usually put on high ground. Gravity can then move the water through the pipes to the customers. Pumps are used to pull the water up from aquifers. Pumps sometimes help water move up hills or steep areas. But utilities do all they can to save energy.

Water travels through large pipes called **mains.** In some cities, the amount of water that goes through these mains is controlled by computers. Large **valves** are also used to control the water. They are just like giant faucet handles. They can shut off the water at important points. If a main breaks or other problems occur, the water can be shut off until repairs are made.

Utilities also sample and test water throughout the distribution system to make sure the water reaching the customers is safe.

Utilities carefully check the amount of water they pump each day. This is very important to people in places where groundwater is used. Taking too much water from an aquifer can cause the ground to sink. This is called **ground subsidence.**

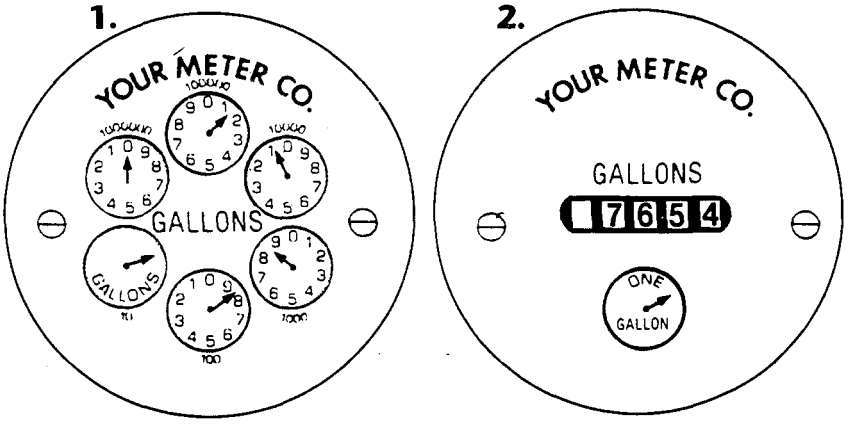
WHAT DO YOU KNOW ABOUT WATER COSTS?

A **water meter** measures the amount of water coming into your home or business. Your water meter may be located in your basement or outside in a pit or hole. A **meter reader** reads the meter on a regular basis. The utility bills you for the amount of water used. The bill covers the costs of treating and distributing the water. Sometimes, a utility must buy water. All of these costs and the wages for the utility's staff must be met.

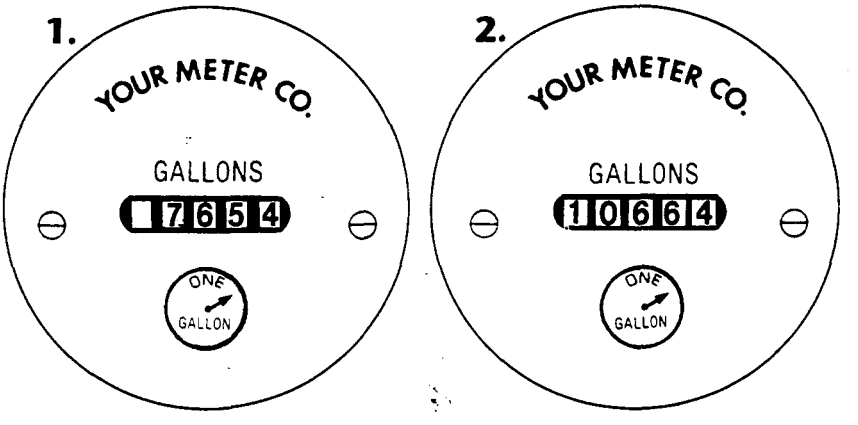
Water is a bargain. The average price of water in the United States is about $1.30 for 1,000 gallons. At that price, a gallon of water costs less than one penny. **How does that compare with one can of soft drink?**

Two kinds of meters are used in North America

The first meter is read like a traditional clock. The second meter is read like a digital clock. Meters can measure in gallons, cubic feet or cubic metres. The meters shown here are measuring in gallons.



Let's say the readings below are for the Smith family. The first meter shows last month's reading. The second meter shows the reading for this month.



Find out how much water the Smith family used in one month. Just subtract the first reading from the second reading. In one month they used _____* gallons of water.

*3,010

WHAT DO YOU KNOW ABOUT WISE WATER USE?

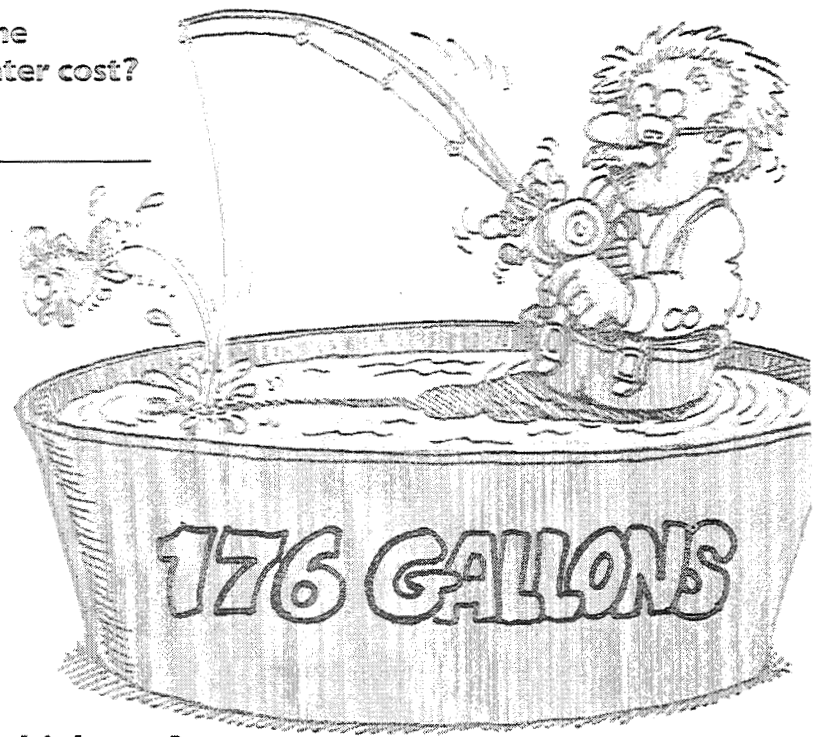
The average person in North America uses 176 gallons of water each day for all uses. That is about 5,280 gallons in a 30-day month. The average price for water in the United States is $1.30 per 1,000 gallons.

How much would the average person pay for one month's water use?

$1.30/1,000 gallons x 5,280 gallons in one month = $_____

What about the Smith family?
How much water did they use in one month? How much would their water cost?

$1.30/1,000 gallons x _____ = $_____



The average price for a gallon of soft drink is about $2.19. At $1.30 for 1,000 gallons of water, 10 gallons of water cost one cent ($.01).

How much does 10 gallons of soft drink cost?

$2.19/1 gallon x 10 gallons = $_____

How much do 1,000 gallons of soft drink cost?

$2.19/1 gallon x 1,000 gallons = $_____

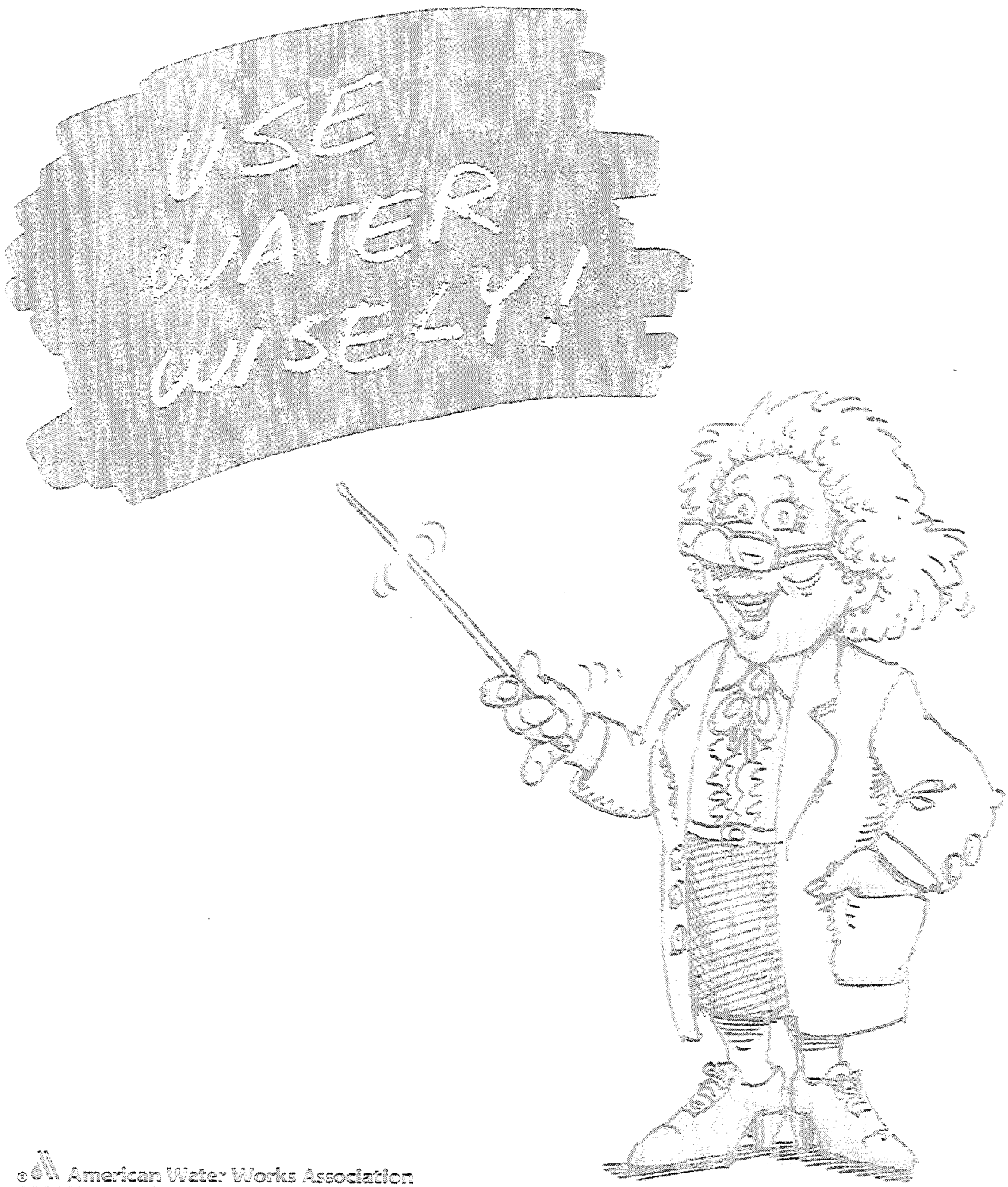
**Water is a bargain...
but we must use it wisely!**

- Water is a valuable natural resource shared by everyone.
- Water is not always available when and where we need it.
- It costs money and uses energy to move water.
- Pollution makes it more difficult and costly to clean water.

Answers: $6.86, $3.97, $21.90, $2,190.00

WHAT CAN YOU DO TO SAVE WATER?

1. Check inside faucets for leaks. Even a faucet with a small drip can waste alot of water..
2. Keep showers to 5 minutes or less in length.
3. Turn off the water while brushing your teeth or washing your hands.
4. Keep a pitcher of water in the refrigerator. Then you won't have to run tap water to cool it.
5. Use dishwashers and clothes washers for full loads only.
6. Use a broom to sweep your driveway, garage or sidewalk instead of using water.
7. Use a bucket of water to wash your bike or the family car. Rinse it quickly with the hose.
8. Be careful to water the lawn, not the sidewalk or street.
9. Water your lawn at night or in the early morning to avoid evaporation.
10. Check outside hoses, faucets and automatic sprinklers for leaks.
11. Never throw oil or chemicals down the drain or into the ground. Your local utility can tell you how to get rid of these pollutants.
12. **Use water only when you need it. Always turn it off when you are finished.**



 American Water Works Association
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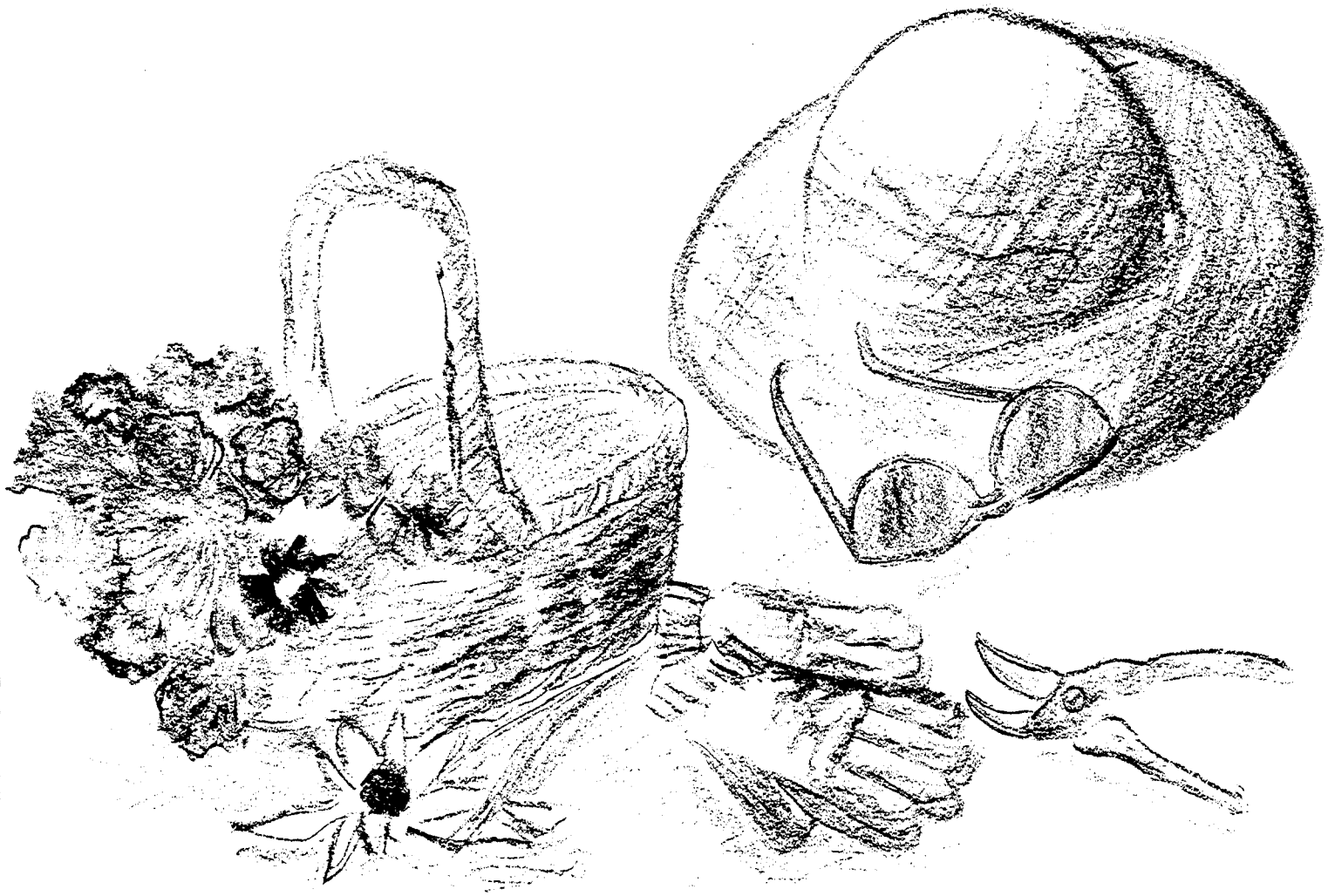
Illustrations by: John Dearstyne

3P-2E-750M-7/00-2/98-PP

ISBN 0-89867-517-0

St. Johns River Water Management District

XERISCAPE™ plant guide



XER•I•SCAPE™

\'zir-ə-skāp\ *noun* [Greek *xeros, dry*]:
water conservation through
creative landscaping

XERISCAPE™

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Why *XERISCAPE*™?

Lantana, Chinese juniper, Pindo palm . . .

Why does the St. Johns River Water Management District care what plants you choose for your yard?

On any given sunny afternoon in Florida, you will find hundreds of folks outside their homes mowing the grass and tending to landscapes. For some people, gardening is work; for others, it is a hobby or even a friendly neighborhood competition.

Unfortunately, wide, lush lawns and many flowers and shrubs need lots of water to flourish. It is estimated that lawn and garden irrigation accounts for about 50 percent of all residential water use in Florida. Some states, such as California and Arizona, restrict the use of landscape plants that have high water needs.

With the goal of wise water management in mind, we offer to you this XERISCAPE plant guide. "XERISCAPE" is simply water conservation through creative landscaping. Its seven principles are planning and design; soil improvements; appropriate plant selection; practical turf areas; efficient irrigation; mulching; and appropriate maintenance. These techniques are particularly effective in Florida's dry, sandy soil.

By carefully following XERISCAPE's seven principles, you can save time and water while making your new or existing landscape attractive and healthy, even during a drought. How you plant the area around your home can make a big difference in water consumption!

The Florida Water Resources Act of 1972 provided a plan for the management of water and related land resources. The District's mission is to manage water and related land resources in the public interest to provide for their conservation, restoration, and proper development and use.

We hope that with the help of this guide, you will be able to make your home or business more attractive and valuable, and assist us in protecting our precious water resources.

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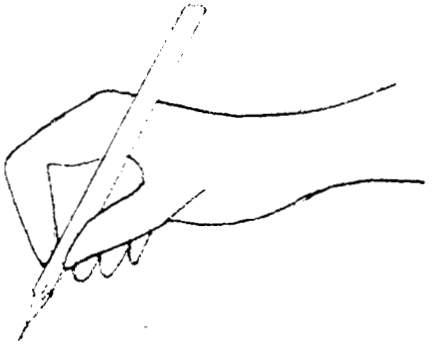
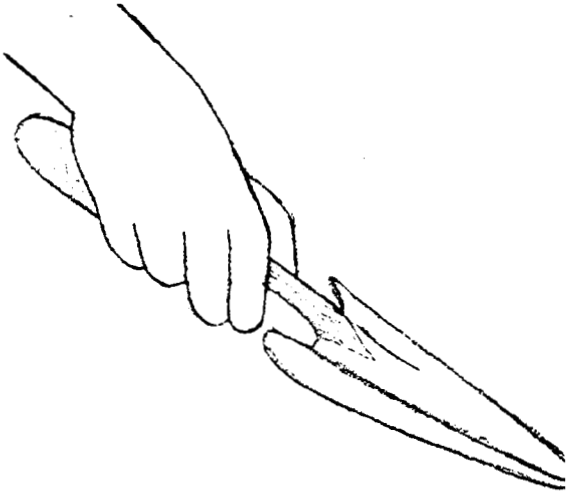
The 7 Principles of *XERISCAPE*™

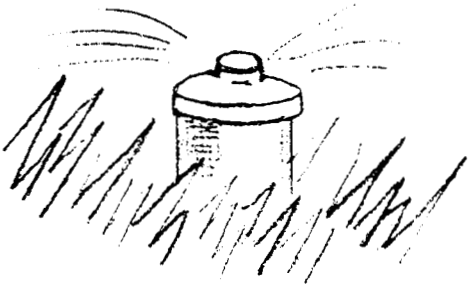
XERISCAPE is simply water conservation through creative landscaping. Industry professionals have proven the success of the technique's seven simple principles. You can apply these same principles to your new or existing landscape. Given the chance, XERISCAPE will save you water, time and money.



1) Planning and design - Create your own XERISCAPE plan or consult a landscape professional for advice. Whatever your choice, evaluate existing vegetation and try to minimize the use of grass, which is a large water user. XERISCAPE allows you to install your landscape in phases, minimizing initial costs.

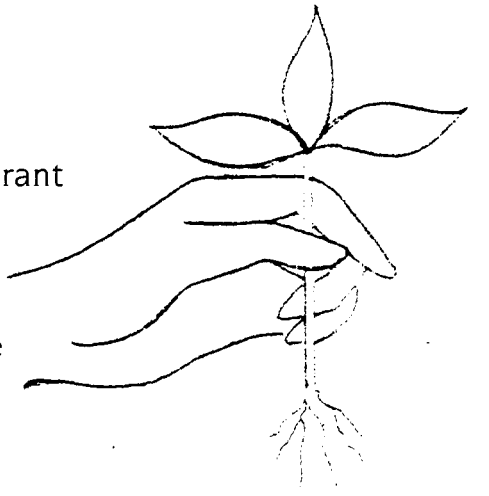


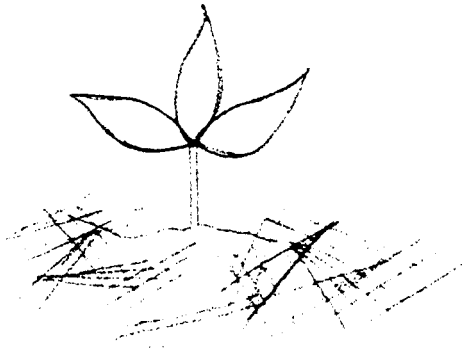
2) Soil improvements - Four to six weeks before planting, add organic material to soil to improve plant growth and water absorption. Examples of organic matter are dry manure, peat, composted leaves and grass clippings. Contact your county cooperative extension service to have your soil analyzed for what improvements will work best.



3) Efficient irrigation - First, group plants with similar water needs. Then design your irrigation system using the right watering tool for the job. Irrigate your plants by visual inspection and need, not by scheduled irrigation.

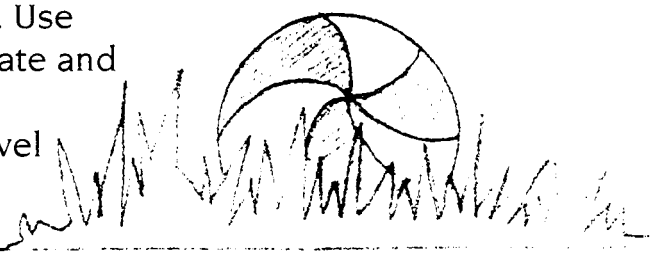
4) Appropriate plant selection - While native, drought-tolerant plants are encouraged in a XERISCAPE plan, almost any plant is appropriate if it's properly placed in your landscape. When choosing a plant, evaluate its growth rate, mature size, light, water and temperature needs. It is critical to then match these needs with a suitable spot in your yard.





5) Mulching - Mulches hold moisture in soil, reduce weed growth, slow erosion and beautify your XERISCAPE. Spread about three inches of mulch such as wood chips, pine straw or leaves around shrubs, trees and flower beds.

6) Practical turf areas - Grass is your yard's largest user of irrigation water, so use turf only where it's functional, such as children's play areas or on slopes to slow runoff. Use turf that is drought-tolerant or adapted to Florida's climate and keep it separate from low-water use plants. Consider alternatives to turf, such as mulches, ground covers, gravel walkways or stepping stones.



7) Appropriate maintenance - By its nature, XERISCAPE reduces maintenance. However, you can improve this efficiency with proper fertilization, pruning, weeding, pest control, mowing and irrigation.

XERISCAPE™ Irrigation Tips

Proper irrigation is essential to a successful XERISCAPE. You will save both water and time if you:

● **Group plants** with similar water needs. This "zoning" prevents plants from being over or under-watered. Grass, for example, requires much more water than drought-tolerant shrubs, so separate them in your XERISCAPE. While many plants need about one inch of irrigation water per week in the growing season, others require only normal rainfall.

● **Water turf only when** it tells you it's thirsty, not by scheduled irrigation. Here's a simple way to know when your grass "asks" for water: just walk on it. Does it lie flat where you've stepped? If it does, then it's time to water. Also, drooping blades that have turned dull in color or fold in half indicate moisture loss. Learn to know when your plants signal for water; don't irrigate just because "it's time."

● **Water thoroughly** less often. It's better to give your lawn one good soaking each week rather than watering lightly each day. In fact, frequent light waterings may actually harm turf because you only wet the soil on the surface. This discourages grass roots from growing deeply for water and shallow root systems are unhealthy for grass.

When you irrigate, apply two-thirds of an inch to one inch of water to the soil. This will soak the ground to a depth of about one foot and force grass to develop a deep root system. Irrigate only as quickly as the soil absorbs water.

● **Use the right watering tool** for the job. Properly maintained sprinklers are effective for lawns. Irrigate individual trees with bubblers, which slowly flood a small area. Vegetable gardens and shrubs are ideal for drip irrigation, where only the individual plant is watered. Irrigate flower beds and ground covers with a soaker hose with the holes facing down. Remember, you need only water the roots of your XERISCAPE plants.

Water Conservation Tips

Follow these simple steps to save you thousands of gallons of water and dozens of dollars on your energy bills.

● **Check** all hoses, pipes and fittings for leaks. Even a small leak can waste hundreds of gallons of water each day. Keep sprinkler heads clean to ensure an even distribution of water. Keep your entire irrigation system well-maintained.

● **Water early** in the morning. That's when cooler temperatures allow the soil to absorb irrigation water before it evaporates. Also, the morning sun will dry water on plant leaves, helping to eliminate an environment for diseases and pests.

● **Water slowly** and close to the ground. The goal is to slowly distribute large drops of water which are not easily moved by the wind. Watering too quickly causes water to run off before it is absorbed into the soil. This is a common water waster. Sprinkling close to the ground reduces evaporation.

● **If it rains, save water** by turning off automatic sprinklers or invest in rain sensors that measure moisture or rainfall and automatically turn off these systems. Also, consider collecting rainfall for reuse.

● **Don't water** the concrete: adjust sprinklers to avoid waste to sidewalks, streets and gutters. Don't use the hose to spray yard debris from walkways; sweep it off.

● **Keep weeds** under control. They rob water from desirable plants. Also, keep plants properly pruned.

Why Mulch?

The physical beauty of mulch is apparent, but the practical benefits are even more striking. A layer of mulch placed directly around shrubs, trees and flower beds will increase the soil's organic content as the material decomposes. You'll be surprised how much water and maintenance time this will save you! In fact, mulching will:

- **reduce watering chores** because mulch retains water in the soil;
- **further reduce watering chores** because mulch cools the soil from the baking sun;
- **even further reduce watering** and maintenance chores because you don't have to water or mow mulch;
- **reduce weeding chores** and the need for chemical weed killers because weeds struggle to sprout through mulch;
- **reduce garden chores** because mulch protects soil from erosion caused by rain.

Mulch can include pine needles, wood chips or well-rotted manure. Leaves make excellent mulch and eliminate burning or bagging chores. Avoid using fresh grass clippings, which degrade quickly and rob nitrogen from the soil. Instead, use them for compost.

For best results, spread three or four inches of mulch in planting beds. Pull the mulch two to three inches away from the base of shrubs and trees to protect the plant stems from rotting. When adding new mulch, stir the old mulch to circulate air and water.

Do not place sheets of plastic or newspaper on the soil before adding mulch. This practice inhibits the absorption of both water and nutrients into the soil as the mulch decomposes.

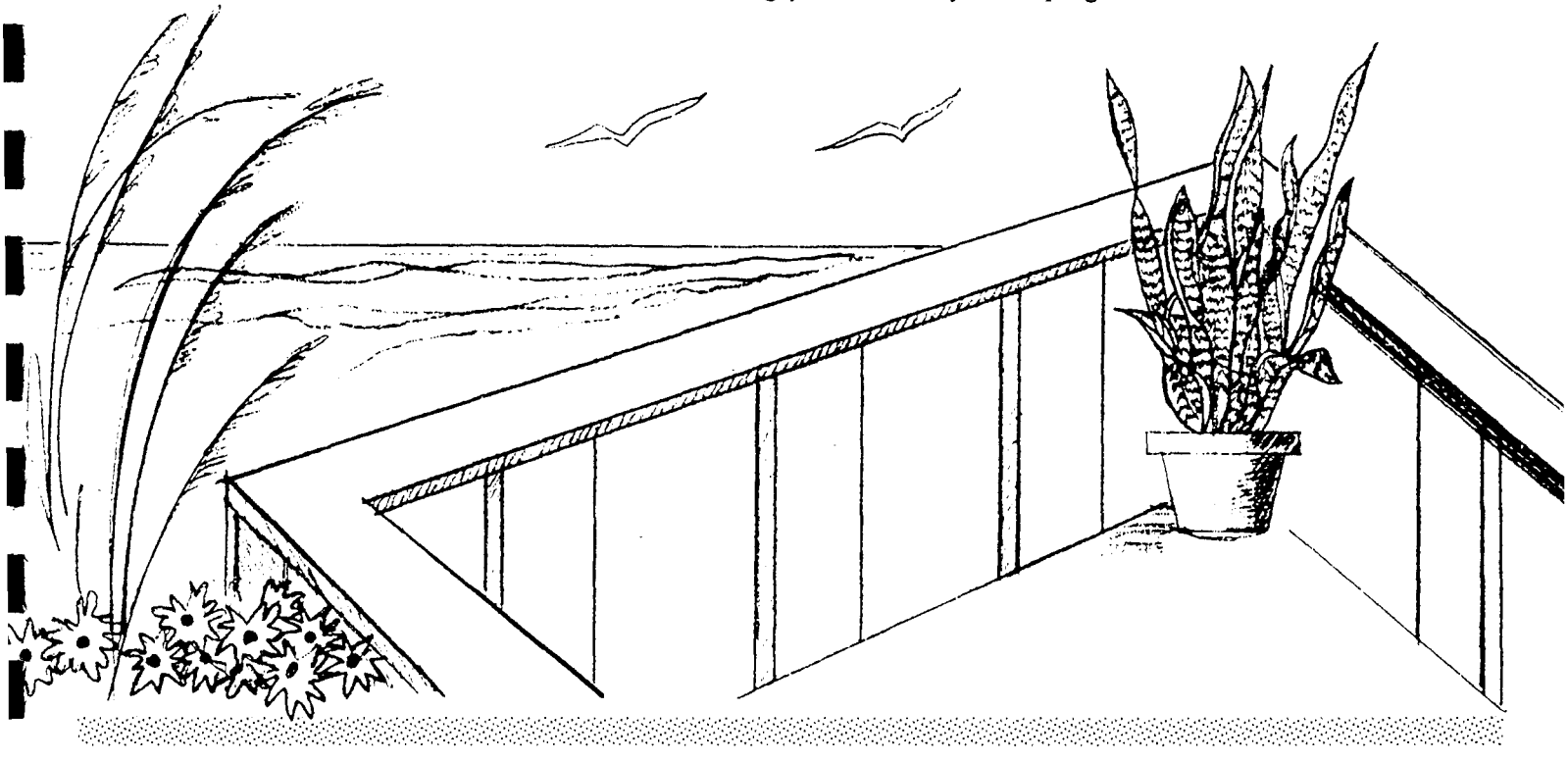
You also may use inorganic mulch, such as gravel or colored rocks, but be aware that these will not hold moisture and may radiate heat around your plantings.

Why Choose Salt Tolerant Plants?

Why choose plants that tolerate salt? Because some counties in the St. Johns River Water Management District - particularly those near the coast or salt marshes - have salt prevalent in both the air and water. Exposure to salty air or saltwater intrusion from a well may severely damage or kill some plants.

Where does this salt come from? Homes near the beach may suffer from salt spray, or stiff winds that blow fine particles of salt and sand into plants. In some neighborhoods, the groundwater is naturally high in salt. Other areas suffer from saltwater intrusion, where saltwater moves underground to replace fresh water. Be careful if your well taps into this unseen water supply. Also, be aware that some household water treatment systems add a significant amount of salt to water they treat.

Use this guide to determine whether or not a plant is salt tolerant. For best results, have your water tested for its salt content. Contact your county cooperative extension office for more information about this service. For the address and telephone number of the extension office serving your county, see pages 30-31.



What Plants to Choose

Does XERISCAPE limit you to a few drought-tolerant shrubs or a yard full of cacti? Certainly not. In fact, almost any plant can fit into a XERISCAPE. The key is to match a plant's climatic needs with a suitable spot in your landscape.

When choosing a plant, pay special attention to its natural height, growth rate, sunlight, soil and water needs. Then evaluate the plant's potential location for factors such as sunlight, wind, temperature, rainfall and humidity. Decide if that potential location will meet the plant's needs. This is a critical step.

For example, don't place a plant that requires a lot of sunlight in a shaded area of your yard. And don't locate a drought-tolerant plant in a low spot where water collects. The best indicator of what will readily grow in your yard is to examine the site's native vegetation. If it grew in a specific spot without your help, it will grow there with your help.

Also, keep in mind a plant's freeze tolerance. A good guideline is to buy trees and plants with rootstock adapted to North Florida's soils and climate. Consider native plants with built-in abilities to endure our area's exposure to drought, disease, pests and salt.

While XERISCAPE does not limit you to native plants, be choosy when buying exotic seeds. Purchase bulbs, flowers, vegetables and fruits acclimated to our special soil types, growing season and temperature ranges. Ideally, choose plants that live on normal rainfall or that require a minimum amount of supplemental irrigation.

Still, the success of your XERISCAPE depends more on *how* plants are used than on *what* plants are used.

Hey, It's a Xeri-quiz . . .

So you think you're water wise and lawn literate? Well, test yourself with the official St. John River Water Management District Xeri-quiz. If you score 100 percent, you're a Xeri-genius. Don't peek at the answers on the next page.

1. Xeriscape means planting your yard:
   a) with only drought-tolerant plants, like cactus.
   b) with virtually any plant, as long as it's located properly.
   c) with mostly grass, to eliminate high water need plants.

2. A small leak in hoses, pipes or fittings can waste:
   a) just ounces of water each day, not a significant amount.
   b) a couple of gallons of water each day, perhaps worth fixing.
   c) hundreds of gallons of water each day, a major waste.

3. The best time to water your plants and lawn is:
   a) early in the morning, when the sun is rising.
   b) in the afternoon, when the sun is warmest.
   c) in the evening, when the sun is setting.

4. When irrigating, the best method is to:
   a) water quickly, which will save water.
   b) water at a moderate pace, which will save water.
   c) water slowly, which will save water.

5. When mowing the lawn, each leaf blade should:
   a) be cut as short as possible to minimize maintenance.
   b) be left at least two-thirds intact for a healthier lawn.
   c) be cut at least once a month, regardless of height.

6. The most efficient way to irrigate your lawn is to:
   a) visually inspect turf and only irrigate when grass "looks" thirsty.
   b) water the same time and day each week: just be consistent.
   c) rely on automatic sprinklers: set timers and eliminate guessing.

(Answers on next page)

with Xeri-answers!

1) **b. Almost any plant** can be a XERISCAPE plant. The key is to ensure your plant's climatic needs - water, soil, sunlight, etc. - are met wherever it is located. Grass can be a large water user and ideally is grown only where it serves a function, such as a child's play area.

2) **c. Even a small leak can waste hundreds of gallons of water** each day. Keep sprinkler heads clean for an even distribution of water. Keep your entire irrigation system well-maintained.

3) **a. Water early** in the morning. That's when cooler temperatures allow the soil to absorb irrigation water before it evaporates. Also, the rising sun will dry water on plant leaves, helping to eliminate an environment for disease and pests.

4) **c. Water slowly,** only as quickly as the ground absorbs the water. Also, water close to the ground. The goal is to slowly distribute large drops of water which are not easily moved by the wind. Sprinkling close to the ground reduces evaporation.

5) **b. Mow grass so that you never remove more than one-third** of the leaf blade. Cutting grass shorter than this stresses the lawn and increases water loss.

6) **a. Water turf only when it "tells" you it's thirsty.** Scheduled irrigation can be wasteful because it waters whether or not your grass needs it. Here's a simple way to know when your grass "asks" for water: just walk on it. Does it lie flat where you've stepped? If it does, then it's time to water. Also, drooping blades that have turned dull in color or fold in half indicate moisture loss. Don't irrigate just because "it's time."

Key to the Tables

Growth Rate
Slow
Medium
Fast

Salt Tolerance
⁂ Moderate salt tolerance
✻ Yes, very salt tolerant

Light Requirements
○ Full sun
◗ Partial sun
● Shade

Drought Tolerance
✤ Moderate drought tolerance - needs occasional irrigation
✤✤ Very drought tolerant - can survive on natural rainfall patterns

❁ ***Native***

Nutritional Requirements
Low **M**oderate **H**igh

Plant Types

Trees and Shrubs -

Deciduous 

Evergreen 

Palm-pinnate 

Palm-palmate 

Groundcovers-

Woody - **W**

Herbaceous -**H**

Vines -

S - spiney
E - evergreen
D - deciduous
R - rambling
T - tendrils
TW - twining
AR - aerial roots

Invasive Plant*
Yes
No

*invasive plants such as wisteria or trumpet creeper won't be a problem if planted in the right place.

XERISCAPE™ Turf Tips

Follow these simple XERISCAPE turf tips for a healthier lawn that requires less maintenance.

● **Raise the height of your lawn mower's blade** to its highest acceptable setting. When you mow the grass, never remove more than one third of the leaf blade. Cutting grass shorter than this reduces the depth that roots will grow and increases water needs. Most St. Augustine and Bahia grasses should not be mowed below three inches in height.

● **Leave short grass clippings where they fall** when you mow. This reduces the lawn's need for both water and fertilizer. Remove thick patches of clippings from turf or this grass layer will restrict water movement into the soil.

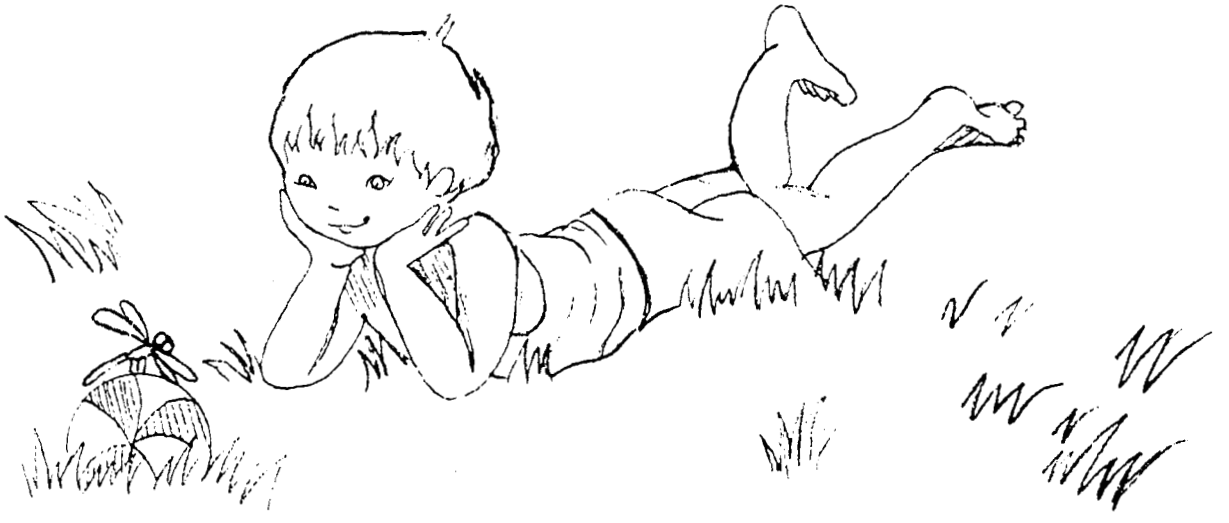
● **Keep your lawn mower's blade sharp** to make a nice clean cut. Grass that is torn and shredded by a dull blade suffers stress and requires more water.

● **Don't over fertilize.** Fertilization stimulates growth and increases water needs. If you do fertilize, use a low-nitrogen product.

● **Consider alternatives** to planting grass in low-use areas. Mulches, ground covers, rock gardens or walkways are excellent options. Remember, lawns can be a huge water user and ideally are grown only where they serve a definite function, such as children's play areas.

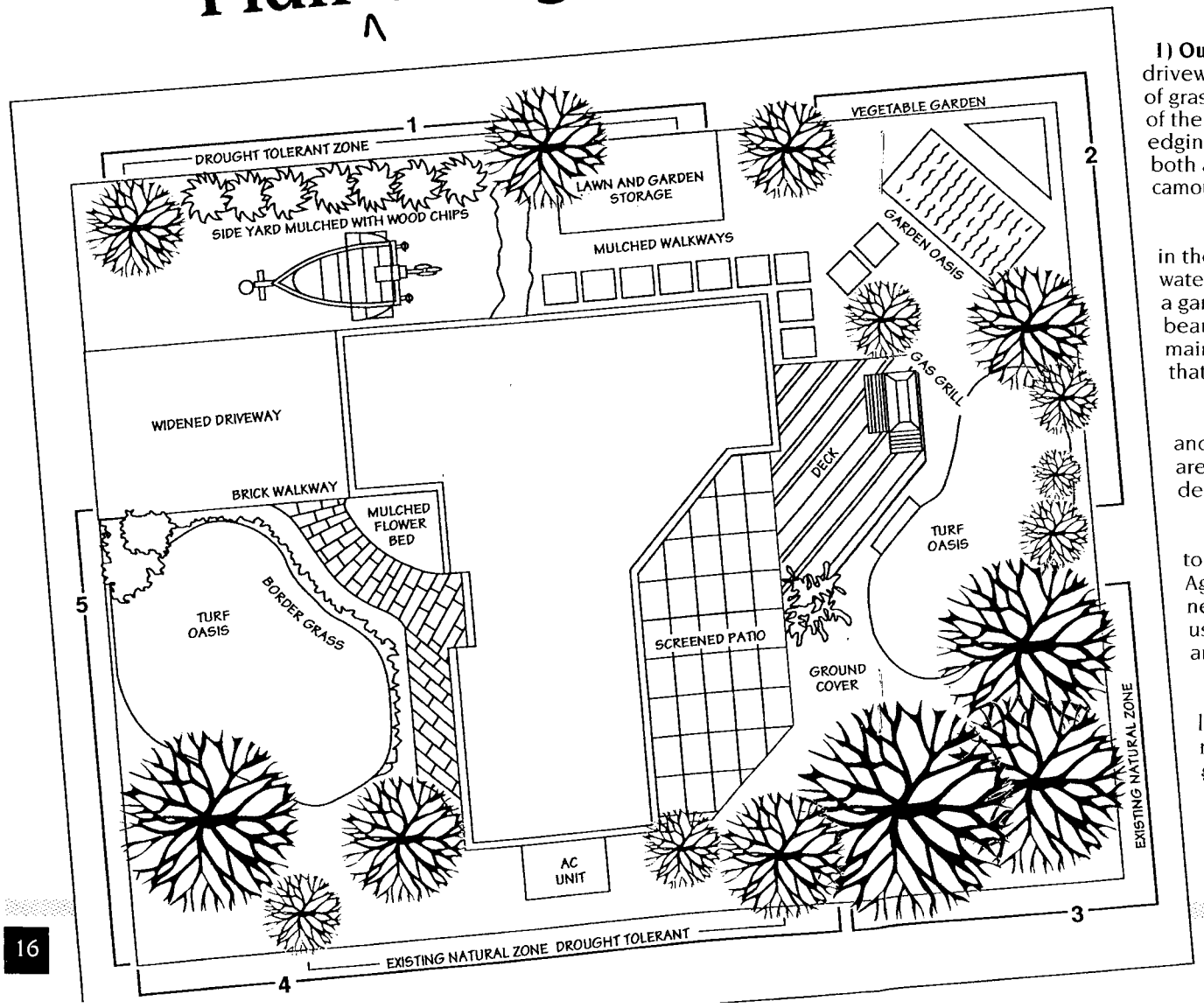
Common Name	Mowing Height (in.)	Mowing Frequency	Drought Tolerance	Salt Tolerance	Wear Tolerance	Light Requirements	Maintenance	Turf Density	Pest Problems
LAWN GRASSES									
Bahia Grass	3-4	7-14	✣✣		G	○	L	L	L
Bermuda Grass	.5-1	3-7	✣✣	✻	E	○	H	H	H
Centipede Grass	1-2	10-14	✣		P	◗	L	M	M
St. Augustine Grass	2-3	7-14	✣	✻	F	◗	M	M	M
Zoysia Grass	1-2	10-14	✣✣	✻	E	○	M	H	M

E=Excellent G=Good F=Fair P=Poor



Plant It Right !

A *XERISCAPE*™ example



1) Our drought-tolerant zone next to the driveway has mulch and low-water shrubs in place of grass. This practice continues along the length of the house and eliminates watering, mowing and edging chores. Notice how the shrubs serve as both a buffer to our northern neighbor and as camouflage for the storage area.

2) Our turf oasis in the back yard is placed in the landscape's lowest spot, which is where water collects. Alternatives to grass in back include a garden, a deck and screened patio. These beautiful additions save water and eliminate maintenance chores. Note the flowering shrub that serves as a windbreak for our gas grill.

3) More drought-tolerant ground covers and shrubs hug the back of our practical turf area. These plants give privacy to our patio and deck while providing shade and windbreaks.

4) Native vegetation, including drought-tolerant shrubbery, is used in the side yard. Again, we avoid choosing grass because it's not needed in an area seldom seen and never used. This decision further reduces watering and maintenance chores.

5) Our practical turf area in the front yard, like that in the back, is rounded in shape to reduce its perimeter; long narrow strips of grass have more border and are inefficient to irrigate. A brick walkway, border grass and mulched flower bed further reduce watering and edging chores and add color accent to the front yard.

Common Name	Natural Height (in.)	Growth Rate	Drought Tolerance	Salt Tolerance	Light Requirements	Nutritional Requirements	Native
FLOWERS							
Annual Sunflower	72	M	✣✣	✻	○	L	
Beach Sunflower	12-24	F	✣✣	✻	○	L	✪
Firewheel Daisy	18	F	✣✣	✻	◗ - ○	L	✪
Geranium	18	F	✣	✲	○	M	
Hibiscus	6-8	F	✣	✲	○	H	
Kalanchoe	6-18	M	✣✣	✲	○	L	
Lantana	4-6	M	✣✣	✻	○	L	
Lavender	24	F	✣✣	✲	○	L	
Lisianthus	24	F	✣✣	✻	○	L	
Marigold	24	F	✣✣		○	L	
Periwinkle	10-18	M	✣✣	✻	○	L	
Portulaca	18	F	✣✣	✻	○	M	
Primrose	6-12	M	✣		◗	M	
Spider Wort	24	M	✣		◗	L	✪
Tickweed	36	F	✣	✲	○	L	✪
Vervain	12-24	M	✣✣	✲	◗ - ○	L	✪

VINES

Common Name	Invasive Plant	Growth Rate	Drought Tolerance	Salt Tolerance	Plant Type	Light Requirements	Nutritional Requirements	Native
Coral Vine	Y	F	✤✤		T,E	○	L	
Creeping Fig	Y	F	✤✤	*	AR,E	◗ - ○	L	
Dwarf Confederate Jasmine	Y	F	✤	*	E	◗ - ○	L,M	
Grapevine	Y	F	✤✤	**	A,R,D	◗ - ○	L	❂
Heralds Trumpet	N	F	✤		TW,E	◗ - ○	M	
Honeysuckle, Japanese	Y	F	✤✤		AR,E	○	L	
Japanese Clematis	N	M	✤		TW,D	○	M	
Jasmine, Dowdy		M	✤		E	◗ - ○	M	
Jasmine, Primrose	Y	M	✤		E	○	M	
Jasmine, Shining	Y	M	✤		E	◗ - ○	M	
Jasmine, Wax	Y	M	✤	*	E	○	M	
Marine Ivy	N	F	✤✤	*	T,D	◗ - ○	L	❂
Morning Glory		F	✤✤	*		○	M	❂
Sicklethorn Vine	N	M	✤✤		S,E	◗ - ○	M	
Trumpet Creeper	Y	F	✤✤		AR,D	◗ - ○	L	❂
Virginia Creeper	Y	F	✤✤		T,D	◗ - ○	L	❂
Wisteria Family	Y	F	✤✤			◗ - ○	L	
Woolly Morning Glory	Y	F	✤		TW,E	○	M	

GROUND COVERS

Common Name	Natural Height Inches	Growth Rate	Drought Tolerance	Salt Tolerance	Plant Type	Light Requirements	Nutritional Requirements	Native
Algerian Ivy	8-12	F	✤	✻	W	◗ - ○	M	
Aloe	12	M	✤✤	✻	H	◗ - ○	L	
Asparagus Fern	12-18	M	✤✤	✲	H	● - ◗ - ○	L	
Beach Bean	6-12	F	✤✤	✻	H	○	L	❂
Beach Panicgrass	12	F	✤✤	✻	H	○	L	❂
Beach Peanut	6	M	✤✤	✻	H	○	L	❂
Blanket Flower	6-12	F	✤✤	✻	H	○	L	❂
Chinese Juniper	1-8	M	✤✤	✲	E	○	L	
Coontie	12-36	S	✤✤	✻	W	◗ - ○	L	❂
Day Lily	12-36	M	✤✤	✻	H	○	M	❂
Dichondra	1-3	M	✤	✲	H	● - ◗	M	
Dwarf Yaupon Holly	24-72	M	✤✤	✻	E	◗ - ○	M	❂
Dwarf Lantana	8	M	✤✤	✲	H	○	L	❂
Fig, Creeping	10-12	F	✤✤	✲	W	◗ - ○	M	
Golden Creeper	12-36	M	✤✤	✻	W	○	L	❂
Gopher Apple	4-8	M	✤✤	✻	H	◗ - ○	L	❂
English Ivy	4-12	M	✤	✻	E	◗	L	
Liriope	12	M	✤✤	✲	H	◗	M	

Common Name	Natural Height Inches	Growth Rate	Drought Tolerance	Salt Tolerance	Plant Type	Light Requirements	Nutritional Requirements	Native
GROUND COVERS								
Matchweed	3	F	✣✣	✻	H	○	L	❂
Mexican Bluebell	18-24	M	✣✣	✻	H	◗ - ○	M	❂
Mondo Grass	6-12	M	✣	✻	H	● - ◗	M	
Oyster Plant	12-24	F	✣✣	✻	H	◗ - ○	M	
Pineland Snowberry	24-36	S	✣✣		W	○	L	❂
Saltmeadow Cord Grass	12-24	F	✣✣	✻	H	○	L	❂
Sea Oats	36-72	M	✣✣	✻	H	○	L	❂
Sea Oxeye Daisy	12-24	F	✣✣	✻	H	○	L	❂
Sea Purslane	12-18	M	✣✣	✻	H	○	L	❂
Seashore Elder	12-24	M	✣✣	✻	H	○	L	❂
Wandering Jew	4-10	F	✣		H	● - ◗	M	
Wild Allamanda	12-24	M	✣✣	✻	W	○	M	❂
Wedelia	6-8	F	✣✣	✻	H	○	L	

SHRUBS

Common Name	Natural Height Feet	Growth Rate	Drought Tolerance	Salt Tolerance	Plant Type	Light Requirements	Nutritional Requirements	Native
Acacia, Sweet	8-10	M	✤	✲		○	M	❂
American Holly	30-45	M	✤✤	✲		◗ - ○	M	❂
Bay Cedar	15-20	S	✤✤	✻		○	L	❂
Beauty Berry	3-5	M	✤✤	✲		◗ - ○	L	❂
Bottlebrush	8-15	M	✤✤	✲		○	L	
Bougainvillea	6-12	M	✤✤	✻		○	L	
Boxthorn	3-4	S	✤✤	✻		○	L	
Butterfly Bush	10-20	M	✤	✲		○	M	
Cactus Family	2-6	S	✤✤	✲		○	L	❂
Cape Honeysuckle	6-8	F	✤	✲		○	M	
Cardboard Palm	2-3	S	✤✤	✻		○	L	
Cat's Claw	10-20	M	✤✤	✻		○	L	❂
Chaste Tree	10-15	M	✤	✻		○	M	
Christmas Berry	6-8	M	✤✤	✻		◗ - ○	L	❂
Coral Bean	3-5	M	✤✤	✲		◗ - ○	L	❂
Crape Myrtle	12-15	M	✤			○	M	
Croton	4-6	M	✤✤	✲		◗ - ○	L	
Fatsia	3-4	S	✤	✲		◗	M	

Common Name	Natural Height Feet	Growth Rate	Drought Tolerance	Salt Tolerance	Plant Type	Light Requirements	Nutritional Requirements	Native
SHRUBS								
Fiddlewood	6-8	M	✣✣	✻		○	L	❂
Florida Privet	6-8	M	✣✣	✻		○	L	❂
Gallberry	6-10	S	✣	✲		◗ - ○	L	❂
India Hawthorn	4-5	M	✣✣	✻		○	M	
Inkberry	1-6	S	✣✣	✻		○	L	❂
Ixora	3-8	M	✣	✲		○	H	
Jaboticoba	10-12	S	✣	✲		○	M	
Juniper, Shore	1-2	M	✣✣	✻		○	L	
Kumquat	12-15	M	✣✣	✻		○	H	
Lantana, Trailing	2	M	✣✣	✻		○	L	
Ligustrum	6-8	S	✣✣	✲		○	M	
Limeberry	2-15	S	✣✣	✲		○	M	
Myrtle, True	8-10	M				○	M	
Natal Plum	5-8	S	✣✣	✻		◗ - ○	M	
Necklace Pod	6-10	M	✣	✻		○	L	❂
Oleander	12-15	M	✣✣	✻		○	L	
Oriental Arborvitae	15-20	M	✣			○	H	
Palmetto Dwarf	5-7	S	✣✣	✻		○	L	❂

Common Name	Natural Height Feet	Growth Rate	Drought Tolerance	Salt Tolerance	Plant Type	Light Requirements	Nutritional Requirements	Native
SHRUBS								
Palmetto, Saw	6-15	S	✤✤	✻		◗ - ○	L	❂
Palmetto, Scrub	3-4	S	✤✤	✲		◗ - ○	L	❂
Pampas Grass	5-8	M	✤			◗	L	
Philodendron, Tree	6-10	F	✤			●-◗-○	M	
Pineapple Guava	8-10	M	✤✤	✲		●	M	
Pittosporum	2-10	S	✤	✻		◗ - ○	M	
Podocarpus, Nagi	8-35	M	✤	✲		◗ - ○	M	
Podocarpus, Weeping	10-20	M	✤	✲		◗ - ○	M	
Podocarpus, Yew	5-12	M	✤✤	✲		●-◗-○	L	
Ponytail Palm	5-15	S	✤✤	✲		○	L	
Red Firethorn	8-12	M	✤	✲		○	M	
Red Top	6-8	M	✤✤	✲		○	M,H	❂
Rosemary	4-5	M	✤✤	✻		○	L	❂
Rosemary, Victorian	4-6	M	✤✤	✲		○	M	
Scarletbush	5-6	M	✤✤	✻		○	M	❂
Sea Grape	12-15	M	✤✤	✻		○	L	❂
Sea Lavender	4-6	S	✤✤	✻		○	L	❂
Silver Buttonwood	15-20	S	✤✤	✻		○	L	❂

Common Name	Natural Height Feet	Growth Rate	Drought Tolerance	Salt Tolerance	Plant Type	Light Requirements	Nutritional Requirements	Native
SHRUBS								
Silverthorn	15-20	M	✤✤			●-◗	M	
Slender Buckthorn	20-30	M	✤	*		○	L	❂
Snowberry	6-9	M	✤✤	*		○	L	❂
Spanish Bayonet	4-10	M	✤✤	*		○	L	❂
Texas Sage	5-6	S	✤✤	*		○	L	
Viburnum Family	6-20	M	✤			◗ - ○	M	❂
Wax Myrtle	15-25	F	✤	*		◗	M	❂
White Indigo Berry	6-10	S	✤	*		○	L	❂
Yaupon Holly	2-8	M	✤✤	*		◗ - ○	M	❂

TREES

Common Name	Natural Height Feet	Growth Rate	Drought Tolerance	Salt Tolerance	Plant Type	Light Requirements	Nutritional Requirements	Native
Cabbage Palm	45-70	S	✤✤	✲		○	L	✪
Cattley Guava	15-25	M	✤✤			◗-○	M	
Chickasaw Plum	10	M	✤✤	✲		◗-○	L	✪
Chinaberry	50-60	F	✤✤	✲		○	L	
Chinese Fan Palm	20-30	S	✤✤			◗ - ○	M	
Cliff Date	25-30	S	✤	✲		○	M	
Copperpod	40-50	F	✤✤	✲		○	M	
Dahoon Holly	25-40	M	✤	✲		○	L	✪
Desert Fan Palm	40-60	M	✤✤	✲		○	M	
Dogwood	15-30	S	✤✤			○	M	✪
Dragon Tree	40-60	S	✤✤	✲		○	M	
Elm, American	80-100	F	✤			○	M	✪
Eucalyptus	30-50	F	✤✤			○	L	
Guava	20-30	M	✤			○	M	
Gumbo Limbo	20-60	F	✤✤	✲		◗ - ○	L	✪
Jacaranda	40-50	M	✤✤			○	M	
Jerusalem Thorn	20-30	F	✤✤	✲		○	L	
Hercules-Club	12-20	M	✤✤	✲		◗-○	L	✪

TREES

Common Name	Natural Height Feet	Growth Rate	Drought Tolerance	Salt Tolerance	Plant Type	Light Requirements	Nutritional Requirements	Native
Longleaf Pine	80-100	M	✣✣			○	L	❂
Loquat	15-20	F	✣✣	✲		○	L	
Mimosa	30-40	F	✣✣	✲		○	M	
Myrsine	10-20	M	✣✣	✲		◗ - ○	L	
Oak, Bluejack	20-30	S	✣✣	✲		○	L	❂
Oak, Chapman	30-45	S	✣✣	✲		○	L	❂
Oak, Laurel	60-100	F	✣✣			○	L	❂
Oak, Live	50-60	M	✣✣	✲		○	L	❂
Oak, Myrtle	10-25	S	✣✣	✲		○	L	❂
Oak, Sand Live	10-30	S	✣✣	✲		◗ - ○	L	❂
Oak, Shumard Red	80-100	M	✣✣			○	L	
Oak, Turkey	40-50	S	✣✣			○	L	❂
Orange Jasmine	10-20	S	✣✣			◗ - ○	M	
Orchid Tree	20-30	F	✣✣			○	M	
Pignut Hickory	80-120	F	✣✣			○	L	❂
Pindo Palm	10-20	S	✣✣	✲		◗-○	M	
Queen Palm	40-45	M	✣			◗-○	M	
Red Bay	50-60	M	✣✣	✲		○	L	❂

Common Name	Natural Height Feet	Growth Rate	Drought Tolerance	Salt Tolerance	Plant Type	Light Requirements	Nutritional Requirements	Native
TREES								
Red Mulberry	30-45	F	✤✤			○	L	
Redbud	20-30	M	✤✤			○	M	❂
Sand Pine	60-80	S	✤✤	✻		○	L	❂
Simpsons Stopper	10-20	M	✤✤	✻		◗ - ○	L	❂
Slash Pine, S. Fl.	80-100	F	✤✤	✲		○	L	❂
Soapberry	35-45	M	✤✤	✻		○	L	❂
Southern Magnolia	60-100	M	✤✤	✻		○	M	❂
Southern Red Cedar	20-40	M	✤✤	✲		◗ - ○	L	❂
Sugar Berry (Hackberry)	40-60	M	✤✤			○	H	❂
Sweetgum	60-100	F	✤✤			○	L	❂
Tabebuia, Golden	35-40	M	✤✤	✲		○	M	
Tabebuia, Purple	15-20	S	✤✤	✲		○	M	
Tough Bumelia	10-20	M	✤✤	✻		◗ - ○	L	❂
Washington Palm	50-80	F	✤✤	✲		○	M	
Wild Date Palm	40-60	S	✤✤	✲		○	M	
Wild Lime	20-30	M	✤✤	✻		○	L	❂
Wild Cinnamon	20-35	S	✤✤	✲		○	L	❂

Plant It Smart!

The plants listed in this guide are all good XERISCAPE plants. Many other plants not listed also may fit your XERISCAPE design. Before choosing the flowers, shrubs, ground covers, vines, trees or grasses you'll use, consider the varied temperature and soil ranges within the 19-county District. For example, plants that grow easily in the southern counties of the District may not thrive in northern areas. Similarly, warm air near water bodies may allow succulents or citrus to thrive where they couldn't survive a few miles inland.

Carefully consider the climate in your yard. Then contact a local nursery or county cooperative extension office to determine both availability and suitability of the plants you choose. Plan to plant it smart!

For Your Information *we have compiled this list of sources and references to help you develop a successful* XERISCAPE.

ASSOCIATION OF FLORIDA NATIVE NURSERIES
P.O. Box 1045
San Antonio, FL 33576
Phone: **(904) 588-3687**

FLORIDA NURSERYMEN AND GROWERS ASSOCIATION
5401 Kirkman Road, Suite 650
Orlando, FL 32819
Phone: **(407) 345-8137**

NATIONAL XERISCAPE COUNCIL, INC.
P.O. Box 163172
Austin, Texas 78716-3172
Phone: **(512) 392-6225**

COUNTY COOPERATIVE EXTENSION OFFICES
serving the St. Johns River Water Management District

Alachua County Extension Service
2800 N.E. 39th Ave.
Gainesville, FL 32609-2658
Phone: **(904) 336-2402**

Baker County Extension Service
Route 3 Box 1074-B
Macclenny, FL 32063-9640
Phone: **(904) 259-3520**

Bradford County Extension Service
P.O. Box 1028
Starke, FL 32091-1028
Phone: **(904) 964-6280 Ext. 204**

Brevard County Extension Service
3695 Lake Drive
Cocoa, FL 32926-8699
Phone: **(407) 633-1702**

Clay County Extension Service
2463 State Road 16 West
Green Cove Springs, FL 32043-0278
Phone: **(904) 269-6355 or (904) 284-6355**

Duval County Extension Service
1010 N. McDuff Avenue
Jacksonville, FL 32205-2083
Phone: **(904) 387-8850**

Flagler County Extension Service
P.O. Box 308
Bunnell, FL 32110-0308
Phone: **(904) 437-3122**

Indian River County Extension Service
2001 9th Ave., Suite 303
Vero Beach, FL 32960-6414
Phone: **(407) 770-5030**

Lake County Extension Service
30205 State Road 19
Tavares, FL 32778-4052
Phone: **(904) 343-4101**

Marion County Extension Service
2232 N.E. Jacksonville Road
Ocala, FL 32670-3615
Phone: **(904) 620-3440**

Nassau County Extension Service
P.O. Box 1550
Callahan, FL 32011-1550
Phone: **(904) 879-1019**

Okeechobee County Extension Service
501 N.W. 5th Ave.
Okeechobee, FL 33472-2573
Phone: **(813) 763-6469**

Orange County Extension Service
2350 E. Michigan St.
Orlando, FL 32806-4996
Phone: **(407) 836-7570**

Osceola County Extension Service
1901 E. Irlo Bronson Hwy.
Kissimmee, FL 34744
Phone: **(407) 846-4181**

Polk County Extension Service
1702 Highway 17-98 South
Bartow, FL 33830-6694
Phone: **(813) 533-0765**

Putnam County Extension Service
20 Yelvington Road, Suite 1
East Palatka, FL 32031-8875
Phone: **(904) 329-0318**

St. Johns County Extension Service
3125 Agriculture Center Drive
St. Augustine, FL 32084-0270
Phone: **(904) 824-4564**

Seminole County Extension Service
250 West County Home Road
Sanford, FL 32773-6197
Phone: **(904) 323-2500 Ext. 5551**

Volusia County Extension Service
3100 E. State Road 44
DeLand, FL 32724-6497
Phone: **(904) 736-0624**

For more information, contact the St. Johns River Water Management District's Division of Public Information and ask for our XERISCAPE fact sheets. Or contact your county cooperative extension office for circulars on water saving information published by the Institute of Food and Agricultural Sciences (IFAS). Availability of this information varies from county to county. Examples of these fact sheets include:

- *Basic Principles of Landscape Design*, Circular 536
- *Conserving Water in the Home Landscape*, WRC-11
- *Coping with Drought in the Landscape*, OH-70
- *Drought Tolerant Plants from North and Central Florida*, Circ. 807
- *Landscaping to Conserve Energy: Trees for North Florida*, EES-40
- *Landscaping to Conserve Energy: Microclimatic Modification*, EES-43
- *Landscape Design for Water Conservation*, OH-72
- *Preparing Your Lawn for Drought*, OH-57
- *Watering Your Florida Lawn*, OH-9

The Institute of Food and Agricultural Sciences (IFAS) at the University of Florida is a statewide organization dedicated to teaching, research and extension services. Through its faculty at research and education centers, and 67 county extension offices in Florida, IFAS works to enhance the quality of life in the state.

Glossary

Annuals - Plants whose entire life lasts one year or growing season.

Deciduous - Plants whose foliage falls off in autumn or winter.

Evergreen - Plants whose leaves remain green all year.

Herbaceous - Green leafy plants with little or no woody tissue.

Invasive plants - Plants that are capable of displacing established plants by taking available water, nutrients and sunlight.

Mowing frequency - Time in days between lawn cuttings.

Native plants - Plants that grow naturally in Florida and have adapted to the climate, soil, location and rainfall patterns of their area.

Nutritional needs - Supplemental nourishment that plants must have to grow or thrive.

Perennials - Plants that live through several growing seasons.

Practical turf area - A place where grass serves a purpose, such as children's play areas.

Wear tolerance - Stamina and resilience of grass.

Woody - Plants that contain wood.

Plant It Smart !

This XERISCAPE plant guide was produced
by the Division of Public Information,
St. Johns River Water Management District
to inform the public of landscape methods
that support water conservation.
We welcome your comments.
For additional copies of this guide, please contact the
St. Johns River Water Management District
Division of Public Information
P.O. Box 1429, Palatka, FL 32178-1429
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Special Thanks and Acknowledgments to:
Dave Baggett, Division of Environmental Sciences,
St. Johns River Water Management District

Palmer Kinser, Division of Environmental Sciences,
St. Johns River Water Management District

Dr. Bob Black, University of Florida,
Institute of Food and Agricultural Sciences (IFAS)

Noel Lake, American Society of Landscape Architects (ASLA)

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South Brevard Water Authority

Southwest Florida Water Management District

Plant It Smart !

St. Johns River
Water
Management
District

St. Johns River Water Management District
P.O. Box 1429, Palatka, FL 32178-1429 Phone: (904) 329-4540

HOME LAWN Irrigation

Written by Alys A. Brockway and Linda B. Landrum ▪ Produced by IFAS and the St. Johns River Water Management District

Home lawn irrigation is often necessary due to Florida's climate. An easy and efficient watering program can be established by deciding when to water, how much water to apply and how the water will be applied.

WHEN DO I IRRIGATE?

Two ways to determine when to water your lawn are 1) visual inspection and 2) direct measurement of soil moisture.

Visual inspection — The most efficient way to water your lawn is to irrigate when it shows signs of stress from a lack of water. Visual signs of water stress include the lawn turning a bluish-gray color; footprints lingering after being made; leaf blades folding in half; and/or soil from the rootzone feeling dry.

Direct measurement of soil moisture — One way to measure soil moisture is with a soil moisture sensor. There are sophisticated sensors which will activate your irrigation system when water is needed. The more basic soil moisture sensors turn off your irrigation system when water is adequate.

General Lawn Irrigation Guide

An irrigation schedule may vary because it depends upon the time of year, the type of soil you have and your location. For example: Are you in North or South Florida? Is your lawn oceanside or is it under an inland oak hammock?

Considering these factors, the following table is a GENERAL guide to lawn watering:

Your Lawn Needs Rain or Irrigation:

Jan:	Once every 10 - 14	days	July:	Once every 3 - 5	days
Feb:	Once every 7 - 10	days	Aug:	Once every 3 - 5	days
Mar:	Once every 5 - 7	days	Sept:	Once every 5 - 7	days
Apr:	Once every 3 - 5	days	Oct:	Once every 5 - 7	days
May:	Once every 3 - 5	days	Nov:	Once every 7 - 14	days
June:	Once every 3 - 5	days	Dec:	Once every 7 - 14	days

Also, you must adjust your irrigation schedule to account for rainfall. Do not rely on one rigid irrigation schedule.

HOW MUCH WATER SHOULD I APPLY?

A single standard measurement to fit every situation is difficult because of different soil types. However, for most Florida soils, an average of 2/3 to 3/4 of an inch of water per application is sufficient to replenish the grass' water needs. Apply only enough water to wet the grass' root system. Do not saturate the soil so fast that runoff occurs.

You have several options to help determine how much water

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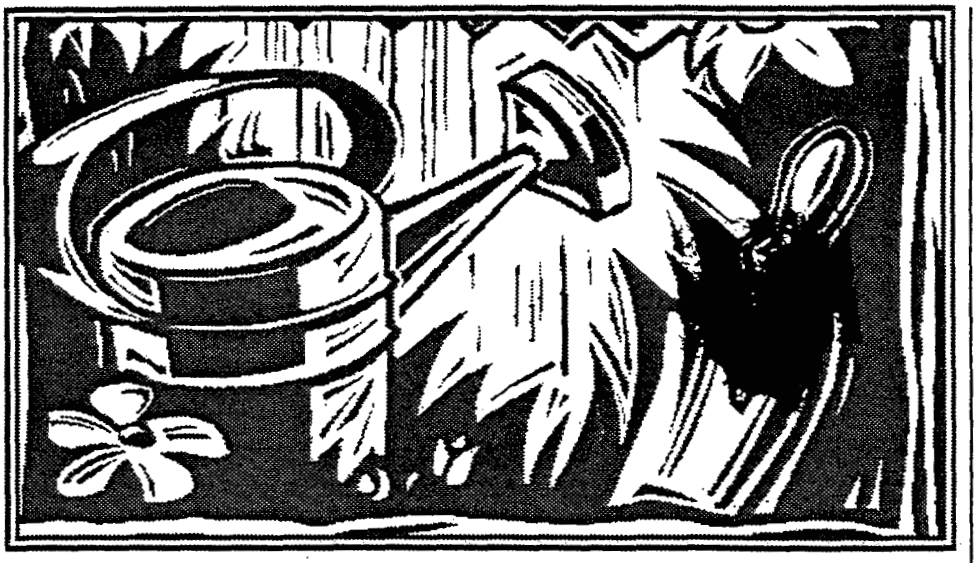
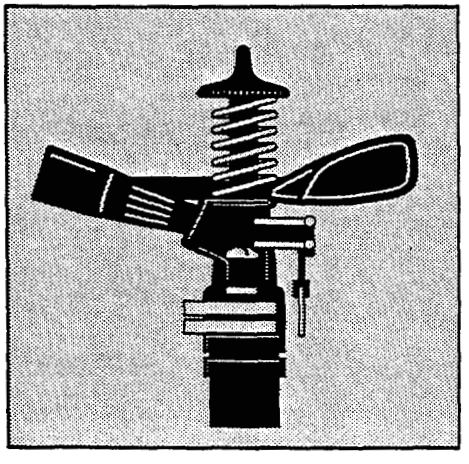


to apply to your lawn. Choose the one best suited for your yard. You may:

- Use a water meter which is permanently installed in the irrigation line. This will indicate the number of gallons applied per minute, allowing you to accurately determine the number of minutes necessary to apply the correct volume.
- Use a rain shut off device on your automatic timed sprinkler system. This device overrides a sprinkler system in the event of a specific amount of rain. It also resets the sprinkler system for normal operation when the turf requires more water.
- Use a soil moisture sensor. The sophisticated sensors will activate your irrigation system when water is needed. The more basic soil moisture sensors turn off your irrigation system when water is adequate.



- Use the in-place measurement of watering by the "can method." Place five to seven wide-mouthed, flat-bottom cans on diagonals throughout the irrigated area. Water for 15 minutes, then measure the depth of water in each can. Average the measurements and use this to determine how long you need to irrigate to apply 2/3 to 3/4 of an inch of water.

WHICH IRRIGATION METHOD SHOULD I CHOOSE?

- A hose-and-sprinkler system. Place the sprinkler in the area which is driest. (Avoid placing the sprinkler in low or wet areas.) Allow the calibrated sprinkler to run the proper length of time to wet the [illegible] with 2/3 to 3/4 of an [illegible]ter. When that [illegible]ove the sprinkler to a[illegible] dry area. Place your sprinkler to allow overlap between areas: ideally, the spray from one sprinkler should reach adjacent sprinklers to assure this overlap.
- Underground irrigation system. An irrigation system can be automatic, manual or a combination of both. Manual systems rely on you to turn them on when your turf needs supplemental irrigation. The automatic system is set for a pre-determined time of day and day(s) of the week.

Regardless of which system you choose, uniformity of application is essential. If in doubt about this, seek the help of a competent lawn professional.

Additional Watering Tips

- Water early in the morning. This reduces evaporation by the hot sun and takes advantage of less wind. Also, watering early reduces the potential for disease development.
- Do not mow the lawn too short. This puts additional water stress on the grass. Most St. Augustine and Bahia grasses should be mowed to a minimum height of three inches.
- Avoid over-fertilization. This requires more watering and mowing.
- Inspect your sprinkler system frequently. Look for breaks, a uniform spray pattern and proper timing.

For more technical information on this subject, request extension bulletin, "Turf Irrigation for the Home," by F.S. Zazueta, A. Brockway, L. Landrum and B. McCarty. This document is available at most county cooperative extension service offices.

SJR St. Johns River Water Management District

IFAS UNIVERSITY OF FLORIDA

XERISCAPE™

Any landscape plan should begin with the seven fundamentals of Xeriscape:

1. PLANNING AND DESIGN

Whether you plan your own design or call on a landscape professional this is the most important step for successful Xeriscape. Regional landscape requirements and existing vegetation must also be considered. A good Xeriscape plan can help minimize initial costs by enabling phased installation.

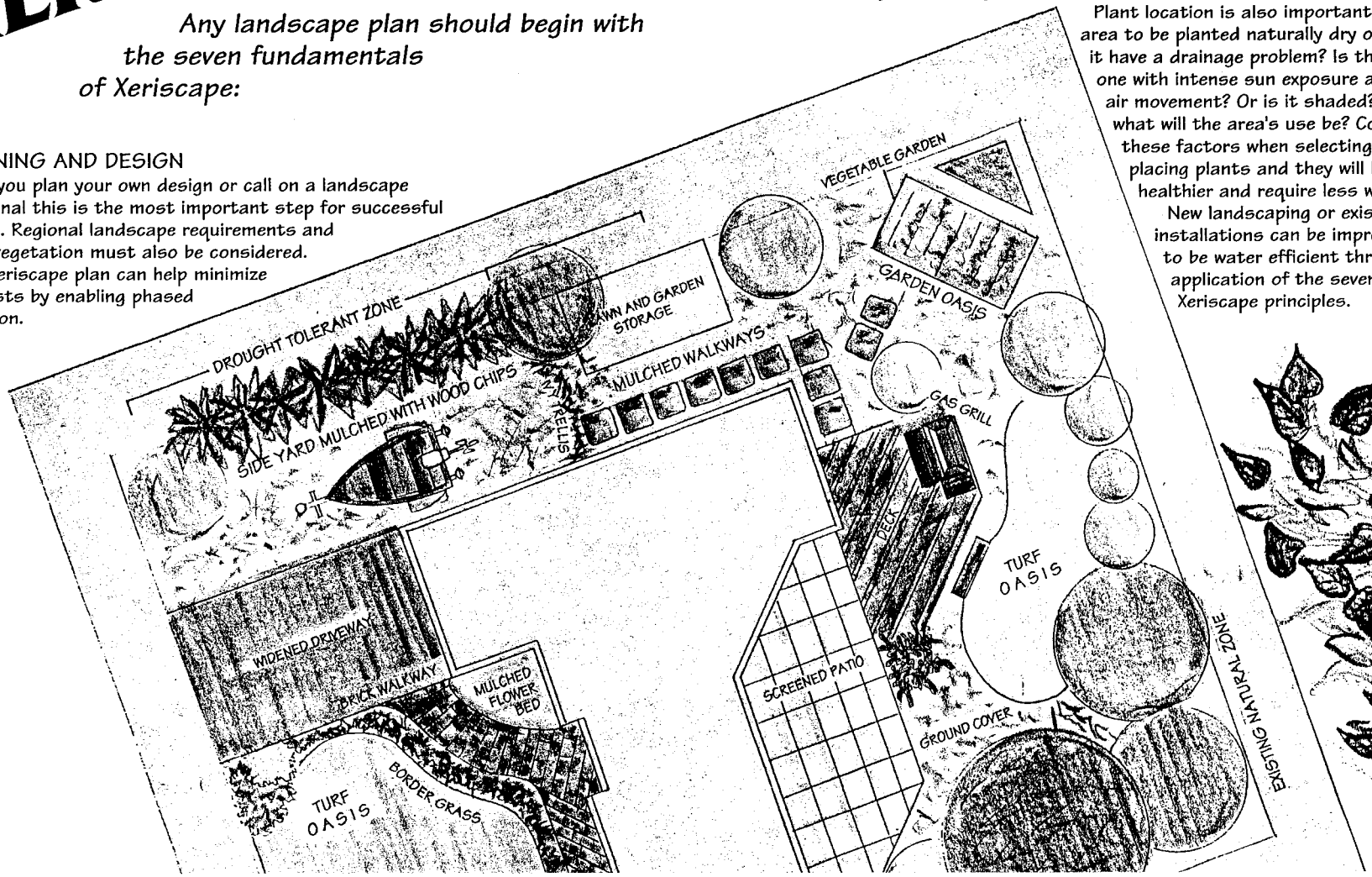
What is Xeriscape?

Xeriscape means water conservation through creative landscaping. While the concept originated in the arid southwest, Xeriscape in Florida does not mean dry landscapes dotted with cactus.

Proper plant selection, efficient irrigation, mulching and appropriate maintenance can mean lush gardens that not only save water, but also can ultimately save money and time as well.

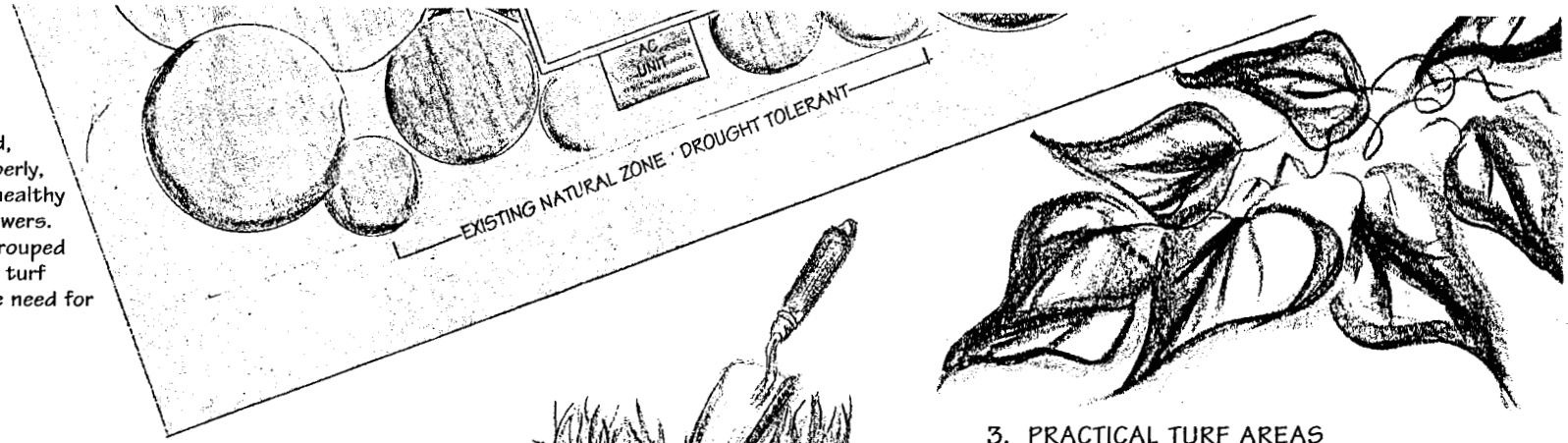
Plant location is also important. Is the area to be planted naturally dry or does it have a drainage problem? Is the area one with intense sun exposure and little air movement? Or is it shaded? And what will the area's use be? Consider these factors when selecting and placing plants and they will be healthier and require less water.

New landscaping or existing installations can be improved to be water efficient through application of the seven Xeriscape principles.



2. EFFICIENT IRRIGATION

Sprinkler systems or drip irrigation systems, if designed, operated and maintained properly, can save water and promote healthy turf and trees, shrubs and flowers. Landscape plantings can be grouped according to water needs and turf areas minimized to reduce the need for irrigation.



3. PRACTICAL TURF AREAS

Turf is a big user of water and should be located only in areas where it is necessary. Turf should also be separated from trees, ground covers, flowering plants and shrubs so that it can be watered separately. Consider replacing some turf with mulched areas, ground covers or other low-water users.

4. SOIL IMPROVEMENTS

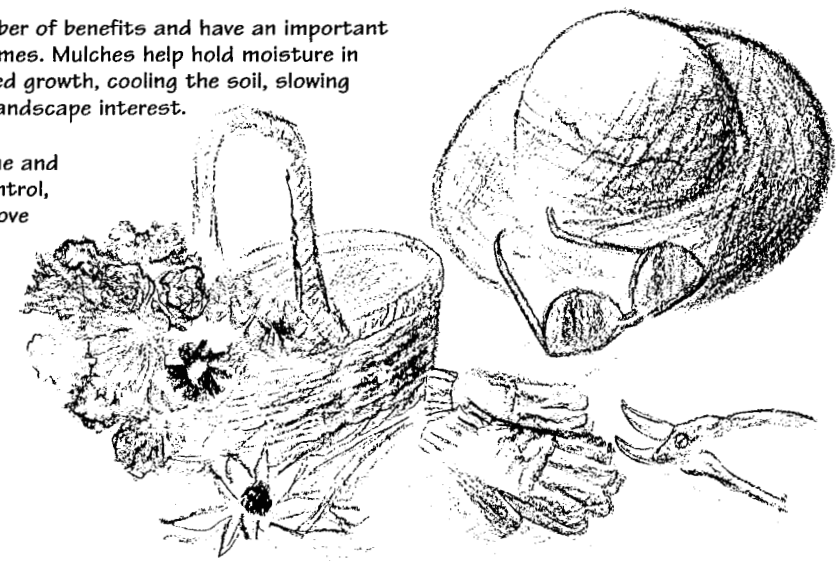
Analysis of soils can determine if and what kinds of soil amendments should be added to help improve water absorption and water-holding qualities of the soil. In addition to providing these benefits, organic matter added to soils can boost the nutrient content of the soil.

5. USE MULCHES

Mulches provide a number of benefits and have an important place in Xeriscape schemes. Mulches help hold moisture in soils while reducing weed growth, cooling the soil, slowing erosion and providing landscape interest.

6. APPROPRIATE MAINTENANCE

Xeriscape landscapes, by their nature, reduce maintenance time and costs. However, limited fertilization, pruning, weeding, pest control, proper mowing and proper use of irrigation systems help improve the efficiency of Xeriscape.



7. USE LOW-WATER PLANTS

Healthy and well-adapted plants that are drought-tolerant are necessary for successful Xeriscape. Drought-tolerant turf is also available. Although not necessary to a Xeriscape plan, native plants are good choices because they often are drought and pest resistant. Putting the right plant in the right place is just as important as plant selection. Take growth rates, mature size, water requirements and availability and temperature tolerances into consideration when selecting plants for certain locations.

xeriscape™ plant list

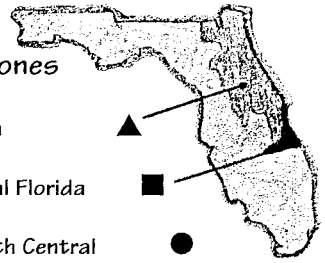
What plants should I use?

Xeriscape often relies on native plants which have built-in abilities to endure heat, drought, diseases, salt exposure and pests. However, a well-designed and executed Xeriscape plan can be achieved with other plants as well. Plant selection will often rely on the overall look desired -- traditional, formal or informal -- as well as the intended uses of the planted areas.

KEY to the plant list

Salt Tolerant ✻

Native Plants ✪



Growing Zones

North Florida ▲

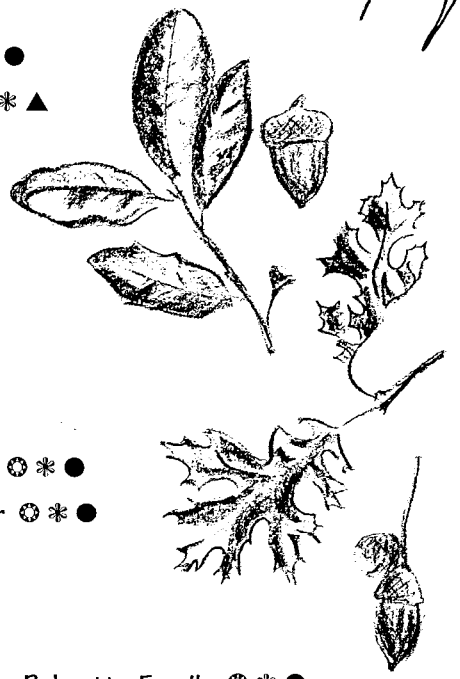
South Central Florida ■

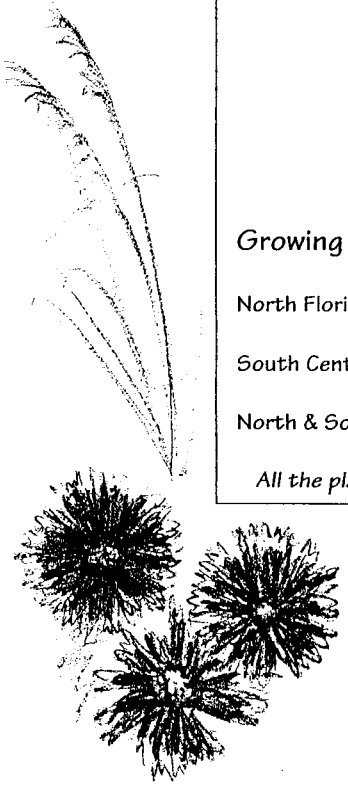
North & South Central ●

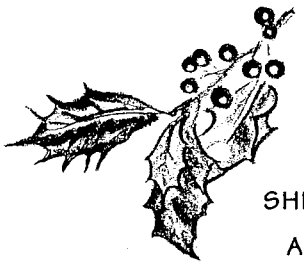
All the plants listed are drought tolerant

TREES

- Cabbage Palm ✪ ✻ ●
- Chickasaw Plum ✪ ✻ ▲
- Crape Myrtle ●
- Live Oak ✪ ✻ ●
- Orchid Tree ●
- Pindo Palm ✻ ●
- Redbud ✪ ●
- Sand Pine ✪ ✻ ●
- Shumard Oak ✪ ▲
- Southern Magnolia ✪ ✻ ●
- Southern Red Cedar ✪ ✻ ●







ANNUALS AND PERENNIALS

- Beach Sunflower ✪ ✻ ●
- Firewheel Daisy ✪ ✻ ●
- Geranium ✻ ●
- Lantana ✻ ●

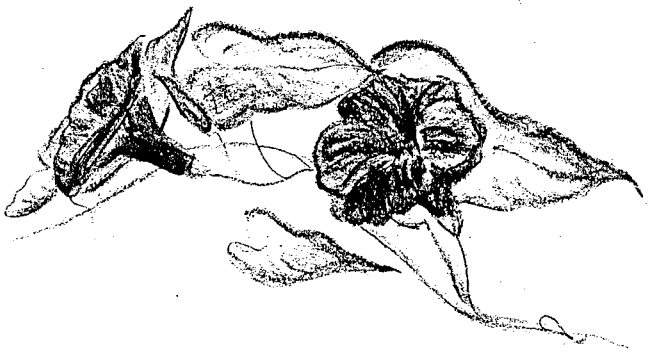
SHRUBS

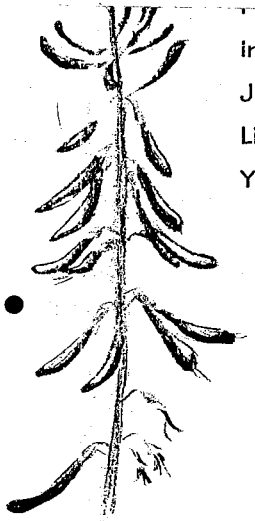
- American Holly ✪ ✻ ●
- Bay Cedar ✪ ✻ ■
- Beauty Berry ✪ ●
- Coral Bean ✪ ✻ ●
- Florida Anise ✪ ●
- Palmetto Family ✪ ✻ ●
- Pampas Grass ✻ ●
- Pineapple Guava ●
- Pittosporum ●
- Red Top ●

- Lantana ✻ ●
- Lisianthus ✻ ◒
- Marigold ●
- Periwinkle ✻ ●
- Portulaca ✻ ●
- Spider Wort ✪ ●

GROUND COVERS

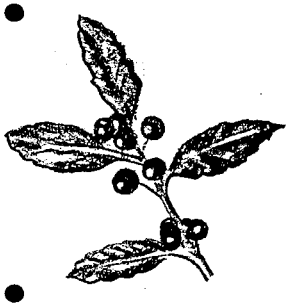
- Aloe ✻ ■
- Asparagus Fern ●
- Chinese Juniper ✻ ●
- Coontie ✪ ✻ ●
- Day Lily ●
- Dwarf Confederate Jasmine ●
- Dwarf Yaupon Holly ✪ ✻ ●
- English Ivy ✻ ●
- Liriope ●
- Mondo Grass ●
- Oyster Plant ✻ ■
- Sea Oats ✪ ✻ ●





- India Hawthorne ✻ ◒
- Junipers ✪ ✻ ●
- Ligustrum ✻ ●
- Yucca ✪ ✻ ●

- Viburnum Family ◒
- Wax Myrtle ✪ ✻ ●
- Yaupon ✪ ✻ ●

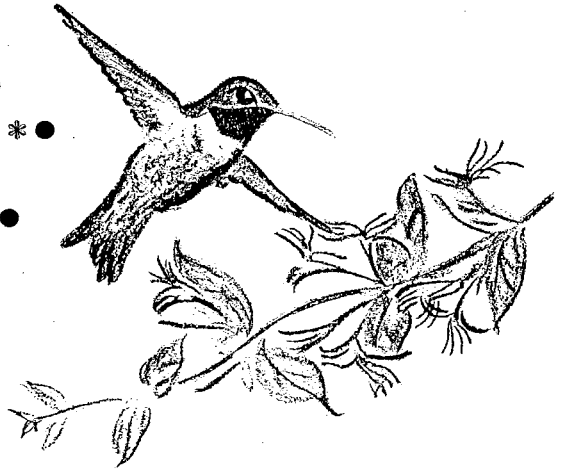


LAWN GRASSES

- Bahia Grass ●
- Bermuda Grass ✻ ●
- Centipede Grass ●
- St. Augustine Grass ✻ ●
- Zoysia Grass ✻ ●

VINES

- Grapevine Family ✪ ●
- Honeysuckle Family ✪ ✻ ●
- Jasmines ■
- Morning Glory Family ●
- Trumpet Creeper ✪ ●
- Wisteria ●



Where can I get help?

Help is available from a variety of sources. One of the best places to start is with your county extension agent or county horticulturist. These offices can offer soil testing services as well as help in making your Xeriscape plan work.

Many nurseries, plant centers and landscape architects are knowledgeable on the subject of Xeriscaping. The National Xeriscape Council, Inc., P.O. Box 163172, Austin, Texas 78716-3172, can supply information.

SJR St. Johns River Water Management District

Produced by the St. Johns River Water Management District, Division of Public Information.
Special thanks to: Dr. Bob Black of the University of Florida and Noel Lake, ASLA.
This document was printed to provide the public with information on landscaping for water conservation.
Inquiries, comments or suggestions are welcomed and should be addressed to the Division of Public Information,
St. Johns River Water Management District, P.O. Box 1429, Palatka, Florida 32178-1429 Phone: (904) 329-4540

F. INDIVID. SYSTEMS

ARLINGTON SYSTEM

(C.U.P. # 2-031-0028)

This audit of the Arlington system covers 1993, and water production records for this period are shown in Attachment 4. This system contains 5,895 residential connections (approximately 20,633 persons), with 443 general service connections. Arlington is a grid system served by four WTPs located at Alderman Park, Columbine, Lake Lucina, and University Park. Each WTP is described below.

Alderman Park WTP

The discharge from this WTP is monitored by an 8" Badger Production Meter. The average daily flow for this audit period is 672,000 gallons, with a maximum day of 987,000 gallons on August 21, 1993. June 1993 was the peak month. Water is supplied by two wells: both wells are 8" diameter, 1,150' deep, and are cased to a depth of 466'.

Columbine WTP

The discharge from this WTP is monitored by an 8" Badger Production Meter. The average daily flow for this audit period is 599,000 gallons, with a maximum day of 1,257,000 gallons on August 9, 1993. May 1993 was the peak month. Water is supplied by an 8" diameter, 1,203' deep well which is cased to a depth of 674'.

Lake Lucina WTP

The discharge from this WTP is monitored by a 10" Badger Production Meter. The average daily flow for this period is 823,000 gallons, with a maximum day of 1,163,000 gallons on June 21, 1993. August 1993 was the peak month. Water is supplied by an 8" diameter, 1,000' deep well which is cased to an unknown depth.

University Park WTP

The discharge from this WTP is monitored by an 8" Badger Production Meter. The average daily flow for this period is 396,000 gallons, with a maximum day of 626,000 gallons on June 8, 1993. May 1993 was the peak month. Water is supplied by an 8" diameter, 1,025' deep well which is cased to a depth of 604'.

Elvia WTP

This plant was placed in service on May 9, 1994. Therefore, no flow records are being presented for 1993. The discharge from this WTP is monitored by a 6" Rockwell Production Meter. Water is supplied by a 16" diameter, 1,301' deep well which is cased to an unknown depth.

This grid system is served by approximately 67.8 miles of galvanized steel, asbestos cement, cast iron, ductile iron, and PVC water mains, ranging in size from 1-1/2" to 12". The water distribution system was primarily installed in 1954, which ongoing additions and replacements as needed.

This audit shows an UFW volume of 79.7 MG during 1993, or 8% of the total production. The additional water conservation efforts described throughout this Plan will attempt to reduce the UFW even further. This system was part of the 1993 leak detection survey, and all leaks were repaired when found.

UFW figures do not include estimates for leaks, breaks, hydrant flushing, plant use, fire flows, or theft.

FOREST BROOK SYSTEM

(C.U.P. # 2-031-0040)

This audit of the Forest Brook system covers 1993, and water production records for this period are shown in Attachment 4. This system contains 183 residential connections (approximately 640 persons), with no general service connections.

The discharge from this WTP is monitored by a 4" Badger-Production Meter. The average daily flow for this audit period is 48,000 gallons, with a maximum day of 100,000 gallons on May 17, 1993. May 1993 was the peak month. Water is supplied by a 6" diameter, 672' deep well, which is cased to a depth of 286'.

This system is served by approximately 2.4 miles of galvanized steel, asbestos cement, cast iron, ductile iron, and PVC water mains, ranging in size from 2" to 8". The water distribution system was primarily installed in 1953, with ongoing additions and replacements as needed.

This audit shows no UFW during 1993.

UFW figures do not include estimates for leaks, breaks, hydrant flushing, plant use, fire flows, or theft.

HOLLY OAKS SYSTEM

(C.U.P. # 2-031-0015)

This audit of the Holly Oaks system covers 1993, and water production records for this period are shown in Attachment 4. This system contains 2,768 residential connections (approximately 9,688 persons), with 156 general service connections. Holly Oaks is a grid system serviced by three water treatment plants (WTPs) located at Holly Oaks, Monument Road, and Queen Akers. Each WTP is described below.

Holly Oaks WTP

The discharge from this WTP is monitored by a 4" Badger Production Meter. The average daily flow for this audit period is 75,000 gallons, with a maximum day of 450,000 gallons on January 27, 1993. January 1993 was the peak month. Water is supplied by a 6" diameter, 750' deep well which is cased to an unknown depth.

Due to sand intrusion in the well, we are proposing to abandon this WTP.

Monument Road WTP

The discharge from this WTP is monitored by a 12" Badger Production Meter. The average daily flow for this audit period is 824,000 gallons, with a maximum day of 1,588,000 gallons on June 11, 1993. June 1993 was the peak month. Water is supplied by a 20" diameter, 984' deep well which is cased to a depth of 595'.

Queen Akers WTP

The discharge from this WTP is monitored by a 6" Badger Production Meter. The average daily flow for this audit period is 190,000 gallons, with a maximum day of 421,000 on May 16, 1993. January 1993 was the peak month. Water is supplied by an 8" diameter, 752' deep well which is cased to a depth of 368'.

This grid system is served by approximately 36.7 miles of galvanized steel, asbestos cement, ductile iron, and PVC water mains, ranging in size from 2" to 12". The water distribution system was primarily installed in 1961, with ongoing additions and replacements as needed.

This audit shows an UFW volume of 55.0 MG during 1993, or 13% of the total production. The additional water conservation efforts described throughout this Plan will attempt to reduce the UFW to less than 10%.

UFW figures do not include estimates for leaks, breaks, hydrant flushing, plant use, fire flows, or theft.

HYDE GROVE SYSTEM

(C.U.P. # 2-031-0038)

This audit of the Hyde Grove system covers 1993, and water production records for this period are shown in Attachment 4. This system contains 343 residential connections (approximately 1,200 persons), with 4 general service connections.

The discharge from this WTP is monitored by a 4" Rockwell Production Meter. The average daily flow for this audit period is 130,000 gallons, with a maximum day of 269,000 gallons on June 13, 1993. June 1993 was the peak month. Water is supplied by an 8" diameter, 757' deep well, which is cased to a depth of 464'.

This system is served by approximately 4.3 miles of galvanized steel, asbestos cement, and PVC water mains, ranging in size from 2" to 8". The water distribution system was primarily installed in 1959, with ongoing additions and replacements as needed.

This audit shows an UFW volume of 8.8 MG during 1993, or 18% of the total production. The additional water conservation efforts described throughout this Plan will attempt to reduce the UFW to less than 10%. This system was part of the 1993 leak detection survey, and all leaks were repaired when found.

UFW figures do not include estimates for leaks, breaks, hydrant flushing, plant use, fire flows, or theft.

JACKSONVILLE HEIGHTS SYSTEM

(C.U.P. # 2-031-0034)

This audit of the Jax Heights system covers 1993, and water production records for this period are shown in Attachment 4. This system contains 3,290 residential connections (approximately 11,515 persons), with 252 general service connections. Jax Heights is a grid system served by three WTPs located at Green Forest, Oak Hill, and Wheat Road. Each WTP is described below.

Green Forest WTP

The discharge from this WTP is monitored by an 8" Badger Production Meter. The average daily flow for this audit period is 251,000 gallons, with a maximum day of 613,000 gallons on March 13, 1993. May 1993 was the peak month. Water is supplied by an 8" diameter, 1,149' deep well which is cased to a depth of 404'.

Oak Hill WTP

The discharge from this WTP is monitored by an 8" Badger Production Meter. The average daily flow for this audit period is 300,000 gallons, with a maximum day of 708,000 gallons on September 19, 1993. September 1993 was the peak month. Water is supplied by a 10" diameter, 1,304' deep well which is cased to a depth of 398'.

Wheat Road WTP

The discharge from this WTP is monitored by an 8" Rockwell Production Meter. The average daily flow for this period is 760,000 gallons, with a maximum day of 1,290,000 gallons on May 16, 1993. June 1993 was the peak month. Water is supplied by a 10" diameter, 1,130' deep well which is cased to a depth of 396'.

This grid system is served by approximately 43.6 miles of galvanized steel, asbestos cement, cast iron, ductile iron, and PVC water mains, ranging in size from 2" to 12". The water distribution system was primarily installed in 1955, which ongoing additions and replacements as needed.

This audit shows an UFW volume of 67.9 MG during 1993, or 14% of the total production. The additional water conservation efforts described throughout this Plan will attempt to reduce the UFW to less than 10%. This system was part of the 1994 leak detection survey, and all leaks were repaired when found.

UFW figures do not include estimates for leaks, breaks, hydrant flushing, plant use, fire flows, or theft.

LAKE FOREST SYSTEM

(C.U.P. # 2-031-0042)

This audit of the Lake Forest system covers 1993, and water production records for this period are shown in Attachment 4. This system contains 784 residential connections (approximately 2,744 persons), with 25 general service connections.

The discharge from this WTP is monitored by a 6" Badger Production Meter. The average daily flow for this audit period is 240,000 gallons, with a maximum day of 406,000 gallons on September 11, 1993. May 1993 was the peak month. Water is supplied by an 8" diameter, 1,160' deep well, which is cased to a depth of 520'.

This system is served by approximately 11.9 miles of galvanized steel, asbestos cement, cast iron, ductile iron, and polyethylene water mains, ranging in size from 2" to 8". The water distribution system was primarily installed in 1967, with ongoing additions and replacements as needed.

This audit shows an UFW volume of 26.7 MG during 1993, or 27% of the total production. The additional water conservation efforts described throughout this Plan will attempt to reduce the UFW to less than 10%. This system was part of the 1993 leak detection survey, and all leaks were repaired when found.

UFW figures do not include estimates for leaks, breaks, hydrant flushing, plant use, fire flows, or theft.

MAGNOLIA GARDENS SYSTEM

(C.U.P. # 2-031-0039)

This audit of the Magnolia Gardens system covers 1993, and water production records for this period are shown in Attachment 4. This system contains 682 residential connections (approximately 2,387 persons), with 18 general service connections.

The discharge from this WTP is monitored by a 6" Badger Production Meter. The average daily flow for this audit period is 169,000 gallons, with a maximum day of 257,000 gallons on May 19, 1993. May 1993 was the peak month. Water is supplied by an 8" diameter, 1,047' deep well, which is cased to a depth of 543'.

This system is served by approximately 8 miles of galvanized steel, asbestos cement, ductile iron, polyethylene, and PVC water mains, ranging in size from 1-1/2" to 8". The water distribution system was primarily installed in 1957, with ongoing additions and replacements as needed.

This audit shows an UFW volume of 10.3 MG during 1993, or 17% of the total production. The additional water conservation efforts described throughout this Plan will attempt to reduce the UFW to less than 10%. This system was part of the 1994 leak detection survey, and all leaks were repaired when found.

UFW figures do not include estimates for leaks, breaks, hydrant flushing, plant use, fire flows, or theft.

ORTEGA HILLS SYSTEM

(C.U.P. # 2-031-0025)

This audit of the Ortega Hills system covers 1993, and water production records for this period are shown in Attachment 4. This system contains 431 residential connections (approximately 1,509 persons), with 5 general service connections.

The discharge from this WTP is monitored by an 8" Hersey Production Meter. The average daily flow for this audit period is 114,000 gallons, with a maximum day of 190,000 gallons on June 6, 1993. May 1993 was the peak month. Water is supplied by an 8" diameter, 956' deep well which is cased to an unknown depth, and a 6" diameter, 800' deep well which is cased to an unknown depth.

This system is served by approximately 4.6 miles of asbestos cement and PVC water mains, ranging in size from 2" to 6". The water distribution system was primarily installed in 1953, with ongoing additions and replacements as needed.

This audit shows an UFW volume of 0.5 MG during 1993, or 1% of the total production. The additional water conservation efforts described throughout this Plan will attempt to reduce the UFW to less than 10%. This system was part of the 1994 leak detection survey, and all leaks were replaced when found.

UFW figures do not include estimates for leaks, breaks, hydrant flushing, plant use, fire flows, or theft.

PONCE de LEON SYSTEM

(C.U.P. # 2-109-0209)

This audit of the Ponce de Leon system covers 1993, and water production records for this period are shown in Attachment 4. This system contains 153 residential connections (approximately 563 persons) with 10 general service connections.

Ponce de Leon WTP

The discharge from this WTP is monitored by a 4" Rockwell Production Meter. The average daily flow for this audit period is 91,000 gallons, with a maximum day of 430,000 gallons on December 18, 1993. August 1993 was the peak month. Water is supplied by a 6" diameter, 400' deep well with an unknown casing depth, and a 10" diameter, 252' deep well which is cased to a depth of 237'.

This audit shows an UFW volume of 7.8 MG during 1993, or 34% of the total production. This is unacceptable; the additonal water conservation efforts described throughout this Plan will attempt to reduce the UFW to less than 10%. This system was part of the 1994 leak detection survey, and all leaks were repaired when found.

PONTE VEDRA SOUTH

(C.U.P. # 2-109-0110)

This audit of the Ponte Vedra South system covers 1993, and water production records for this period are shown in Attachment 4. This system contains 221 residential connections (approximately 774 persons) with no general service connections. Ponte Vedra South is a grid served by two WTPs located at A1A North and A1A South. Each WTP is described below.

A1A North WTP

The discharge from this WTP is monitored by a 4" Rockwell Production Meter. The average daily flow for this audit period is 38,000 gallons, with a maximum day of 104,000 gallons on May 23, 1993. May 1993 was the peak month. Water is supplied by a 6" diameter, 750' deep well with an unknown casing depth.

A1A South WTP

The discharge from this WTP is monitored by a 4" Rockwell Production Meter. The average daily flow for this audit period is 26,000 gallons, with a maximum day of 114,000 gallons on May 7, 1993. May 1993 was the peak month. Water is supplied by a 6" diameter, 750' deep well with an unknown casing depth.

This audit shows an UFW volume of 10.3 MG during 1993, or 31% of the total production. This is unacceptable; the additonal water conservation efforts described throughout this Plan will attempt to reduce the UFW to less than 10%. This system was part of the 1994 leak detection survey, and all leaks were repaired when found.

GRIDDED SYSTEM

The Ponce de Leon and Ponte Vedra South systems were gridded together in August 1993. This grid system is served by approximately 9.3 miles of asbestos cement and PVC water mains, ranging in size from 2" to 12". The PVC water distribution system in Ponce de Leon was primarily installed in 1982, with ongoing additions and replacements as needed. The primary installation of the distribution system in Ponte Vedra South is unknown.

UFW figures do not include estimates for leaks, breaks, hydrant flushing, plant use, fire flows, or theft.

PONTE VEDRA SYSTEM

(C.U.P. # 2-109-0118)

This audit of the Ponte Vedra system covers 1993, and water production records for this period are shown in Attachment 4. This system contains 1,334 residential connections (approximately 4,669 persons), with 160 general service connections. Ponte Vedra is a grid system served by two WTPs located at Ponte Vedra North and Corona Road. Each WTP is described below.

Ponte Vedra North WTP

The discharge from this WTP is monitored by a 10" Rockwell Production Meter. The average daily flow for this audit period is 474,000 gallons, with a maximum day of 970,000 gallons on December 5, 1993. December 1993 was the peak month. Water is supplied by a 10" diameter, 857' deep well with an unknown casing depth, and a 10" diameter, 252' deep well which is cased to a depth of 385'.

Corona Road WTP

The discharge from this WTP is monitored by an 8" Rockwell Production Meter. The average daily flow for this audit period is 635,000 gallons, with a maximum day of 1,267,000 gallons on August 13, 1993. May 1993 was the peak month. Water is supplied by a 10" diameter, 880' deep well which is cased to a depth of 247', and a 12" diameter, 880' deep well which is cased to a depth of 364'.

This grid system is served by approximately 29.6 miles of asbestos cement, cast iron, ductile iron, and PVC water mains, ranging in size from 2" to 12". The water distribution system was primarily installed in 1969, with ongoing additions and replacements as needed.

This audit shows an UFW volume of 17.0 MG during 1993, or 4% of the total production. This system was part of the 1994 leak detection survey, and all leaks were repaired when found.

UFW figures do not include estimates for leaks, breaks, hydrant flushing, plant use, fire flows, or theft.

ROYAL LAKES SYSTEM

(C.U.P. # 2-031-0036)

This audit of the Royal Lakes system covers 1993, and water production records for this period are shown in Attachment 4. This system contains 991 residential connections (approximately 3,469 persons), with 1,047 general service connections.

The discharge from this WTP is monitored by a 10" Rockwell Production Meter. The average daily flow for this audit period is 2,997,000 gallons, with a maximum day of 3,836,000 gallons on May 25, 1993. August 1993 was the peak month. Water is supplied by 3 wells which draw water from the Floridan Aquifer. Well # 1 is 8" in diameter and 1,312' deep, and cased to a depth of 373'; Well # 2 is 20" in diameter, 1,300' deep, and cased to a depth of 525'; and Well # 3 is 12" in diameter, 1,066' deep, and cased to a depth of 471'.

We currently meter the total WTP discharge. However, in 1995 we propose to monitor the withdrawals from each individual well.

This system is served by approximately 46.4 miles of galvanized steel, asbestos cement, cast iron, and PVC water mains, ranging in size from 2" to 12". The water distribution system was primarily installed in 1956, with ongoing additions and replacements as needed.

This audit shows an UFW volume of 61.8 MG during 1993, or 6% of the total production. The additional water conservation efforts described throughout this Plan will attempt to reduce the UFW even further.

UFW figures do not include estimates for leaks, breaks, hydrant flushing, plant use, fire flows, or theft.

SAN JOSE SYSTEM

(C.U.P. # 2-031-0033)

This audit of the San Jose system covers 1993, and water production records for this period are shown in Attachment 4. This system contains 3,687 residential connections (approximately 12,905 persons), with 320 general service connections.

The discharge from this WTP is monitored by a 12" Badger Production Meter. The average daily flow for this audit period is 2,200,000 gallons, with a maximum day of 3,373,000 gallons on June 20, 1993. June 1993 was the peak month. Water is supplied by 3 wells which draw water from the Floridan Aquifer. Well # 1 is 12" in diameter and 1100' deep, with an unknown casing depth; Well # 2 is 8" in diameter, 1,200' deep, and cased to a depth of 521'; and Well # 3 is 20" in diameter, 1,200' deep, and cased to a depth of 700'.

We currently meter the total WTP discharge. However, in 1995 we propose to monitor the withdrawals from each individual well.

This system is served by approximately 46.4 miles of galvanized steel, asbestos cement, cast iron, and PVC water mains, ranging in size from 2" to 12". The water distribution system was primarily installed in 1956, with ongoing additions and replacements as needed.

This audit shows an UFW volume of 104.6 MG during 1993, or 13% of the total production. The additional water conservation efforts described throughout this Plan will attempt to reduce the UFW to less than 10%.

UFW figures do not include estimates for leaks, breaks, hydrant flushing, plant use, fire flows, or theft.

SAN PABLO SYSTEM

(C.U.P. # 2-031-0165)

This audit of the San Pablo system covers 1993, and water production records for this period are shown in Attachment 4. This system contains 860 residential connections (approximately 3,010 persons), with 32 general service connections.

The discharge from the Marsh View WTP is monitored by an 8" F&P Production Meter. The average daily flow for this audit period is 475,000 gallons, with a maximum day of 1,025,000 gallons on July 16, 1993. May 1993 was the peak month. Water is supplied by a 12" diameter, 600' deep well, which is cased to a depth of 355'.

This system is served by approximately 12.3 miles of galvanized steel, cast iron, ductile iron, and PVC water mains, ranging in size from 2" to 10".

This audit shows an UFW volume of 29.5 MG during 1993, or 14% of the total production. The additional water conservation efforts described throughout this Plan will attempt to reduce the UFW to less than 10%. This system was part of the 1994 leak detection survey, and all leaks were repaired when found.

UFW figures do not include estimates for leaks, breaks, hydrant flushing, plant use, fire flows, or theft.

ST. JOHNS NORTH SYSTEM

(C.U.P. # 2-109-0071)

This audit of the St. Johns North system covers 1993, and water production records for this period are shown in Attachment 4. This system contains 636 residential connections (approximately 2,226 persons), with 6 general service connections.

The discharge from this WTP is monitored by a 4" Neptune Production Meter. The average daily flow for this audit period is 276,000 gallons, with a maximum day of 768,000 gallons on August 7, 1993. August 1993 was the peak month. Water is supplied by 2 wells which draw water from the Floridan Aquifer. Well # 1 is 4" in diameter, 460' deep, and cased to a depth of 360'; and Well # 2 is 4" in diameter, 500' deep, and cased to a depth of 360'.

This system is served by approximately 9.8 miles of PVC water mains, ranging in size from 2-1/2" to 8". The water distribution system was primarily installed in 1984, with ongoing additions and replacements as needed.

This audit shows an UFW volume of 16.4 MG over the past 12 months, or 16% of the total production. The additional water conservation efforts described throughout this Plan will attempt to reduce the UFW to less than 10%. This system was part of the 1993 leak detection survey, and all leaks were repaired when found.

UFW figures do not include estimates for leaks, breaks, hydrant flushing, plant use, fire flows, or theft.

VENETIA TERRACE SYSTEM

(C.U.P. # 2-031-0041)

This audit of the Venetia Terrace system covers 1993, and water production records for this period are shown in Attachment 4. This system contains 239 residential connections (approximately 837 persons), with no general service connections.

The discharge from this WTP is monitored by a 4" Badger Production Meter. The average daily flow for this audit period is 43,000 gallons, with a maximum day of 90,000 gallons on attachedJune 19, 1993. May 1993 was the peak month. Water is supplied by a 6" diameter, 833' deep well, which is cased to a depth of 441'.

This system is served by approximately 3 miles of galvanized steel and asbestos cement water mains, ranging in size from 2" to 6". The water distribution system was primarily installed in 1956, with ongoing additions and replacements as needed.

This audit shows an UFW volume of 2.2 MG during 1993, or 12% of the total production. The additional water conservation efforts described throughout this Plan will attempt to reduce the UFW to less than 10%.

UFW figures do not include estimates for leaks, breaks, hydrant flushing, plant use, fire flows, or theft.

OTHER SMALL SYSTEMS

The following page shows the rest of JSUC's systems, which are not large enough to require consumptive use permits. Most of the systems are supplied by water purchased from the City of Jacksonville.

SYSTEM	PWSID #	SOURCE OF SUPPLY	NUMBER OF CUSTOMERS	1993 ADF (MGD)	1993 MDF (MGD)
Bon Air	2160099	Purchased	13	0.003	0.012
Brackridge	2160105	Purchased	172	0.041	0.080
Greenfield	2160438	Purchased	115	0.042	0.106
Lofton Oaks	2454338	Pumped	0	N/A	N/A
Milmar Manor	2160769	Purchased	114	0.034	UNK
Nassau County Detention Facility	2454135	Pumped	1	0.018	0.049
Ridgeland	2160954	Purchased	178	0.052	UNK
Riverview	2160970	Purchased	282	0.080	0.144
Town & Country	N/A	Purchased	35	0.070	UNK
Westwood	2161257	Purchased	56	0.015	0.061

G. SCHEDULE

SCHEDULE OF WATER CONSERVATION ACTIVITIES

CONSERVATION ACTIVITY	IMPLEMENTATION DATE	FREQUENCY
BEGIN ESTIMATING WATER USED FOR FIRE PROTECTION; INCLUDE ESTIMATES IN MONTHLY UFW REPORTS	JAN 1995	MONTHLY
BEGIN ESTIMATING WATER USED FOR LINE FLUSHES; INCLUDE ESTIMATES IN MONTHLY UFW REPORTS	JAN 1995	AS THEY OCCUR
PRINT WATER CONSERVATION KIT INFORMATION ON CUSTOMER BILLS	1st QUARTER OF 1995	N/A
METER INDIVIDUAL WELLS AT ROYAL LAKES AND SAN JOSE WTPs	1995	N/A
INITIAL LEAK DETECTION SURVEY OF ALL JSUC SYSTEMS	1993	N/A
REPAIR LEAKS AS THEY ARE FOUND	1993	AS NEEDED
ANALYZE SURVEY, SUBMIT LEAK DETECTION & REPAIR PLAN TO SJRWMD	1996	N/A
INSTALL REUSE AT SAN PABLO & ORTEGA HILLS	1995	N/A
IMPROVE REUSE AT MONTEREY	1994	N/A
SELL REUSE TO GOLF COURSES	(SEE SCHEDULE IN REUSE SECTION)	
INCREASE FREQUENCY OF CLASSROOM PRESENTATIONS	1994	AS REQUESTED
INCREASE FREQUENCY OF BILL STUFFERS	1994	QUARTERLY
INCLUDE WATER CONSERVATION TIPS ON BILLS	1992	ONGOING

Person Responsible for Implementing Plan:

Philip Heil, Vice President

Name & Title

Signature

11/4/94

Date

721-4600

Phone Number