Thurston Co Env. Health Dept.
Copy

WATER SYSTEM FEASIBILITY STUDY

for

SUMMIT LAKE

in

THURSTON COUNTY WASHINGTON

Thurston County Public Works Department
Olympia, Washington 98502-6045

May 1991

Gray & Osborne, Inc.
CONSULTING ENGINEERS

WATER SYSTEM FEASIBILITY STUDY
FOR
SUMMIT LAKE
IN
THURSTON COUNTY, WASHINGTON

MAY 1991

DISCLAIMER: ANY MENTION OF TRADE NAMES, COMMERCIAL PRODUCTS, SERVICES OR SUPPLIERS IN THIS PUBLICATION DOES NOT CONSTITUTE ENDORSEMENT BY THURSTON COUNTY OR GRAY & OSBORNE, INC.

PREPARED FOR: THURSTON CO. DEPARTMENT OF PUBLIC WORKS
2000 LAKERIDGE DRIVE S.W.
OLYMPIA, WASHINGTON 98502-6045

PREPARED BY: GRAY & OSBORNE, INC.
701 DEXTER AVENUE N., #200
SEATTLE, WASHINGTON 98109

G&O #90759

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

CHAPTER I

INTRODUCTION

PURPOSE AND SCOPE

This study was authorized by the Thurston County Department of Public Works in December of 1990. Its purpose is to determine the physical and financial feasibility of providing a water system for the residents of Summit Lake. On December 16, 1990, the consultant presented a proposed scope for the study at a regular meeting of the Lake Management District Board, which was well attended by the public.

At the scoping meeting, it was made clear by the residents that there was minimal support for a central treatment plant and other traditional components such as booster stations, transmission and distribution mains and storage reservoirs. Considerable interest was expressed, however, in individual home treatment systems, several of which already exist in Summit Lake residences. The scope of this study was therefore modified accordingly.

The purpose of the study does not include an evaluation of the need for, or feasibility of, centralized waste treatment. There will necessarily be some review of the estimated impact that waste sources have on Summit Lake as a source of potable water.

SOURCE OF BACKGROUND INFORMATION

The background information contained in this section has been summarized from the following three documents:

1990 Rector, Julie. Washington's Citizen Lake Monitoring Program, 1989 Data Summary, Summit Lake, Thurston County. Washington Department of Ecology, Environmental Investigations and Laboratory Services Program.

1990 Summit Lake Non-point Pollution Field Survey, Final Report, August 1990. Thurston County Environmental Health Division.

1988 Davis, Susan and Gooding, Lynn. Summit Lake Water Quality Investigation - Evaluation of its Use as a Drinking Water Source. Thurston County Health Department, Environmental Health Division.

SUMMIT LAKE STUDY AREA

Summit Lake

Summit Lake is located in a steep, forested valley in the northwestern corner of Thurston County, nine miles west of Olympia. It is approximately two miles long, has a shoreline length of approximately 5.6 miles, and a surface area of approximately 530 acres. It is fed by intermittent streams, seeps, and springs. Summit Lake has a maximum depth of 100 feet and a mean depth of 53 feet. The outlet of the lake is Kennedy Creek, which flows to the north and discharges into Totten Inlet. The surrounding terrain is steep and rugged. The lake elevation is approximately 500 feet, and the surrounding ridges are as high as 1200 feet.

Summit Lake has been characterized as oligotrophic, meaning that it is a water body that has low nutrient concentrations, little plant or algae growth, and very clear water. The lake has been treated in the past with rotenone to remove rough fish.

The lake is heavily used for recreation, including such activities such as fishing, boating, and swimming. There are two boat ramps on the lakeshore. Presently, fish are stocked in the lake. Untreated lake water is drawn from the lake for drinking and other domestic uses by many residents in the area.

Failing septic systems and stormwater runoff have been identified as potential sources of water quality problems. At the present time, there is no watershed management plan in place to protect the water quality of the lake; however, a Lake Management District has been formed and is making progress toward that end. It is generally recognized, however, that the number and diversity of waste sources

are such that complete protection of the lake as a drinking water source is not achievable. Several sources of contamination are naturally occurring or so diffused as to preclude prevention or isolation and treatment; and it is unlikely that residents of the area would be willing to curtail potential sources of contamination such as boating, swimming, or fishing, important elements of the lifestyle attendant to lakeshore home ownership.

Land Use

There is a total of 627 lots in the Summit Lake area. The majority of the lots (454, or 72%) are developed; 173 lots (28%) are presently undeveloped. About 414 of the lots (66%) are lake waterfront lots; the remaining 213 lots (34%) are located on the upslope side of the road that encircles the lake. There are 3 waterfront community areas on the lake. The Washington Department of Wildlife maintains a public access on the south shore. The Boy Scouts of America operate a 126 acre camp along the west end of the lake. The remaining land within the watershed is in commercial timber production.

TABLE 1
LOT USE IN THE SUMMIT LAKE AREA

LOT USE	WATERFRONT LOTS	UPLAND LOTS	TOTAL
Year-round single family residence	149	30	179
Seasonal single family residence	195	20	215
Multiple family residence	1	0	1
Recreational	23	6	29
Garage	0	5	5
Vacant Dwelling	14	12	26
Undeveloped	32	140	172
TOTAL	414	213	627

Source of data: "Summit Lake Non-point Pollution Field Survey, Final Report", August, 1990. Thurston County Environmental Health Division.

The number of seasonal residences presently exceeds the number of year-round residences. However, there is an apparent trend to convert seasonal residences to year-round residences. Of the 414 waterfront lots, approximately 36% are used as year-round residences; 52% are used as seasonal or recreational residences, and about 8% are presently undeveloped. There are 4 businesses operating out of 4 year-round residences.

HISTORY OF PREVIOUS STUDIES

Water Quality Monitoring, 1975 - 1978

The Thurston County Health Department and the Summit Lake Community Club undertook a study to monitor bacteriological water quality at 8 sampling sites. After the study was completed, there was considerable discussion about the installation of a community sewer system, but the project was not pursued.

Water Quality Monitoring, 1982

The Summit Lake Community Club began a monitoring program in which 4 of the 8 sites used in the 1975-1978 study were sampled on a monthly basis.

Sanitary Survey and Water Quality Monitoring, 1984 - 1985

The Thurston County Health Department contracted with Entranco Engineering to perform a septic tank leachate survey of the shoreline. Several areas with elevated bacteria counts were identified. A sanitary survey of these areas was then performed by Health Department staff, and as a result, some septic tank failures were identified and corrected. The Health Department began monthly sampling in April 1985 at the 4 sites used in the 1975-1978 study but not being sampled by the Summit Lake Community Club.

Water Quality Investigation, 1986 - 1987

The Environmental Health Division of the Thurston County Health Department conducted a water quality investigation to evaluate the use of Summit Lake as a drinking water source. The results of this investigation are described in the 1988 document entitled "Summit Lake Water Quality Investigation - Evaluation of its Use as a Drinking Water Source". In February 1987 the Health Department issued a Health Advisory advising against the use of raw lake water for drinking water purposes.

Lake Management District, 1989

A three-year Lake Management District was formed to help fund a non-point pollution action program within the Summit Lake watershed. The three primary activities are:

(1) non-point pollution survey of the watershed for the purposes of (a) locating failing septic tanks and any other sources of contamination of the lake (b) initiating corrective actions, and (c) gathering information necessary for the development of a water quality protection strategy;

(2) public involvement and public education efforts;

(3) development of a strategy to protect water quality through the efforts of the Summit Lake Advisory Board.

Non-Point Pollution Survey, 1990

The Thurston County Health Department, Environmental Health Division staff conducted a non-point pollution survey that included a survey/inspection of waterfront and upland properties. The results of this survey are presented in the August 1990 document entitled "Summit Lake Non-point Pollution Field Survey, Final Report".

CHAPTER II

EXISTING SITUATION

This chapter will briefly summarize the existing source of drinking water for the residents around Summit Lake, the current practice of wastewater treatment and disposal, and the current regulation of drinking water systems. The last section presents information on the functions of lake management and water districts in the sponsorship of drinking water systems.

EXISTING WATER SUPPLY

Table 2 summarizes the various water sources of domestic water for developed lots around Summit Lake. As this table shows, Summit Lake serves as the water source for the majority of residents. A typical individual domestic water system includes a weighted water intake pipe on the bottom of the lake a number of feet from shore, a pump located in a pumphouse on shore, and a pressure tank. Some of these systems include disinfection.

TABLE 2
DOMESTIC WATER SOURCES

WATER SOURCE	NUMBER OF DEVELOPED LOTS	PERCENTAGE OF DEVELOPED LOTS
Lake	284	62
Well	58	13
Spring	2	1
Other	4	1
None	56	12
Unknown	51	11
TOTAL	455	100%

Source of data: "Summit Lake Non-point Pollution Field Survey, Final Report", August, 1990. Thurston County Environmental Health Division.

Table 3 presents a summary of the domestic water treatment methods used by the residents of Summit Lake. This table indicates that only 7% of the residents are known to adequately disinfect their water and that only 7% are known to filter their water. It is not known if these filtration devices protect the entire home, or a single tap.

TABLE 3
WATER TREATMENT METHODS

WATER SOURCE	NUMBER OF DEVELOPED LOTS	PERCENTAGE OF DEVELOPED LOTS
Carry bottled water	76	17
Boil water or manually add chlorine	14	3
Automatic disinfection with or without filtration	18	4
Filtration	33	7
None	174	38
Unknown	139	31
TOTAL	454	100%

Source of data: "Summit Lake Non-point Pollution Field Survey, Final Report", August, 1990. Thurston County Environmental Health Division.

EXISTING WASTEWATER TREATMENT AND DISPOSAL

Table 4 summarizes the types of on-site sewage disposal systems used on lots with year-round and seasonal residences. On many of the lots, it is not possible to install a septic tank / drainfield system due to limitations posed by various characteristics of the lots.

TABLE 4

TYPE OF ON-SITE DISPOSAL SYSTEM USED FOR YEAR-ROUND AND SEASONAL RESIDENCES

SEPTIC SYSTEM TYPE	YEAR-ROUND RESIDENCES	SEASONAL RESIDENCES
Standard	52%	32%
Mound	1%	1%
Pressure Distribution	11%	3%
Pumped	21%	12%
Outhouse	2%	34%
Cesspool	0%	2%
Seepage Pit	3%	6%
Other	3%	5%
Unknown	6%	5%

Source of data: "Summit Lake Non-point Pollution Field Survey, Final Report", August, 1990. Thurston County Environmental Health Division.

Table 5 summarizes the condition of on-site sewage disposal systems for year-round and seasonal residences. The failure rate listed in Table 5 is for observed surface failures only. It is believed that a greater number of sub-surface failures are occurring than surface failures.

TABLE 5

CONDITION OF ON-SITE SEWAGE DISPOSAL SYSTEMS FOR YEAR-ROUND AND SEASONAL RESIDENCES

CONDITION	YEAR-ROUND RESIDENCES	SEASONAL RESIDENCES
Operational	66%	51%
Suspect	16%	17%
Failures	5%	8%
Unknown	13%	24%

Source of data: "Summit Lake Non-point Pollution Field Survey, Final Report", August, 1990. Thurston County Environmental Health Division.

During the 1990 sanitary survey, 138 drainage pipes from shoreline properties to the lake were identified, some of which were found to be transporting bacteriological contaminants to the lake.

REGULATION OF DRINKING WATER SYSTEMS

Background

The Federal Safe Drinking Water Act passed in 1974 established a federal program to promote the provision of safe potable water in America. As the Federal implementing agency, the Environmental Protection Agency passed regulations setting standards for bacteria, turbidity, metals, organics, pesticides and radionuclides and their safe level in drinking water. Specific monitoring and reporting requirements were also established. In addition to these federally enforced primary standards called Maximum Contaminant Levels (MCLs) relating to public health, the EPA also set standards for chlorides, hardness, color, pH, iron and manganese, etc., called secondary standards. These relate only to aesthetics

such as color, taste, and odor, not health, and are therefore called secondary standards.

Federal vs. State Regulation

This federal law contained provisions wherein states could receive primary enforcement responsibility, called "primacy", for implementing these requirements, if they met certain conditions. They needed to develop an adequate health or environmental agency having program management capability, including a certified laboratory, and they needed to adopt their own state regulations that were at least as broad as the federal rules, and as stringent. The State of Washington received primacy in 1978 and operates an effective program. While the federal definition of a public water system subject to federal rule is a minimum of 15 connections or 25 persons served, the State of Washington increased its jurisdiction to as few as two connections (e.g. a duplex served from the same well). While all but one or two states have received primacy to administer the federal program, few regulate down to systems as small as two connections. Because of the large number of the very smallest systems in Washington, it is impossible for state regulatory officials to provide the same level of oversight to the smallest systems as to those larger systems potentially impacting the health of a large number of citizens. Unfortunately, this includes the technical assistance as well as enforcement aspects of program administration.

The 1980s ushered in the suddenly escalating public interest in the health hazards of hazardous wastes and toxic chemicals in the environment. Major spills and other environmental disasters worldwide proved that even deep aquifers were not safe from contamination by volatile organics and other cancer-causing chemicals. Congress responded with sweeping changes to the 1974 Act, called the Safe Drinking Water Act Amendments of 1986. In summary, the Amendments expanded the number of regulated contaminants from 22 to 83, and even named the specific compounds of most serious concern. EPA has been responding with a series of complex and far-reaching regulations. For certain health hazards, such as the protozoa *Giardia lamblia*, a standard protective of health cannot practically be set due to the cost and technical difficulty of monitoring. In these cases, EPA has prescribed a treatment technique, such as filtration and disinfection for surface waters, in lieu of setting an MCL. Coliform monitoring has been increased and the

addition of new volatile and synthetic organic compounds with new monitoring requirements is steadily increasing utility operating costs. EPA's new rule requiring filtration and disinfection of surface waters was effective on June 30, 1989. States were allowed 18 months to adopt their companion regulations before EPA became effective. Since Washington's rule was not in place by December 30, 1990, EPA's rule is technically enforceable at the federal level. EPA Region 10 and Washington's Department of Health are now discussing interim enforcement of this rule (along with the new EPA coliform rule) in the State of Washington. By December 30, 1991, according to the current schedule, the State DOH is to identify those public water systems which are served by surface water - which includes springs and certain shallow wells directly influenced by surface waters - and which will be required to filter and disinfect their supplies.

Current State Regulation

Although the Department of Health's new surface water treatment rules have not been issued, their current rules at WAC 248-54-097, Source Control, specify the conditions Summit Lake would have to meet to be approved as a new source of a public water system (two or more connections). A complete description of the watershed and lake quality would be required, along with a "Watershed Control Program". If the lake were to be used untreated, the program would have to show that: "All facilities and activities in the watershed affecting public health shall be under the surveillance of the water purveyor and shall be satisfactorily limited and controlled so as to preclude degradation of the physical, chemical, microbiological, viral and radiological quality of the source of supply". Summit Lake could not meet this requirement for source approval without treatment, and the Department's new rules will be even more stringent. See Chapters V and VI for further discussion on this subject.

Role of the County

The regulation of drinking water, being a key element in any effective public health protection program, is naturally of interest to local units of governments such as counties. The State DOH has in place a program of cooperation and shared responsibility with counties for administration of their drinking water program, in return for which it passes along a certain portion of its federal grant. In Thurston

County, agreement has been reached for the County Health Department to take responsibility for the following activities:

- Bacteriological sample analysis (WAC 248-54-740) for larger systems.

- Well site approval and control (WAC 248-54-660) for systems with 10-99 connections.

- For non-community systems - 60 or more days of operation per year and as few as 10 connections, the County is responsible for:

  - o developing and adopting standards and regulations

  - o reviewing and approving engineering reports, plans and specifications, existing systems, and well site control

  - o developing and implementing a sampling program (WAC 248-54-740)

  - o an improvement program

  - o conducting sanitary surveys (WAC 240-54-810)

  - o responding to complaints and providing technical assistance

  - o enforcing public notification requirements when systems violate standards or monitoring requirements, and posting "boil water" notices and issuing other health advisories (WAC 248-54-750)

  - o initiating and assisting in enforcement actions (WAC 248-54-780)

  - o providing training in water system design

Another area in which counties have been mandated to exercise control is under Section 63 of the recently enacted Growth Management Bill, H & SB 2929. Section 63 alters the current building permit process requiring proof of an adequate water supply available before issuing a building permit. Counties must consider water supplies, both in quantity and quality, when evaluating subdivision proposals. (The Uniform Building Code followed by the County Public Works Department requires potable water in buildings with plumbing systems). This applies not only to surface sources and drinking water, but also to groundwater withdrawals (and not just those over 5,000 gal/day requiring a water rights permit). Proof of this adequate supply can be in the form of:

- a water right permit from DOE
- a letter from an approved water purveyor stating the ability to provide water; or
- a "water availability notification", such as a well log and test results.

Under current state-issued guidelines for County implementation of Section 63, an adequate quantity is 400 gal/day for an individual supply; for a well, lake or stream intake pump with a pressure tank, this equates to a pump operating at 3.34 gal/min. for more than two hours per day. Concerning source type, all systems must provide a safe supply. Quality requirements the counties are encouraged to enforce are bacteriological and metals (inorganics) of health significance, e.g., arsenic, barium, cadmium, chromium, mercury, fluoride, lead, nitrates, selenium, silver and sodium. For a new public water system (again, two or more connections), the system should be in full compliance with WAC 248-54.

In late November 1990, the Department of Health surveyed Washington Counties to assess the status of their implementation of Section 63 of the Growth Management Act. The results are summarized in Table 6. The column headings are as follows:

A. Is Section 63 being enforced?
B. Has an implementing ordinance been passed?
C. Is verification of water availability required?
D. Must a public system be in substantial compliance with WAC 248-54?

E. Is a water right required from DOE?

F. Is a protective covenant required for 100 foot well radius?

G. Is a bacteriological analysis required for individual supplier?

H. Nitrate?

I. Primary inorganics (metals)?

J. Opinion of DOH's interim guidelines:

Too stringent	S
OK as is	OK
Too weak	W
Not sure	?

K. Concern over liability by certifying individual supplies?

L. Does lack of testing increase liability?

M. Should the DOH issue formal rules?

N. Should the State Board of Health regulate individual supplies?

It is clear that most county health organization are taking the requirements seriously. It is also interesting to note that while they do not generally want the Department of Health to issue rules to implement Section 63, there is strong support for the Board of Health to regulate individual water supplies.

The Department of Health is expecting a bill to come out of this current session of the Legislature authorizing creation of an operating permit program for water systems. The procedures established for this new program may served as a vehicle to define the State's expectations regarding implementation of Section 63. Other legislation amending the Growth Bill has been introduced, but is not expected to pass. The Department is also meeting with the Department of Ecology, Department of Community Development and the Association of Washington Counties to discuss Section 63 implementation. Reissued guidelines are likely by next fall; however, it is unlikely that the Board of Health will choose to regulate individual water supplies.

TABLE 6

COUNTY HEALTH DISTRICT IMPLEMENTATION OF GROWTH BILL SECTION 63 (as of 12/90)

	A	B	C	D	E	F	G	H	I	J	K	L	M	N
Benton-Franklin	N	N	Y	N	N	N	N	N	N	S	N	N	Y	N
Bremerton-Kitsap	N	N	N	Y	Y	N	Y	Y	Y	S	N	?	N	Y
Chelan-Douglas	Y	N	N	Y	?	Y	Y	Y	N	?	N	N	N	Y
Clallam	Y	N	N	Y	Y	N	Y	Y	N	OK	N	N	Y	Y
Cowlitz-Wahkeakum	Y	N	N	Y	Y	Y	Y	N	N	?	Y	Y	N	N
Grays Harbor	N	N	N	Y	Y	N	Y	N	N	OK	Y	Y	N	Y
Island	Y	Y	N	Y	Y	Y	Y	Y	N	OK	N	N	N	N
Jefferson	Y	N	N	Y	Y	N	Y	Y	Y	S	N	Y	Y	Y
Lewis	N	N	N	Y	N	N	N	Y	N	S	Y	Y	N	N
Lincoln	Y	N	N	Y	Y	N	Y	Y	N	S	Y	Y	N	N
NE Tri-County	N	N	Y	N	N	N	N	N	N	S	Y	Y	N	?
Okanogan	Y	N	N	Y	N	N	N	N	N	?	Y	N	N	N
Pacific	Y	N	N	N	Y	Y	Y	N	N	OK	N	Y	Y	Y
Seattle-King	Y	N	N	Y	Y	Y	Y	Y	N	W	Y	Y	Y	Y
Skagit	N	N	N	Y	Y	N	Y	Y	N	W	N	Y	N	Y
Snohomish	Y	N	N	Y	Y	N	Y	Y	Y	OK	N	?	Y	Y
SW Washington	Y	?	N	?	Y	?	Y	Y	N	?	?	?	?	?
Tacoma-Pierce	Y	Y	N	Y	Y	N	Y	Y	Y	OK	N	N	N	Y
Thurston	Y	N	N	Y	N	N	N	N	N	?	N	N	Y	Y
Walla-Walla	Y	N	N	Y	Y	N	N	N	N	?	Y	?	N	N
Whatcom	Y	N	N	Y	Y	Y	Y	Y	Y	W	Y	Y	N	N
Yakima	N	N	Y	N	N	N	N	N	N	W	?	?	Y	Y

Y = Yes; N = No

Thurston County's Health Department has obtained the services of a consultant for assistance in implementing these new growth management requirements relating to adequate water supply. While the County has not yet adopted a final position, a draft policy entitled "Interim Water System Approval" is currently under review. A copy is included in Appendix A. The direction the County appears to be headed is very clear: surface water is generally unacceptable as a source of drinking water for an individual water system. If no alternative source is available, continuous filtration and disinfection will be required. If a system is proposed meeting these requirements, the property owner would be required to file a Notice of Understanding with the county auditor before a Building Site Approval would be issued. This Notice would alert future owners to the limitations and health concerns of this type of source and treatment system. The County's proposed policy goes on to state that property with this type of system would not be eligible

for federal financing options, nor would the County give a favorable response when lending institutions request an evaluation. Similarly, for subdivision or other land use permit approval, the proposed use of an inadequately treated surface source for water supply would not be acceptable.

The County currently has in place procedures for "Loan Certification" and "Operational Permits". Information on these requirements is also included in Appendix A. Current experience of the County is that they rarely receive a request to certify a water system for property at Summit Lake, since owners are aware of the source limitations. If a request is received, the County reports that Summit Lake is an unapproved drinking water source. The County's requirements for septic system approval are also detailed and exacting. Because of the difficulty in obtaining County certification for individual water and septic systems at Summit Lake, most property sale transactions are probably completed under private contract between the buyer and seller.

Recognizing the potential public health threat associated with continued use of Summit Lake for drinking water, the County Health Department issued a Public Health Advisory in February of 1987. A copy is included in Appendix A. Residents were advised against use of the raw lake water for drinking, cooking or related domestic purposes, without disinfection. The Advisory included supporting background information and encouraged community action. The Health Advisory currently remains in effect.

FORMATION OF A WATER DISTRICT

The existing lake management district (LMD) formed in 1989 is an effective organization for accomplishing many of the objectives which are part of a program to protect ecological values in and around Summit Lake. However, a lake management district would have certain definite limitations were it to be considered as a mechanism to undertake a drinking water improvement project:

- The principal purpose of an LMD is lake improvement and maintenance, not utility service for water supply.

- An LMD is a special assessment area like a utility local improvement district, but it is not a special purpose government like a water district.

- In listing the purposes for which LMD assessments or rates and charges may be used, RCW 36.61 makes no mention of provision of drinking water or utility-type services.

- The resolution by the County to create the LMD must include a plan laying out its program and the number of years it is to exist.

- Tasks specifically related to utility formation or development, such as the planning or construction of a water supply system, are not eligible for LMD funding.

A more appropriate organization to undertake the provision of a centralized water treatment, storage and distribution system is the water district; or, in the case of providing both water and wastewater services, a water and sewer district. Water districts are governed by the Revised Code of Washington Title 57. When properly formed, they have many of the essential powers of a municipality under Washington law; they can:

- acquire property (by purchase or condemnation) within and without district boundaries, including water rights

- lease real or personal property

- exercise the power of eminent domain

- construct, condemn and/or purchase, maintain and supply waterworks

- generate electricity (as a byproduct of water supply)

- obtain easements for treatment, storage, or transmission facilities

- fix rates, charges, connection fees; establish installment plans

- prepare and adopt comprehensive plans

- manage, operate, maintain or repair private or public water systems

- fluoridate water

- create and fill staff positions; accomplish work by contract or force account

- construct, maintain, operate and develop street lighting systems

- issue revenue bonds; establish local improvement districts; levy special assessments; issue general obligation bonds; issue revenue warrants and revenue bond anticipation warrants

- levy a general tax, annually, on all property located in the district

- annex territory (or withdraw territory within the district)

Some of the steps to be accomplished in forming a water district include: *

- agree on need and propriety with County; prepare legal description of proposed boundaries

- circulate petition for formation; 25% of qualified elector's signatures required. Preliminary expense property tax levy not to exceed $1.25/1,000

- prepare petition for nomination of three commissioners; file and have verified, give public notice

- hold hearing including State Environmental Policy Act (SEPA) process

- hold election covering formation, tax levy, and commissioners

- hold organizational meeting; identify source of comprehensive plan funding

- Adopt comprehensive plan, construction standards, and connection, meter and water service charges

- obtain necessary service franchises for operation

- acquire financing and arrange for contraction of system; sources include:

    o loans and/or grants from DOH, FmHA, county, etc.

    o sale of revenue bonds

    o formation of ULID (requires signature of 51% of voters after hearing)

    o property owner (developer) guarantees

* "Checklist for formation of Water District (RCW Title 57), by Jonson & Jonson, P.S., April 1989.

THE UTILITY LOCAL IMPROVEMENT DISTRICT (ULID)

Were a sponsoring entity such as a Water District formed, it would have no operating system or other equity available for use as collateral to secure financing. The District could, however, use the ULID as a method to raise revenue and secure financing of a new water system. The ULID provides a legal means of combining the property owners within the District to finance the system. The complete costs of the system, including engineering design, construction, administration, fiscal, legal, right-of-way acquisition, etc., are all included for assessment against the

property, less any grants obtained. Procedures are detailed in RCW Chapter 35.44 (laws of the State of Washington).

The formation of a ULID may be initiated either by resolution of the Water District's Board of Commissioners or by a petition signed by owners of property within the ULID's boundaries. Formation by resolution is perhaps faster, but formation by petition of the property owners can also be less controversial and show strong support for the project.

If the formation of a ULID is by petition, the signers must comprise ownership of at least fifty-one percent (51%) of the land within the limits of the proposed ULID boundaries. Following the filing, the Water District would determine the sufficiency of the petition. If the District determines that the petition is sufficient, or if the ULID were initiated by resolution of the Board of Commissioners, the District would proceed to adopt a resolution declaring its intention to form the ULID and to order the improvement. The district would then conduct a public hearing to hear objections. Following the hearing, the District could pass a resolution to create the ULID. Upon final creation of the ULID, the final water system design plans and specifications are prepared, approvals and permits from regulatory agencies are obtained, and competitive bids are secured.

At or near the completion of construction, the final assessment roll is prepared and statements are mailed to individual property owners, along with a notice of public hearing. The hearing is held, necessary changes made, and the final assessment role is accepted and adopted by a resolution of the Water District. The final assessment is submitted to the County Assessor/Treasurer for collection. The property owners may pay the assessment against the property in one lump sum, or any amount they choose, within 30 days after notice. Whatever remains unpaid must be paid to the Assessor by annual installments, plus interest sufficient to retire the revenue bonds.

The monies needed to finance the project, over and above any grants obtained, are usually provided from the sale of revenue bonds. The revenue bonds are repaid with funds derived from the ULID assessment paid by the property owners. A resolution is prepared authorizing a revenue bond issue and setting forth the

pledge of the ULID assessments. The bonds are sold and assessments levied against the property. The monies derived from the payment of the ULID assessments may only be utilized for repayment of the bonds. Operating revenue is obtained from separate user charges billed by the District.

Sources of funding and methods of financing are also discussed in Chapter VIII of this Study.

HOMEOWNER'S ASSOCIATION

Another alternative for organization of an entity to sponsor development of a water system is the homeowners association. While many of these are in existence and successfully operate small water systems, there are also many that experience serious difficulties in providing a service and product meeting minimum standards. Volunteerism is often only moderately successful, experience is lacking, and the ability to raise adequate revenues is limited. Homeowners associations are generally limited to very small systems which start by purchasing a previously constructed system and then overseeing its operation. They are not recommended for larger systems in today's climate of increasingly complex technical and regulatory agency requirements. The homeowners association would also not be recommended as an entity for managing a system of individual home treatment units. The problems inherent in the management of these systems is discussed in more detail in Chapter VII. Oversight of homeowners associations by regulatory agencies is particularly difficult.

COUNTY SPONSORSHIP

Although the County would probably first look to local ownership and operation of a water treatment system around Summit Lake, there is the possibility of County sponsorship. The County has sponsored development of sewerage systems to alleviate health hazards, and the Public Works Department does operate some water systems in conjunction with sewer systems they operate.

There is no clear County policy on ownership of water systems; however, in May of 1985 the County Commissioners adopted a policy document prepared by the Public Works, Planning and Health Departments entitled "County Sewerage Policies". A

copy is included in Appendix A; this document is instructive as to what the County might consider regarding operation of a water and sewer system around Summit Lake. The document recognized that the County role up to that time was to limit its activities to the operation of its existing small treatment systems. However, the realities of urban growth management suggested there were situations in which the County would be called upon to provide additional services itself or through a private contractor.

The document evaluates alternatives for ownership and operation of sewerage systems in the County, including the County, water and sewer districts, improvement districts, code and non-code cities, public utility districts and private entities. Importantly, the policy adopted states that, for unincorporated areas outside the Lacey-Olympia-Tumwater urbanizing area, the County should be the sewer provider. It also states that where the County provides sewer service, it also should be the water provider. This recognizes the economies of scale and benefits of coordinated utility planning. Specific developed areas with current health hazard or water quality problems, which would appear to include Summit Lake, are specifically mentioned as candidates for County treatment systems.

The policy concludes with several important statements regarding operations and management:

- The County would be owner and permit holder.
- The County would manage contracts for studies, siting, design and construction management of facilities.
- The rate payers would bear as much of the cost as legally possible.
- Operation and maintenance would be by the County or thorough contract.
- ULIDs would be considered only where majority support existed. In actual recent practice, the Commissioners appear to be leaning more toward 60-65% support to help insure a successful project.

CHAPTER III

GROUNDWATER OCCURRENCE

Since 13 percent of the currently developed lots around Summit Lake use groundwater as their drinking water source, it is appropriate to consider wells as a potential source of supply for a central drinking water system. Since individual wells are not regulated, there is no requirements for reporting of well quantity or quality experience. A brief review of geologic information was made, therefore, along with a review of readily available well logs submitted by drillers. The resulting data does permit some assessment of the potential for development of a groundwater source.

LOCAL GEOLOGY

The only substantive hydro-geologic information for the Summit Lake area is contained in Water Supply Bulletin No. 10, Geology and Groundwater Resources of Thurston County, Washington, Vol. 2, 1966(1). This work, however, together with available well drillers logs for recently drilled wells, provides a good basic understanding of the potential for the residents of Summit Lake to be served by a community well.

Summit Lake lies within the geohydrologic area known as the Black Hills, which consist of youthfully dissected uplands composed primarily of Eocene basalt. They are the eastern outlying edge of the Olympic Mountain Range. Referring to the geology map of the Summit Lake Vicinity (Figure 1), all the land surrounding all but the extreme southwest corner of the lake is underlain by volcanic (basaltic) rock of chiefly the Northcraft and Crescent formations, with some intrusive bodies not mapped separately. None of these formations has any value as an aquifer.

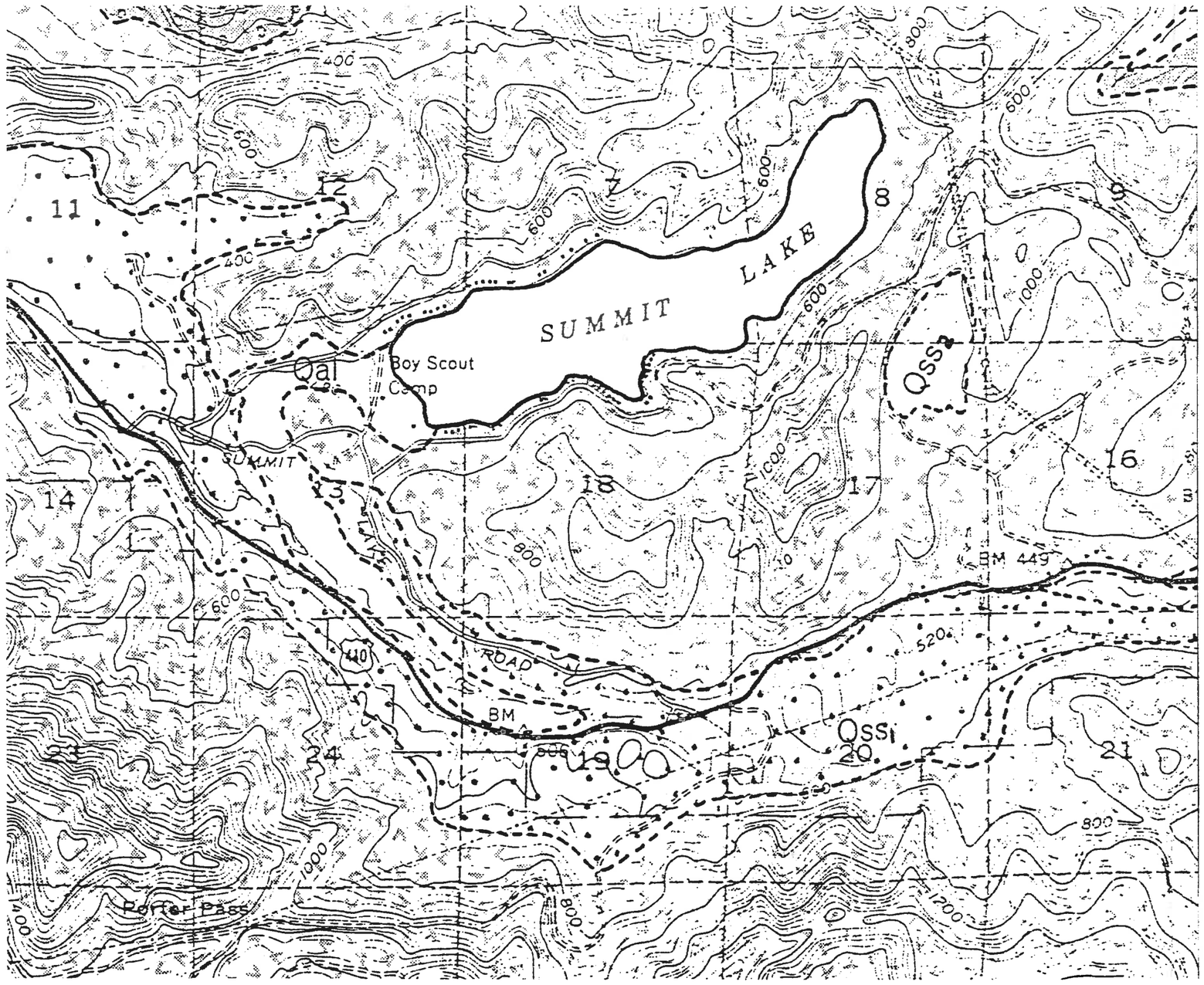
The area southwest of the lake identified as Qal is alluvium comprised predominantly of fine-grained deposits of detritus and peat. These include some lake deposits, marine alluvium and artificial fill. Locally, these deposits do yield some water to wells. The area symbolized as Qss is known as Salmon Springs drift

(1) By John B. Noble and Eugene F. Wallace, State of Washington, Department of Conservation, Division of Water Resource.

and is stratified glacialfluvial sand and gravel. Oxidation staining is common. In some other geohydrologic areas, such as the Pennisular Area to the northeast of Summit Lake and the Prairie Area in eastern Thurston County, this material forms an important regional aquifer. However, the water bearing materials are of irregular and unknown distribution, therefore yields vary widely from place to place and are unpredictable. There generally is a good chance of reasonable production from a drilled well, but the required drilling depth is uncertain. The drift is missing in places, and is normally not more than 30 feet thick. Permeability is relatively low, in most areas. Groundwater availability is depected in Fig. 2. The bulletin contains this specific summary discussion (1966): "In the Summit Lake area groundwater development is sparse...The groundwater occurs chiefly in the weathered Tertiary volcanic rocks, although some occurs in the uppermost zones of the underlying unweathered rocks. Most supplies are obtained from seep developments or dug wells which intercept the shallow groundwaters moving toward the lake, but some water has been obtained from the volcanic rocks at a depth of about 60 feet. Yields of as much as 10 gpm can be expected in this area".

WELL DATA

Tables 7 and 8 summarize well data obtained from Thurston County files. Only limited water quality data was available for these wells. The location of these wells, coded to the tables, is shown in Fig. 3.



SUMMIT LAKE
THURSTON COUNTY

GEOLOGY AROUND SUMMIT LAKE
SOURCE: WATER SUPPLY BULLETIN NO. 10

Gray & Osborne, Inc.
CONSULTING ENGINEERS

FIGURE 1

TABLE 7

DEEP WELL QUALITY IN THE SUMMIT LAKE AREA
SOURCE: THURSTON COUNTY RECORDS

MULTIPLE STATION ANALYSIS

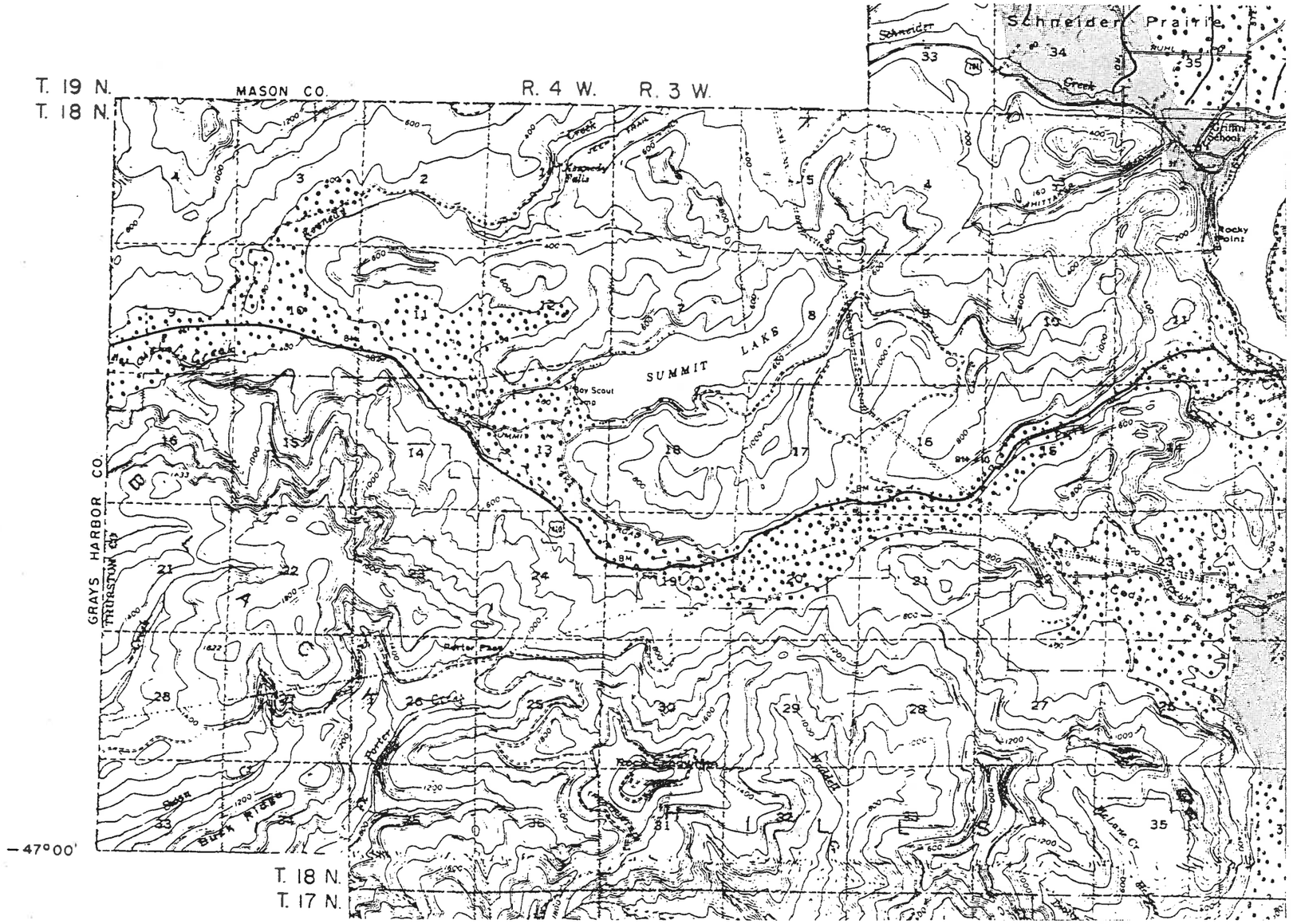
LOCAL I.D.	FT. DEPTH	SP. COND.	pH	MG/L TOT. HARDNESS	MG/L CHLORIDE	MG/L TDS	MG/L Fe
04R03	60	610	7.60	210	140	399	.028
07L02	420	138	7.10	29	11	94	.004
16P02	80	352	7.80	110	56	215	.011
18A01	400	134	9.50	--	5	105	.530
19C01	115	135	7.20	57	4	93	.053

TABLE 8

DATA FROM WELL DRILLERS LOGS, SUMMIT LAKE AREA
SOURCE: THURSTON COUNTY RECORDS

WATER WELL REPORT

	LOCATION		DEPTH FT.	STATIC W.L., FT.	GPM	DRAW-DOWN FT.	AFTER	DRILLER
1.	SE/SW	S7 T 18 R3	420	15	1	405	1 hr.	Williams
2.	SW/SW	8 18 3	40	Surf.	20	6	1 hr.	Mykol
3.	SE/NE	8 18 3	600	585'	0 (Rock)			Williams
4.	SE/NW	8 18 3	160	dry	0 (Rock)			Williams
5.	--	8 18 3	460	78'	1.5	377	1 hr.	Williams
6.	--	8 18 3W	215	178'	1.5			Richardson
7.	NW/NW	17 18 3	400	141	5	259	1 hr.	Williams
8.	NW/NW	17 18 3	125	95	15	20	1 hr.	Mykol
9.	NW/NW	12 18 4	97	dry				Mykol
10.	SE/SE	13 18 4	227	dry				Williams
11.		13 18 4	71	22'	2.5	290	1/2 hr.	Mykol
12.	NW	13 18 4	32		20	0	2 hrs.	Diamond
13.	SE	13 18 4	40	19	20	3	1 hr.	Tims
14.		13 18 4	230	49	1			Williams
15.	SE/NE	14 18 4	143	Surf.	15	100	1 hr.	Williams
16.	NE/SE	14 18 4	40	7	15	15	1 hr.	Mykol
17.	W1/2 NE	14 18 4	45	16	10	12	1 hr.	A-1



Areas of doubtful ground-water supply. Very few well records available. Yields of most wells less than 10 gpm.

Areas where ground-water supply is generally adequate for domestic and small irrigation supplies. Yields of most wells range from 10 to 50 gpm.

SUMMIT LAKE
THURSTON COUNTY

AVAILABILITY OF GROUND WATER NEAR SUMMIT LAKE

Gray & Osborne, Inc.
CONSULTING ENGINEERS

FIGURE 2

CONCLUSIONS

The foregoing data and discussion suggest the following conclusions regarding the potential for groundwater as a source of drinking water for the residents of Summit Lake:

- There are successful individual residence wells around Summit Lake at present. The County's 1989 non-point pollution field survey tallied 58 residences as being served by wells, and 2 by springs.

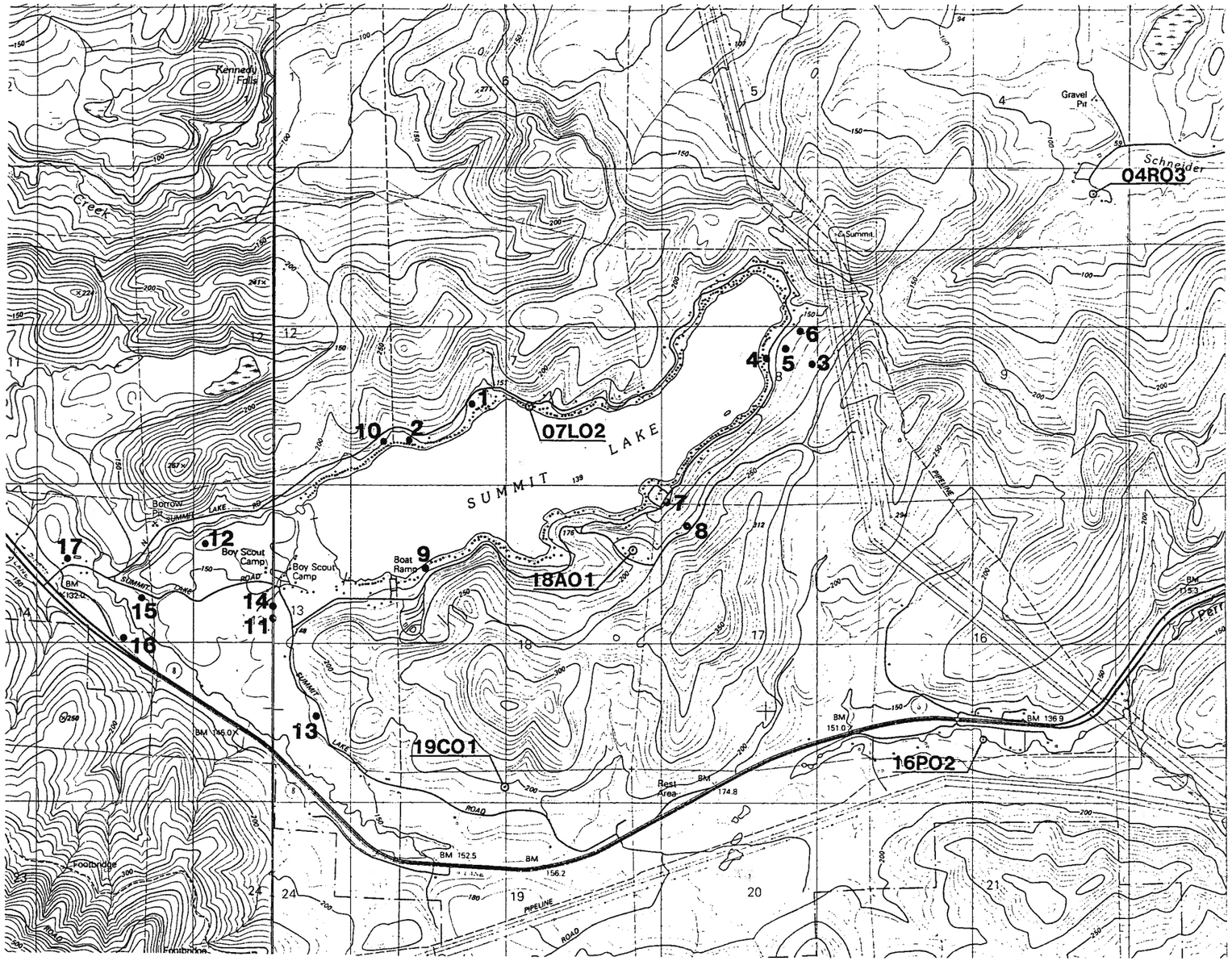
- There are no high-volume producing wells; the largest for which information was available was 20 gpm (three wells); each of these is shallow, with a high static level, and little drawdown. It is not known if these sites could support as many as three 125 gpm wells, which would be required to serve all the residents living around the lake.

- The limited quality data available suggest potential problems: hardness, chlorides, dissolved solids and iron. In all likelihood treatment would be required, and disinfection advised.

- Based on the number of dry and deep holes, drilling to obtain an adequate yield even for an individual residence could be very costly.

Based on discussions with hydrogeologists and drillers familiar with the Summit Lake area, groundwater availability is limited. There are no large producers now, and most of the area around the lake is underlain by tertiary bedrock. The area southwest of the lake has some potential, but a test well which could be converted to a producing well would be recommended. Two sites would be preferable, close to the lake and toward the highway. Typically, alluvial outwash has high iron and manganese, and therefore treatment could be required. If adequate water were available, 2-3 wells would probably be required, 100-150 ft. deep, at a drilling cost of approximately $20,000 - $30,000 each.

Because potential does exist for a groundwater source, although at some risk, this alternative will be presented later for cost feasibility.



SUMMIT LAKE
THURSTON COUNTY

APPROXIMATE LOCATIONS OF EXISTING WELLS AROUND SUMMIT LAKE SOURCE: THURSTON COUNTY

Gray & Osborne, Inc.
CONSULTING ENGINEERS

FIGURE 3

CHAPTER IV

WATERBORNE DISEASE

The information presented here is necessarily very summary in nature; interested readers are directed to Waterborne Diseases in the U.S., by Gunther F. Craun, CRC Press, Boca Raton, Florida, 1986, from which most of this information is obtained.

ETIOLOGY

The reporting of most water-related illness is voluntary in the U.S., and many waterborne outbreaks are not diagnosed or recognized as such, investigated or reported. Waterborne diseases are those transmitted through the ingestion of contaminated water, with water acting as the passive carrier of the infectious or chemical agent. Cholera and typhoid fever, the classic waterborne diseases in history, have been largely eliminated. Diseases caused by other bacteria, viruses, protozoa and helminths may also be transmitted by contaminated drinking water; these are transmitted by fecal-oral route from human to human or animal to human, and drinking water is only one of several possible sources.

Most commonly transmitted diseases and other acute effects can be grouped generally as follows: bacterial diseases; viral diseases; parasitic diseases; and acute chemical poisonings. Most importantly:

Bacterial diseases

Campylobacteriosis: *C. jejuni*, one of the most common causes of human diarrhea. Causes both epidemics and sporadic infections in backpackers. Invades the colon, causing gastroenteritis with symptoms of diarrhea, nausea, vomiting, abdominal cramps, fever and malaise.

Cholera: rare in the U.S., but not in some foreign countries.

Enterotoxigenic *Escherichia coli* Gastroenteritis: uncommon cause of outbreaks in the U.S., but the most common cause of diarrhea in American travelers to foreign countries. Caused large outbreak in 1975 at Crater Lake in Oregon. Some 2,200 persons became ill, some severely, after drinking water contaminated by sewage. Symptoms, often severe, include abdominal cramps, nausea, vomiting and low grade fever.

Salmonellosis: common in U.S., some 2 million cases a year, primarily children under age 5. Usually transmitted via food. Largest waterborne outbreak in the U.S. was in Riverside, CA in 1965, 2,000 cases. Symptoms similar to *C. jejuni.*

Typhoid fever: now uncommon in U.S., and especially rare as waterborne disease.

Shigellosis: waterborne transmission is common source. Causes collitis with ulceration; symptoms include diarrhea and dysentary, fever and grossly bloody stools.

Yersinia enterocolitica Infection: role of water in transmission is uncertain; was found in Washington State in 1981-82 in tofu packaged in untreated spring water contaminated by Yersinia. Symptoms can range from fever and abdominal cramps to pseudo-appendicitis.

Viral Diseases

Hepatitis A: second most commonly reported infectious disease in U.S.; the third most commonly reported cause of waterborne outbreaks in the U.S. Usual enteric symptoms, plus jaundice; may last several months.

Norwalk gastroenteritis: a rather recently discovered virus; 3/4 of the reported outbreaks were waterborne. Short duration, vomiting, diarrhea and headache.

Rotovirus gastroenteritis: also newly recognized. Most common in children, responsible for about half the hospitalized cases of acutely ill children in the U.S. under age 2. Hospitalization is occaissioned by significant dehydration. First outbreak from a waterborne source was at a Colorado ski resort in 1981.

Parasitic Diseases

Amebiosis: common in the U.S., caused by *Entamoeba histolytica*. Mild gastroenteritis, frank dysentery, fever and bloody stools. Waterborne outbreaks now becoming rare.

Giardiasis: caused by the protozoa *Giardia lamblia*, commonly known as "beaver fever". Now the most commonly detected intestinal parasite in the U.S. First waterborne outbreak was identified in Aspen, Colorado in 1964 -65; now on the rapid increase. No longer only a backpackers' disease, carried by rodents and most warm blooded animals such as dogs and deer. Expensive and difficult to monitor for in water supplies, but easily isolated in stools. Symptoms may be severe and continue for months, including epigastric pain, bloating, fatigue and intermittent diarrhea with greasy, malodorous stools. Now the most commonly reported causative pathogen of waterborne outbreaks in the U.S. A recent study by Central Washington State University in Ellensburg showed that in excess of 99% of alpine voles examined were carriers of G. lamblia. These voles live in meadow water courses in alpine areas.

Acute Chemical Poisonings

These are often divided into three groups: flouride, most often due to failure of flouridation equipment; heavy metals; and "others", such as pesticides, solvents and petroleum products. Only this latter category would be expected as a protential problem at Summit Lake. As a group, chemical poisonings are the most commonly recognized cause of illness producing waterborne outbreaks in the U.S. However, this statistic can be misleading. The leading cause in this group is actually contamination of distribution systems by inadequate cross-connection control or backflow prevention programs. Illnesses from synthetic organic contaminants reaching or spilled in surface water sources are relative unusual. Spills producing concentrations likely to cause acute health threats through

drinking water usually are detected early, because of their exceeding the taste or odor threshhold. As will be discussed later, treatment systems are not designed to remove high concentrations of organics unless they are routinely found in the source and there are no source alternatives; or the treatment system is an interim design as a remedial cleanup measure for a contaminated source. It is important, however, that source protection programs include measures to prevent episodes of organic contamination and identify appropriate response procedures. Routine potable water monitoring will detect recurring levels of organic contaminants and treatment systems can generally be retrofitted or modified for their removal. In the design of treatment systems, it is generally not economically justifiable or cost-effective to treat for contaminants that are not normally present or would not normally represent a serious health threat.

* Craun, G.F. Outbreaks of waterborne diseases in the U.S.: 1971-1978, J. Am. Water Works Assoc., 73, 360, 1981.

RESPONSIBILITY OF THE CONSUMER

In the case of individual home drinking water systems, the consumer carries the prime responsibility for the quality of his or her drinking water. If a decision is made not to treat, the consumer should be aware of the risks involved. It is also important that "unexplained" illnesses receive medical attention, and that the patient inform the physician of the unprotected source and untreated supply of drinking water. Although the rise in reported incidence of waterborne disease may be due to better reporting by medical authorities to governmental officials, a study in Colorado a few years ago showed that only one in four cases of waterborne disease is reported as such. Only through early diagnosis and reporting can the remaining potentially affected population be alerted so appropriate precautions can be taken.

Depending on the nature of the transaction, the homeowner may also have the responsibility to inform a buyer of his or her property as to the nature of the unprotected water supply. There could also be considered to exist a moral obligation to inform renters or guests in the home of the potential for contacting illness from drinking untreated water known to contain indicator bacteria.

WATER SUPPLY AND PUBLIC HEALTH

Almost all drinking water in the U.S. comes from surface or groundwater supplies. While groundwater traditionally has generally enjoyed a preferred status, waste handling and management practices are now such that entire aquifers can be threatened or even contaminated. The principal health concern in water supply is to prevent waterborne transmission of infectious disease. As hazardous wastes and man-made synthetic organics have come into common being, water treatment systems must now be designed to protect against these contaminants also. More sophisticated treatment and disinfection techniques are being developed and employed as water supplies receive a wider range of contaminants in increasing concentrations. Meanwhile, new state regulations for drinking water protection, treatment and monitoring are being mandated by changes in the Federal Safe Drinking Water Act, and by implementing regulations being promulgated by the U.S. Environmental Protection Agency.

The earliest water treatment in the U.S. goes back to 1889 when the first modern rapid sand filter was installed in Lawrence, Mass. By 1904, some 10 percent of the urban population drank filtered water, rising to 30 percent in 1914. In 1908, disinfection of Jersey City, New Jersey's water was provided using sodium hypochlorite. Most recently, the concept of "multiple barriers" of treatment, i.e. filtration followed by disinfection, has gained wide acceptance. Either single barrier alone is less effective and can experience periods of little or no effective protection, due to operational problems or other disruptions. Disinfection alone is not effective unless prior treatment has greatly reduced interfering substances and the microbiological population. Similarly, in cases where disinfection has failed or been inadequate, prior filtration or other treatment alone has not been sufficient to prevent transmission of waterborne disease.

Surface sources, such as Summit Lake, and their watersheds are particularly at risk. Wild and domestic animals have been clearly shown to be important sources of giardiasis and other waterborne disease infections. The reporting of disease outbreaks is largely voluntary, and therefore may well understate the actual occurrence of outbreaks. But in the U.S. during the period 1971-1985, more waterborne outbreaks were reported than in any previous 15 year period since

1920. During this 15 year period, 123 outbreaks were attributed to surface water sources that were either untreated or inadequately treated.*

Also during this period 14 percent of outbreaks were attributed to surface water sources that received only inadequate or interrupted disinfection. In these same systems, statistics show a steady increase in the occurrence of giardiasis. *Giardia/lambia* being particularly resistant to disinfectants, require for their inactivation that the water be especially free of interfering substances, and that there be an adequate combination of disinfectant residual and contact time. The disease rate, as a final statistic, for community systems which only disinfected was fourteen times that for surface systems which provided both treatment and disinfection.

*Craun, Gunther F., Surface water supplies and health, J. Am. Water Works Assoc., 80, 40, 1988.

BACTERIOLOGICAL QUALITY OF SUMMIT LAKE

The presence of both total and fecal coliform bacteria in Summit Lake are well documented in the earlier cited study entitled: Summit Lake Water Quality Investigation--Evaluating its Use as a Drinking water Source, and will only be summarized here. Sampling results for bacteriological and certain other water quality criteria are available for eight shoreline and two deep water stations. In addition, eight residences were sampled at the tap (where state and federal maximum contaminant level (MCL) standards are actually applied). Finally, nine inlet streams and Kennedy Creek, the outlet, were also sampled.

The principal conclusion that can be drawn from these 10 months of rather intensive sampling is that the untreated water from Summit Lake is bacteriologically unsafe for human consumption. Fifty-five percent of the tap samples analyzed for bacteria fail the State Department of health MCL for total coliform. No one source of bacteriological contamination exists for easy remedy; creeks, road and surface drainage, septic tank leachates, private drainage systems, wildlife, pet wastes and recreational uses of the lake all contribute. It is also important to note that all the samples taken from the middle of the lake, considered the most representative of general lake quality, failed the total coliform

standard for drinking water, at the tap. The samples did meet water quality criteria for lakes (for other than potable purposes).

The near shore stations showed significant (>50%) fecal contamination. Fecal coliform are found in the intestinal tract of humans and warm-blooded animals, and thus are more serious, indicating the risk of waterborne pathogenic disease. At the tap, samples were somewhat better, 22 percent positive for fecal, but still representing a serious potential for disease presence. The improvement could be caused by home intakes being located in deeper water; this is not known from the data collected during the study. Generally, about 1 in 14 houses disinfect their drinking water. It is very possible that some of these systems are improperly designed, installed, operated or maintained, and may not be achieving adequate disinfection.

The study concludes with recommendations that the 1987 Health Advisory (to boil and/or filter and disinfect lake water for consumption) continue; that a water system feasibility study be undertaken; and that a lake protection strategy be developed.

These are important recommendations. Unfortunately, because of the diffuse nature of the sources of bacterial contamination, no single action short of providing treated and disinfected drinking water for all residents will reduce this contamination to safe levels meeting established health standards.

CHAPTER V

PERFORMANCE AND DESIGN CRITERIA

GENERAL

In this section, the basis for estimating future water use for the Summit Lake service area is established by defining the criteria for the maximum day and peak period water usage. Design criteria for a Summit Lake central system's source, storage, transmission, distribution, and monitoring and control facilities are presented in this section.

WATER CONSUMPTION

A knowledge of the quantity of water required is essential to the evaluation and the planning of water supply systems. Since planning is concerned with water use at some future date, the quantity of water required must be estimated from projected population growth and per capita consumption.

In this analysis, water consumption is expressed in gallons per connection per day (gpcd), and represents the annual average consumption based on all connections to the system and for all uses.

Factors that affect the amount of water consumed include water quality, cost, metered service, commercial and industrial facilities, and water pressure. The cost of delivered water influences water consumption, but is of greatest importance for large consumers. As costs are lowered, consumption increases. The utilization of water meters also has a significant influence on the amount of water consumed. Excessively high pressures in distribution systems result in increased waste of water due to excessively high flow rates and due to potential increased leakage.

A central water system must reliably and economically supply water meeting State standards for drinking water quality in sufficient quantities and pressures to meet existing and projected demands within the planning period. Performance and design criteria upon which the system selection is based are from:

1. Washington State:

(a) State Department of Health (DOH) Drinking Water Regulations (WAC 248-54)

(b) Water System Coordination Act Fire Flow Regulations (WAC 248-57)

(c) DOH Sizing Guidelines for Public Water Supplies

(d) DOH Planning Handbook: A Guide for Preparing Water System Plans

2. Other:

(a) Recommended Standards for Water Works, Policies for Review and Approval of Plans and Specifications for Public Water Supplies, A Committee Report of the Great Lakes - Upper Mississippi River Board of State Public Health and Environmental Managers (often referred to as "Ten States Standards"), 1987 Edition.

(b) Thurston Co. Design Standards for Public Water Systems, adopted August 5, 1985. These are included in the Appendix for reference only, as they only apply to the Thurston County Urban Water Supply Service Area.

(c) Insurance Services Office Guide for Determination of Required Fire Flow

SOURCE CAPACITY CRITERIA

The Washington Department of Health, in "Sizing Guidelines for Public Water Supplies", recommends minimum production capability of the source and associated pumping equipment, for systems located west of the Cascade Mountains, of 800 gallons per residential connection per day, to meet water demands for domestic

uses, commercial, industrial and industrial uses, and large tract irrigation. This allowance is intended to represent an average maximum day demand for public water systems throughout the State of Washington to be used only when actual system demand data is not available. Maximum day demand is defined as the greatest volume of flow into the system for any day of the year. Ten States Standards contains a similar recommendation that the total source capacity equal or exceed the design maximum day demand. For this study, source capacity will be considered adequate if it equals or exceeds the design maximum day demand, as recommended by DOH and Ten States Standards guidelines. Obviously, this is not a concern for Summit Lake as the source, but it would be for groundwater (wells).

For source reliability, Ten States Standards recommends that the total capacity of the source equal or exceed the design average day (maximum day) demand with the largest producing well out of service. This criteria will be used to evaluate source reliability in this plan, in the case of the well alternative.

FIRE FLOW REQUIREMENTS

The amount of water required for fire-fighting purposes is specified in terms of rate of flow (in gallons per minute) and an associated duration of time (in minutes). Fire flows should be delivered at a system residual pressure of at least 20 psi. The fire-fighting demand required for a specific building depends on its type of construction, floor area, height, type of occupancy, and other factors. The fire-fighting demand for an area that contains more than one building is usually assumed to be equal to the fire-fighting demand of the building within the area that has the largest fire-fighting demand.

The Insurance Services Office (ISO) of the Municipal Survey Service provides guidelines for the determination of required fire flows. The Washington Surveying and Rating Bureau uses these guidelines to establish minimum fire protection requirements for existing residential, commercial, industrial, and institutional facilities.

The "Water System Coordination Act Fire Flow Regulations" (WAC 248-57) establishes minimum performance standards related to fire protection for new and

expanding public water systems. These minimum fire flow requirements are shown in Table 9.

TABLE 9

MINIMUM FIRE FLOW REQUIREMENTS*

Development Classification	Minimum Fire Flow Requirements
Residential	500 gpm/30 min.
Commercial & Multifamily Structures	750 gpm/60 min.(1)(2)
Industrial Facilities	1,000 gpm/60 min.(2)

* Water System Coordination Act Fire Flow Regulations (WAC 248-54)

(1) Greater than 4,000 square feet

(2) May be subject to higher flow requirements when evaluated on an individual basis

STORAGE CAPACITY CRITERIA

Water reservoirs provide water to meet the normal fluctuations in demand occurring throughout the day and to equalize water system pressures, to meet emergency demands from a failure in the water system, and to meet demands for fighting fires. Storage capacity requirements are therefore usually based on three components:

(1) Equalizing (operating) storage;

(2) Emergency (standby) storage; and

(3) Fire flow storage.

Treatment facilities and pumping units are normally operated at a uniform rate to meet the average demand for the day. Equalization storage is used to meet demands during periods of the day in which instantaneous demand is greater than the average demand. The volume of equalizing storage depends on the magnitude of diurnal variations in system demand, the source production rate, and mode of system operation.

Emergency storage is provided to meet demands of a source failure, pump failure or a break in a transmission line. The amount of emergency storage should be based on the reliability of supply and pumping equipment, standby power sources, and the anticipated length of time the system could be out of service.

Fire flow storage is provided to insure that the volume of water required for fire-fighting will be available on demand. When stored water is available for fire-fighting, the impact of fire-fighting on the water pressure in the distribution system is reduced. The rate at which water must be supplied to fight a fire is so great that fire flows usually account for the largest short-term increases in demand placed on a water system.

Table 10 lists the storage requirements specified by the Department of Health and typically used by municipal water system engineers.

TABLE 10

SUMMARY OF STORAGE VOLUME REQUIREMENTS

	DOH	Conventional Design
Equalizing Storage Volume	Difference between max. instantaneous demand and source production rate multiplied by 150 min. (1) or based on mass analysis of hourly demand data for maximum day	25% of vol. used on the max. day
Emergency Storage Volume	200-800 gallons per residential connection, depending on the total system pumping capacity with the greatest capacity pump out of service	100% to 300% of vol. used on max. day
Fire Flow Storage Volume	Not specified	reqd. fire flow rate multiplied by reqd. duration
Total Storage Volume Required	No specified	Sum of equalizing, emergency and fire flow storage volumes

Notes:

(1) Sizing Guidelines for Public Water Supplies.
(2) Presumably for maximum day; in units of gpm.
(3) If pumping is based on reservoir levels.
(4) If pumping is on a continuous basis to provide the average demand for the day.

In this plan, criteria recommended by DOH will not be used because maximum instantaneous demand data are not available to calculate equalizing storage volume. Required storage volumes will be calculated with criteria conventionally used in municipal engineering, as summarized in Table 10.

PRESSURE REQUIREMENTS

Water distribution systems should be designed to maintain operating pressures within the system between 40 and 80 pounds per square inch at ground elevation. A minimum residual pressure of 30 psi in water mains should be maintained under maximum demand flow conditions, excluding fire demand. Water systems should also be able to maintain, under fire flow conditions, positive pressure throughout the system, and a 20 psi residual pressure in the mains supplying the fire hydrants in use. Maximum pressures of 100 pounds per square inch can be allowed in small, low-lying areas not subject to high flow rates and surge pressures.

PIPELINE SIZING

The diameters of pipes within a water distribution system should be sized to deliver water needed for the purpose of fighting fires, in addition to requirements for normal maximum demands, while maintaining the pressure requirements described above. To minimize head losses due to friction and to reduce the possibility of severe water hammer, pipe diameters should be sized so that water velocity is not greater than eight feet per second during fire flows, or five feet per second during the maximum day demand.

The minimum diameter of distribution mains should be six inches unless a smaller diameter is justified by hydraulic analysis. For diameters greater than six inches, minimum main size should be established using recognized hydraulic analysis techniques.

The minimum diameter of mains serving fire hydrants should be six inches if looped or eight inches for a dead-end line.

Fire hydrants should be installed at all intersections. Hydrant spacing in commercial, industrial and multiple family residential districts should not exceed 330 feet. The spacing in single family residential districts should not exceed 600 feet. Any hydrant branch exceeding 50 feet in length should be eight inches in diameter. No more than one hydrant should be installed on any dead-end eight inch branch.

Valves should be installed at intersections, with a normal maximum of 800 feet in the distribution system. Valve spacing in commercial, industrial and multiple family residential districts should not exceed approximately 500 feet or one-quarter mile in arterial mains. Auxiliary valves should be installed on each hydrant branch.

SOURCE REQUIREMENTS

Water Quantity

As discussed above, DOH recommends that a public water system provide a minimum supply of 800 gallons per residential connection. It is recommended that a central Summit Lake system provide a supply equal to the maximum daily demand. For the alternative in which the source of supply is from wells, it is recommended that the system be capable of meeting the maximum day demand with the largest well out of service, or that the well sources be provided with an auxiliary source of power to insure water supply during periods of power outages.

Water Quality

A public water system must furnish its consumers with safe, palatable water. Safe water may be defined as water free of pathogenic organisms, toxic substances and excessive amounts of mineral and organic matter. Palatable water may be defined as water free or nearly free of color, turbidity, taste and odor, of moderate temperature and aerated for freshness of taste.

Source waters for public water supplies are never found in a pure state. During normal passage through the atmosphere, over the surface of the earth, or through the pores of the ground, water acquires numerous impurities. Depending upon the type and concentration, some of these impurities may not be harmful and, in fact, may be beneficial. The presence of other impurities may be so objectionable as to preclude use of the water for a public supply. Therefore, to assure the greatest possible protection to health, enjoyment, and usefulness, standards of acceptability are established which define not only the types of impurities a supply may contain, but also the maximum permissible concentrations of these impurities.

The State of Washington Department of Health, under WAC 248-54, has established rules to protect the health of consumers using public water supplies, and to provide the basic regulatory requirements for provision of high quality drinking water. They establish standards which specify watershed protection requirements for surface public water systems, the minimum degree of treatment for all water supplies, maximum contaminant levels (MCLs) for physical, chemical and bacteriological constituents of finished water, and monitoring and operating procedures for public water systems. Again, it is pointed out that no "public water system" exists presently at Summit Lake. These rules would apply were one to be found. However, since these standards represent a level of quality that will ensure the protection of public health, they should be applied to any source being evaluated for potable purposes, and any system used for treatment and disinfection. At law, however, they are not enforceable for individual supplies or systems not qualifying as a "public water system" under the DOH rules.

Monitoring of the water quality is required by DOH to insure that a high water quality is maintained. Table 11 presents the DOH monitoring requirements and indicates the sampling and analysis frequency.

TABLE 11

WATER QUALITY MONITORING REQUIREMENTS

Monitored	Frequency
Coliform testing	Monthly samples with follow-up samples for positive results and source sampling every three months.
Turbidity	For surface water sources: currently one sample daily at or before point of entry to distribution system; will change with new surface water treatment rules.
Inorganic chemicals and physical parameters	One sample for each groundwater source every three years; every 12 months for surface water.
Trihalomethanes	No monitoring required at this time (pop. <10,000).
Pesticides	For surface water sources, one sample every three years.
Volatile organic chemicals	Quarterly monitoring first year; repeat schedule based on vulnerability.
Synthetic organic and inorganic chemicals (new rules)	Scheduled to be implemented in 1992.
Radionuclides	Currently every four years; new rules scheduled to be implemented in 1994.
Corrosion Control/ Lead Monitoring (new rules)	Scheduled to be implemented in 1992.

Presently, community systems are required to monitor total coliform levels in the distribution system. EPA promulgated a new Total Coliform Rule in June 1989. DOH is required to revise their standards to meet the requirements of this new Total Coliform Rule by January 1991. DOH plans to propose revised standards in spring of 1991 and to implement the revisions in fall of 1991. Changes mandated by the new Total Coliform Rule include:

- Compliance based on presence/absence of total coliforms rather than estimated density.

- MCL for systems analyzing less than 40 samples per month: no more than one sample per month may be coliform - positive.

- A system must collect a set of three (3) repeat samples for each total coliform - positive sample within 24 hours of being notified of the original result.

- All total coliform samples count in compliance calculations, except those samples invalidated by DOH.

- If any routine or repeat sample is total coliform - positive, the system must analyze that total coliform culture to determine if either fecal coliforms or *E. Coli* are present. DOH must be notified the same business day if fecal coliforms or *E. Coli* are detected.

- The total coliform analyses are to be conducted using the 10-tube MTF technique, 5-tube MTF Technique, or the P-A coliform test of the minimal media ONPG-MUG Test.

Additional monitoring requirements may result when EPA promulgates the new corrosion control/lead monitoring rule, scheduled for early in 1991. Under the proposed rule, systems serving fewer than 50,000 people must implement corrosion control if average lead levels exceed 0.01 mg/l, in 5 percent of the samples or a pH of less than 8.0 in 5 percent of the samples. The samples are to be collected at the customer's tap in the first draw in the morning from targeted high risk locations.

The timetable for EPA promulgation and DOH implementation of the lead rule is uncertain at this time.

MONITORING AND CONTROL SYSTEM

A monitoring and control system should be capable of providing adequate data to allow operation of the system efficiently and allow informed planning decisions about the water system. As a minimum, records should indicate the amount of supply produced, booster pump station pumping volumes, and the volume of water metered at the individual service connections. It is desirable to have a central location where the status of all the systems facilities can be monitored. Table 11 presents suggested monitoring capabilities.

TABLE 12

RECOMMENDED MONITORING CAPABILITIES

Facility	Monitoring Capability
Well Source or Intake Pumping Station	-on/off status -power status -production rate and total flow -water level -system pressure
Treatment Facility	-on/off status -power status -flow rate and total flow -process parameters
Booster Pump Station	-on/off status -power status -flow rate and total flow -suction and discharge pressure

Reservoir	-water level
	-overflow status

Control features may be added to a central monitoring station to allow the operation of system components from a remote location.

SUMMARY: A BASIS FOR DESIGN

These requirements of Federal and State law for public water systems can also be thought of as "criteria for a safe water supply". They form the basis for design of any complete public water system, and can be summarized from the above requirements as follows:

1) Existence of a watershed protection and control program (or in the case of groundwater, a wellhead protection program). While this program is separate from the installation of a treatment system, it is a necessary adjunct to a complete treatment program, to insure continued viability of the source.

2) Provision of the minimum degree of treatment to protect against those contaminants for which a monitoring standard cannot be set.

3) Proper design of the system to insure that the maximum contaminant levels (MCLs), established both as primary (health) standards and secondary (aesthetic) standards, are met. The primary MCLs are enforceable at law.

4) Adequate monitoring to insure finished water is meeting the MCLs estalbished to protect public health. The DOH monitoring requirements do not apply to individual home treatment systems.

5) An operation and maintenance program to insure continued optimal performance of system components, so that public health is protected at the lowest practical cost and risk.

CHAPTER VI

A CENTRAL SYSTEM

REQUIREMENTS

The water system requirements will be determined for the Lake Management District assuming that the entire District will become a single water service area. The facilities within the service area will include either groundwater or surface water supplies, a treatment plant, storage facilities, and the means to distribute the water to individual consumers. The requirements for the proposed facilities must be evaluated in terms of meeting the existing and future population needs. Presently, there are 455 developed lots within the Lake Management District that could be connected to the proposed water system. The number of existing developed lots was determined from Table 2 and included both year-round and seasonal residences. There are an additional 172 lots that are undeveloped which will be included as the potential for future growth and connections to the water system. The future requirements of the water system will therefore be based on a total of 627 connections.

SUPPLY

Table 13 presents the present and future requirements for supply for the service area. The total supply required is shown in both gallons per day (gpd) and gallons per minute (gpm). A 37% increase in supply capacity would be required to meet the needs of future growth in the service area.

TABLE 13
SERVICE AREA SUPPLY REQUIREMENTS

	NO. OF CONNECTIONS	SUPPLY REQUIRED PER CONNECTION	TOTAL SUPPLY REQUIRED	REQUIRED CAPACITY
Present	455	800 GPD	364,000 GPD	255 GPM
Future	627	800 GPD	501,600 GPD	350 GPM

STORAGE

Storage facilities are sized based on the emergency, equalizing and fire flow storage required for the service area. The emergency storage is recommended to be equal to the maximum day demand of the service area, which is defined as equal to the supply capacity. Equalization storage is defined as equal to 25% of the maximum day demand. Fire flow is based on DOH standards (WAC 248-57) of 750 gpm for 60 minutes for commercial and multi-family land uses and 500 gpm for 30 minutes for residential land uses. It is recommended that the system be designed to meet fire flow of 750 gpm for 1 hour which will meet the highest flow requirements for the service area. Table 14 shows the existing and future storage requirements for the service area. The existing number of connections would require 500,000 gallons of storage to provide adequate emergency equalization and fire flow storage. A 34% increase in storage capacity would be required to meet the needs of future growth in the service area.

TABLE 14

SERVICE AREA STORAGE REQUIREMENTS
(IN GALLONS)

	PRESENT	FUTURE
Emergency	364,000	501,600
Equalization	91,000	125,400
Fire Flow	45,000	45,000
TOTAL:	500,000	672,000

The storage reservoirs should be located at an elevation which will provide adequate water pressure to the services in the system. The highest elevation in the Lake Management District is approximately 920 feet. The lake surface elevation is approximately 456 feet. Most of the developed lots are adjacent to the lake and are below the 525 foot elevation. Typically, one reservoir 46 feet in diameter and 40 feet tall would be provided initially with a smaller second reservoir located at the other end of the developed service area provided for future growth. It is

recommended that the reservoir be established at a location which will provide a static water pressure of 50 psi at the 525 foot elevation. The reservoir overflow should be placed at an elevation of 640 feet. The height of the reservoir should be approximately 40 feet so there is only a 20 psi pressure difference in the system between when the tank is full and when it is empty. Water pressure for the upland lots can be established with a smaller reservoir located at a higher elevation or by using booster pump stations.

TRANSMISSION AND DISTRIBUTION

The minimum transmission and distribution main sizes are determined by the fire flow requirements, which are greater than the maximum day demands. Table 15 shows the volume of water a dead-end water main can deliver at a velocity of 8 feet per second (fps). Looped lines can deliver twice the volume of a dead-end main. Dead-end mains serving residential land use areas with a fire flow of 500 gpm should have a minimum diameter of 6 inches. Dead-end mains serving commercial and multi-family land use areas should have a minimum diameter of 8 inches. A looped 6-inch main is adequate to serve all land use areas within the proposed service area. If there is sufficient pressure head on the distribution system, a 6-inch diameter main circling Summit Lake would be adequate to meet fire flow requirements.

TABLE 15

FLOW (GPM) IN WATER MAINS
AT 8 FEET PER SECOND

LINE SIZE	DEAD-END	LOOPED
4"	313	626
6"	705	1,410
8"	1,250	2,500
10"	1,960	3,920
12"	2,820	5,640

Individual services should have meters to monitor consumption; since the service area contains both vacation and year-round residences, it will be important to base billings on water use.

SURFACE WATER TREATMENT

The EPA's new Surface Water Treatment Rule (SWTR) establishes the filtration and disinfection requirements for public water systems using surface water sources. If the centralized water system alternative is pursued and Summit Lake is used as the source of supply, then requirements of the SWTR will have to be met. EPA has published a guidance manual for advising state agencies on how to comply with the SWTR. The guidance manual establishes criteria to determine whether filtration is required, how disinfection will be practiced, provides reporting requirements and sets a schedule for compliance. When the State Department of Health (DOH) adopts its new surface water treatment rules, they must be at least as stringent as EPA's.

The general criteria for determining if a surface water source must be filtered are:

1. Total and Fecal Coliform Concentrations
2. Turbidity Levels
3. Disinfection Guidelines

The fecal coliform levels must be below 20 per 100 ml or the total coliform levels less than 100 per 100 ml prior to disinfection, in 90 percent of the samples taken in the previous 6 months. Two samples a week would be required for a system the size of the proposed centralized water system. Turbidity levels in the water prior to disinfection cannot exceed 5 Nephelometric Turbidity Units (NTUs) based on grab samples collected every four hours or on a continuous basis. The disinfection guidelines include criteria for *Giardia* cyst and virus inactivation, disinfectant residual levels and disinfection system redundancy.

In addition to the general criteria, there are site-specific conditions that must be met to satisfy the requirements for not providing filtration. These site-specific conditions include:

1. A watershed control program.
2. On-site inspections.
3. A history of no waterborne disease outbreaks.
4. Compliance with the Total Coliform MCL.
5. Compliance with the Total Trihalomethane (THM) MCL.

Three of these conditions are most important in evaluating whether a source on Summit Lake would be required to be filtered. The lake water turbidity and coliform levels should be established to determine if these general conditions are met. The one site-specific condition that must be analyzed is the ability to institute a watershed control program. The remainder of the conditions would be dependent on the operations of a centralized water system practicing only disinfection.

Based on the results presented in "Summit Lake Water Quality Investigation", (Davis and Gooding, 1988) the total coliform criteria for requiring filtration was exceeded seven times and the fecal coliform criteria was exceeded five times between October 1986 and July 1987. This represents approximately 9% and 6% of the samples taken in this period. Over 90% of the samples taken during the study met the total and fecal coliform criteria. The monitoring program mandated by the SWTR would require approximately the same number of samples as collected in the study.

Limited turbidity data collected on Summit Lake, two samples, would indicate that the turbidity is quite low, but additional sampling would be required to establish annual turbidity limits. (A single recent sample from a resident tap showed a turbidity level of 0.9 NTU.)

A watershed control program would be required to exhibit that the utility system can control access and activities in the watershed of a drinking water source. Clearly this is impossible for the Summit Lake watershed. The shoreline of the

lake is almost completely developed and there is no centralized sewage collection system to dispose of domestic sewage. Most sewage disposal is accomplished by septic tanks or outhouses.

Based on the present Summit Lake water quality, the potential for future degradation of the water quality and the inability to control access and activities in the watershed of Summit Lake, it is reasonable to assume that if the lake is used as the source of supply, it will be necessary to provide both filtration and disinfection to meet requirements of the SWTR. This assumes that a "public water system" is formed which becomes subject to state and EPA regulation. It would not appear practical, if even possible, for an entity to establish controls over the activities and land uses in the Summit Lake watershed that would be required as part of a watershed control program acceptable for continued use of the lake for a water supply source without filtration. Many of the current activities, such as boating, swimming and fishing, would have to be curtailed, a centralized sewage treatment system constructed and the watershed managed so as to preclude or control activities that would be potential sources of contamination. There is no apparent alternative to adequate filtration and disinfection if Summit Lake is to continue as a source of drinking water.

FILTRATION ALTERNATIVES

Filtration is generally provided by passing water through a bed of sand, a layer of diatomaceous earth or a combination bed of coarse anthracite coal overlaying finer sand. Filters are classified and named in a number of ways. For example, based on application rate, sand filters can be classified as either slow or rapid; yet these two types of filters differ in many more characteristics than just application rate. They differ in their removal process, bed material, method of cleaning, and operation. Based on the type of bed material, filters can be classified as sand, diatomaceous earth, dual-media (coal-sand) or even multi-media in which a third layer of high density sand is used.

Current technologies that are in practice include:

1. Conventional Treatment (CT)
2. Direct Filtration (DF)
3. Slow Sand Filtration (SSF)
4. Diatomaceous Earth Filtration (DE)
5. Package Treatment Plants (PTP)

Conventional Treatment

The term *"conventional"* treatment denotes a water treatment technique that includes flocculation, sedimentation, and filtration processes. There are accepted design criteria for sizing each of the processes used in conventional water treatment plants. Conventional water treatment may be appropriate when the raw water quality is not known or the raw water turbidity is high (>25 NTU). Treatment technologies that are less expensive than conventional treatment will provide an excellent quality finished water. The following is a discussion of the water treatment technologies that will be considered for the water treatment plant. See Figure 4 for depiction of a conventional treatment process.

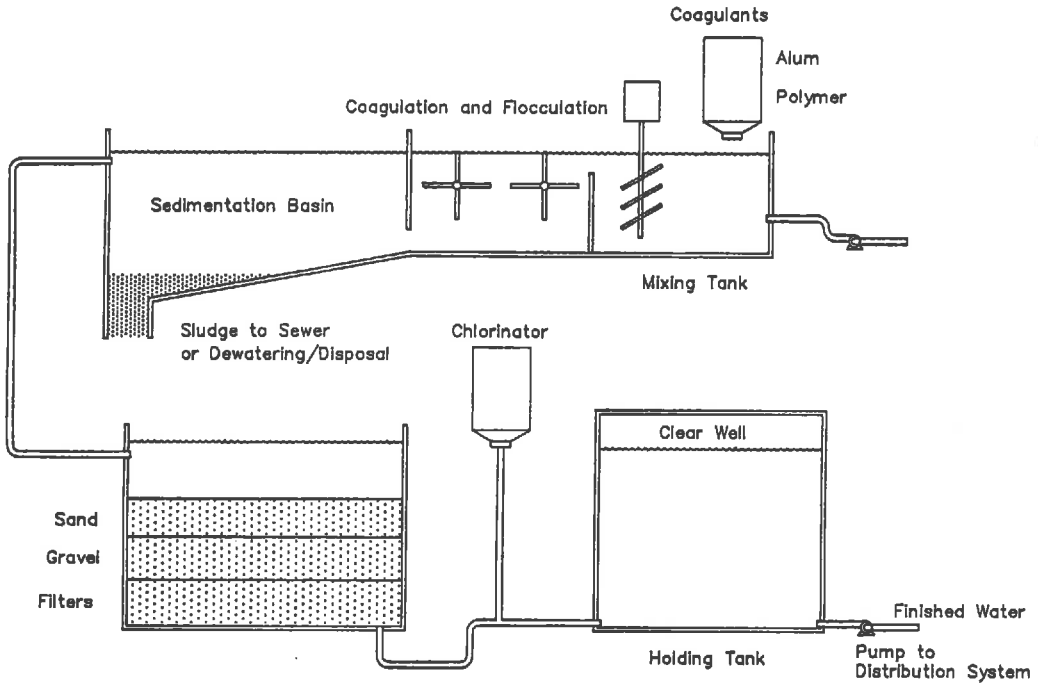


FIG. 4. CONVENTIONAL TREATMENT SCHEMATIC

Direct Filtration

A direct filtration plant can include several different pretreatment unit processes, prior to filtration, depending upon the application. In its simplest form, the process includes only in-line filters preceded by chemical coagulant application and mixing. The mixing requirement can be satisfied by influent pipeline turbulence when the chemical coagulant is added to a pump impeller casing. In larger plants with gravity filters, an open rapid-mix basin with mechanical mixers may be used.

Figure 5 illustrates the unit processes of a typical direct filtration plant. Note that this is similar to the conventional process, but that it lacks the sedimentation step.

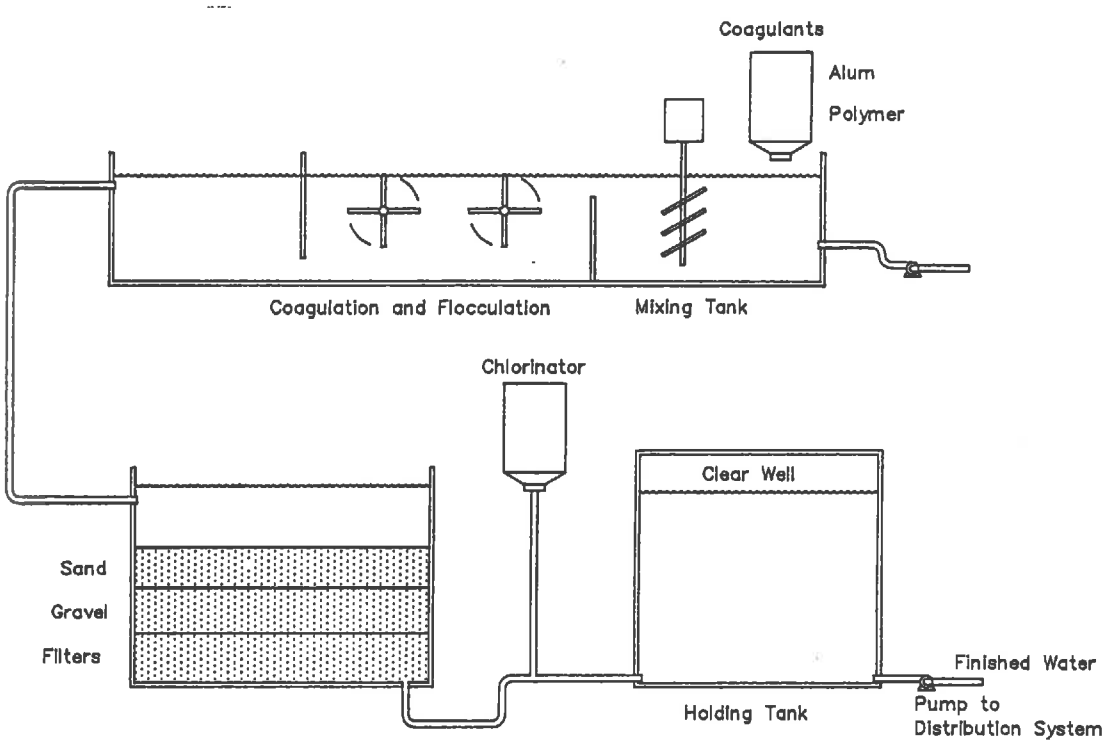


FIG. 5 DIRECT FILTRATION SCHEMATIC

Another variation of the direct filtration process consists of the addition of a coagulant to the raw water followed by rapid mixing and flocculation. The chemically conditioned and flocculated water is then applied directly to a dual or mixed-media filter. Flocculation results in better performance of certain dual-media filter designs for specific water supplies.

Since all solids removal in direct filtration takes place in the filters, this process is limited to raw water turbidities of less than approximately 14 Nephelometric Turbidity Units (NTUs). The principal advantage of direct filtration is that cost savings up to 30% can be realized when compared with conventional water treatment plants, as a result of elimination of the sedimentation basin and equipment. Additional cost savings may be realized in decreased chemical use because it requires less coagulation to produce a filterable floc compared to a settleable floc. The quantity of sludge produced by direct filtration is less than that produced by conventional treatment.

Disadvantages to the direct filtration process may include shorter filter run times, inability to treat high turbidity raw water, and increased backwash water requirements. Direct filtration plants may also require more operator attention to produce a high quality effluent than a conventional plant.

Several types of filters are appropriate for the direct filtration process. Automatic Valveless Gravity Filters (AVGF) units presently have the advantage of being simple to operate, minimum maintenance, and small energy requirement. The disadvantage to these units is that they are expensive to enclose by a building because they are 21 feet tall. When placed outside the units are subject to freezing and corrosion.

Several suppliers have pre-engineered direct filtration units that utilize both dual and mixed media filter beds. These units include the piping and valving necessary to provide automatic backwash of the filters initiated by either headloss, increasing treated water turbidity or by both. The advantage of these units over the AVGF units is that the effluent from the filter can be monitored and a backwash initiated when the effluent turbidity reaches some preset level. AVGF units backwash when the headloss reaches a certain level but a breakthrough of

turbidity may occur prior to the headloss reaching that level. The predesigned filter units are typically designed based on a loading rate of 5 gpm/ft^2. The filter bed media can be either a dual or mixed media. The disadvantage of predesigned filter units with automatic backwash is that they require a high volume of backwash water which is typically supplied by a pump. This backwash pumping increases power demand resulting in greater expense. The greater volume of water required for backwashing results in less net production of treated water.

Slow Sand Filtration

The slow sand filtration process differs significantly from conventional and direct filtration. In addition to having a much lower loading rate (0.05 to 0.10 gpm/ft^2), slow sand filters:

1. Use biological processes as well as physical-chemical processes for solids removal.

2. Use smaller sand particles in a single media filter bed.

3. Are not cleaned by backwashing but rather the top layer of sand media is removed.

4. Have longer run times before head losses require media cleaning.

5. Require a period of ripening before the filter can be put into service.

6. Require a high quality raw water with little variation in raw water quality.

Since slow sand filters have much lower loading rates than the conventional or direct filtration process, they require more area. Slow sand filters have the advantage of being simple to operate and inexpensive to maintain. See Figure 6 for components of this process.

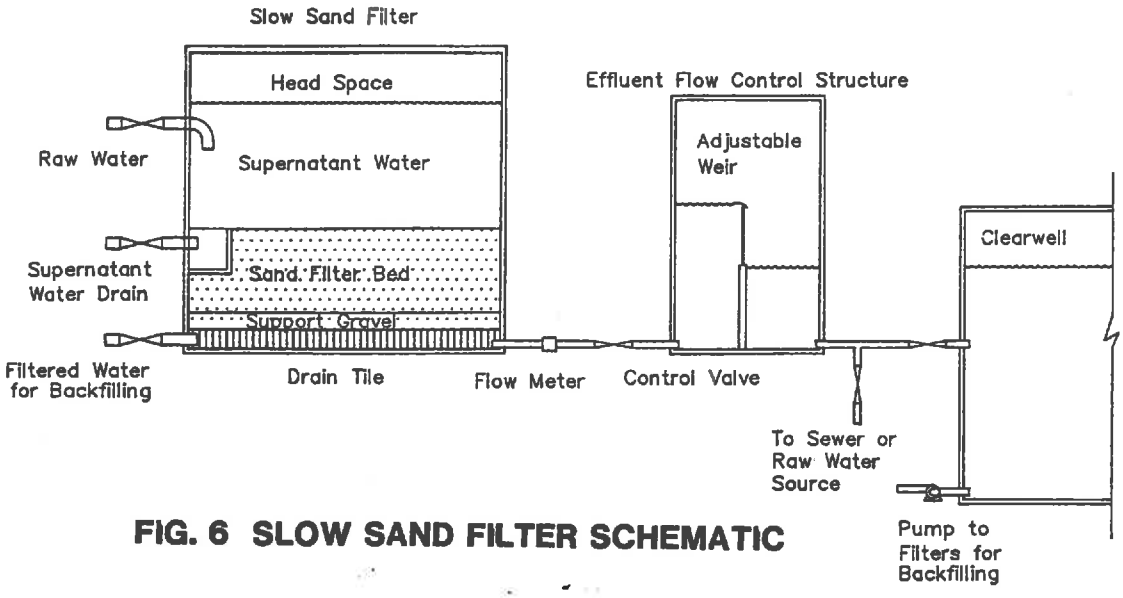


FIG. 6 SLOW SAND FILTER SCHEMATIC

Design Considerations

Slow sand filters are typically constructed as covered concrete basins with a 30-42 inch deep uniform sand filter bed over a 1 foot layer of support gravel. The filters have a loading rate of 0.5 to 10 gpm/ft^2. Two filters are required so water production is not interrupted during the required ripening period and during cleaning. A minimum of one foot of water must be maintained over the top of the sand filter and flow through the filter must be continuous and uninterrupted to assure optimum performance.

Cleaning is accomplished by scraping off 1 or 2 inches from the surface. Typically, once the depth is reduced to 24 inches, new sand is added. The sand has an effective size of 0.25 to 0.35 mm, and a uniformity coefficient of 2 to 3. Effective size is defined as the 90% retained size of the sand; therefore, 10% of the sand is finer than the effective size and 90% is coarser. The uniformity coefficient is determined by dividing the 40% retained sieve size by the effective size. The larger the uniformity coefficient, the less homogeneous the sand is.

Slow-sand filters produce poorer quality finished water at the beginning of a run (right after scraping), and require a filter-to-waste (or ripening) period of 1 to 2 days before being used to supply the system. A ripening period is an interval of time immediately after a scraped or resanded filter is put back on-line, in which the turbidity is significantly higher than the normal operation mode.

Diatomaceous Earth Filtration

Diatomaceous earth (DE) filtration, also known as precoat or diatomite filtration, is applicable to direct treatment of surface waters for removal of relatively low levels of turbidity and microorganisms.

Diatomite filters consist of a layer of DE about 3 mm (1/8 inch) thick supported on a septum or filter element. The thin precoat layer of DE must be supplemented by a continuous body feed of diatomite, which is used to maintain the porosity of the filter cake. If no body feed is added, the particles filtered out will build up on the surface of the filter cake and cause rapid increases in headloss. The problems inherent in maintaining a perfect film of DE on the septum have restricted the use of diatomite filters for municipal purposes, except under certain favorable raw water quality conditions, i.e., low turbidity and good bacteriological quality. Figure 7 depicts this process.

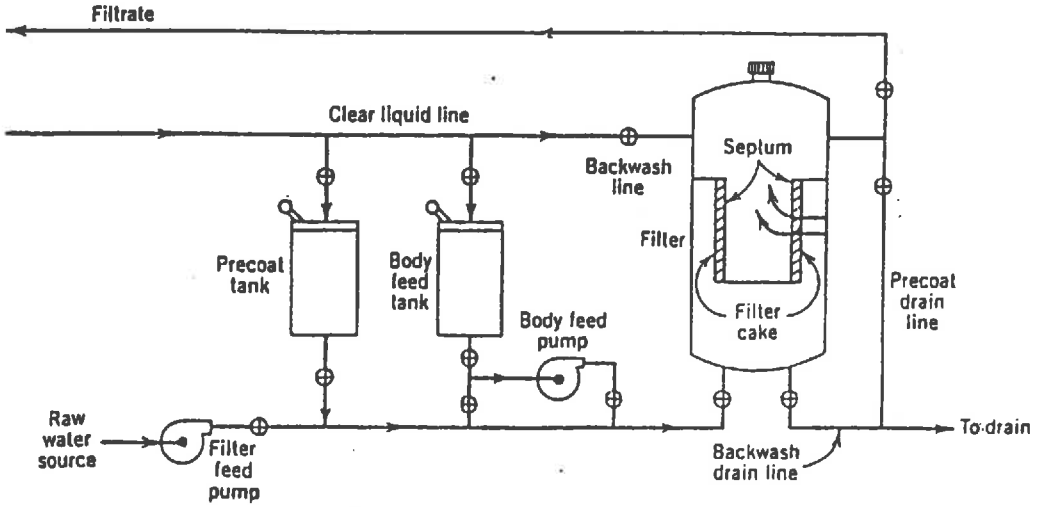


FIG. 7. DIATOMACEOUS EARTH FILTRATION

Package Plants

Package plants are not a separate technology in principle from conventional or direct filtration technology. They are, however, different enough in design criteria, operation and maintenance requirements that they should be handled as an alternate technology. The package plant is designed as a factory-assembled, skid-mounted unit generally incorporating a single, or at the most, several tanks. A complete treatment process typically consists of chemical coagulation, flocculation, settling and filtration. Package plants generally can be applied to flows ranging from about 25,000 gpd to approximately 6 mgd. Several types of treatment processes are used in package plants; three are listed below.

Conventional Package Plants

Package water treatment plants are available from several manufacturers in a wide range of capacity, incorporating a complete treatment process (coagulation, flocculation, settling, and filtration). Design criteria used for these package plants varies widely. Some manufacturers adhere closely to accepted conventional design practices such as 20- to 30-minute flocculation detention time, a 2-hour sedimentation detention time and rapid sand filters rated at 2 gpm/sq. ft. Other manufacturers have utilized new technology including tube settlers and high-rate dual and mixed-media filters to reduce the size of a plant and hence extend the capacity range of single factory-assembled units.

Tube Type Clarification Package Plants

A flow diagram for a package plant incorporating tube settlers is shown in Figure 8. The coagulant chemicals are added at the influent control valve. A polyelectrolyte coagulant aid is supplied as the water enters the flash mix chamber or static mixer. After the treatment chemicals are added and mixed, the water is introduced into a mechanical flocculator. Flocculation detention time can vary from 10 minutes in small units to 20 minutes in larger units. The flocculated water is then distributed through a bank of tube settlers, which consist of many 1-inch deep, split-hexagonal-shaped passageways that provide an overflow rate, related to available settling surface area, of less than 150 gpd/sq ft. This overflow

rate, together with a settling depth of only 1 inch, can result in effective removal of flocculated turbidity with a detention time of less than 15 minutes.

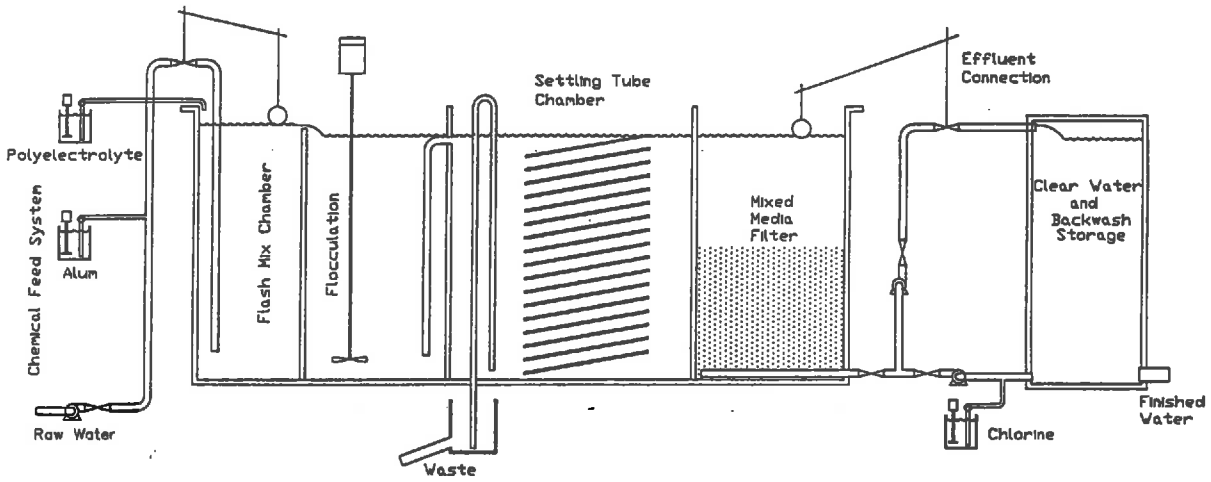


FIG. 8 TUBE TYPE CLARIFICATION PACKAGE PLANT SCHEMATIC

After passing through the tube settlers, the clarified water flows to a gravity mixed-media filter. The filters are designed to operate at a constant flow rate. The package plant filter is designed to backwash automatically once a preset filter headloss is reached. The operator may override the automatic controls and backwash the filter manually. During backwash, the material accumulated in the tube settlers is automatically drained from the unit.

Adsorption Clarifier Package Plant

A package plant manufacturer introduced a new concept in package water treatment plant design in the early 1980s that utilized an upflow filter of low-density plastic bead media (sometimes called an adsorption clarifier), followed by a mixed-media filter for final polishing. The adsorption clarifier replaces the flocculation and settling processes and results in an extremely compact unit. Figure 9 is a flow diagram of an Adsorption Clarifier Package Plant illustrating the operating cycles. During operation, chemically coagulated water is introduced into the bottom of the adsorption clarifier compartment where it passes upwards through a bed of buoyant adsorption media. The adsorption clarifier combines the processes of coagulation, flocculation, and settling into one unit process.

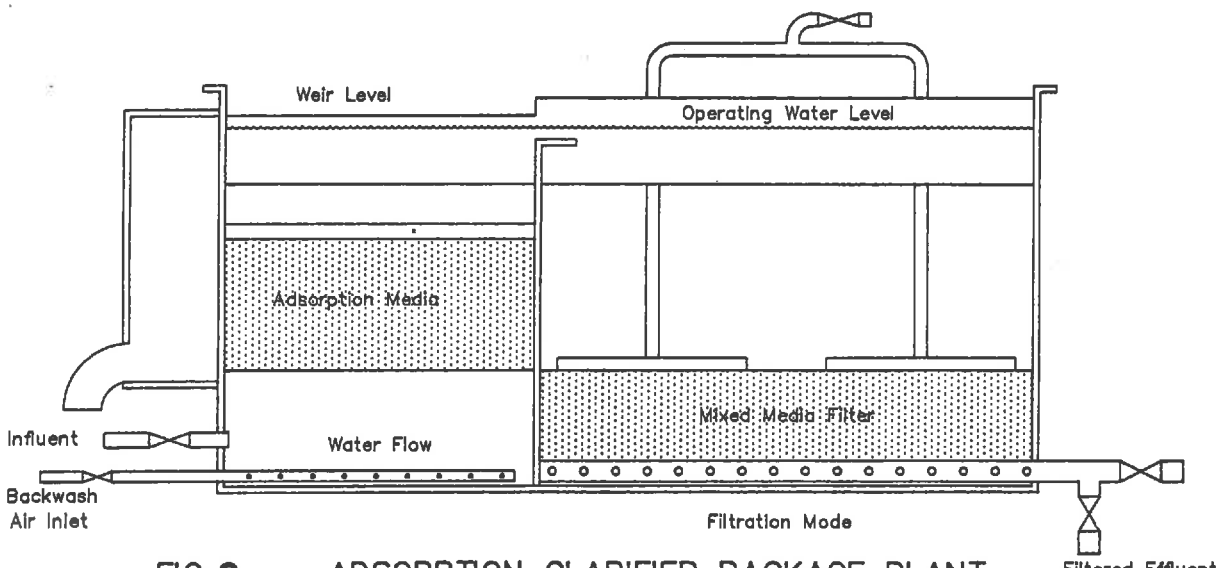


FIG. 9 ADSORPTION CLARIFIER PACKAGE PLANT

In passing through the adsorption media, the chemically coagulated water is subjected to: (1) mixing, (2) contact flocculation, and (3) clarification. At operating flow rates, the mixing intensity defined by the mean temporal velocity gradient value, G, ranges from 150 to 300 sec^{-1}. Flocculation is accomplished by turbulence as water passes through the adsorption media and is enhanced by contact with flocculated solids attached to the media.

Turbidity removal in the adsorption clarifiers is accomplished by adsorption of the coagulated, flocculated solids on the surfaces of the adsorption media and on previously attached solids. The adsorption clarifier provides pretreatment, which may be better than the performance achievable with complete flocculation and settling processes. Turbidity removal in this stage may range up to 95 percent.

Cleaning of the adsorption clarifier is accomplished by flushing. This flush cycle is initiated by a timer, but the equipment also includes a pressure switch that monitors headloss across the adsorption media and can automatically initiate a flushing cycle if required. Air is distributed through perforated laterals beneath the adsorption media. This causes an immediate expansion in the adsorption media and a vigorous scrubbing action takes place. Dislodged solids are then hydraulically flushed out of the top of the adsorption clarifier to waste. Influent water is used to flush the adsorption clarifier. Flushing frequency may vary, depending upon influent water quality. Typically, the controls are set up to initiate a flushing cycle every 4 to 8 hours. Unlike conventional filters, complete cleaning of the adsorption clarifier is not required, as the majority of solids are removed by the violent agitation provided during the first minutes of the flush cycle. Also, more efficient performance of the adsorption clarifier occurs if some residual solids are left on the media.

The mixed-media filter is backwashed in a manner similar to a conventional filter. Although the filter may not necessarily be backwashed each time the adsorption clarifier is flushed, the equipment is designed to ensure that a backwash cycle is always preceded by a flushing cycle.

Application Criteria and Requirements

Before selecting a package plant for a particular application, it must be determined that it can produce the required quality and quantity of water from the proposed raw water supply. Package plants characteristically have limitations (especially those employing high-rate unit processes) related to the quality characteristics of the raw water supply, which must be recognized. For example, such factors as low raw water temperature, high or flushing turbidity, excessive color, or atypical coagulant dosages (higher than expected based upon normal turbidity levels) may influence the selection and rating of a particular package plant. The manufacturer's nameplate capacity of a package plant may have to be downrated or a larger unit selected to handle difficult treatment conditions. Water supplies of consistently high turbidity (greater than 200 NTU) may require presedimentation prior to treatment in a package plant.

It is recommended that all records of raw water quality be reviewed to determine the full range of treatment conditions to be expected before a particular capacity package plant is selected. Especially valuable are laboratory analyses of representative raw water supplies to provide information critical to a proper application. Under certain conditions, on-site pilot tests may be justified and warranted to verify the suitability of a package plant. This is especially important because many of the new package plant designs employ high-rate, short-detention time unit processes which require close control in order to perform effectively. Advance information on the quality of the proposed raw water supply and its treatment characteristics helps to ensure a successful installation.

Each of these technologies provides different levels of treatment; their selection is based on the source water quality. A summary of the treatment capabilities of the various technologies is presented in Table 16. The treatment capabilities are based on the number of log removals of *Giardia* cysts, viruses and total coliforms.

TABLE 16

REMOVAL CAPABILITIES OF FILTRATION PROCESSES[1]

	LOG REMOVALS		
	GIARDIA CYSTS	VIRUSES	TOTAL COLIFORM
Conventional Treatment	2-3	1-3	>4
Direct Filtration	2-3	1-2	1-3
Slow Sand Filtration	2-3	1-3	1-2
Diatomaceous Earth Filtration	2-3	1-2	1-3

1 Package treatment plants have various treatment processes; no standard removal efficiencies have been established.

One (1) log removal is equal to 90% removal. Two (2) log removal is equal to 99% removal and so on. The removals shown in Table 16 are based on proper operation and maintenance of the particular technology.

In general, conventional treatment, direct filtration, slow sand filtration and diatomaceous earth filtration can be designed and operated to achieve the maximum removal of the water quality parameters indicated in Table 16. However, for the purpose of selecting the appropriate filtration and disinfection technologies and for determining design criteria, these filtration processes should be assumed to achieve a 2-log removal of *Giardia* cysts and a 1-log removal of viruses. This conservative approach will assure that the treatment facility has adequate capability to respond to non-optimum performance due to changes in raw water quality, plant upsets, etc. The balance of the required removals and/or inactivation of *Giardia* cysts and viruses would be achieved through the application of appropriate disinfection.

General guidelines for selecting filtration processes, based on total coliform count, turbidity, and color are presented in Table 17. It is not recommended that filtration systems other than those listed in Table 17 be used when the general raw water quality conditions exceed the values listed, unless it has been demonstrated through pilot testing that the technology can meet the performance criteria under the raw water quality conditions expected to occur at the site.

The filtration processes listed in Table 17 are capable of achieving the required performance criteria when properly designed and operated if they are treating a source water of suitable quality (i.e., generally within the ranges indicated in Table 17).

Note that the removal of organics is not listed as a criteria for design of a filter plant. Most filtration processes utilizing chemical coagulation and flocculation will meet standards for removal of naturally occurring organic compounds, but they may not remove certain synthetic (man-made) organics such as pesticides, solvents or fuels. If these contaminants are routinely present in the source (not the case in Summit Lake), the treatment system can be designed for their removal. It is not normally cost-effective, however, to provide this more sophisticated and costly treatment as a precaution, for example, against accidental spills of contaminants. If spills occur, they generally are reported or detected and the treatment plant is taken out of service until the threat is past. Many filtration designs can accommodate the later addition of unit processes for organics removal, such as powdered or granular activated carbon filtration, should it become necessary. For individuals who wish to take this precaution or remove organics below even the health protection level, there are effective point-of-use (faucet) devices, or more expensive whole house systems, that will provide this added level of protection. See Chapter VII for further discussion of home treatment systems.

TABLE 17

GENERALIZED CAPABILITY OF FILTRATION SYSTEMS TO ACCOMMODATE RAW WATER QUALITY CONDITIONS

	GENERAL RESTRICTIONS		
TREATMENT	TOTAL COLIFORMS (#/100 ML)	TURBIDITY (NTU)	COLOR (CU)
Conventional with predisinfection	<20,000	No restrictions	<75
Conventional without predisinfection	<5,000	No restrictions	<75
Direct filtration with flocculation	<500	<7-14	<40
In-line filtration	<500	<7-14	<10
Slow sand filtration	<800	<10	<5
Diatomaceous earth filtration	<50	<5	<5

Table 18 summarizes the limited water quality data available on the design parameters shown in Table 17. Additional water quality testing would be necessary to determine the turbidity and color levels.

TABLE 18
SUMMIT LAKE WATER QUALITY DATA

Total Coliforms	<200 (#/100 ml)
Turbidity	1 NTU*
Color	15 color units*

* **Based on single sample**

COST ESTIMATES

Project Costs

Estimated project construction costs and total project costs are presented in this section of the report where appropriate project construction costs are based on recent actual projects designed by Gray & Osborne. The construction costs presented are based on a pre-design level of analysis and detail, and by this nature, may not completely define all construction requirements.

Construction costs include an estimate for Washington State sales tax and a contingency factor of 20 percent to allow for more specific construction requirements which may be identified in the final design.

The total project costs include allowances for engineering services for survey design, preparation of permits, easements, preparation of contract documents, construction management inspection, facility startup where appropriate and as-builts. The overhead costs of 30% also include legal, administrative and financing. The overhead costs however do not include the cost of property acquisition, easements and their negotiation. In specific project cost estimates where major site acquisition is required, the costs may be included as a specific line item.

The cost estimates provided are based on March 1991 costs and the Engineering News Record (ENR), Construction Cost Index (CCI) for that same period. The ENR-CCI Seattle area for this report is 4,975. The ENR-CCI is based on calculated prices of construction materials and labor, based on a value of 100 in 1913. The cost estimates can be updated in future years by utilizing the ENR-CCI for the Seattle area of that particular point in time.

SUPPLY

Based on the existing water quality data it is suggested that direct filtration with flocculation be considered as the optimum treatment technology suitable for Summit Lake water. Both slow sand and diatomaceous earth filtration have limited abilities to remove color from source waters. Direct filtration can provide adequate treatment for Summit Lake water for a lower cost than a conventional treatment process.

A direct filtration plant can include several different pretreatment unit processes depending upon the application. In its simplest form, the process includes only in-line filters preceded by chemical coagulant application, mixing and flocculation. The mixing step can be satisfied by influent pipeline turbulence or with a device called a static mixer. In larger plants with gravity filters, an open rapid-mix basin with mechanical mixers typically is used. Refer again to Figure 4, illustrating the unit processes of a typical direct filtration plant including flocculation.

The direct filtration plant should be sized to provide 255 gpm with the capacity to expand to 350 gpm at some future date based on the water supply requirements discussed in the previous section.

The intake for the water treatment plant should be able to furnish, under all foreseeable conditions, an adequate supply of raw water. The quality of the raw water should be as consistent as possible to minimize the need for adjustment of treatment chemical doses and other process variables. The intake should be designed to be capable of withdrawing water from various depths in the lake to provide flexibility in obtaining the best quality water and to react to seasonal changes in water quality.

A previous study has documented the presence of both total and fecal coliforms at ten different sampling points in the lake. Apparently, there are several sources of contamination and the entire lake is effected. There is no preferred intake location based on existing water quality data. The treatment process is designed to remove the levels of coliforms presently found in the lake. Care should be taken in locating the intake structure away from potential sources of contamination, i.e.,

failing septic systems, but the direct filtration process can successfully treat the existing level of coliform contamination.

The raw water will be pumped from the intake to the treatment plant location. The treatment chemicals, typically aluminum sulfate and polymers, are injected to the raw water and mixing is accomplished by either mechanical mixing or through the use of a motionless mixing element. The chemically treated water is then flocculated (gently mixed) to allow the particles in the water to stick together. The water then passes through a sand and anthracite filter where the particles in the water are removed by adsorption unto the filter media. The filtered water is then disinfected by the addition of chlorine.

Following filtration, the treated water is stored in a structure called a clearwell. Disinfectant is added to the water in the clearwell and an adequate contact time is provided to allow additional removal (or inactivation) of *Giardia* cysts and viruses. The total removal requirements is 3-log (99.9%) for *Giardia* and 4-log (99.99%) for viruses. Direct filtration provides 2-log *Giardia* removal and 1-log virus removal. An additional 1-log removal of *Giardia* and 3-log removal of viruses must occur in the disinfection process. Chlorination is typically used as a disinfecting agent in municipal water treatment plants. Chlorine is much more effective in inactivating viruses than *Giardia* cysts so the critical factor in determining contact time required in the clearwell is based on *Giardia* cyst inactivation. The inactivation of Giardia cysts is based on chlorine concentration (C) times the contact time (T). A CT value may be calculated based on chlorine concentration times contact time. The contact time is determined based on either actual flow studies or, in this case, on theoretical contact times in the proposed clearwell structure. The CT required to achieved a 1-log removal of Giardia cysts is affected by both water temperature and pH. Assuming a low water temperature of $5^{o}C$, a pH of 6.5 and a chlorine concentration of 1 mg/l; the required CT value for 1-log *Giardia* cyst removal is 42. In this case, that corresponds to approximately 45 minutes contact time. The contact time should be doubled to account for uneven mixing and low water conditions in the clearwell. Based on the ultimate flow of the plant, 350 gpm, and the contact time required, 90 minutes, the clearwell should be designed to hold 31,500 gallons or 4,210 cubic feet. The size of the clearwell may be limited by providing increased baffling and a circuitous flow path that minimizes "short circuiting".

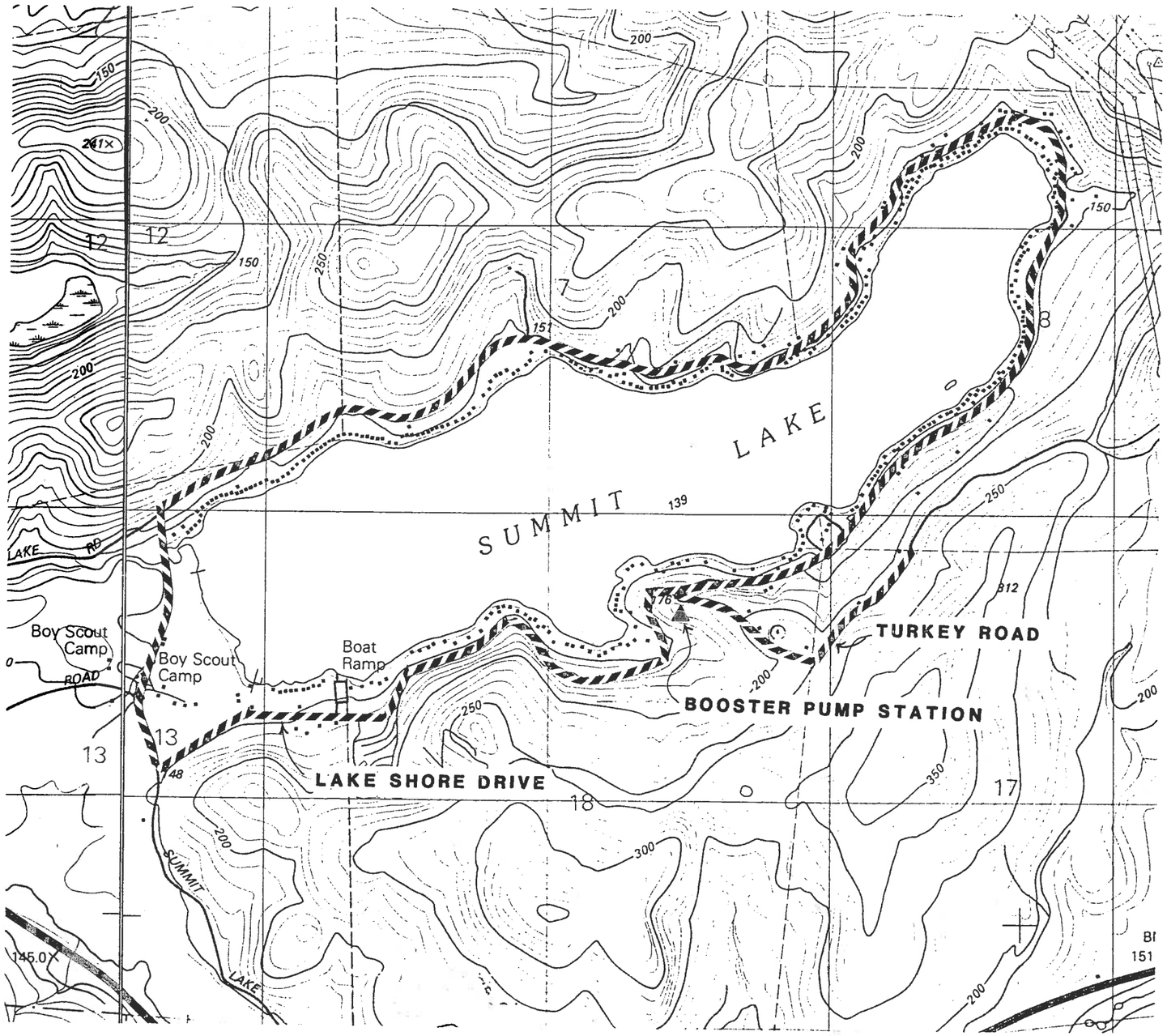
Table 19 shows a breakdown of the estimated costs for the direct filtration water treatment plant. The estimate includes a metal building to house the treatment unit, the distribution and backwash pumps, the intake structure, the clearwell structure, backwash basins and all electrical and control components. The estimate includes an auxiliary generator to provide backup power during power outages.

TABLE 19

DIRECT FILTRATION WATER TREATMENT PLANT
COST ESTIMATE

	ITEM	COST
1.	Mobilization	$40,000
2.	Metal Building	80,000
3.	Distribution Pumps	23,000
4.	Backwash Pumps	14,000
5.	Treatment Unit	252,000
6.	Intake and Raw Water Piping	36,000
7.	Utilities	7,000
8.	Backwash Basins	28,000
9.	Clearwell	40,000
10.	Electrical	32,000
11.	Instrumentation and Control	34,000
12.	Auxiliary Generator	32,000
	Subtotal	$618,000
	Contingency (20%)	123,600
	Subtotal	$741,600
	Taxes (7.8%)	57,800
	TOTAL	$799,400

A direct filtration plant of the size discussed, including the clearwell, will cost approximately $800,000 to construct. Annual costs to operate and maintain a plant of this type could be as high as $45,000.



6-INCH WATER MAIN

SUMMIT LAKE
THURSTON COUNTY

PROPOSED WATER TRANSMISSION SYSTEM

Gray & Osborne, Inc.
CONSULTING ENGINEERS

FIGURE 10

STORAGE

A centralized water system will require 500,000 gallons of storage to meet the needs of the existing developed lots. The storage requirement could increase to 672,000 gallons if all the lots within the Lake Management District were developed. Initially, it would be necessary to construct the existing storage requirement of 500,000 gallons. Assuming that the reservoir were 40 feet tall, the diameter would need to be 46 feet. A one-acre site would be required at some location and a suitable elevation to provide sufficient water pressure to the majority of homes circling the lake. The overflow elevation should be at 640 feet so the site elevation should be approximately 600 feet. For a reservoir of this size, it is recommended that it be constructed from welded steel plates. The reservoir should meet the requirements of the American Water Works Association (AWWA) for welded steel tanks (D-100).

The construction cost of a 500,000 gallon welded steel reservoir is $320,000.

TRANSMISSION

The area around Summit Lake contains bedrock outcroppings that may increase the cost of installing the proposed water line in the roadway right-of-way. It is estimated that approximately 5% of the proposed alignment around Summit Lake would require excavation of bedrock. This excavation work would increase the installation cost of the water line. Installation of the water line along the Lake shore was considered as an alternate alignment. This alternate alignment was not considered feasible due to the anticipated problem of obtaining easements, difficulty of construction in the shoreline area, permitting concerns and the difficulty of maintaining such a water line.

A centralized water system would require a transmission and distribution system to deliver water to the customers around Summit Lake. Figure 10 shows the proposed layout for a water transmission and distribution system. The water system would include a 6-inch water main extending around the lake and a 6-inch dead-end main on Turkey Road N.W. The total length of the loop around the lake on Lake Shore Drive is approximately 34,000 feet and the length of the dead-end on Turkey Road N.W. is approximately 6,000. Fire hydrants would be spaced every 600 feet along

the 6-inch pipeline. Isolation valves should be spaced every 1,000 feet along the 6-inch pipeline. The installation of the fire hydrants may be deferred to a later time to decrease initial construction costs. The total construction cost of transmission lines, services, meters and fire hydrants is estimated to be $1,122,000. Approximately $100,000 of costs could be deferred by not installing fire hydrants.

The services located above the 525 foot contour will require a booster pump station to provide adequate pressure. This will require that a small pump station be installed to provide service to the approximately 10 lots on Turkey Road N.W. Initially the pump station would be required to serve less than 10 services. The pump station would be required to have a capacity of 35 gpm to provide service to the 10 services in this area. Additional growth in this upland area would require an increase in capacity of this pump station. The pump station would be unable to provide fire flow to the upland services. The construction cost of the booster pump station would be $32,000.

A GROUNDWATER ALTERNATIVE

The potential for successful wells was discussed in a previous section. It was estimated that drilling costs would be approximately $60,000 - $90,000 to develop a sufficient number of producing wells with adequate capacity. Outfitting of these wells with pumps, motors and controls would cost another $95,000. There is a reasonable potential for treatment to be required for iron and manganese. The least capital cost alternative would be to use a "sequestering" process to keep the metals in solution through the distribution problem, so they do not cause aesthetic problems (taste and staining). Iron and manganese, in the levels that are likely to be encountered, would not be considered a health hazard. The sequestering process consists simply of the addition of a polyphosphate chemical metered in proportion to the flow rate. Capital costs are low for the equipment (estimated at $2,000 for the three wells). The addition of the sequestering agent creates a nutrient-rich environment supporting bacteria growth in the storage and distribution facilities, therefore disinfection similar to the surface water treatment alternative would be required. Proper dosage, however, would not result in any significant increase in phosphate output from septic systems, because of the bonding to iron and manganese ions. The estimated capital cost of these facilities is $10,000. Annual operation and maintenance costs of these well facilities is estimated at $12,000.

Storage and distribution facilities for wells would be essentially identical to those described above for the surface water central system alternative.

SUMMARY OF CAPITAL AND ANNUAL COSTS

The capital costs for construction of a central water system include the water treatment, storage, transmission and distribution facilities. The construction costs shown here include Washington State sales tax and a 20% contingency to allow for design problems and site conditions that are not foreseen at this stage.

Table 20 presents the estimated construction costs for both the groundwater supplied and the surface water supplied central water systems. It is assumed that the total project cost equals 130% of the construction cost. The additional 30% includes legal, administrative financial and engineering costs.

TABLE 20

ESTIMATED CONSTRUCTION COSTS

FOR A CENTRAL WATER SYSTEM

	Groundwater Supplied	Surface Water Supplied
Well Development (3 wells)	$90,000	----
Production Facilities	95,000	----
Groundwater Treatment	10,000	----
Surface Water Treatment	----	800,000
Storage Reservoirs	320,000	320,000
Transmission Pipelines	1,122,000	1,122,000
Booster Pump Station	32,000	32,000
Total Construction Cost:	$1,669,000	$2,274,000
Project Costs (30%):	500,700	682,200
Total Project Cost:	$2,169,700	$2,956,200
Monthly Cost Per Connection (amortized over 20 yrs. at 8%):	$40.47	$55.15

The monthly cost per connection shown in Table 20 is based on the existing 455 developed lots in the Lake Management District. The monthly cost calculated assuming that a 20-year term loan at 8% is used to finance to total project costs. This analysis does not make allowances for any grants that may be obtained to help defray the cost of the projects.

Table 21 shows the projected annual O & M costs for operating both the groundwater supplies and a surface water supplied central water system under consideration. The O & M costs for the surface water supplied system are considerably higher because of increased chemical, power and operator costs associated with the proposed direct filtration treatment plant. The groundwater supplied central system O & M costs were based on 1.5 full-time employees. The surface water supplied central system O & M costs were based on 2.0 full time employees. It was assumed that a 20% operating reserve was maintained for both central system alternatives.

TABLE 21

PROJECTED CENTRAL SYSTEM O & M COSTS

	Groundwater Supplied	Surface Water Supplied
Annual Costs	$70,000	$103,000
Operating Reserve (20%)	14,000	21,000
Total O & M	$84,000	$124,000
Monthly O & M Costs	$16.55/month	$24.43/month

The total capital and O & M monthly costs for the groundwater supplied and surface water supplied central water systems are $57 per month and $80 per month respectively. The monthly cost may be reduced if additional connections to the system reimbursed the water system through "late-comers agreements". The monthly charges could be reduced as much as 30 percent if all the undeveloped lots within the Lake Management District connected to the system.

CHAPTER VII

HOME TREATMENT SYSTEMS

BACKGROUND

In approximate numbers, there are about 60,000 community systems (serving more than 15 connections or 25 persons) in the U.S. serving 220 million people. Of these, 51,000 are classified as "small", serving systems of less than 3,300 persons for a total served of about 25 million. These same small systems experienced 89 percent of the 43,000 violations of the Safe Drinking Water Act's maximum contaminant levels. EPA chooses 3,300 as a size cutoff because, on the average, it is the size above which the system can afford to have an operator. In addition to this large number of small systems with so many problems, there are some 19 million people served by individual wells for which little quality information is available.

The treatment requirements for small systems can be generally described as:

- low construction and operating costs
- simple, reliable technology
- low maintenance, suitable for part-time operation
- little or no requirement for disposal of solids.

Individual home treatment systems obviously satisfy many of these criteria. By reason of their not requiring expensive storage, pumping, transmission and distribution facilities, they provide an attractive alternative to centralized treatment. Some types of treatment units, such as water softeners to remove natural mineral content or "hardness" interfering with plumbing systems and cleaning processes, have been around for many years. Some manufacturers have enjoyed years of success in marketing effective products that perform as advertised. During the last several years, however, the concern of citizens over the possibility of contaminated supplies, and especially carcinogenic compounds, has created a booming market for small treatment units. Many are not effectively

designed, constructed or marketed, giving the industry a bad name. A trade organization called the Water Quality Association has flourished in recent years as a trade association offering opportunities for its members to enhance the professionalism of their products and services. States are beginning to regulate the industry, requiring truth in advertising and priority programs to help educate and protect the consumer. Water utilities are finding that people are quick to turn to bottled water or home treatment devices to solve problems ranging from removing taste and odors associated with disinfection by chlorination, to removal of trace inorganics or organics well below conservative standards set to protect public health. Some consumers are misled into purchasing units that may or may not remove contaminants, whose presence is unknown, at great cost only to have the units malfunction or fall into disrepair, and perhaps even become a health threat. Utilities see these situations as undermining their efforts to provide a quality product and service, or to legitimately raise rates to meet increasing treatment and monitoring costs necessary for the protection of public health.

EVALUATING DEVICES

Home treatment devices or systems fall into two distinct categories: Point of entry (POE) devices, which treat the entire supply for the whole household; or point of use (POU) devices, which treat only an individual faucet or tap in the house. Some characteristics of this distinction are obvious. POE devices are larger and more costly, and may require more substantial maintenance, such as chemical regeneration or backwashing and solids disposal. POU devices are smaller, more easily installed and maintained, but only protect the single tap. POU devices will not prevent the transmission of contaminants through aerosol inhalation, ingestion or dermal absorption of water from other than the single tap. On the other hand, being less expensive and easier to maintain, some people will be more prone to proper maintenance of a POU device. Treatment at the tap may preclude the need for maintaining a disinfectant residual in the house plumbing to prevent bacterial regrowth.

Since the principle purpose of POU devices is to enhance or "polish" water that is already potable, such as by removing the taste and odor of relatively high levels of disinfectant, their use is not acceptable from a public health standpoint if the rest of the outlets or taps are a source of untreated water that is known to carry

contaminants. Since this is the current situation at Summit Lake, POU devices cannot be recommended for whole-house treatment.

The many choices of treatment process, type of unit, cost, size, performance, operation, supplier, etc., leave many consumers in a quandary as to how to make a selection. In many cases the key threshold question is not even considered let alone answered: is treatment even necessary? While there are many sources for POE/POU devices (most any major hardware, variety, department or appliance store, for example), consumers should be aware of:

Water Quality Association National Headquarters & Laboratory 4151 Naperville Rd. Lisle, Illinois 60532 (312) 369-1600	The WQA is the trade association for manufacturers and suppliers of POUs. They publish Voluntary Product Promotion Guidelines and Professional Standards, and have a program for certified water specialists who can analyze water in the home. A WQA "gold seal" on the POU equipment indicates it meets industry performance standards.
National Sanitation Foundation 3475 Plymouth Road P.O. Box 1468 Ann Arbor, Michigan 48106 (313) 769-8010	The NSF is an independent third-party non-profit organization which develops concensus standards, product testing and certification, research and education and training. It has standards for: Drinking Water Treatment Units - Aesthetic Effects; Cation Exchange Water Softeners; Drinking Water Treatment Units - Health Effects; Ultraviolet Disinfection Systems; and Reverse Osmosis Drinking Water

Treatment Systems. It lists products that have been tested by standard and by company.

Extensive information is available from both of these organizations. The most helpful listing service to the consumer is the "NSF Listings - Drinking Water Treatment Units and Related Products, Components and Materials", which can be ordered from the NSF for $8.00. A copy is included in Appendix C. The NSF's Standard 53, Drinking Water Treatment Units - Health Effects, is being revised to include reduction claims for the entire list of 83 contaminants which the EPA is regulating under the 1986 Safe Drinking Water Act Amendments. The NSF standards are also available at a cost of $30.00 each. More information on the NSF can be found in Appendix C.

There are other organizations that have performed and reported tests on home water treatment devices: The Rodale Press, Product Testing Department, 33 E. Minor St., Emmaus, PA 18049; Gulf South Research Institute; Canadian Bureau of Health, Ottawa, Canada; and *Consumer Reports* magazine.

POSITION OF REGULATORY AGENCIES

Because of the negative aspects of POE/POU devices, especially the difficulty of proper maintenance and the potential for bacteria to grow on filters and be released into the home drinking water, regulatory agencies have had negative or no position on their use. That position, however, is beginning to change. The EPA in its regulation on removal of volatile organic compounds (VOCs), (Federal Register, July 8, 1987) addressed for the first time its position on POE/POU devices and bottled water. The regulation states that POE/POU devices are not designated as "Best Available Technology" because: (1) difficulty in monitoring performance; (2) not generally affordable by large metropolitan water systems; and (3) not all water is treated. Therefore, POU devices and bottled water are considered acceptable only for use as an interim measure, that is, as a temporary solution while the system receives a time extension (exemption) from the state agency. POE devices

are considered acceptable as a means of compliance with MCLs (for VOCs only). However, POE systems must meet the following conditions:

(1) Central Control. A managing entity must be responsible for operating and maintaining the devices. Units can be privately owned.

(2) Effective Monitoring. The system must develop and obtain state approval for its monitoring plan, which demonstrates health protection equivalent to a central treatment system.

(3) Application of Effective technology. The state must require adequate verification of performance, field testing and engineering design review for all devices.

(4) Maintaining Microbiological Safety. The design application must address the potential for bacterial releases from some activated carbon and certain other filter devices. Backwashing or post-contactor disinfection may be necessary.

(5) Protection of all Consumers. Every building connected to the system (or every building in the area experiencing the need for treatment) must have a POE device installed, maintained and adequately monitored. If a home is sold, the rights and responsibilities of the system customer regarding the treatment device must be transferred to the new owner.

Again, this EPA position relates only to POE devices used to meet VOC MCLs on an interim basis. EPA's rules on surface water treatment, synthetic organics, inorganics and coliform are all silent on the issue. And, again, Summit Lake is not now a public water system subject to EPA or state regulation. However, the EPA position does establish an important set of conditions, based on sound scientific evaluation and judgment, for the application of POE devices.

The State of Washington Department of Health has a guideline paper available on POE/POU devices. A copy is included for reference in Appendix E. In summary, DOH's position is not to approve home treatment units for use on public water systems. Furthermore, they do not endorse their use on private residences. They cite the following reasons:

1. The difficulty and cost of pre-design studies required to size and select units.
2. The limited number of laboratories certified to run tests.
3. The problems for the homeowner in providing proper maintenance, repair, replacement and monitoring.
4. The potential for bacteria growth on the filter or in the treatment unit.
5. The false sense of security the homeowner can get.

The Department does list, however, an exception to their Guideline position. If an engineering report is prepared in accordance with the WAC 248-54 and the Department has the ultimate responsibility for design and specification review, approval is possible. Their approval is likely to be based on a clear showing that individual home treatment is more feasible than central treatment and supply from an economic, engineering and public health standpoint. Central management, operation and maintenance of the systems must also be assured.

OPERATION AND MAINTENANCE PROBLEMS

Regulatory agencies have been hesitant to accept long-term use of individual home treatment systems, and for understandable reasons. Although the manufacturing industry has clearly made advances in the quality of the products they produce, neither they nor regulatory personnel nor health professionals have ultimate control over the choices the homeowner makes on which units are selected, how they are installed, or how often they are serviced or tested. Individual homeowners are responding to widely-varying levels of concern, education, training, mechanical skills etc. influencing them in their actions. High-pressure sales techniques by sales persons not trained in drinking water treatment are also common.

Because of the widely differing applications that can be made of the same piece of equipment, and the ranges of flow and contaminant loading to which they are subjected, an owners manual cannot always be written to cover every application. Homeowners are often constrained by financial resources and consequently may select other than the best unit to solve the problem, or they may service the unit at a less than optimal frequency from a health protection standpoint. There is also a natural tendency to assume that once a unit is installed and appears to be operating properly, it will continue to do so indefinitely. If the finished water produced by the device maintains a consistent appearance, taste, odor, etc., there is a tendency to assume that the recommended frequency of backwashing, cleaning or element replacement, or sampling and testing, are not important. Again, all too often cost is a factor in not selecting a monitoring device that tells when service is needed, such as a flow meter, or the regular service offered by the supplier is not used. Thurston County reports "dismal failure" in their experience with individual home sewage chlorination systems, for many of these same reasons.

The failure of the average homeowner to select the proper treatment units, install them properly, and then operate and maintain them effectively, has contributed to the hesitancy of the regulatory agencies to accept individual home treatment systems to remedy unsafe supply problems. There are some success stories from around the U.S., however. The five criteria listed above, if followed carefully, would greatly increase the chances of success. If a responsible authority were to specify the appropriate units, supervise their installation in all the consumers' homes, and insure that regular monitoring and maintenance were performed, favorable results are likely. However, this approach may still be acceptable to regulatory authorities only as an interim solution to the longer-term need for a comprehensive central treatment system.

DESCRIPTION OF POE DEVICES

Residents of the Summit Lake area, at the scoping meeting for this Study, expressed strong interest in the application of home treatment units to the provision of potable water around the lake. Approximately 7% of the residences using Summit Lake as their drinking source now have home treatment units, and 7% provide disinfection. It is not known whether these are POE or POU devices, or if these homes have both treatment and disinfection units.

The discussion of home treatment units from this point on will only relate to POE units, because of the need to provide treatment and disinfection of all water for the entire household. Regulatory agencies will not approve POU devices alone as the only treatment for a non-potable source, for obvious reasons. There would continue to be a significant risk associated with the occasional or accidental ingestion (e.g. by tooth-brushing) of water from other unprotected faucets in the home, or from the shower. POU devices are only useful as enhanced treatment for a potable supply, such as to remove taste, odor or color which may be an aesthetic rather than a health concern. Another possible application would be to remove trace amounts of a substance below the established MCL, because of a special health problem an individual may have, or for a special purpose such as removing chlorine for fish tank water. A POU device cannot be considered reliable protection for the entire house served by an unsafe supply, the situation currently facing consumers of Summit Lake water. Since Summit Lake water has been shown to contain significant concentrations of both total and fecal coliform, disinfection in addition to filtration is considered necessary. Although there are no known sample results for *Giardia lamblia,* this protozoa is expected to be present. Therefore, microfiltration devices with a retention size of 1 micron or less should be provided, as *Giardia* cysts are 7-10 microns in diameter. A discussion of the several types of treatment devices available for use in the home follows.

Mechanical Filters

These filters are specifically designed to remove solid particles from the water, acting as fine screens. One type uses specially graded sand or other synthetic graded material as the filter media in a tank similar to a water softener. These filters must be backwashed periodically and are not effective in some cases where turbidity is due to extremely fine particles. Another type is the "cartridge" filter, which uses media formed or shaped into more or less rigid cartridges. They are generally made of fibrous material or porous ceramics and may remove *Giardia* cysts, large bacteria and very small aesthetic fibers, depending on pore sizes. These cartridges generally must be disposed of regularly and clog fairly easily with high turbidity.

Activated Carbon (AC) Filters

Carbon is especially effective in adsorbing soluble organic compounds and certain gases, such as chlorine and hydrogen sulfide, which may contribute taste and odor to a water supply. This would be the device of choice for removal of pesticides, solvents and fuels, for example (VOCs and SOCs). They can be in the form of granular tank-type filters, or as finely divided powders incorporated into cartridges. Granular filters must be backwashed and cartridges replaced. Because carbon filters are subject to bacterial contamination, they should be used to treat only water that is microbiologically safe, or they should be used following disinfection. If AC filters are treated with chlorine solutions additional carbon must periodically be added, as the chlorine oxidizes and uses some of the carbon in the process.

Reverse Osmosis (RO)

In the RO process, water to be treated is forced against a semipermeable membrane, which allows some of the matter to pass, but rejects impurities, including dissolved minerals. RO is effective against salts, metals, nitrate, asbestos, *Giardia* cysts and bacteria. The rejected water and impurities must be wasted and in large quantities: 50 - 90% of the flow to the unit, depending on the design and manufacturer. The RO membranes do degrade and fail in time, so maintenance is important.

Water Softeners

Water hardness is due to the presence of certain dissolved minerals, compounds of calcium and magnesium, causing both the formation of soap curd and the deposition of a hard scale on the inside of plumbing pipes. Softeners use either a cation or an anion exchange process, containing a bed of permanent softening material in the form of small granules or beads initially charged with sodium ions. As the hard water passes through the bed, the calcium and magnesium are attracted and held by the bed, releasing sodium into the water. The bed is recharged with a salt brine-solution, usually automatically.

DISINFECTION ALTERNATIVES

Disinfection by Chlorine

Chlorination has long been regarded as a safe and reliable method of destroying disease-causing organisms. It also has the distinct advantage of providing a residual of the disinfectant to remain in the distribution or plumbing system to continue to destroy bacteria and prevent bacterial regrowth. Chlorine reacts with impurities in the water, which, if at high levels, reduce its effectiveness. The chlorine remaining after these compound-forming reactions occur is the available "free chlorine" that is most effective as a disinfectant. The important parameters in insuring effective chlorination are concentration of the chlorine, contact time, pH of the source, temperature, and turbidity level. If tannic and humic acid compounds are present in the source water, chlorine can cause the formations of trihalomethane compounds, which are known carcinogens and have safe levels set by the State and EPA. These compounds can be removed by certain types of filtration. The source of chlorine for the home system is a solution prepared from household hypochlorite bleach or dry powder or tablet forms of calcium hypochlorite. Monitoring to insure a residual remains in the system is important.

Ultraviolet Disinfection (UV)

UV disinfection devices house a germicidal UV lamp that destroys bacteria and inactivates viruses without chemicals. To remove *Giardia* cysts, the disinfection process must be followed by filtration. The advantages of UV are its ready availability, ease of operation and maintenance, short contact time, and the absence of subsequent objectionable compound formation. However, it leaves no residual disinfectant to protect against bacteria in the distribution or plumbing system. Turbidity reduces UV effectiveness by building up dirt on the lamp. The UV demand of the water, similar to chlorine demand, affects the exposure time and intensity of the radiation needed for proper disinfection. Strict maintenance is important.

Ozone Disinfection

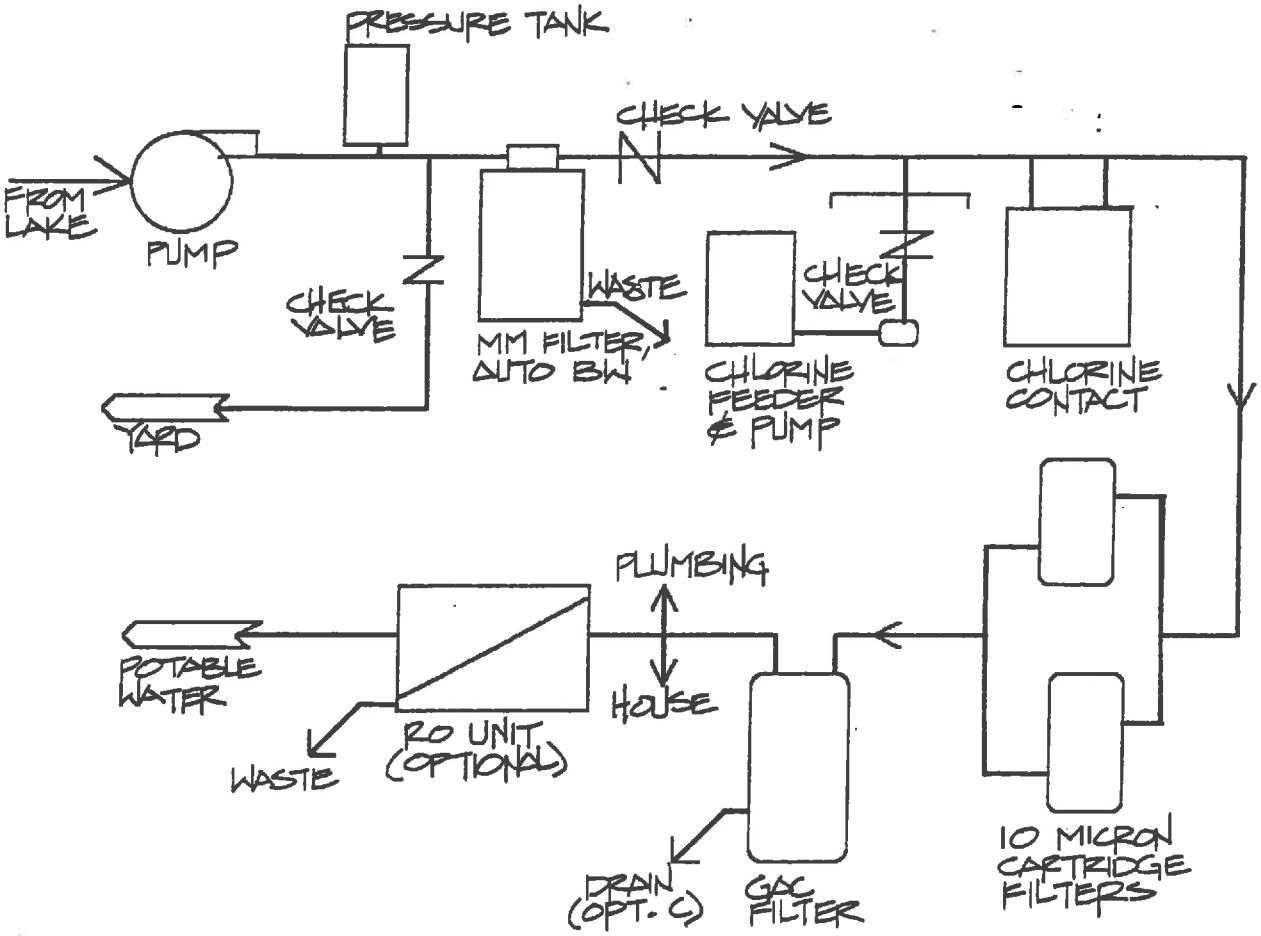
Ozone (O_3) is widely used as a primary disinfectant in other parts of the world, but only recently used in the U.S. This toxic gas is formed when air containing oxygen is passed between charged electrodes. It is a powerful disinfectant requiring shorter contact time than chlorine. However, it is unstable, requiring generation on-site. It is insoluble, requiring efficient contact with the water. As in the case of UV, it requires a secondary disinfectant, because ozone leaves no residual in the system. In larger systems, operation and maintenance of equipment is complex and critical. Although POE ozone devices for homes are available, they are not popular.

OPTIONS FOR SUMMIT LAKE

Because of the expressed interest of Summit Lake residents, two suppliers of POE devices were contacted to assist in the identification of specific units suitable for use in Summit Lake homes: Culligan Water Conditioning of Centralia and EcoTech Systems and Services of Olympia. The options will be identified using a C or E so that readers know which supplier provided the equipment information included in the option.

Option 1C (Fig. 11)

This is a "turnkey" operation in which the dealer would install and service the entire system. It consists of a 3/4 HP intake pump; 20 gal. pressure tank (both provided by Owner); an optional mixed media (roughing) filter with automatic backwash; a sodium hypochlorite solution tank (chlorine) with mixer and injector feed pump; a 120 gal. chlorine contact tank; 2-10 micron cartridge filters; and a carbon filter. An optional RO unit is available for use at the tap that provides the household drinking and cooking water, as protection against *Giardia.* The carbon filter is an exchangeable unit which the dealer would replace as required. This eliminates the chlorinated (0.5 ppm concentration of Cl_2) backwash from being discharged to, and possibly upsetting, the residence's septic tank or the ecology of the lake shoreline.



SUMMIT LAKE
THURSTON COUNTY

HOME TREATMENT SYSTEM
OPTIONS 1C & 2C
SOURCE: CULLIGAN WATER CONDITIONING, CENTRALIA

Gray & Osborne, Inc.
CONSULTING ENGINEERS

FIGURE 11

Option 2C (Fig. 11)

This is the same system as Option 1C, but with the exchange carbon filter replaced by a similar unit with automatic backwash feature. The backwash water would be discharged to the septic tank, which would need to be monitored for upset as described above. Backwashing requires 60-90 gal. approximately weekly. As an alternate, the backwash water could be directed to a sump and a surface drain.

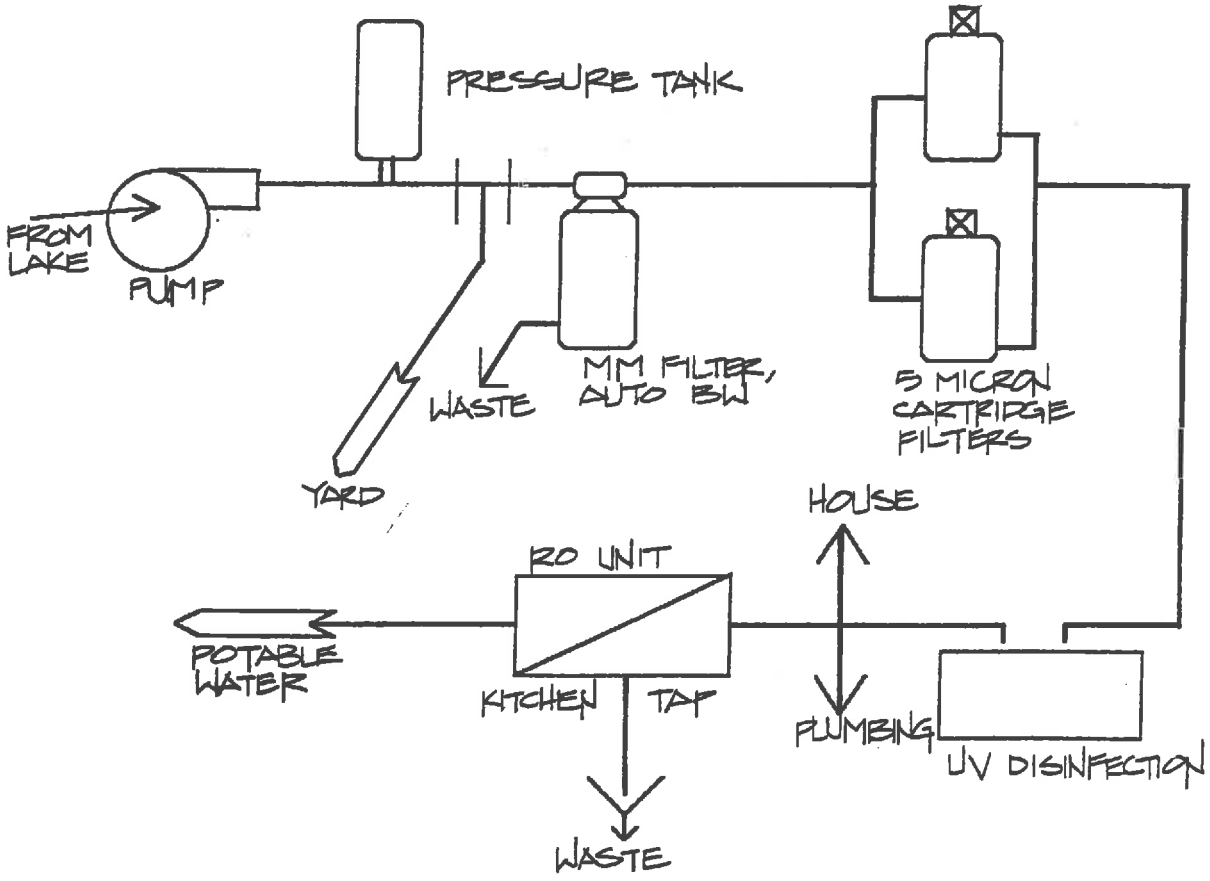
Option 3C (Fig. 12)

In this option, the chlorination equipment is replaced by a UV disinfection unit following the cartridge filters. The activated carbon filter is omitted, and the RO unit becomes a required item at the tap to protect against *Giardia.*

This option is only feasible in the case of high quality water (turbidity less than 5 NTU and no color). Monitoring of system performance is important to insure that the roughing and cartridge filters perform their function of particulate removal, so that the UV tube remains clean and effective. If *Giardia* cysts are present, they will not be inactivated by the UV unit, but should be removed by the RO filter. Color is potentially a concern, as it may not be removed by the mixed media and cartridge filters. Again, the RO unit would provide a second microbiological barrier, but only at the tap where it is located. It is recommended, if additional sampling demonstrated *Giardia* to the present in the lake, that the cartridge filters be changed to 5 micron pore size, or even 1 micron if available.

Assuming the homes in which these systems would already have an intake pump and pressure tank, as well as space for the treatment unit installation, the costs for these options would be as follows:

2 - 3/4" check valves
1 - 3/4" flow switch
chemical feeder and injection pump
120 gal. chlorine contact tank
1 - 10" cartridge filter housing, plus



SUMMIT LAKE
THURSTON COUNTY

HOME TREATMENT SYSTEM
OPTION 3C
SOURCE: CULLIGAN WATER CONDITIONING, CENTRALIA

Gray & Osborne, Inc.
CONSULTING ENGINEERS

FIGURE 12

One of the following options:

exchange carbon filter, or
regenerable backwash carbon filter, or
UV unit and roughing filter, in
lieu of chlorine feed, injector and tank

Total Cost, including installation: $3,095

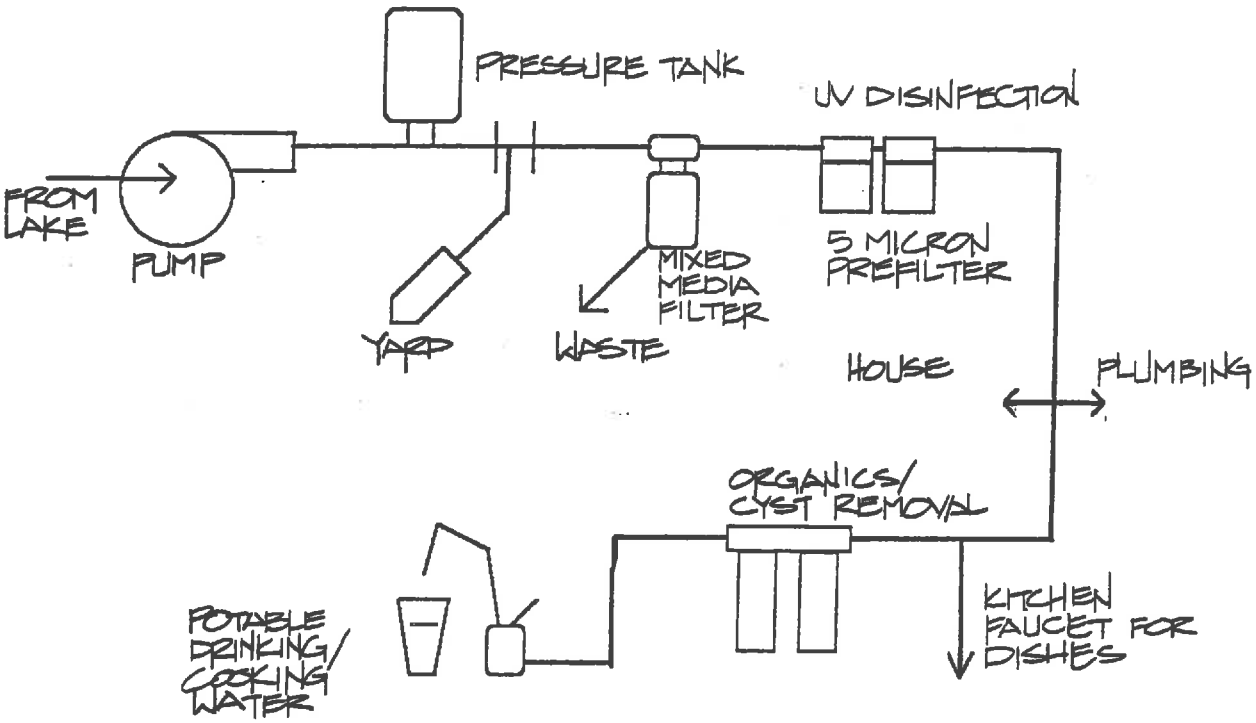
Optional Units*	Purchase	Rental (5-yr Plan)
9" carbon filter exchange tank		$68/mo.
9" carbon filter regenerating tank		$88/mo.
3/4" UV disinfection unit		$88/mo.
RO unit	$850	$18/mo.
Roughing filter (each tank)	$1,250	$25/mo.

Typical Maintenance Costs*

Exchange carbon filter tanks, approx.	$19 ev. 3 mos.
Fill chlorine solution tank, approx.	$7/mo.
Replace cartridge filters, approx.	$6.85/mo.
Replace UV lamp, approx.	$125/yr.
Rebed regenerable carbon	$120/cu. ft.
Labor/service call, yearly	$30
Yearly bacteria sample	N/C

* Prices are based on a minimum of 100 houses installing equipment. Maintenance costs are approximate, depending on frequency of actual service required.

The Culligan units are certified by the National Sanitation Foundation under Standard 42, Aesthetic Effects, but not under Standard 53, Health Effects. All their units discussed here carry the "gold seal" of the Water Quality Association as meeting the WQA's industry standards of performance. Culligan's RO unit is certified by the NSF under Standard 58, Reverse Osmosis units.



SUMMIT LAKE
THURSTON COUNTY

HOME TREATMENT SYSTEM
OPTION 4E
SOURCE: ECOTECH, OLYMPIA

Gray & Osborne, Inc.
CONSULTING ENGINEERS

FIGURE 13

Option 4E (Fig. 13)

Following the owner-provided intake pump and pressure tank, this system includes an automatic backwashing mixed media prefilter followed by a 10 gpm 5 micron filter with built-in UV lamp for disinfection. Cost: $1,940, plus necessary adapting valves and fittings, depending on local conditions. Annual operating cost for lamp replacement and cleaning $125.

Option: for longer-lived stainless steel chamber for UV unit, add $385 first cost plus $15 annually. For less expensive pre-filter unit, deduct $375 first cost.

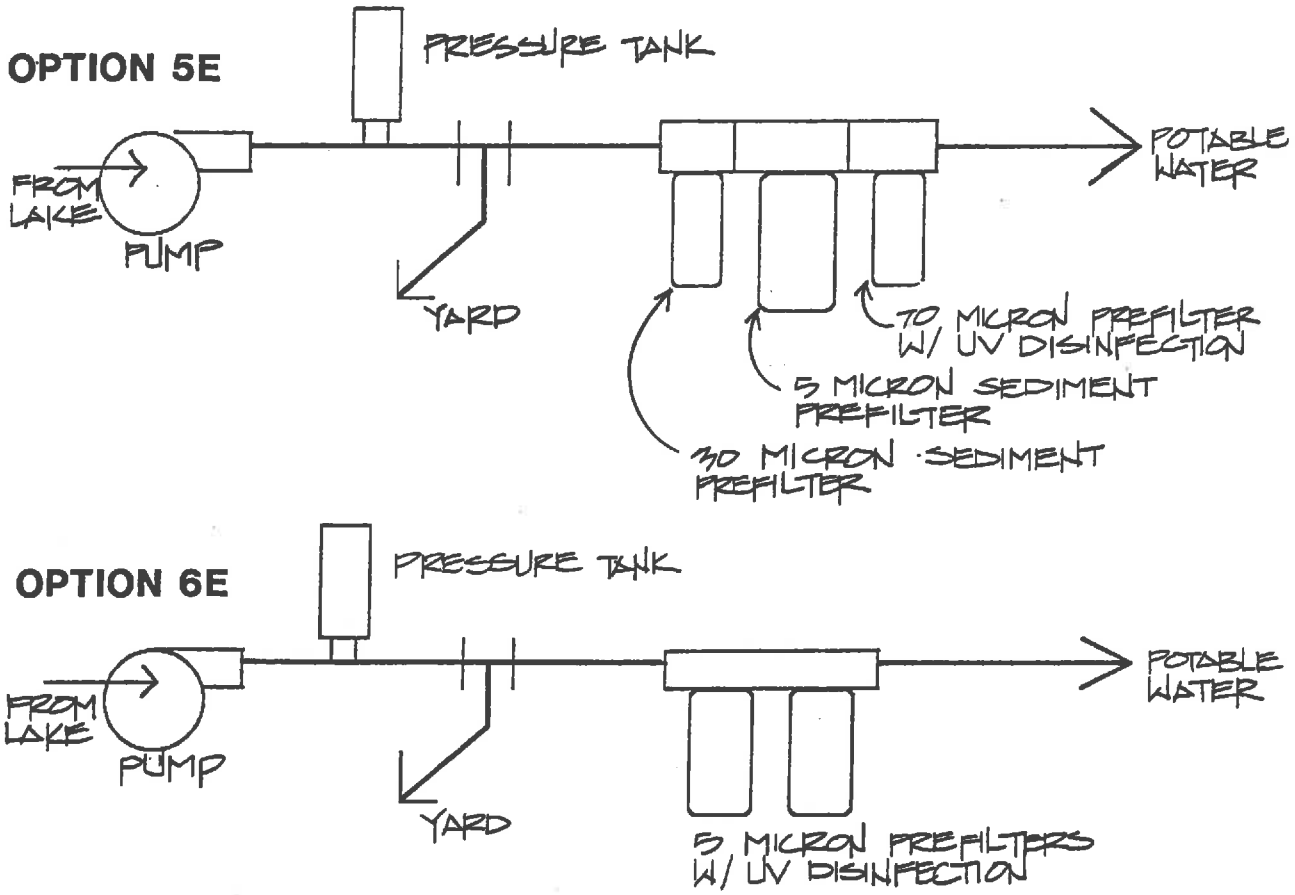
If *Giardia* are known to be present in the supply, not inactivated by UV disinfection, at the kitchen tap add a 5 micron granular activated carbon filter followed by a 0.5 micron ceramic filter, with a monitor faucet. Additional cost: $385 first cost plus $29 annually for cartridge replacement.

Option 5E (Fig. 14)

This 8 gpm unit is less sophisticated and costly, consisting of a 30 micron poly stage 1 filter, a 0.5 micron stage 2 filter, and a 70 micron radial granular carbon stage 3 filter. The stage 3 filter houses the UV lamp for disinfection. The first cost is $1,287 plus adapting fittings, etc.; annual cost for cleaning and lamp replacement is $450 if dealer provides all parts and service, or $250 if service is provided by owner. Normal filter replacement frequency is quarterly on the 30 micron filter, and twice yearly on the 0.5 micron and carbon filters.

Option 6E (Fig. 14)

This last option is a simpler and less costly unit, but it may not provide complete protection against *Giardia.* It consists of a 5 micron poly stage 1 filter, incorporating a UV disinfection unit. The system is rated at 10 gpm. The first cost is $895 plus necessary fittings; filter replacement is estimated monthly; annual operating cost is $630 for full service, including lamp replacement and new cartridges, or $210 parts only.



SUMMIT LAKE
THURSTON COUNTY

HOME TREATMENT SYSTEM
OPTIONS 5E & 6E
SOURCE: ECOTECH, OLYMPIA

Gray & Osborne, Inc.
CONSULTING ENGINEERS

FIGURE
14

The Ecotech units are not listed by the National Sanitation Foundation; their water conditioner carries the Water Quality Association "gold seal".

Various POU devices are available for an individual faucet, but cannot be recommended as the only treatment for a home being served by water from Summit Lake (as previously discussed). In order to meet the important criteria set by EPA for POE systems, discussed earlier, consideration should be given to homeowner association or water district sponsorship of a program properly established and staffed to insure that every home in the service area receives equal protection and that units are installed, inspected, tested, maintained and operated in an acceptable manner. Units could be obtained by competitive bid with engineered specifications, with the possibility of cost savings over the costs facing individual homeowners. The following table, Table 22, summarizes the costs of the various home treatment options as presented by local suppliers. In Chapter VIII an option for centralized management of these individual home systems will be presented.

TABLE 22

SUMMARY OF HOME TREATMENT SYSTEM COSTS

Option	Installation Cost	Annual Maintenance	Equivalent Total Annual Cost*
1C			
MMF (selected option)	$1,250		
C12 injector	3,095	$84	
C12 tank	incl.		
2 - 10M filters	incl.	82	
Carbon filter (exchangeable)	incl.	76	
RO unit (selected option)	850	34	
Service charge		30	
TOTAL:	$5,195	$306	$916

2C

MMF (selected option)	$1,250		
Cl2 injector	3,095	$84	
Cl2 tank	incl.		
2 - 10M filters	incl.	82	
Carbon filter (backwash)	incl.	120	
RO unit (selected option)	850	20	
Service charge		30	
TOTAL:	$5,195	$336	$946

3C

MMF (auto backwash)	$3,095		
2 - 5M cartridge filters	incl.	125	
UV disinfection	incl.	125	
RO Unit	850	34	
Service charge		30	
TOTAL:	$3,945	$314	$777

4E

MMF (auto backwash)	$1,940		
S M prefilters	incl.	$300	
UV disinfection	incl.	125	
UV chamber (option selected)	385	15	
SMGAC filter	385	29	
0.5 M ceramic filter	incl.		
TOTAL:	$2,710	$469	$787

5E

30 M filters	$1,287	$450	
0.5 M filter	incl.	incl.	
70 M GAC	incl.	incl.	
UV disinfection	incl.	incl.	
TOTAL:	$1,287	$450	$601

6E

5 M filters	$895	$630	
UV disinfection	incl.	incl.	
TOTAL:	$895	$630	$735

* Installation costs amortized at 10% for 20 years.

CHAPTER VIII

SUMMARY, COMPARISONS AND CONSIDERATIONS

INTRODUCTION

This study to this point has reviewed the existing situation regarding water supply to the residents of Summit Lake; evaluated water quantity and public health conditions; and discussed several alternatives, in considerable detail, for improved treatment. The purpose of this chapter is to summarize all this material in the form of a comparison of alternatives, with emphasis on their costs and how they satisfy the criteria for protection of public health. After a narrative summary of each alternative is presented, a comparison chart is included for all the alternatives, for easy reference. The chapter concludes with a discussion of financing options to be considered if a project is to be pursued.

This study does not attempt an evaluation of the effects each alternative would have on property values for the residences around Summit Lake, or for those lots or adjacent parcels of land currently undeveloped. Such an evaluation would require an extensive market study of comparable sales between the Summit Lake area and a similar lake area having an approved water system and similar characteristics, if such an area could even be found. Representative market data may not be available if most property sales are by private contract. Another key factor complicating this type of an evaluation is the relative influence the presence or absence of sewerage collection and treatment systems would have on property values. Attendant to these types of improvements, normally, is an increase in the assessed or appraised value of property and increased property taxes. However, experience would suggest that as residential areas increase in value due to external improvements, the continued upgrading results in appreciation more than offsetting the increased property tax levels.

THE "NO ACTION" ALTERNATIVE

Description

This alternative consists of a continuation of the existing practice of individual supply and treatment of water for each residence. Currently 13% of the developed lots are on wells and 62% are served from Summit Lake. Of the 284 developed lots with water supply from Summit Lake, only 7% filter and disinfect their water, presenting a significant threat of contacting waterborne illness. As more information for this subject is disseminated to the public, it is likely that additional residents will take more precautions or provide treatment and disinfection. Until (or unless) an outbreak occurs, however, significant change is unlikely.

Costs

The cost of providing drinking water will remain at stable very low levels, except for those isolated occurrences of an inadequate treatment system provided by the homeowner.

Pros

1. Low cost, low maintenance.
2. Not a public system, therefore no routine sampling or reporting requirements.

Cons

1. No standard for or surveillance of system condition.
2. Significant potential for waterborne illness.
3. Would not meet any regulatory agency standards.
4. Would restrict choices for financing property sale agreements.
5. Future building permits unlikely; County loan certifications not available.
6. Would limit property value appreciation.

INDIVIDUAL HOME TREATMENT SYSTEMS

Description

Under this alternative, individual homeowners would each purchase their own home treatment system, such as depicted in Chapter VII, Options 1C-3C and 4E-6E. A homeowners association or other organization could be formed to oversee the process, and some sort of incentive process designed. Hopefully the results presented in this study would be helpful in stimulating interest and enabling an informed choice of treatment devices. The organization could also provide some oversight or encouragement of operation and maintenance.

Costs

The costs for six (6) options range from $895-$5,195 for initial installation, and from $630-$306 for annual maintenance. This assumes the supplier would install replacement parts, filter cartridges and perform basic maintenance. The annual costs could be reduced if homeowners purchased the parts and did their own maintenance. Median and average costs for the six options were $3,045 and $3,204 for initial installation, and $468 and $418 for annual maintenance costs, respectively.

Pros

1. Improved level of protection, in general, over the "no action" alternative.
2. Homeowners retain control over choice of treatment units and cost.

Cons

1. Inconsistent installation and inconsistent oversight of systems.
2. No assurance of consistent proper operation and maintenance.
3. No public health protection for homes without treatment.
4. Regulatory and lending agency approvals unlikely.
5. Uncertainty of future regulatory agency actions regarding POE units.

CENTRALLY MANAGED HOME TREATMENT SYSTEMS

Description

This alternative envisions a system wherein each residence has the identical basic treatment system components, varying only by size based on flow requirements, with perhaps an option for polishing at the faucet at additional cost. The concept would include the requirement that all residences would participate and all persons would receive the same level of health protection. A water district would be formed to administer the program, or as an option, the County could sponsor the project until a local legal entity were established. Additional sampling would be conducted to better character Summit Lake quality, and professional assistance would be utilized to design a system meeting the established standards (MCLs) for potable water provided by a public water supply system. The preliminary engineering report would, as much as possible, identify standard certified treatment units, which could be furnished and installed through a competitive bidding process. An organization would be established for routine inspection, servicing and testing of all residence systems, and certified staff recruited. Homeowner agreements would be required to insure access by maintenance staff.

The design of this system, and organization procedures for centralized ownership and management, would be submitted for and presumably receive the approval of regulatory agencies (DOH and Thurston County). A public water system would be established and hopefully qualify for financial assistance from granting or lending agencies. This would be the first such system of centrally-managed individual home treatment systems in the State of Washington. The key to its initial success and approval is the development of a plan and design showing cost-effectiveness and engineering feasibility, as compared to other alternatives for central treatment, and the meeting of all DOH requirements. Because of this, the costs to develop, upgrade and maintain a system of this nature will likely exceed those for the previous alternative of individual home treatment systems managed by the homeowners.

Costs

The costs for this alternative are difficult to estimate at the general feasibility level. The evaluation in Chapter VII identifying the six (6) options provides basic information. Approval of this approach would require a demonstration that the level of treatment and public health protection equals or exceeds that of a central filtration and disinfection facility. The design would therefore include some redundancy in unit performance and reliability, with flow monitoring or headloss indicators to identify need for component service or element replacement. A standard would need to be established for each residence's plumbing and electrical service, to insure optimum performance of the treatment system. These costs would be borne by each homeowner. Care would be exercised to insure that any unit resulting in a waste discharge, e.g., filter backwash or RO membrane reject, would not upset the septic system or lakeshore ecology (if discharged to surface drainage.) The benefits of competitive bidding may be offset by the need to establish an inventory of service and replacement parts, a storage and service building, vehicle and communications for staff, etc.

Pros

1. Good levels of health protection with moderate risk level.
2. Regulatory agency approval likely.
3. Good chance of lending agency approval and eligibility.
4. Potential for approval of additional building and growth.
5. Enhancement of property values possible.

Cons

1. Will require intensive effort to plan, design, receive approval and implement.
2. Support and cooperation of every homeowner will be difficult to obtain.
3. Redundancy and reliability equal to central treatment difficult to achieve (e.g., electrical service).
4. High cost.
5. Future degradation of lake water quality could require more extensive treatment.

6. Uncertainty of future regulatory agency action regarding POE units.

A CENTRAL GROUNDWATER SYSTEM

Description

Under this alternative, the homeowners would either form a water district or a ULID under the County's sponsorship, and develop a groundwater source that would be transmitted throughout the service area by underground pipelines. A storage reservoir would be constructed to provide emergency capacity and insure system reliability. Individual services would be metered to provide a means for billing users based on their use of the water. The availability of groundwater is discussed in Chapter III. There is a high possibility that any groundwater encountered would require treatment for the removal of iron and manganese. If a water district is formed, the monthly rates charged to customers must be sufficient to pay for the necessary personnel, O & M requirement and replacement materials. If a ULID were formed, the County would assume responsibility for operating and maintaining the water system.

Costs

The costs for this alternative are developed in Chapter VI. The annualized initial capital investment and the ongoing O & M costs for each customer would be approximately $57 per month or $684 annually based on the participation of the existing 455 developed lots in the Lake Management District.

Pros

1. Least cost of centrally-maintained and operated systems.
2. Regulatory agency approval virtually certain.
3. Enhancement of property values likely.
4. Will provide reliable supply.
5. All customers receive same level of service and public health protection.

Cons

1. Likelihood of finding adequate quantity of well water is uncertain.
2. A possibility that groundwater would require more expensive treatment, depending on quality of water encountered.
3. Uncertainty of long-term supply from the aquifer.
4. May be subject to future regulations which could require more extensive treatment.

A CENTRAL SURFACE WATER SYSTEM

Description

This alternative is similar to the central groundwater system except that Summit Lake is used as the source of supply. If Summit Lake is used as the source of supply, then the water must be filtered and disinfected prior to use. A system of pipelines and storage facilities would be installed to deliver the water to customers at an adequate pressure. The community would be required to form a water district or a County-sponsored ULID.

Costs

The costs for this alternative are developed in Chapter VI. The annualized initial capital costs and ongoing O & M costs will be approximately $80 per month or $960 annually based on the participation of all 455 developed lots in the Lake Management District.

Pros

1. Regulatory agency approval virtually certain.
2. Enhancement of property values likely.
3. Will provide most reliable source of supply.
4. All customers receive the same level of service.
5. Central treatment system most easily modified to meet future regulations.

Cons

1. High capital and O & M costs.
2. May be subject to future regulations which could require more extensive treatment.
3. Degradation of Summit Lake water quality could require more extensive treatment.

SUMMIT LAKE WATER SYSTEM
FEASIBILITY STUDY-
COMPARISON OF ALTERNATIVES

ALTERNATIVE	FEATURES	COSTS	CONSIDERATIONS
No Action	Continuation of existing practice.	Very low - electricity and equipment, varies from house to house	Not a "public water system", not subject to regulation. Continues on County "boil water" advisory; health threat continues with good chance of illness outbreaks. No commercial loan approvals or building permits possible.
Individual Home Treatment	Decision to treat and choice of equipment by Owner; O & M arranged by Owner.	First cost = $900 - $5,200 Amortized at 10%, 20 yr. = $106-$611/yr. O&M = $630 - $306/yr. Total annual cost = $736 - $937 per household treated.	Little incentive to treat - limited health protection. No guarantee of proper application of units or consistent O & M. Regulatory approvals, certifications, building permits, etc., unlikely.
Centralized Management of Individual Home Treatment Systems	For each home: pump, pressure tank, plumbing and electrical by Owner. District or County specifies mixed media filter with automatic backwash to yard drain; two 5 micron filters; UV disinfection; RO unit at faucet(s). Maintenance and inspection provided, access guaranteed by restrictive covenant/homeowner agreement.	First cost = $4,000 Amortized at 10% 20 yr. = $470. O & M = $400. Total annual cost = $870 per household, assuming 400 residences. Additional first cost to upgrade plumbing to be borne by homeowner. Additional cost for administration of a District organization, building, billings, etc. estimated at $20/month.	Should provide a safe supply of water with good reliability. Probably approvable with effort, by regulatory agencies. Requires each resident to participate and grant access. Building permits likely, property values should increase. Lending agencies should respond positively. System management will present many unique administrative challenges. System may require upgrading or other changes based on operational experiences or changes in Summit Lake water quality. First system of its kind in State of Washington.
Central Groundwater System	Includes wells, water treatment, transmission pipeline, and a storage reservoir. A water District or ULID is formed to operate and maintain the water system. Individual services are metered, water treatment to include sequestering for iron and manganese and disinfection.	Initial Capital Cost = $2,196,700 Amortized at 8%, 20 yr. = $486 annual cost. O & M = $199 assuming 455 customers. Total annual cost is $685, including administration.	Will provide a safe supply of water with good reliability. Regulatory agencies will approve system. Delivers same quality water to all customers. Most cost effective solution, if water can be found. Enhancement of property values likely. Quality and quantity of groundwater is a concern; some uncertainty in eventual costs. Well water may require more extensive treatment to assure acceptable quality.
Central Surface Water System (Summit Lake)	Includes surface water treatment plant, transmission pipeline and a storage reservoir. A water district or ULID is formed to operate and maintain the system. Individual services are metered. Water treatment process will be direct filtration.	Initial Capital Cost = $2,956,200 Amortized at 8%, 20 yr. = $662 annual cost O & M = $293 assuming 455 customers. Total annual cost is $955, including administration.	Will provide a safe supply of water with good reliability. Regulatory agencies will approve system. Delivers same quality water to all customers. Higher cost solution, but is most reliable over long term. Requires high degree of water system operator skill. Most enhancement of property values and growth depending on eventual solution to sewage system problems.

FIGURE 15

SOURCES OF FINANCIAL ASSISTANCE

If a water supply project were to be locally sponsored, sources of funding would be somewhat limited by reason of there being no collateral to pledge as security. This restricts sources to certain grants and loans and the sale of revenue bonds, with the pledge of future income and constructed facilities as security.

Public Works Trust Fund Loans

The Public Works Trust Fund Program is operated by the State Department of Community Development. Its purpose is to provide funds for repair, reconstruction, replacement, rehabilitation or improvement of public works systems. The program offers 20-year maximum term loans of up to $2,500,000 for a single project. Interest rates of one to three percent are available, depending on the level of local participation: for 30% local participation, the rate is 1%, for only 10% local participation, the interest rate rises to 3%. In any case, interest rates are obviously well below market levels. Local jurisdictions are required to adopt a one-quarter of one percent (1/4%) excise on real property dedicated to capital improvements. They must also have a long-term plan for financing public works needs.

Preliminary discussions with program staff indicate a replacement water supply system(s) for Summit Lake would probably be eligible for a loan under this program. The project's priority would be enhanced by the County's certification of the existing public health hazard and need for the project. Either the County or another legal entity such as a newly-formed water district would be an eligible loan applicant. The local match (10-30% or more) could come from any source, including another lending or granting agency. Applications are due in July of each year (July 13 in 1991). If the County were to apply, and a water district formed later, the District could assume application sponsorship from the County. In either case the project sponsors would have to own all the facilities, and have permanent easements for all private property crossing. Eighty percent of the project area would have to be already developed, and there may be a restriction that any expansion area would have to excluded.

A project consisting of centrally owned, operated, maintained and managed individual home treatment systems would be eligible for funding if approved by the State as a public water system, and if the individual home treatment system were the most cost-effective alternative. Property owners would have to agree to system ownership of all household units and access for operation and maintenance by staff. This agreement would need to be in place within 30 days of the filing of a loan application, in order for the application to remain valid.

Referendum 38 Grants

The State Department of Health has had grant funds available, to assist public water systems with capital improvement needs, for many years. Although the program is no longer funded by the legislature, the agency still operates the program on revenue returning from projects completed below budget, or return of unused contingency funds. A waiting list currently exists for these grants, but projects continue to be funded as revenues are received. Priority is on a first-come, first served basis, so early applications are encouraged. The grants are 40% of eligible project costs; the other 60% local share can come from any source. Program staff indicate a Summit Lake project would be eligible; loan application could be by the County initially, and sponsorship switched later to whatever type of entity were formed to sponsor the project.

Community Development Block Grants

The State Department of Community Development distributes federal funds to local governments for the repair, improvement and construction of public works. Grants of up to $500,000 per project are offered. Eligibility requirements include very low income levels and economic need of the community. It is unlikely that the Summit Lake area could meet these criteria. Applications for each fiscal year are submitted in January.

Farmers Home Administration (FmHA)

The FmHA is a federal agency that distributes grants and loan for water systems, sewerage systems and solid waste facilities in rural areas and towns with populations up to 10,000. Financing through the FmHA is available only to the

extent that all other financial sources have been exhausted. The availability of grant funds is limited, but loan programs are more readily available.

A formula exists for determining project eligibility in terms of grants vs. loan amounts. Need, income level and ability to pay are considered; program staff indicate that for Summit Lake, revenue bonds could perhaps be purchased at an interest rate of 6 - 7%. If project costs resulted in a monthly user charge in excess of $25.00 per month, the project may be eligible for accompanying grants (if funds are available). Funding from other sources can be used in conjunction with FmHA grants and loans.

ULIDs (Utility Local Improvement Districts)

This process was described in some detail in Chapter II. The ULID revenue is income paid to a municipality, county or district from assessments levied against specific properties benefitted by the installation of the water system improvements in the defined area. ULIDs are formed by the jurisdiction, by resolution on their own initiative or in response to a petition by the property owners. Each separate property in the ULID is assessed in proportion to the benefits received from the water system improvements. The individual property assessments can either be paid up front or financed on an annual basis. Unpaid assessments are a lien against the property and are paid upon transfer of ownership.

Revenue Bonds

Revenue bonds are issued and sold by a municipality, county or district when large amounts of money are needed to construct capital facilities benefitting the jurisdiction as a whole. The principal and interest payments for these bonds are repaid from general revenues, operating income and ULID assessments. To qualify to sell revenue bonds, the jurisdiction's net operating income (gross income less expenses) must exceed all outstanding indebtedness by a factor called the coverage factor, typically 1.3 or 1.4. For Summit Lake's situation as a new drinking water source, the FmHA would be a likely candidate to purchase revenue bonds for a Summit Lake water system project. Their coverage factor requirements may be as low as 1.1.

SUMMIT LAKE PUBLIC HEALTH ADVISORY
FEBRUARY 6, 1987

APPENDIX A-1

THURSTON COUNTY HEALTH DEPARTMENT

ENVIRONMENTAL HEALTH DIVISION
2000 Lakeridge Dr. S.W.
Olympia, Washington 98502
(206) 786-5455
Patrick M. Libbey, Director

TO: Summit Lake Residents and Property Owners using raw lake water as a source of drinking water

FROM: Charles D. (Don) Leaf R.S.
Director, Environmental Health Division
Gary Goldbaum M.D., Consulting Health Officer

DATE: February 6, 1987

PUBLIC HEALTH ADVISORY

YOU ARE HEREBY NOTIFIED AND ADVISED NOT TO USE RAW LAKE WATER FOR DRINKING, PREPARATION OF UNCOOKED FOODS, AND OTHER TYPES OF CONSUMPTION SUCH AS TEETH-BRUSHING.

EXPLANATION

I. Health Advisory

Based on the water sample results, the Thurston County Health Department advises lake residents and property owners not to use raw lake water as a source of drinking water. The potential for disease transmission has been documented by this Department, however no illnesses resulting from the consumption of Summit Lake water have been reported to this Department to date. It is the intent of this advisory to prevent an out-break of water-borne illness due to consumption of raw lake water.

Water for human consumption should be obtained from a safe source with known water quality. If the lake is the only source of water available to you, intermediate steps should be taken to disinfect any water to be used for drinking, cooking, and teeth-brushing. While disinfection will not remove chemical contaminants such as pesticides or fuels, it will reduce the risk of illnesses caused by organisms such as bacteria, viruses, and protozoa.

Interim measures for obtaining or preparing safe drinking water are listed in Section IV. Information on disinfection procedures for preparing drinking water is available from the County Health Department and can be obtained by calling 786-5455. Please ask for the brochure

entitled "Safe Drinking Water in Emergencies" by the U.S. Department of Health, Education, and Welfare.

Whole-house disinfection and filtration systems are available from local suppliers, and questions regarding their effectiveness, cost, etc. should be directed to the manufacturers and sales representatives of such units.

Long term solutions to the problem of safe drinking water at Summit Lake have not been considered, and the Health Department has no recommendations at this time. The problem, however, is a lake-wide condition and a community decision appears to be necessary.

II. Water Quality Monitoring Program

Thurston County Health Department, in conjunction with the lake community group, has been monitoring the bacterial water quality of Summit Lake since April 1985. Since November 1985 water samples have been collected on a monthly basis both from faucets and from docks at regular locations around the lake.

In Fall of 1986 the Health Department expanded the monitoring program to include measuring lake temperature, conductivity, and clarity and monitoring streams flowing into the lake. Although this monitoring is expected to continue through August 1987, there is sufficient data at this point to release preliminary findings and recommendations to lake residents.

III. Findings

The over-all bacteriological quality and water clarity of the lake is excellent when compared with the standards established for recreational waters. However, results from faucets sampled indicate that bacteriological drinking water standards cannot be consistently met in domestic systems drawing water directly from the lake without any type of disinfection. For example, only 38% of 29 faucet samples taken during the months of October '86 through January'87 met the established safe drinking water standard of not greater than 1 coliform bacteria per 100 milliliters of sample.

We have found that the water quality is being impacted by such things as on-site sewage systems, road and driveway run-off, run-off from cleared denuded lots, underground lot drainage systems, and recreational activities as well as natural sources such as wildlife. While it is possible to reduce the impacts of some of these sources, it is impossible to completely eliminate all of them and assure a safe drinking water supply from the lake.

IV. Interim Recommendations for Drinking Water
(in order of preference)

1. Hauling water from a safe, approved source; i.e. City of Olympia

2. Boiling for 10 - 15 minutes

* 3. Chlorination with household bleach with 5.25% available chlorine; ex. Purex or Chlorox.
Mix 8 drops of bleach per gallon of water. Let stand for at least 30 minutes at room temperature before using.

* 4. Tincture of Iodine
Mix 20 drops of iodine per gallon of water. Let stand at room temperature for at least 30 minutes before using.

* Double the amount of chemical added if water is cloudy.

A brochure entitled "Safe Drinking Water in Emergencies" by the U.S. Department of Health, Education, and Welfare describes the procedures listed above and is available from the Thurston County Health Department.

DESIGN STANDARDS FOR THE DEVELOPMENT OF PUBLIC WATER SYSTMS ORDINANCE NO. 8149

APPENDIX A-2

ORDINANCE NO. 8149

AN ORDINANCE establishing design standards for the development of public water systems.

WHEREAS, the Board of County Commissioners of Thurston County (Board) finds that various public water systems, particularly in the rapidly developing areas near Olympia, Lacey and Tumwater, have been developed with inadequate fire protection storage, water mains and lines, and otherwise in a substandard manner; and

WHEREAS, the Board finds that existing regulation of said water system development is inadequate to protect and promote the public safety, health and welfare; and

WHEREAS, the Board is authorized by Article 11, Section 11 of the Washington Constitution and RCW 36.32.120, and by Chapter 70.116 RCW (Public Water System Coordination Act), to adopt standards and regulations which seek to remedy those problems and to protect and promote the safety, health and welfare of the general public;

NOW, THEREFORE, BE IT ORDAINED BY THE BOARD OF COUNTY COMMISSIONERS OF THURSTON COUNTY as follows:

Section 1. The Board hereby adopts and incorporates by reference herein the attached regulations entitled "Thurston County Design Standards for Public Water Systems."

Section 2. If any provision of this ordinance, including the regulations adopted by reference herein, or its application to any person or circumstance is held invalid, the remainder of the ordinance or the application of the provision to other persons or circumstances is not affected.

Section 3. This ordinance shall be effective September 1, 1985.

ADOPTED: Aug 5, 1985.

ATTEST:

Patti K. Fick
Clerk of the Board

BOARD OF COUNTY COMMISSIONERS
Thurston County, Washington

Les Eldridge
Chairman

APPROVED AS TO FORM:

PATRICK D. SUTHERLAND
PROSECUTING ATTORNEY

Karen Fraser
Commissioner

By: Robert D. Tobin
Robert D. Tobin
Deputy Prosecuting Attorney

George L. Barner Jr.
Commissioner

TABLE 2

THURSTON COUNTY

DESIGN STANDARDS FOR PUBLIC WATER SYSTEMS

Standard	Discussion
1. APPLICABILITY	
1.1 These minimum regulations apply to all existing and future "public" water systems located within the Thurston County Urban Water Supply Service Area, as designated by motion of the Thurston County Board of County Commissioners on October 23, 1984, and as thereafter amended.	These are minimum standards and individual water systems may adopt and enforce more stringent requirements as a condition of service.
1.2 Water system facilities existing on the effective date of these regulations September, 1985 need not be modified to meet these standards. However, any new water system facilities or extension, expansion or enlargement of existing water system facilities must comply with these standards unless, prior to the effective date of these regulations, plans for said action were approved by the Thurston County Health Department or the State of Washington Department of Social and Health Services (DSHS) pursuant to WAC 248-54 or rights have vested pursuant to RCW 58.17.140 (State Subdivision Act.	Existing water systems will not be required to replace existing facilities unless such improvements are needed to serve a larger area.
1.3 Reference herein to a "class" of water system (Classes 1 through 4) refers to a determination of class, pursuant to WAC 248-54-015, based upon the number of new services to be provided by the water system.	
2. WATER SUPPLY	No change from existing State and County requirements.
2.1 Each water system must have a supply of water which meets water quantity requirements of WAC 248-54 and WAC 248-57. Water supply shall be based upon recorded water rights in accordance with RCW 90.54, WAC 173-590, and requirements of the State of Washington Department of Ecology (DOE).	
2.2 In order to enhance the reliability of water supply pursuant to WAC 248-57-700, water systems are encouraged to have multiple sources of supply.	
2.3 In order to ensure the reliability of water supply during power failure or other emergency conditions, Class 1 systems shall have gravity storage, standby power, multiple power sources, or alternative sources of supply.	

Standard

Discussion

3. DISTRIBUTION SYSTEM

In addition to complying with DSHS requirements for water distribution systems, water systems shall comply with the following requirements:

3.1 Except as specified herein, all water mains shall be constructed in accordance with the most recent edition of the "Standard Specifications for Road, Bridge and Municipal Construction" prepared by the Washington State Department of Transportation and the Washington State Chapter of the American Public Works Association, referred to hereafter as the Standard Specifications.

3.2 Class 1 or 2 water systems shall be designed by a professional civil engineer licensed by the State of Washington. Class 3 or 4 water systems shall be designed by such an engineer or by a water system designer certified by Thurston County Health Department.

3.3 Whether or not storage of water for fire flow is provided in a system, the system must be hydraulically capable of distributing the following flows to fire hydrants serving the following land uses occupancies:

This section establishes the design criteria for sizing the pipes in a water system. It is not setting a storage requirement. This is done in paragraph 5.2.

LAND USE OCCUPANCY CLASSIFICATION PURSUANT TO UNIFORM FIRE CODE	REQUIRED FIRE FLOW CAPABILITY
Group R, Division 3 Dwellings and lodging houses):	Provide 750 gallons per minute (gpm) at 20 pounds per square inch (psi) residual pressure while simultaneously maintaining no less than 10 psi residual pressure at any point in the distribution system, while meeting the maximum instantaneous domestic water demand.
All other occupancy Classifications:	As determined by the Thurston County Fire Marshal.

3.4 Regardless of water pipe sizes which may be capable of delivering the fire flows prescribed in Section 3.3, minimum distribution pipe sizes are as follows:

Regardless of the calculations from 3.3 above, these minimum pipe sizes are considered good practice to insure that the system can supply fire protection in the future.

Standard

Discussion

DISTRIBUTION SYSTEM CONFIGURATION	MINIMUM PIPE SIZE
Standard distribution main installation:	8-inch diameter
Looped main installation with interties at one quarter mile intervals or closer:	6-inch diameter
Cul-de-sacs or non-extendible, dead end water mains	2-inch or whatever size is required to meet the projected maximum fire flow and instantaneous domestic water demand.

3.5 PVC pipe shall meet the standards of SDR 21 and be no less than the Class 200 working pressure standards of the American Society of Testing Materials (ASTM). All other pipe and materials including services lines and meters shall meet no less than AWWA Class 150 working pressure requirements.

3.6 Valves shall be installed in the distribution system at sufficient intervals to facilitate system repair and maintenance, but in no case shall there be less than one valve every one thousand feet (1,000').

3.7 When fire hydrants are not provided on dead end mains, 2-inch blow-off assemblies with gate valve and box meeting AWWA standards shall be installed to allow flushing of the dead end main.

4. FIRE HYDRANTS

4.1 Fire hydrants shall be installed at intervals of not more than 700 feet on all lines serving R-3 occupancies (dwellings and lodging houses), provided that for cul-de-sacs or dead-end streets, no property shall be more than 350 feet from a fire hydrant. For lines serving other occupancies, fire hydrants shall be installed, if at all, at intervals and locations designated by the Thurston County Fire Marshal.

All new water systems will be required to install fire hydrants at the time the water system is constructed. This eliminates the existing problem of how to pay for later installation of fire hydrants.

4.2 Fire hydrants shall be served by water mains 6 inch in diameter or larger.

4.3 Fire hydrants shall be furnished and installed according to Standard Specifications and shall be equipped with 6 inch auxiliary valves, valve boxes, blocking or tie rods, and drain pits.

Standard	Discussion
4.4 Fire hydrants shall be provided with two, 2-1/2 inch nozzle ports and one pumper connection port. All pumper ports shall meet the sizing and hose thread requirements of the Fire District or Fire Department in whose service area the hydrant is located. The 2-1/2 inch nozzle threads shall be National Standard threads. Fire hydrants shall be painted to standards of the applicable fire protection agency.	
4.5 Where a water system does not provide the fire storage specified in these standards at the time of fire hydrant installation, the hydrants shall be painted a color designated by the applicable fire protection agency to indicate that the hydrant is not a full service hydrant.	Some small systems may not be able to meet the fire storage requirements initially, however, by installing the fire hydrants full fire protection will be available once the storage or a system intertie is constructed. The local fire fighting agencies favor this approach.

5. STORAGE

5.1 Domestic Storage. Water systems shall comply with DSHS requirements for domestic equalizing and standby storage.

5.2 Fire Flow Storage. Unless an exception is granted pursuant to 5.3, water systems shall have fire flow storage in addition to any domestic storage provided pursuant to Section 5.1 which is capable of providing the following fire flow:

This storage requirement is greater than DSHS requirements but is a minimum requirement based on good fire fighting practice as outlined in the standards of the Insurance Services Office (ISO) which are enforced in Thurston County.

LAND USE OCCUPANCY CLASSIFICATION PURSUANT TO UNIFORM FIRE CODE	MINIMUM FIRE FLOW REQUIREMENTS
Group R, Division 3 (Dwellings and lodging houses):	750 gpm for 30 minutes
All other occupancy classifications:	As determined by the Thurston County Fire Marshal pursuant to the Uniform Fire Code

The dwellings portions of this paragraph extends fire flow requirements to residential development which has been exempted by current County ordinances.

5.3 Fire Flow Exceptions. For other than Class 1 systems, the Thurston County Fire Marshal may grant exceptions to the fire flow storage requirements prescribed in Section 5.2, if the Marshal finds that the proposed system for which an exception is desired lies within the future service area of an existing purveyor, but the service is too distant from the purveyor's existing service to be connected at the time

All systems are required provide fire storage; however, it is recognized that this could be a severe burden to short plats or small developments. This exemption

Standard

of the request, and a plan for the proposed system exists which shows how fire flow will be provided in the future, either independently or by intertie with another purveyor. If the plan proposes that the storage capability be provided by intertie, then the water system plan of the other purveyor shall be amended to accommodate the planned intertie.

Discussion

process may encourage development to seek water from larger existing systems which would further the goals of the Coordinated Water System Plan and the Coordination Act.

6. APPEAL

6.1 Administrative Appeal or Variance Request to Hearing Examiner. Any person who desires a variance from these standards, or any person who is aggrieved by an administrative decision pertaining to the application of these regulations may appeal to the Thurston County Hearing Examiner in the manner prescribed by Chapter 2.06, Thurston County Code. The appeal shall be in writing and submitted to the Thurston County Health Department with an appeal fee of $50.00. Notice of public hearing shall describe the time, place and purpose of the hearing, and shall be published and mailed 10 days before the hearing, and shall be given as follows:

The Hearings Examiner was chosen as the appeal authority since the examiner is directly involved in the land development process and most water systems are developed as part of a land development action. No new appeal process is required and since the development industry is accustomed to the Hearings Examiner process, there should be little difficulty in using this procedure.

Publication. Notice shall be published in a newspaper of general circulation in the county.

Written Notice. Written notice shall be mailed to the appellant, the subject purveyor (if other than the appellant) and other affected parties as determined by the Health Department.

6.1.1 Variance Standard. The written request for a variance shall include information addressing the following issues:

a. The nature of the relief requested.
b. Why the water system is unable to comply with the standards.
c. Documentation prepared by a licensed professional engineer that granting the relief requested would not result in an unreasonable risk to public health or safety.
d. A proposed schedule for attaining compliance with the standards, or providing mitigating measures or conditions.
e. Other pertinent facts.

If the examiner finds that special hardships would result by not granting the relief request, and that the general purposes of these standards would not be frustrated by granting relief, then the examiner may

grant the relief requested, or grant such other relief, including the attachment of conditions, as he deems reasonable under the circumstances. The examiner may receive or solicit information or opinions from governmental agencies, the Water Utility Coordinating Committee, or persons regarding the request for relief.

6.1.2 Administrative Appeal Standard. The written administrative appeal shall include information addressing the following issues:

a. Identify the specific regulatory provision which has allegedly been misinterpreted or misapplied.
b. The nature of the relief requested.
c. Other pertinent facts.

If the examiner finds that the staff erred in interpreting or applying these standards, the examiner shall issue a written decision accordingly.

6.3 Appeal to County Commissions. The decision of the hearing examiner may be appealed to the Board of County Commissioners by filing a written notice of appeal with the Thurston County Health Department within twenty days of the hearing examiner's final decision, or within ten days in the event the appeal is from the examiner's decision on reconsideration. The appeal shall be considered in the manner prescribed by Chapter 2.06, Thurston County Code.

POLICY: INTERIM WATER SYSTEM APPROVAL

APPENDIX A-3

DRAFT

POLICY: INTERIM WATER SYSTEM APPROVAL

PROBLEM STATEMENT: Many laws, statutes, codes and ordinances pertain to the approval, construction, and operation of water supplies. Staff need clear policy direction while the water program is developed and until the implementation strategy for the Growth Management Act is defined.

OBJECTIVE: To provide clear policy and approval process for development review.

BASIS: Thurston County Sanitary Code,
Art. IV sections 10, 12, & 13.
Art. III County Drinking Water Regulations
WAC 173-160 Minimum Standards for Well Construction
WAC 248-54 State Board of Health Drinking Water Reg.
Uniform Building Code/Uniform Plumbing Code,
Chapter 10
Thurston County Coordinated Water System Plan

INTERIM POLICY:

I. General: Any proposal for the location of an individual or community water system must be reviewed to assure that the source is not located in the area of known contamination, as delineated by the groundwater staff, and that adequate source protection can be maintained. If the source is proposed within an area of special concern, the groundwater staff are to be consulted in the decision to approve or deny the source construction. The groundwater staff will provide a current map of such areas of concern.

II. The following is required for water supply approval prior to the issuance of a Building Site Approval for existing lots of record:

A. Individual Water System
1. Groundwater Source Proposed: construction of a well must meet the requirements of Washington State Department of Ecology standards for well construction (WAC 173-160).
2. Spring Water Proposed: springs shall meet the requirements of Thurston County Sanitary Code, Article III, section 12.6.
3. Surface Water Proposed: It shall be generally unacceptable to use surface water as a source of potable water for an individual water system. In the event that no suitable alternative is

available, surface water may be considered. The minimum requirements shall be:
- -a water right permit issued by department of ecology
- -water treatment to include continuous filtration and disinfection.
- -a notice of understanding must be filed

4. Notice of Understanding
In the event a surface water source will be used with a treatment system, a Notice of Understanding must be signed by the property owner and filed with the county auditor prior to the approval of the BSA. The notice will alert the applicant and future owners to the following:
--While the treatment unit(s) may, in theory provide drinking water which meets the minimum potability standards for bacteria, they may not protect against contamination by chemicals. Additionally, routine operation and maintenance practices are essential for the provision of safe drinking water. It is recognized by state and local health departments that the maintenance of individual home treatment systems is generally inadequate, and generally there is a lack of source protection and control especially when considering chemical contaminants.
--The Department of Housing and Urban Development (HUD) under 24 CFR Part 200, Minimum Property Standards for One and Two Family Dwellings, states that "Water that requires continuing or repetitive treatment to be safe is not acceptable. Individual dwelling water purification units are not an acceptable alternative but may be used to improve acceptable water." This means that those houses served by individual water supplies requiring treatment for potability will <u>not</u> be eligible for federal financing options such as FHA loans, etc.
--Thurston County Environmental Health will <u>not</u> give favorable statements regarding such systems when water system evaluations for lending/financial institutions are requested.

B. Public Water System
1. the system is approved by the jurisdictional health authority.
2. the lot under review is among those approved for

water service and the water service is available to the lot.

3. the water system is in full compliance with construction, operation, and water quality monitoring requirements.

III. The following is needed for subdivision or other land use permit approval:

A. Individual Water Systems

1. a review of local well logs, USGS data, or other available information is required to provide reasonable assurance that water can be attained.

2. the well or spring isolation area must be contained wholly on the lot created or protective covenants must be secured prior to final approval.

3. the use of surface water does not meet the requirement for potable or safe water supply and is not acceptable.

B. Public Water Systems

see II.B. above

HEALTH DEPARTMENT APPLICATION FOR LOAN CERTIFICATION

APPENDIX A-4

THURSTON COUNTY
WASHINGTON
SINCE 1852

COUNTY COMMISSIONERS.
George L. Barner, Jr.
District One
Diane Oberquell
District Two
Les Eldridge
District Three

PUBLIC HEALTH AND
SOCIAL SERVICES DEPARTMENT

Patrick M. Libbey, Director
Diana T. Yu, MD, MSPH
Health Officer

LOAN CERTIFICATION INFORMATION - PUMPING TANKS

This Department would like to take the time to remind you of the requirements for the loan certification process. There have been some inconsistencies between pumpers which need to be corrected. The following are the requirements:

1) All septic tanks must be pumped through the manhole lids. The tanks should not be pumped through the baffle inspection ports. Two compartment septic tanks should have both compartments pumped, baffles should also be cleaned and properly inspected.

   When the tank has been pumped just prior to the inspection, the outlet and inlet baffle lids should be opened along with the manhole lids. Septic tanks that have been previously pumped, within the past three (3) years, should have at least the outlet baffle inspection port open.

2) **Drainfields should be exposed to the perforated drainpipe and should be easily visible.** Lately, tight lines and drain rock have been uncovered but no perforated pipe is exposed, this is not acceptable. The drainpipe must be uncovered.

   The section of perforated drainfield pipe exposed should be a minimum of ten (10) feet from the septic tank.

3) Baffle replacements should be made with plastic "tees", concrete or other material approved by the Health Officer. Metal baffles or plastic elbows are not acceptable for baffle replacement or repair.

4) Please note on the pumper slip if there is anything unusual with the system, i.e.. black rock, ponding, driveway over drainfield, tank covered by concrete patio etc.

5) If you are pumping the tank for an operational permit, please make a note of this on the pumpers slip.

In order to be fair and consistent with all pumpers and homeowners, the above requirements will be strictly adhered to. If there is ever any problem please let me know and thank you for the continued high quality of work. If you or your firm have any questions please feel free to contact this department at 786-5455.

MS.1.PUMPERS

LCA #_____ OPTS #_____ TAX PARCEL #_____ FEES $109.00

Water [ ]
Septic [ ]
Reinspection [ ]

ENVIRONMENTAL HEALTH SECTION
2000 Lakeridge Dr. S.W.
Olympia, WA 98502
(206) 786-5455 or 1-800-624-1234

THURSTON COUNTY HEALTH DEPARTMENT
APPLICATION FOR LOAN CERTIFICATION

PROPERTY ADDRESS_____

DIRECTIONS TO PROPERTY_____

_____

LEGAL DESCRIPTION_____

_____

NO. OF BEDROOMS_____ YEAR HOUSE WAS BUILT_____ TAX PARCEL #_____

OWNER/BUILDER AT TIME OF SEWAGE SYSTEM CONSTRUCTION_____

SEND REPORT TO :_____

_____

_____

_____

SIGNATURE OF APPLICANT_____ PHONE_____

THE SEPTIC TANK MUST HAVE BEEN PUMPED WITHIN THE LAST THREE YEARS, A COPY OF THE PUMPER SLIP (FROM THE PUMPER) MUST BE SUBMITTED TO THE HEALTH DEPARTMENT BEFORE THE SYSTEM CAN BE INSPECTED; THE OUTLET BAFFLE AND AT LEAST ONE OF THE DRAINFIELD LINES MUST BE EXPOSED TO THE PERFORATED PIPE.

FOR DEPARTMENT USE ONLY - DO NOT WRITE BELOW THIS LINE

DATE RECV'D_____ RECV'D BY_____ RECEIPT #_____ RECORD SEARCH BY_____

1) Evidence indicates that the sewage system:
   - [ ] appeared to be functioning satisfactorily at the time of inspection.*
   - [ ] appeared to be malfunctioning at the time of inspection. The Department, however, will not require a repair of the system as no health hazard exists at this time.

2) As of _____ corrections were made to the septic tank and/or drainfield to indicate suitable operation at the time of reinspection.
   Initials_____

3) Bacteriological analysis indicates that the water system:
   - [ ] has had a recent sample showing negative coliforms.
   - [ ] is unsatisfactory for human consumption.

4) The well construction and protective well radius:
   - [ ] are [ ] are not - in satisfactory compliance with sanitary standards.
   - [ ] water system not evaluated.

5) As of _____ corrections were made to the water system to indicate adequate protection of the water supply at the time of reinspection.
   Initials_____

* A determination of no observable failure is not a guarantee of future performance of the sewage system.

DATE OF INSPECTION_____ DATE OF REINSPECTION _____

COMMENTS _____

_____

_____

_____

Environmental Health Specialist_____

PUMPER'S SLIP

PUMPER'S NAME_____

PUMPER'S PHONE NUMBER_____

SITE ADDRESS_____

DATE PUMPED_____GALLONS PUMPED_____

TANK SIZE_____# OF COMPARTMENTS_____

TANK CONDITION (Check All Applicable Boxes)

_____ Fluid level okay in both compartments (at lower lip of outlet pipe)

_____ Baffles in satisfactory condition

_____ Bottom/sides in good condition (no cracks or holes)

_____ Other (explain)_____
_____

DRAINFIELD CONDITION (Check All Applicable Boxes)

_____ Open

_____ Not Open (explain)_____
_____

_____ Drainrock clean (no black slime) and unsaturated (no ponding or of saturation)

_____ Other (explain)_____
_____

NOTE:Tank outlet or inlet baffle lid must be exposed and at least one hole exposing the drainfield (to the level of the pipe) must be dug prior to inspection.

_____ _____

DATE SIGNATURE OF PUMPER

SEWERAGE POLICIES
MAY 1985

APPENDIX A-5

COUNTY SEWERAGE POLICIES

THURSTON COUNTY, WASHINGTON

MAY 1985

APPROVED BY BOARD OF THURSTON COUNTY COMMISSIONERS

Les Eldridge
Chairman

Karen Fraser
Commissioner

George L. Barner Jr.
Commissioner

Dated: MAY 20, 1985

This report was prepared by staff from Thurston County Public Works, Planning and Health Departments:

Al Williams
Jerry Hendricks
Les Whisler
Steve Chamberlain
Don Leaf
Linda Hoffman

TABLE OF CONTENTS

A. INTRODUCTION

1. Background

In September, 1982, the Board of County Commissioners authorized the Public Works, Health and Planning staffs to initiate development of county sewerage policies. The initial plan of study included the completion of staff sewerage policy recommendations.

A staff task force met regularly in late 1982 and early 1983. The work of the task force included review of relevant land use plans and development goals, review of current sewerage policies, legal options and requirements as they relate to sewerage, and identification of problems with existing policies. The task force then reviewed a number of options for revising current policies and developed a set of policy recommendations. These recommendations were transmitted to the Board of County Commissioners in early 1983. Prior to consideration of the policy recommendations, the Board decided to initiate the next step of a sewerage general plan for two target study areas: Boston Harbor and Grand Mound. The more detailed planning for the two areas was intended to provide further information with which to evaluate county-wide sewerage policies and possibly develop new policies.

2. Purpose of Study

The purpose of this study is to provide the Board of County Commissioners with adequate information to evaluate alternative county sewerage policies. The results of this study will include:

* Defining current county sewerage policies.

* Development and review of alternative future county-wide sewerage policies.

* Defining current and anticipated sewage disposal problems within the two study areas.

* Investigating possible alternative sewage disposal methods and costs in the selected study areas.

* Evaluating community reactions and county concerns to a possible implementation of sewer service in the two study areas.

* Public input to a sewerage general plan.

* Recommendations.

B. CURRENT COUNTY SEWERAGE POLICIES

Current Thurston County sewerage policies are contained in the following documents:

1977 Amendment to the Thurston County Comprehensive Plan
1979 Policy Statement adopted by the Board of Health
1983 Memorandum of Understanding on Urban Growth Management (701 Agreement) signed by the County Commissioners and the cities of Lacey, Olympia and Tumwater

Each of these documents is summarized below.

1. County Comprehensive Plan Amendment

In January 1977, the Thurston County Comprehensive Plan was amended to adopt, by reference, the LOTT Complex Facility Planning Study as the basic sewerage planning document for the northern county metropolitan area. Because of an extensive sewage treatment problem, that same amendment included language encouraging alternate forms of sewage treatment in lieu of individual septic systems in the Griffin Sub-Area. The second part of the amendment enabled the county to own and operate the Olympic View Subdivision sewage treatment facilities in that sub-area.

2. Board of Health Policy

In 1979, the Board of Health adopted a sewerage policy generally summarized as:

a. The county provides limited management services for on-site systems.

b. The county will only manage those sewage treatment systems currently managed.

c. Health Department operational permits are required for individual and small community domestic/commercial systems for flows greater than 1,200 GPD.

d. No package treatment or lagoon systems are allowed.

e. Only cities provide sewer service connections to central treatment plants.

3. Memorandum of Understanding on Urban Growth Management

Subsequent to adoption of the Board of Health policy, and as a result of further questions regarding the county's sewerage intentions, the Memorandum of Understanding on Urban Growth Management was adopted by motion of the County Commissioners. The Memorandum states the following:

a. Cities should be the primary utility providers in the Urban Growth Management Planning Area. The county may provide utility service in that area on an interim basis, provided the development agrees to annex to the city when contiguous. It is preferable for the county to contract with a city for interim utility provision; however, there may be situations in which the county would need to provide the service itself or through a private contractor.

b. Municipal utilities shall not extend beyond the Urban Growth Management Planning (UGMP) Area, except to connect existing sewage treatment problems in already developed areas or to address emergency public health and safety problems outside the UGMP boundary but within the Agreement Area.

4. Summary

From the above policy statements it is clear that Thurston County has chosen to limit its role in sewerage provision to ownership and operation of its existing small treatment facilities. The Board of Health policy provides the greatest constraint on county sewerage activity through the prohibition of additional package treatment and lagoon systems.

C. COUNTY SEWERAGE GENERAL PLAN POLICY ALTERNATIVES

1. Problems With Current Sewerage Policies

During the late 1970's and early 1980's, a number of concerns were expressed about current county sewerage policies. These concerns are outlined as follows:

* There is a perceived lack of county policy regarding the long-range role of the county in urban service provision.
* There is a concern that county policy is inhibiting higher densities and industrial development in unincorporated areas.
* Due to soils, geologic conditions and existing or potential health hazards, there is a need to provide sewage treatment beyond individually managed on-site disposal in portions of urban and rural areas.
* Current policy does not sufficiently address public health concerns regarding long-range uses and protection of ground water resources.

These concerns led the Board of County Commissioners in 1982 to initiate the process of reviewing current policies and evaluating alternative sewerage policies.

2. Basic Policy Issues

Two basic policy issues form the framework for developing alternatives to current policies.

* Should sewage treatment systems other than individually managed on-site systems be allowed and if so where?

* Who should own and operate the sewerage systems (if there are any)?

The above issues are discussed separately in the following two sections.

3. If Allowed, Where Should Sewerage Systems Be Permitted?

Six alternatives have been identified as possible policies about where to allow sewerage systems in the county:

a. Nowhere other than current operations (keep existing policy).

b. Only in identified health hazard and water quality problem areas.

c. Only in designated urban growth areas as identified by county plans and ordinances.

d. In designated urban growth areas and identified health hazard or water quality problem areas (combination of "B" and "C" above).

e. Anywhere on a case-by-case basis meeting certain priorities, such as:

(1) Correcting health hazards
(2) Correcting water quality problems
(3) Enable development to occur to maximum zoned densities which could not occur otherwise without sewers.
(4) Financial feasibility.

(The key difference between this alternative and the others is that each request would be evaluated individually and the priorities would potentially not be as limiting as in Alternatives "a-d" above.)

4. Criteria for Evaluation

Four criteria have been identified for evaluating these policy alternatives:

* The ability to correct identified health hazards and water quality problems.
* The potential for allowing growth to maximum zoned densities and uses.
* The ability to provide a degree of advanced identification of sewerage areas for planning purposes.
* Clear county policy.

Figure 1 provides a matrix evaluation of the five alternative sewerage location policies based on the four criteria. A rating system of low, medium, and high was used for the evaluation.

5. Alternatives for Who Should Own and Operate Sewerage Systems in Thurston County. If any of the location alternatives described above is chosen, other than current policy (Alternative a), then the issue of ownership and operation is raised. A number of entities have the legal

authority to own and operate sewerage systems. These include the county, sewer and water districts, improvement districts, code and non-code cities, the Public Utility District (PUD) and private entities (although private entities cannot hold the sewage discharge permit). Figure 2 provides an overview of the provisions of state law regarding each of these possible entities.

6. Evaluation Criteria. The following eight criteria have been used to evaluate the various entities empowered to own and operate sewerage systems.

(1) Financial stability of the entity.

(2) Long-term continuity of the entity.

(3) Ease of establishing a sewerage system.

(4) Ability to address other sewerage service areas (potential for consolidated management of satellite systems).

(5) Ability to ensure consistency between utility provision and the adopted county land use and service policies.

(6) County liability.

(7) Ability to obtain public funding.

(8) Ability to obtain state discharge permit (NPDES).

The evaluation of the alternative entities based on the eight criteria is presented in Figure 3 in the Appendix. A rating system of low, medium, and high has been used.

D. CONCLUSIONS

The decision as to whether or not to change current sewerage policies involves a number of factors, These go beyond those discussed in the evaluation criteria. The decision ultimately requires a balanced judgment about the degree of problems with current policies and the degree to which alternative policies would address the utilities problems without creating new problems.

1. Conclusions on Sewerage Policy Alternatives

The following conclusions are based on an analysis of problems and the evaluation of policy alternatives.

a. The most immediate need for sewerage systems is in areas of presently identified health hazards and water quality problems.

b. Sewerage systems are needed in other areas in order to achieve maximum zoned uses and densities. In those areas, the problem is how to protect ground water quality in the future if sewers are not installed.

c. The availability of sewage treatment beyond on-site septic systems will often remove constraints to development, providing a stimulus to growth of an area. The impact is considered either favorable or unfavorable by people in the community depending on their perspectives and goals.

d. The more involvement by the county in providing sewerage service, the more control over other related impacts and operations. However, with more control comes a higher degree of liability.

e. The county can choose to be in a responsive mode by deciding case-by-case sewerage requests and by allowing other entities (such as districts, cities, or private) to own and operate sewerage systems. However, the county would be giving up some of its control over the planning, programming and operations of sewerage systems.

(If the county authorizes private entities to own and operate sewerage systems, the county still has the legal obligation to hold the State discharge permit. The county would, therefore, have the liability for performance under the permit without the direct control over that performance.)

E. POLICIES

NOTE: These policies address the portions of the unincorporated county that are outside of the Lacey/Olympia/Tumwater urban growth area. Policies for the latter area will be addressed at a future time.

1. General Policies

b. Thurston County should allow sewer systems in designated growth areas. In rural areas, sewer systems shall be allowed only to correct identified current health hazards or water quality problems.

Discussion

This policy recognizes and supports the relationship between sewerage planning and land use planning. Urban growth areas are generally the only areas with densities high enough to make sewer service economically viable. Although there may be cases where sewerage is economically feasible in the rural area, it would not be allowed, in order to maintain overall rural densities and a coordinated rural level of services.

This policy would include an exception to allow sewerage for rural areas where existing pockets of higher density development have created water quality problems.

b. Thurston County, through the County Services Act, should be the primary sewer system provider.

Discussion

For the unincorporated area addressed by these policies, the county should be the sewer provider in order to achieve maximum coordination with county land use and service policies and to achieve coordinated planning, programming, and management of multiple sewerage systems. This would also permit provisions for service at the lowest administrative costs.

c. In areas where the county provides sewer service, the county should also be the water provider.

Discussion

The above policy would not include Board takeover of existing privately-owned water systems unless the current owner agrees to transfer the system. A combined water and sewer utility system provides the opportunity to use the same personnel and equipment to operate and maintain the system, resulting in lower costs and rates to consumers. Centralized county management of water and sewer provides for coordinated utility planning in a service area. The ability to achieve certainty of utility payment which comes with centralized management is really necessary. Otherwise it becomes excessively burdensome for the county to deal with nonpayment of bills.

2. Policies for Geographic Areas

a. South County Growth Areas

Treatment facilities requiring a state discharge permit may be considered by the Board of County Commissioners on a case-by-case basis in designated growth areas, or portions thereof, around Yelm, Tenino, Rainier, Bucoda and Rochester/Grand Mound as identified in the Thurston County Comprehensive Plan and sub-area plans. Requests may be referred to the County Planning Commission for clarification of growth area boundaries if needed.

Discussion

Because the Comprehensive Plan does not now have specific growth area boundaries for portions of the south county, additional criteria will need to be developed for reviewing such requests.

b. Rural Areas

(1) The county should continue to require operational permits for individual and small community domestic/commercial

septic systems. No treatment systems should be allowed except in specific problem areas as identified below.

2. As an exception to the above, specific developed areas with current health hazard or water quality problems may be considered for treatment systems by the Board of County Commissioners. Individual solutions for these areas will be developed on a case-by-case basis. Decisions on the design capacity and service area designation for any such systems will be made with consideration of adopted zoning designations of adjacent areas.

3. Policies on Operations and Management

a. The county shall be the owner of the sewerage system and holder of the discharge permit and establish rates in accordance with RCW 36.94.

b. The county shall engage the engineering consultant to provide the studies, siting, design and construction administration of the sewerage system.

c. It is the intent that all preliminary planning and engineering costs as much as legally possible be borne by the ratepayers.[1]

d. Operation and maintenance will be provided by the county or by contract with a city or a private entity.

e. ULIDs will only be considered under the following circumstances: (a) 51 percent of the area within the boundaries of the requested ULID supports the proposal; or (b) the Health Officer has officially declared there is a health problem within the proposed sewer service area.

Discussion

The rationale for the 51 percent is the need to not place the county current expense money at risk. The Board, in each case, would enter into an understanding that a project would not proceed to construction unless it has 51 percent of the district support, even though by law it could proceed. (This provision would not preclude the Board from proceeding to construction, however, if there is declared to be a health or water quality problem which must be corrected.)

LH:lde:sjo/1184.4

[1] This is to prevent general taxpayers from subsidizing development of utilities.

OPERATIONAL PERMIT REQUIREMENTS

APPENDIX A-6

THURSTON COUNTY
WASHINGTON
SINCE 1852

COUNTY COMMISSIONERS
George L. Barner, Jr.
District One
Diane Oberquell
District Two
Les Eldridge
District Three

PUBLIC HEALTH AND
SOCIAL SERVICES DEPARTMENT

Patrick M. Libbey, Director
Diana T. Yu, MD, MSPH
Health Officer

OPERATION AND MAINTENANCE PERMIT INFORMATION SHEET

The Thurston County Sanitary Code requires issuance of an Operational permit for all sewage disposal systems permitted in the county after September 1, 1990. Operational permits are also required for existing systems at time of sale of the property, when systems are repaired, or expanded, or when required of specific areas as contained in the conditions of a Geologically Sensitive Area.

An Operational Permit is a renewable, notarized and recorded document stating specific operation and maintenance requirements. Owners of sewage disposal systems are required to apply for the initial permit.

Thurston County Environmental Health notifies the property owner when the Operational Permit expires. A new permit is then written and sent to the system owner. It is the system owner's responsibility to assure and provide documentation that the requirements of the permit have been satisfied. A representative from the Health Department may inspect the system before issuance of the new permit. A system may be reclassified and have the conditions modified before a permit is renewed.

The purpose of Operation and Maintenance Permits for on-site sewage disposal systems is to help assure protection of the public health. The permit establishes operational, maintenance and management requirements for on-site sewage disposal systems, to possibly increase the lifespan of the system, reduce public exposure to sewage, assure adequate treatment of septic effluent and reduce impacts to surface and ground water.

An on-site sewage disposal system generally provides a satisfactory method of waste disposal when properly located, designed, installed, and maintained. Routine operational and maintenance procedures help to ensure that on-site systems properly treat the effluent, as well as, prolong system life. We appreciate your continued cooperation in maintaining a clean and healthful environment.

Continued on the reverse side...

The following is a summary of the operational fees:

AUDITOR FILING FEE:
A fee charged by the Auditor's office to file the Protective Covenant.

OPERATION AND MAINTENANCE ADMINISTRATION FEE:
A fee to cover the cost of administering the operational permit.

WATER QUALITY MONITORING FEE:
A fee used to perform ground water testing and monitoring throughout all of Thurston County. This program's purpose is to maintain safe drinking water and detect failing septic systems. The fee is based on the amount of sewage effluent that is discharged into the ground. The current fee is $2.20 per month per E.R.U. (Equivalent Residential Unit).

1 single family dwelling = 1 E.R.U.
1 duplex = 2 E.R.U.s.
Apartments = 0.8 E.R.U. per apartment
Mobile Home Parks = 0.8 E.R.U. per space
Larger systems (schools, restaurant etc.) = 1 E.R.U. per 221 gallons used per day (based on system design flow or actual water use figures).

FIELD INSPECTION FEES:
A fee to cover the cost of an inspection of the on-site sewage disposal system. A Health Department representative will visually inspect the drainfield area and check the placement of the septic system. The intent of the inspection is to locate failing drainfields.

3) Written documentation, on forms provided by this department, from the pumper on the condition of the septic tank (pumper's statement).

4) Appropriate fees for the loan inspection and operational permit. The operational permit fees will vary for commercial or non-residential structures and must be calculated on an individual basis. The legal owner will be billed annually for the operational permit.

In order for this department to complete the Loan Certification process in an efficient and timely manner, all of the above should be properly completed.

Upon completion of the loan certification field inspection, the application will be forwarded to the operational permit section. This section will set up the operational permit and record the protective covenant. Once the operational permit is set up and protective covenant recorded, the loan certification (health letter) will be released and the operational permit sent to the legal owner.

Thank you in advance for your cooperation. If you have any questions please do not hesitate to contact this department at 786-5455.

S.1.O&MLOAN5

THURSTON COUNTY
WASHINGTON
SINCE 1852

COUNTY COMMISSIONERS
George L. Barner, Jr.
District One
Diane Oberquell
District Two
Les Eldridge
District Three

PUBLIC HEALTH AND
SOCIAL SERVICES DEPARTMENT

Patrick M. Libbey, Director
Diana T. Yu, MD, MSPH
Health Officer

MEMORANDUM

DATE: AUGUST 29, 1990

FROM: MARIE GIBSON M.G.

SUBJECT: CLARIFICATION OF OPERATIONAL PERMIT REQUIREMENTS

As of September 1, 1990, the Thurston County Sanitary Code requires Operational Permits for the following:

1) All new sewage disposal systems.

2) All existing systems at the time of sale of the property.

3) When systems are repaired, altered or expanded.

4) Other conditions as they apply.

The following will be exempt from the new regulations:

1) All Real Estate Purchase and Sale Agreements signed and dated prior to September 1, 1990.

2) Loan Certification applications received in our office prior to September 1, 1990.

Thank you again for your continued cooperation. If you have any questions please contact this department at 786-5455.

S.1.O&MEXEMP

THURSTON COUNTY
WASHINGTON
SINCE 1852

COUNTY COMMISSIONERS
George L. Barner, Jr.
District One
Diane Oberquell
District Two
Les Eldridge
District Three

PUBLIC HEALTH AND
SOCIAL SERVICES DEPARTMENT

Patrick M. Libbey, Director
Diana T. Yu, MD, MSPH
Health Officer

MEMORANDUM

DATE: August 23, 1990

FROM: Marie Gibson M.H.

SUBJECT: Operational Permits

To Whom It May Concern:

The Thurston County Sanitary Code, as of September 1, 1990, requires Operational Permits for the following:

1) All new sewage disposal systems.

2) All existing systems at the time of sale of the property.

3) When systems are repaired, altered or expanded.

4) Other conditions as they apply.

Due to the changes in the Sanitary Code the "Loan Certification" (Health Letter) program will be updated to reflect the new requirements. This department will provide an information/application packet that will include an application for loan certification, protective covenant for the operational permit and an information sheet on operational permits. The packet must be completed in order to initiate the "Loan Certification" process. The following are the items that are needed:

1) A completed application for loan inspection.

2) A completed protective covenant for the operational permit. The protective covenant must be signed by the current legal owner and be notarized. No pasting or taping over the covenant form will be accepted.

Continued on the reverse side...

REVISED 11-20-90

PROTECTIVE COVENANT

PARCEL NUMBER _____

LEGAL DESCRIPTION _____

_____

_____

_____

_____

_____

_____

_____

I, (We) the undersigned, being the owner___ of the above described real property, in order to provide for the healthful development and use of said real property and so as to further provide for the control of sewage disposal upon said real property, on this _____ day of _____ 19____, do hereby covenant for my respective heirs, administrators, executors and assigns, to keep the covenant hereinafter set forth.

COVENANT

An Operational Permit is required by Article IV of the Thurston County Sanitary Code to ensure proper operation and maintenance of the on-site sewage disposal system__ located on the above described real property. This permit shall be obtained and kept current by the owner of such property.

This covenant shall run with the land and shall be binding on all parties, their successors in interest and assigns, having or acquiring any right, title, or interest in the land described herein or any part thereof, and shall insure to the benefit of each owner thereof.

WITNESS _____ hand__ this _____ day of _____ 19_____

_____ _____
(SIGNATURE) (PRINT NAME CLEARLY)

_____ _____
Owner___ (SIGNATURE) (PRINT NAME CLEARLY)

STATE OF WASHINGTON)
) ss.
County of _____)

I, the undersigned, a Notary Public in and for the above named County and State, do hereby certify that on this _____ day of _____ 19_____, personally appeared before me _____

_____,

to me known to be the individual__ described and who executed the within instrument, and acknowledge that he (they) signed and sealed the same as _____ free and voluntary act and deed, for the uses and purposes therein mentioned. GIVEN under my hand and official seal the day and year last above written.

FOR AUDITOR'S USE ONLY _____

_____

NOTARY PUBLIC in and for the State of Washington, residing in _____

DRINKING WATER SAMPLE RESULTS

APPENDIX B

STATE OF WASHINGTON
DEPARTMENT OF HEALTH

WATER BACTERIOLOGICAL ANALYSIS

SAMPLE COLLECTION: READ INSTRUCTIONS ON BACK OF GOLDENROD COPY
If instructions are not followed, sample will be rejected.

DATE COLLECTED (MONTH / DAY / YEAR)	TIME COLLECTED	COUNTY NAME
2 / 5 / 91	2 : 15 ☐ AM ☒ PM	TC

TYPE OF SYSTEM: ☐ PUBLIC ☐ INDIVIDUAL (serves only 1 residence)
IF PUBLIC SYSTEM, COMPLETE: I.D. No. [ ][ ][ ][ ][ ][ ] CIRCLE CLASS 1 2 3 4

NAME OF SYSTEM: Summit Lake

SPECIFIC LOCATION WHERE SAMPLE COLLECTED (ie. kitchen tap @ school, fire station, fountain): Private Residence

SYSTEM OWNER/MGR. NAME AND TELEPHONE NO.: ( )

SAMPLE COLLECTED BY: (Name) Thurston Co. Health Dept.

SOURCE TYPE: ☒ SURFACE ☐ WELL ☐ SPRING ☐ PURCHASED ☐ COMBINATION or OTHER

SEND REPORT TO: (Print Full Name, Address and Zip Code)

Gray & Osborne Engrs.

WASHINGTON

TYPE OF SAMPLE (Check only one in this column)

1. ☒ DRINKING WATER — check treatment → ☐ Chlorinated (Residual: ____ Total ____ Free); ☐ Filtered; ☒ Untreated or Other ____
2. ☐ RAW SOURCE WATER
3. ☐ NEW CONSTRUCTION or REPAIRS
4. ☐ OTHER (Specify) ____

COMPLETE IF THIS SAMPLE IS A **CHECK** SAMPLE

PREVIOUS LAB NO. ____

PREVIOUS SAMPLE COLLECTION DATE ____

REMARKS: Run Total + Fecal Coliform

LABORATORY RESULTS (FOR LAB USE ONLY)

MPN - COLIFORM	STD PLATE COUNT	SAMPLE NOT TESTED BECAUSE:
___/5 tubes positive	____/ml	☐ Sample Too Old
MPN DILUTION: ____/100 ml	TEST UNSUITABLE: 1. ☐ Confluent Growth; 2. ☐ TNTC; 3. ☐ Excess Debris; 4. ☐ ____	☐ Not in Proper Container
MF COLIFORM: 3 /100 ml		☐ Insufficient Information Provided—Please Read Instructions on Form
FECAL COLIFORM: ☐ MPN ☒ MF 2 /100 ml		☐ ____

FOR **DRINKING WATER** SAMPLES ONLY, THESE RESULTS ARE: ☐ SATISFACTORY ☒ UNSATISFACTORY

SEE REVERSE SIDE OF GREEN COPY FOR EXPLANATION OF RESULTS

LAB NO.	DATE, TIME RECEIVED	RECEIVED BY
80-00787	FEB 05 1991	

DATE REPORTED: FEB 08 1991

LABORATORY:

REMARKS

DOH 305-002 (REV. 12/89)

DP CENTER COPY

135

Laucks 82 YEARS
Testing Laboratories, Inc.
940 South Harney St., Seattle, WA 98108 (206) 767-5060 FAX 767-5063
Chemistry, Microbiology, and Technical Services

25

CLIENT: Gray & Osborne, Inc.
701 Dexter Ave. N. #200
Seattle, WA 98109

ATTN : Dick Field

Work ID : Drinking Water Analysis
Taken By : Client
Transported by: Greyhound #0326082812503
Type : Water

Certificate of Analysis

Work Order# : 91-02-094
DATE RECEIVED : 02/07/91
DATE OF REPORT: 02/21/91
CLIENT JOB ID : Project Name: Summit Lake

SAMPLE IDENTIFICATION:

	Sample Description	Collection Date
01	Summit Lake	02/05/91 02:11

COMMENTS ON LEAD IN DRINKING WATER:

The Maximum Contamination Level (MCL) allowed for lead in drinking water, per current EPA and State of Washington regulations, is 0.05 mg/L. The State of Washington's Department of Health and the EPA are asking your laboratory to advise you that if the level of lead in your drinking water is above 0.02 mg/L (even if it is below the MCL), the EPA recommends corrective action. You should follow the EPA's guidance, found in the EPA booklet "Lead in School Drinking Water." The laboratory does not have copies of this booklet; contact the EPA Safe Drinking Water Hotline at 1-800-426-4791.

KEY
< indicates "less than"

Unless otherwise instructed all samples will be discarded on 04/07/91

Respectfully submitted,
Laucks Testing Laboratories, Inc.

J. M. Owens

Laucks 82 years
Testing Laboratories, Inc.
940 South Harney St., Seattle, WA 98108 (206) 767-5060 FAX 767-5063

Chemistry, Microbiology, and Technical Services

REPORT ON SAMPLE: 9102094-01
Client Sample ID: Summit Lake

Date Received : 02/07/91 Collection Date : 02/05/91

Test	MCL		Results	
Arsenic	0.05	<	0.010	mg/L
Barium	1.0	<	0.25	mg/L
Cadmium	0.01	<	0.002	mg/L
Chromium	0.05	<	0.010	mg/L
Iron	0.3		0.06	mg/L
Lead	0.05	<	0.005	mg/L
Manganese	0.05	<	0.010	mg/L
Mercury	0.002	<	0.001	mg/L
Selenium	0.01	<	0.005	mg/L
Silver	0.05	<	0.010	mg/L
Sodium		<	10	mg/L
Hardness			26	mg/L, as CaCO3
Conductivity	700		52	Micromhos/cm, 25.C
Turbidity	1.0		0.9	NTU
Color	15.0	<	5.0	Color Units
Fluoride	2.0	<	0.2	mg/L
Nitrate	10.0		0.3	mg/L
Chloride	250	<	10	mg/L
Sulfate	250	<	10	mg/L
Copper	1.0	<	0.3	mg/L
Zinc	5.0	<	0.3	mg/L

MCL = Maximum Contamination Level established for drinking water under current EPA and State of Washington regulations. No MCL has been established for hardness or sodium, although 20 mg/L is a recommended MCL for sodium.

The Maximum Contamination Level (MCL) for lead is 0.05 mg/L. The State of Washington's Department of Health and the EPA are asking your laboratory to advise you that if the level of lead in your drinking water is above 0.02 mg/L (even if it is below the MCL), the EPA recommends corrective action. You should follow the EPA's guidance, found in the EPA booklet 'Lead in School Drinking Water.' The laboratory does not have copies of this booklet; contact the EPA Safe Drinking Water Hotline at 1-800-426-4791.

NATIONAL SANITATION FOUNDATION

INFORMATION LETTER

QUALITY GUIDE

LISTINGS (BACK COVER POCKET)

APPENDIX C

National Sanitation Foundation

3475 Plymouth Road
P.O. Box 1468
Ann Arbor, Michigan 48106 U.S.A.
Telephone: 313-769-8010
Telex: 753215 NATSANFND UD
FAX: 313-769-0109

Dear Madam/Sir:

Thank you for your request for information on drinking water treatment systems. We're very happy to be able to send the Listing Book for NSF's drinking water treatment unit program. This Listing information indicates the water treatment functions for each system that have been verified by NSF. The preface section of the Listing Book and the fact sheet on the reverse side explains a little bit about our services.

We're also enclosing a reprint of an article that recently appeared in HEALTH & ENVIRONMENT DIGEST. It explains what the different types of drinking water treatment devices are capable of doing to various water contaminants. It also gives some more information about the NSF certification process.

The National Sanitation Foundation (NSF) is an independent, not-for-profit organization dedicated to helping solve public health and environmental problems. One of our major services is to evaluate, test, and inspect products in the public health field. We then certify those products that comply with the standards that we have previously helped develop.

We currently have five Standards for Drinking Water Treatment Units; Standard 42: Drinking Water Treatment Units - Aesthetic Effects; Standard 44: Cation Exchange Water Softeners; Standard 53: Drinking Water Treatment Units - Health Effects; Standard 58: Reverse Osmosis Drinking Water Treatment Systems; and Standard 62: Distillation Systems. An additional Standard is under development; Standard 55: Ultraviolet Disinfection Systems.

We recommend to users to learn what contaminants are in the water, determine what treatment technology will reduce this contaminant, and then select a specific system. By selecting a system listed by NSF for reduction of the contaminants of interest, a user can have confidence that the unit will effectively reduce the contaminant to acceptable levels -- if properly installed and maintained according with the manufacturer's instruction.

Should you have any further questions about the Listing and testing programs offered by NSF, once you've reviewed the enclosed information, please feel free to contact me.

Sincerely,

Nancy J. Culotta
Manager
Water and Wastewater Programs

gh4/DWTUs.NJC

Enclosures: Annual Listing Book
Health & Environment Digest - Reprint

NSF

•is a nonofficial, not-for-profit corporation chartered in 1944 under the laws of the State of Michigan

•develops and adopts voluntary, consensus standards in areas of concern to public health and the environment

•evaluates and tests products, systems, and services against NSF standards, other voluntary consensus standards, and government regulations

•undertakes scientific and objective evaluations, analyses, special testing, and studies for government, manufacturers, foundations, and others

•provides education and training programs, including national conferences, seminars, and workshops; offers credits in continuing education

•provides services worldwide

•has fully instrumented laboratories for physical, chemical, and microbiological testing and evaluation

•operates through offices in Ann Arbor, Michigan; Montclair, California; Doylestown, Pennsylvania; Atlanta, Georgia; and Brussels, Belgium; and laboratories and test facilities in Ann Arbor and Chelsea, Michigan and Sacramento, California.

The mission of NSF is to provide clients and the general public with objective, high quality, timely, third-party services at acceptable cost. Services include development of consensus standards, voluntary product testing and certification with policies and practices which protect the integrity of registered Marks, education and training, and research and demonstration, all relating to public health and the environmental sciences.

Health & Environment
DIGEST

A publication of the Freshwater Foundation
Featuring information from its Health & Environment Network

Volume 3, No. 6 July 1989

Feature Article

Home Water Treatment: What's The Use of Point-of-Use?

Whether in a river or underground, water dissolves minerals and organic materials from the rocks and soils it flows through. Today, human activities add more: nitrate from agricultural fertilizers, pesticides, industrial solvents, heavy metals.

While municipal water utilities treat water to meet minimum federal or state standards for purity, the 40 million U.S. citizens who depend on private wells have no assurance that their water meets such standards. In some cases, their water clearly contains chemical contaminants. Further, even treated water may still contain contaminants that affect taste, color, or odor.

For people who have water quality problems, a home water treatment device may be the answer. But, as our feature author points out, not all water treatment systems address the same problems. The devices come in a bewildering array of types, advertising claims, and effectiveness. What's more, as our Commentary author points out, most cannot limit the exposures that householders may get from skin or inhalation exposure to volatile organic compounds that vaporize from hot water in showers or dishwashers. Here, however, is a quick guide to sorting out the choices—BSM.

Today's citizens are worried about water quality. They're deluging physicians, health departments, and consumer activists with questions on point-of-use drinking water treatment devices. What's the basis for their concern?

First, media coverage of surface and groundwater pollution is triggering such questions as: "Could this happen where I live? Is my water already contaminated? Does anyone know?" Next, the drinking water treatment industry is booming. Opportunistic entrepreneurs are selling "purifiers" to solve any water problem a homeowner may be worried about. Third, regulators and legislators are setting drinking water standards, supporting environmental clean up, and requiring water treatment device manufacturers to verify their claims, raising consumer awareness even more.

What, in fact, do water treatment devices actually do? Which devices address specific contaminants? How can professionals, regulatory officials, and citizens determine whether these devices work?

What kinds of devices?

Point-of-use (POU) drinking water treatment systems are one option available to citizens whose water is contaminated. They are installed on single or multiple taps, but cannot treat water for an entire house or building. Most home treatment systems sold are point-of-use devices and treat water for drinking and cooking only.

Point-of-entry (POE) systems are installed on the

by Nancy J. Culotta, National Sanitation Foundation

main water line and treat the entire water supply entering a building. Until recently, most POE systems were limited to reducing iron content or softening the water. They can, however, address a wider range of pollutants and use different technologies to address different contaminants.

Activated carbon filters

Activated carbon can adsorb many organic chemicals, such as trihalomethanes, reducing their levels in drinking water. Carbon will also reduce undesirable tastes, odors, color, and some inorganic chemicals, such as chlorine. But they haven't proved effective in reducing other inorganics, such as nitrate. Carbon filters have a limited effective life; to assure continued performance, they must be maintained according to manufacturers' specifications. If the filter isn't changed regularly, it becomes saturated, and chemicals removed by the filter can diffuse back into the drinking water. Because carbon filters are subject to bacterial contamination, they should be used to treat only water that's microbiologically safe or of known quality.

Mechanical filters

Mechanical filters physically remove such particles as sediment and rust from the water. Generally made of fibrous material, porous ceramics, or diatomaceous earth, they may remove *Giardia* cysts, large bacteria, and very small asbestos fibers, depending on the pore size rating.

Reverse osmosis

Reverse Osmosis (RO) systems usually consist of an RO module, a product water storage tank, and a dispensing faucet. The RO module, the heart of the system, contains a semipermeable membrane that filters small amounts of finished drinking water into the storage tank. The remaining water, containing inorganic chemicals and particles, flows from the RO module into a drain. Reverse osmosis can lower levels of total dissolved solids (salts), metals, nitrates, asbestos, *Giardia* cysts, and bacteria. Many RO systems today also include a carbon filter to reduce organic chemicals, including pesticide levels in the drinking water. Because most RO membranes are subject to degradation and eventual failure, owners must follow the manufacturer's recommendations for maintenance and replacement.

Water softeners

Softeners fall into two types: cation and anion exchange units. Cation softeners substitute positively charged sodium or potassium ions for positively charged calcium and magnesium (hard water), iron, and manganese ions. Cation softeners can eliminate stains on plumbing, reduce soap film on skin, hair, and dishes, and deter scale buildup in pipes. Anion softeners substitute negatively charged hydroxyl ions (OH^-) for such ions as sulfates, nitrates, bicarbonates, and chlorides. Because cation exchange softeners add sodium to the water, there is a question of whether they significantly affect sodium intake. According to the Water Quality Association, an industry trade association, the sodium obtained from drinking softened water is only 5-10 percent of the amount normally obtained from foods. How much sodium is in softened water depends on the hardness of the raw water: one grain of hardness/gallon (17.1 mg/liter) in raw water adds 7.5 mg sodium/quart of softened water.[1]

UV disinfection

Ultraviolet (UV) disinfection devices house a germicidal UV lamp that destroys bacteria and inactivates viruses without chemicals. For cyst removal, the water needs further mechanical filtration. Turbidity affects UV disinfection and builds up dirt on the lamp. Periodic inspection and maintenance is required. Finally, UV has no effect on organic or inorganic chemical contaminant levels.

Distillers

These devices boil water in one compartment, condense the vapor, and collect it in another. Dissolved solids, metals, minerals, and particles remain in the boiling water, reducing contaminant levels in the condensed water. The boiling also kills microorganisms.

Because some volatile organic chemicals could distill over into the finished water,

there are questions about distillation's ability to reduce organics in water. The National Sanitation Foundation is planning such research, including investigating volatilization of organic contaminants into the air.

Which brand works?

Which brands of POU devices are effective, and which type is best for correcting specific problems? Before buying a treatment device, homeowners should have their water thoroughly tested by a competent, independent laboratory. This will identify specific water problems, so that a homeowner can buy the right system to correct them. To assure effective performance, the system should carry National Sanitation Foundation certification.

The National Sanitation Foundation (NSF), a nonprofit third party testing and certification organization, has a certification program for drinking water treatment systems. NSF's five current standards for evaluating POU/POE devices cover carbon, softeners, mechanical filtration, distillation, and reverse osmosis systems. A proposed standard, scheduled for adoption this year, will address UV disinfection systems.

To achieve certification, a water treatment device must satisfy four requirements. First and foremost, it must meet the manufacturer's reduction claims. A manufacturer chooses the contaminants for which NSF will certify reduction claims in accordance with the standard. NSF then tests the system to verify that the claim meets the reduction level specified in the standard. For carbon and mechanical filtration systems, the test is conducted for the life (capacity) of the device. For water softeners, verification tests are conducted through several regeneration cycles. Because the start-up period for RO systems is critical, the verification test is seven days. All systems that make health-related reduction claims must have a warning device to alert users when the system isn't working properly.

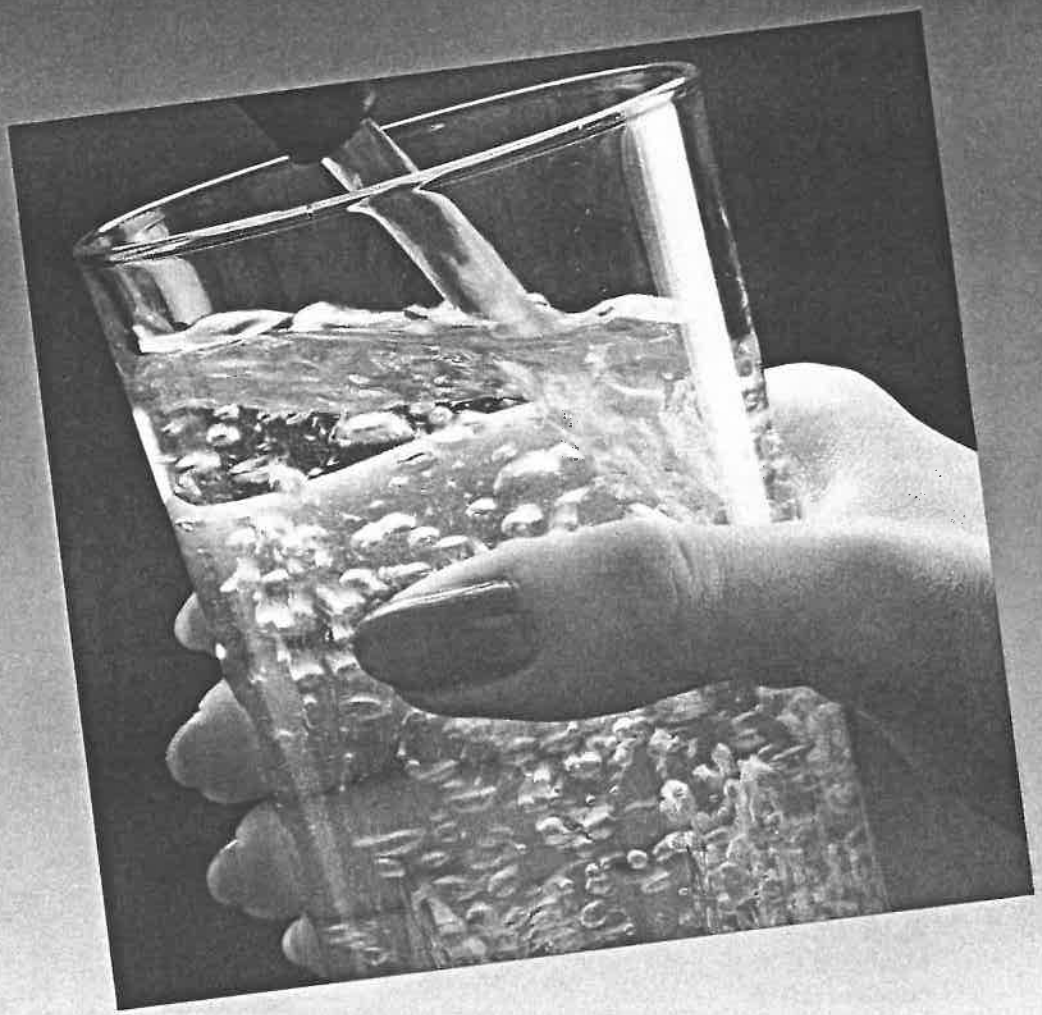
The standards also require a toxicological review of all materials in the system to be sure they're suitable for contact with drinking water. Next, the system is exposed to chlorinated deionized test water, which is then analyzed to assure that the system itself is not contributing color, taste, odor, or contaminants of toxicogical significance to the water.

Structural integrity is the third requirement. Certified devices must pass rigorous pressure and cycling tests to ensure that they will work properly if installed and operated according to the manufacturer's instructions. The final requirement covers literature supplied with the system, and the unit's identification label, or data plate. The standards require the device to clearly display information on certified claims and the system's operation.

Once a system is certified, the company and system are included in the published and electronically accessed NSF Listings for Drinking Water Treatment Systems. NSF inspectors also conduct unannounced annual inspections of the company to certify continued compliance with standards. Each certified system is retested every five years or whenever design changes are made.

For citizens and regulators both, an NSF Mark on a treatment device certifies that the system has been thoroughly tested for structural integrity and contaminant reduction performance. Thus, when health officials or citizens have a specific need to recommend or buy a POU/POE drinking water treatment system, an NSF Mark can help identify an appropriate device.

Determining The Quality Of Your Drinking Water



A Step by Step Guide from
NSF International
3475 Plymouth Road
Ann Arbor, MI 48105

FLOW DIAGRAM
THE QUALITY OF YO

HOW'S MY DRINKING WATER?

This question is asked with increasing frequency as more and more people have become concerned over the issue of water quality. The publicity surrounding incidents of contaminated water supplies around the country has led to a heightened public awareness of issues of drinking water, its quality and treatment.

This flow diagram and accompanying charts offer a simple, step-by-step method of determining the quality of the drinking water at a specific location.

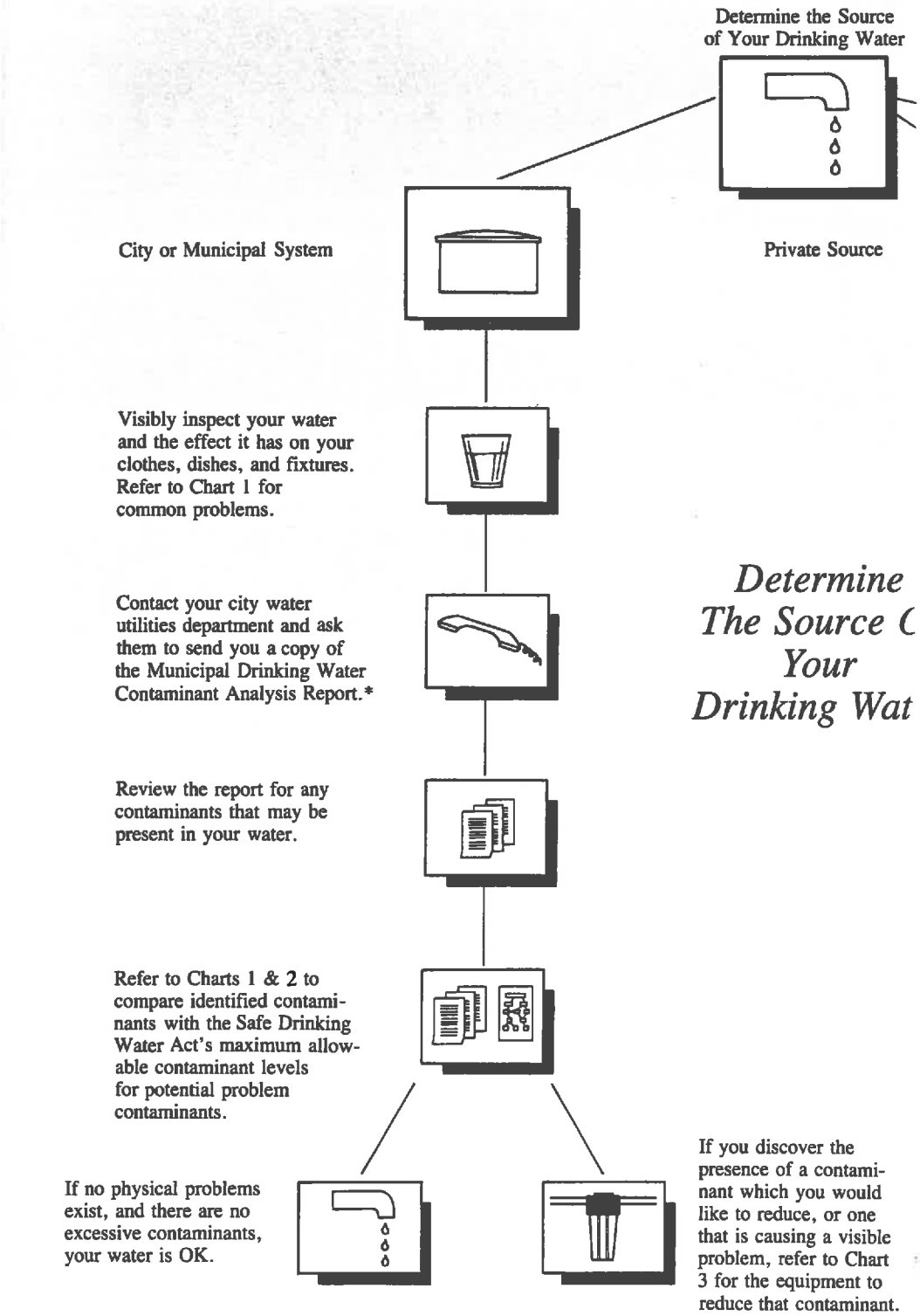
INSTRUCTIONS FOR USING THIS STEP-BY-STEP GUIDE

The key to using the flow diagram is starting at the top and following the lines downward to the next appropriate step. The first choice — determining the source of your drinking water — will establish your course of action.

Some of the steps will refer you to Chart 1, Chart 2 or Chart 3. You will find them included within this brochure.

These charts will assist you in identifying the following:

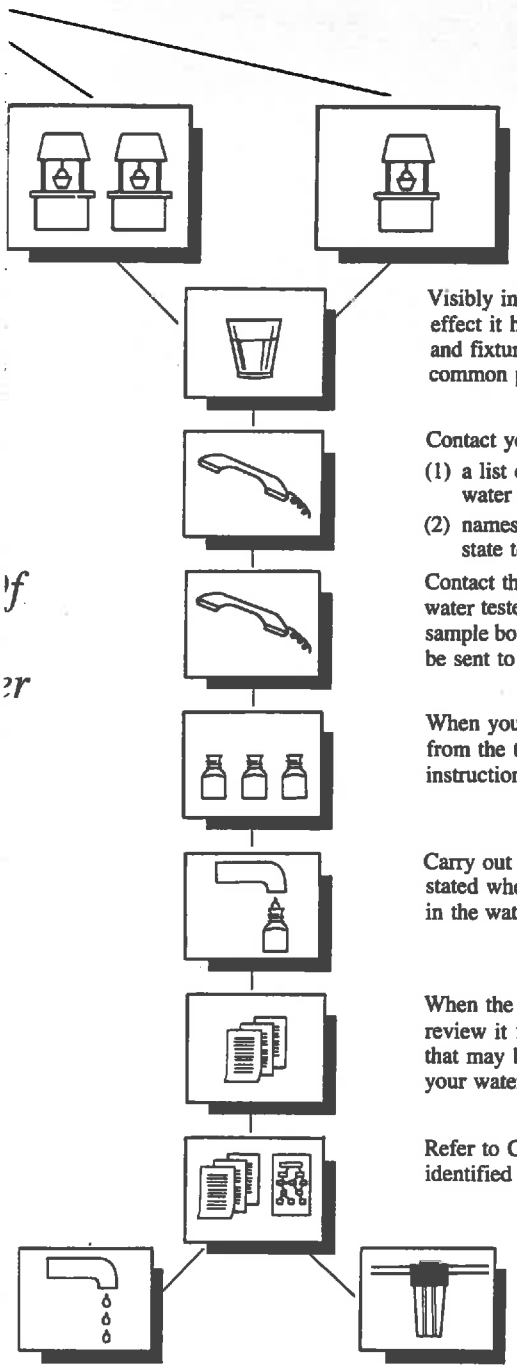
- Chart 1 — Visible Problems
- Chart 2 — Safe Drinking Water Act — Maximum Contaminant Levels
- Chart 3 — Index of Water Treatment/ Contaminant Combinations



Determine The Source C Your Drinking Wat

*Notes: *Public water supplies must meet the requirements of Chart #2. The utility may also measure contaminants not listed in Chart #2. There may be contaminant levels you would like to reduce further using supplemental treatment. Please, emphasize that you are considering supplemental treatment. Your water treatment professionals are justifiably proud of the quality of the water they produce.*

TO DETERMINE
UR DRINKING WATER



Private Well

Visibly inspect your water and the effect it has on your clothes, dishes, and fixtures. Refer to Chart 1 for common problems.

Contact your local Health Dept. and ask for:
(1) a list of the typical types of local well water contaminants
(2) names of analytical labs certified in your state to conduct drinking water analysis.**

Contact the lab to get your drinking water tested, requesting that the necessary sample bottles and instructions be sent to you.

When you have received the materials from the test lab, read their instructions very carefully.

Carry out the instructions *exactly* as stated when collecting and sending in the water samples.

When the lab sends you their report, review it for any contaminants that may be present in your water.

Refer to Charts 1 & 2 to compare identified contaminants.

If no physical problems exist, and there are no excessive contaminants, your water is OK.

If you discover an excessive level of a contaminant, or one that is causing a visible problem, refer to Chart 3 for the equipment to reduce that contaminant.

*** Laboratories may be certified for some or all contaminants. Be sure to pick a lab based on the analysis you need.*

Chart 1
VISIBLE PROBLEMS

Problem	Symptom	Possible Contaminant
Stained fixtures and clothes	red or brown	- iron
	black	- manganese
	green or blue	- copper
Reddish-brown slime	iron bacteria	- iron
Off-color water	cloudy	- turbidity
	black	- hydrogen sulfide - manganese
	red	- iron
	brown or yellow	- iron - humic & tannic compounds
Unusual taste and odor	rotten egg	- hydrogen sulfide
	metallic	- pH, corrosion index, iron, zinc, copper, lead
	salty	- total dissolved solids, chloride
	septic, musty or earthy	- total coliform bacteria
	bleach-like	- chlorine
Corrosive water	deposits, pitting	- Corrosion index, pH, copper, and lead

NSF International (NSF) is an independent, not-for-profit organization that develops standards, and then tests and evaluates products and materials to those standards. Products that meet the requirements of the appropriate standard are then certified by NSF and are allowed to bear the NSF mark.

Founded in 1944, the company works with products in the areas of public health and the environment.

For a complete listing of all the drinking water treatment units that are certified by NSF, write to the address on the front of this brochure.

Chart 2

THE SAFE DRINKING WATER ACT

MAXIMUM CONTAMINANT LEVELS

PRIMARY CONTAMINANTS	Maximum Contaminant Level (MCL)
Metals:	
Arsenic	0.05 mg/l
Barium	1.0 mg/l
Cadmium	0.01 mg/l
Chromium	0.05 mg/l
Lead	0.05 mg/l
Mercury	0.002 mg/l
Selenium	0.01 mg/l
Non-Metals	
Fluoride	4 mg/l
Nitrate	10.0 mg/l
Volatile Organic Chemicals:	
Total Trihalomethanes	0.10 mg/l
Benzene	0.005 mg/l
Vinyl chloride	0.002 mg/l
Carbon tetrachloride	0.005 mg/l
1,2-Dichloroethane	0.005 mg/l
Trichloroethylene (TCE)	0.005 mg/l
1,4-Dichlorobenzene	0.75 mg/l
1,1-Dichloroethylene	0.007 mg/l
1,1,1-Trichloroethane	0.2 mg/l

PRIMARY CONTAMINANTS	Maximum Contaminant Level (MCL)
Herbicides, Pesticides, PCBs:	
Chlordane	0.02 mg/l
Endrin	0.0002 mg/l
Heptachlor	0.01 mg/l
Hexachlorobenzene	0.02 mg/l
Lindane	0.004 mg/l
Methoxychlor	0.1 mg/l
Toxaphene	0.005 mg/l
PCBs	0.008 mg/l
2,4-D	0.1 mg/l
2,4,5-TP Silvex	0.01 mg/l
Phenols:	
Pentachlorophenol	0.22 mg/l
Physical Parameters:	
Turbidity (in turbidity units)	1 TU
Radioactivity	15 picocuries
Microbiology:	
Coliform bacteria	0 per 100 ml

SECONDARY CONTAMINANTS	Maximum Contaminant Level (MCL)
Metals:	
Copper	1.0 mg/l
Iron	0.3 mg/l
Manganese	0.05 mg/l
Zinc	5.0 mg/l
Non-Metals	
Chloride	250 mg/l
Sulfate	250 mg/l
Total dissolved solids	500 mg/l
Physical Parameters	
Color	15 units
Corrosivity	none
Foaming agents	0.5 mg/l
Odor	3 t.u.
H	6.5-8.5

*For purposes of this brochure, mg/l = milligrams per liter = parts per million = ppm; 1ppm = 1,000 ppb; ppb = parts per billion = micrograms per liter = μg/l

Chart 3

INDEX OF WATER TREATMENT/CONTAMINANT COMBINATIONS

EQUIPMENT **OPTIONS / CONTAMINANT	Aluminum	Arsenic	Asbestos	Barium	Cadmium	Chloride	Chlorine***	Chromium	Color	Copper	Endrin	Fluoride	Giardia Cysts	Hardness	Iron (FE2)	Iron (FE3)	Lead*	Lindane	Manganese	Mercury	Methoxychlor	Nitrate	Particulates	Pesticides / Herbicides / PCB's	Radium	Radon	Selenium	Silver	Sulfate	Tannic Acids	Taste & Odor	Total Dissolved Solids	Total Trihalomethanes (TTHM)	Toxaphene	Turbidity	VOC's	Zinc	2,4-D	2,4,5-TP Silvex
Carbon							•	•		•							•	•			•			•		•				•	•			•		•			•	•
Filtration		•						•				•		•					•				•												•					
Reverse Osmosis	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
Distillation	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
Cation Exchange					•	•								•			•		•					•															
Mixed Mineral Bed																																								
Activated Alumina		•																																					
Anion Exchange																																							
Phosphate/ Polyphosphate																																							

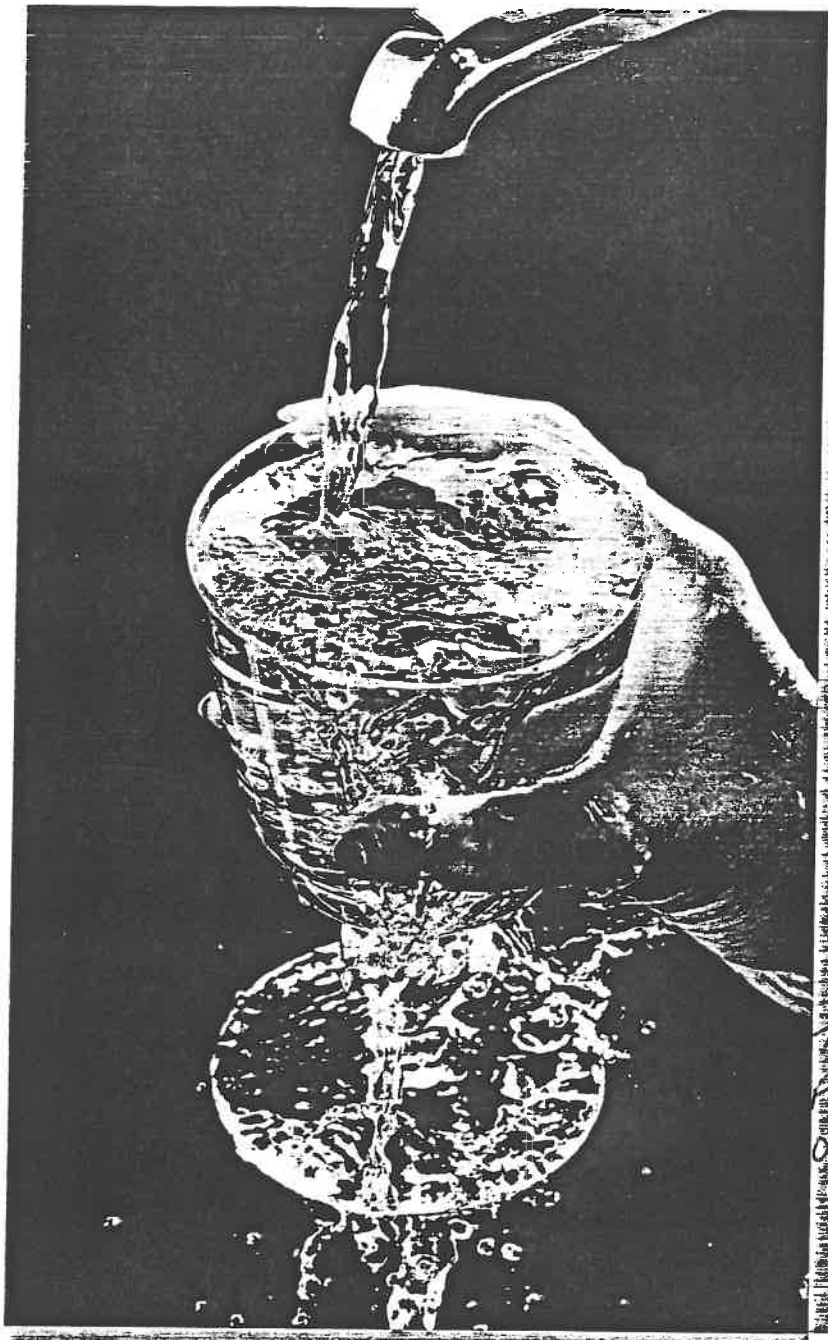
Notes: *Not all carbon units are effective for lead reduction. Ask for proof of performance. **Some equipment may reduce additional contaminants because of its unique design and/or combinations of technology. Ask for proof of performance. ***Not all reverse osmosis units are effective for chlorine reduction. Ask for proof of performance.

NSF International
3475 Plymouth Road
Ann Arbor, MI 48105

HOME TREATMENT SYSTEMS

OPTIONS 1C, 2C, 3C
OPTIONS 4E, 5E, 6E

APPENDIX D

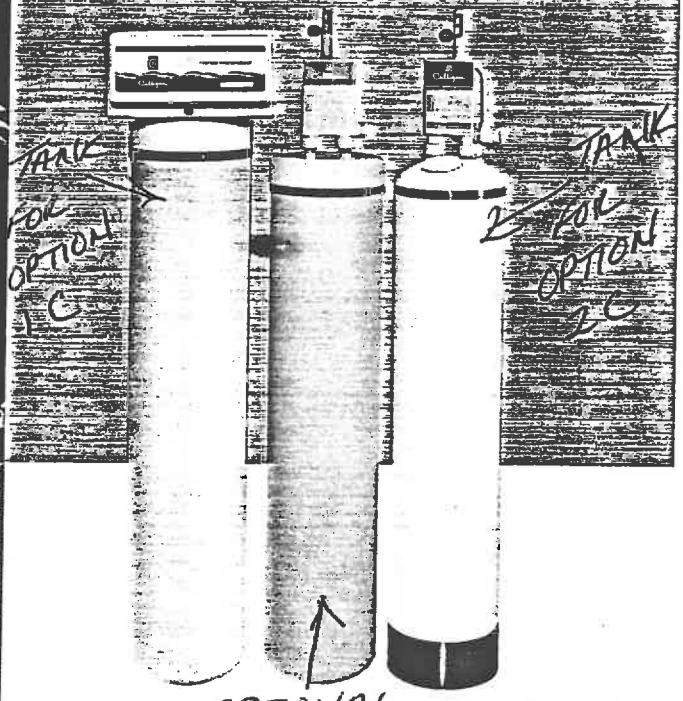


Culligan WATER FILTERS

OPTIONS 1C & 2C

fully automatic and budget priced models that control

- tastes and odors
- sulphur water
- rusty iron water
- corrosive acid water
- dirty, cloudy water



Have sparkling, crystal clear, good tasting, odor-free, stain free water from every faucet in your home. Enjoy all the clean, filtered water you want all the time, through the use of a properly selected Culligan water filter.

NOTE: THERE IS NO BROCHURE FOR THE 120 gallon retention TANK USED IN BOTH OPTIONS

Water means life

Culligan means water

Culligan WATER FILTERS

Your Culligan Man will choose the right filter system for your individual needs after careful on-the-spot tests of your water, backed up when required, by analyses from a Culligan factory laboratory. You know you're getting the best equipment from people who care, with over 40 years of experience in water conditioning.

Taste and Odor Filters

They contain Cullar® activated charcoal produced to exacting specifications. It controls chlorine and other common bad tastes and odors. Will also remove most objectionable organic colors. Units available in fully automatic or lever operated models.

Rust and Iron Filters

When filled with the Culligan filtering material that is right for your particular water, these Culligan iron filters will free you of red fixture stains, fabric discoloration, discolored water, and cloudy, darkened or bitter beverages. Fully automatic or lever operated models.

Sulphur Water Filters

Hydrogen sulfide, the cause of that "rotten egg" odor in water, is oxidized and eliminated by these Culligan units. Fully automatic or lever operated models.

Acid Water Neutralizing Filters

Red stains and blue stains often come from acid water, eating away the iron or copper from your pipes and fixtures. Culligan Cullneu® filters neutralize the acid, stop staining, protect your plumbing from eventual leaks and replacement. Fully automatic and lever operated models available.

Sediment Filters

Culligan Filtr-Cleer® models offer a new method of filtration that gives cleaner water and overcomes the drawbacks of previous methods of filtration for the home. Available in fully automatic or lever operated models.

CONTROL VALVES SPECIALLY DESIGNED FOR EACH SYSTEM

AUTOMATIC CONTROL CENTER
Fully automatic. 6-day timer. Durable, corrosion-resistant Noryl® valve. Now available with Culligan Filtr-Sentry™ metered regeneration feature.

THREE POSITION LEVER CONTROL VALVE
Simple operation. One lever to move. Built-in bypass never interrupts water supply. No motor, no complicated mechanical parts.

NOTICE: The appliance is designed to be used only on water known to be of acceptable bacterial quality. Periodic testing of private and non-municipal supplies is recommended.

NOTE: The contaminants or other substances removed or reduced by this water treatment device are not necessarily in your water.

NOTE: Operational, maintenance and replacement requirements are essential for this product to perform as advertised.

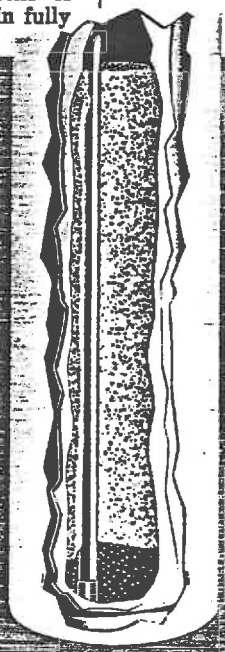
Long-Life Tank Construction

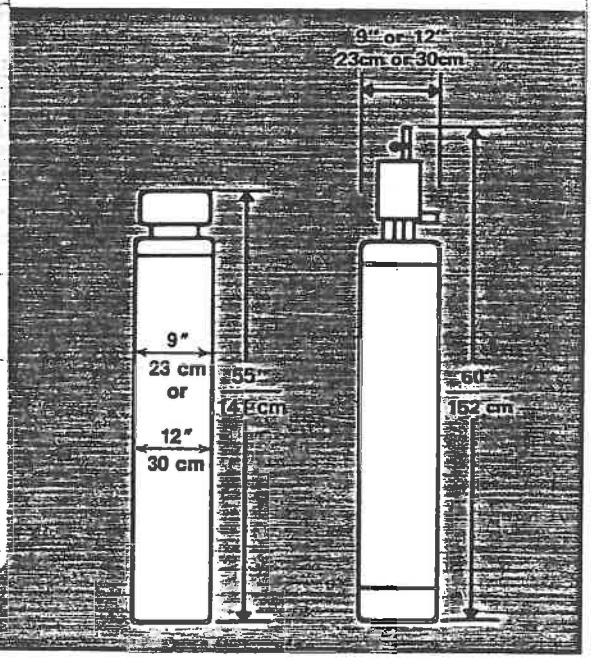
Culligan Tripl-Hull™ uses corrosion-proof inner shell, enclosed in heavy steel, which is enclosed in an attractive jacket.

CULLIGAN SERVICE, provided by factory trained technicians, is always available—Promptly, efficiently, economically. Ask about our Culligan Warranty.

Simply call and say

"HEY CULLIGAN MAN!"®

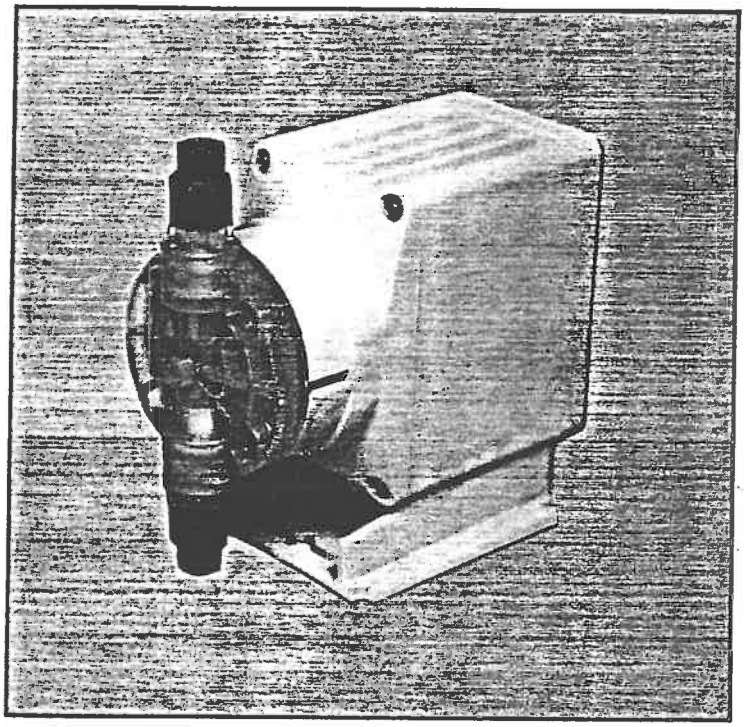




Culligan®

CULLIGAN UNI-DOSE CHEMICAL METERING PUMPS

- FOR OPTIONS 1C + 2C DOES NOT SHOW CHLORINE SOLUTION TANK THAT THIS PUMP RESTS ON TOP OF - TANK IS WHITE -



RUGGED AND DURABLE

Demanding water conditions require tough solutions. That's why Culligan is introducing the Uni-Dose line of chemical metering pumps.

The Uni-Dose feeder is a new breed of chemical metering pump designed to withstand even the harshest environments. It's weather-proof housing is made of a corrosion resistant, glass-filled polypropylene which is resistant to degradation by ultraviolet light. The internal electrical components are protected by a built-in lightning protection circuit.

The Culligan Uni-Dose metering action combines accuracy with reliability for a superior performance and product life. The Uni-Dose pump has unique self-cleaning Uni-valves which sluff off scale. And, when maintenance is necessary, its modular design makes it an easy task.

Dependable, Accurate Output

The Uni-Dose pump offers accurate output through a single adjustable stroke length knob.

Each pump features an electromagnetic drive which means no fans or motors are needed. The solid state pulser is fully encapsulated and protected from corrosive environments. Power consumption is minimal, and is used only during the discharge portion of each stroke.

Safe and Reliable

The Uni-Dose pump features built-in pressure relief so that if the back pressure exceeds the strength of the magnetic coil, the pump stops stroking, preventing damage. A thermostatic protection circuit prevents overheating and premature pump failure.

Three Models

Uni-Dose pumps are available in three different models. Each model is fully compatible with a host of chemicals for water conditioning applications. For specific chemical compatability information, consult the factory.

THE CULLIGAN PROMISE

At Culligan, we understand that a water improvement system is an investment in your family's well-being. That's why our 1350 dealers worldwide don't just sell products — they sell water quality you can count on. We stand behind our products with written limited warranties and our unequaled Culligan Service. No matter where you live, you can depend on Culligan expertise to work for you — today and tomorrow.

TECHNICAL SPECIFICATIONS

MODEL	ELECTRICAL INFORMATION	OUTPUT CAPACITY Gallons/Day	STROKES Per MINUTE	MAXIMUM INJECTION PRESSURE	DIMENSIONS	SHIPPING WEIGHT
U031C	115VAC/60Hz. 1.33 amps 20 Watts	4.8 — 24.0	100	80 psi (5.5 bar)	L 7.75" (20 cm) W 4.06" (10.5 cm) H 6.38" (16.0 cm)	7 lbs. (3.2 kg)
U021C		2.4 — 12.0	50			
U011C		1.2 — 6.0	25			

CULLIGAN
S.W. WA WATER TREATMENT
1321 S. Gold
Centralia WA 98531
736-0157

Culligan®
TRUST THE EXPERTS.

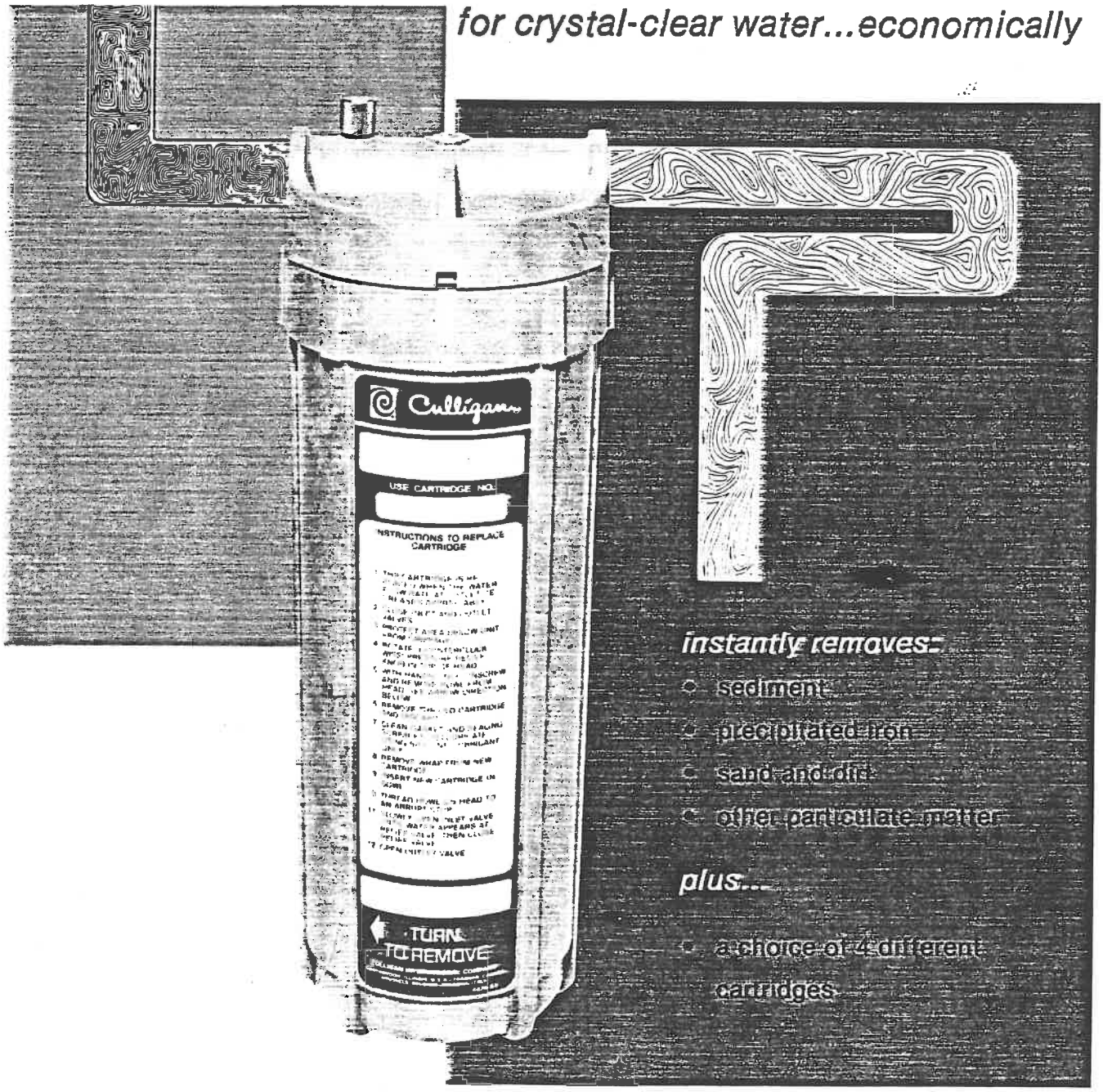
Cat. No. 01-8196-61

Printed in USA 9/90

Culligan®

FILTR-GARD™ compact water filters

for crystal-clear water...economically



water treatment worldwide T.M.

Culligan® FILTR-GARD compact water filters

What Filtr-Gard Is
Filtr-Gard is a small compact in-line water filter, with replaceable cartridges, that filters out dirt, turbidity, sand, grit, sediment and other types of particulate matter from your water supply. Installs easily in your inlet water supply line to give you clear water for all uses.

How It Works
Incoming water passes through the Filtr-Gard cartridge that you select (see below). Undesirable particulate and suspended matter is trapped in the filter cartridge pores. Eliminates cloudy water caused by dirt and sediment, "red water" caused by particles of iron and rust.

FEATURES

Efficient, economical. Low initial cost, modest upkeep. Simple ¾" plumbing connection. Filtr-Gard cartridges are available in four types to do a variety of filtering jobs. Filtr-Gard can be used separately or in combination with other water conditioning equipment.

Sturdy construction. Fltr-Guard is constructed of rugged, corrosion-proof, high-impact-resistant components. Choice of clear or opaque filter bowl. Transparent plastic bowl permits easy visual inspection of filter cartridge. Unit operates on water pressures up to 125 pounds per square inch, temperature up to 100°F, flow rates up to 5 gallons/minute. Where higher flow rates are needed, multiple units may be installed in parallel. Unit measures 5 inches in diameter, 13 inches in height.

Simple cartridge replacement. Shut-off valves are installed in the water line for cartridge replacement. Cartridge replacement is simple; takes only minutes. Built-in pressure relief valve makes opening the unit easy. Inexpensive replacement cartridges are available from Culligan dealers.

Versatile, dependable. Filtr-Gard may be used for many filtering applications to provide improved water quality and to protect water-using appliances from silt and sediment damage. Homes may choose medium or coarse filter cartridges; business and industry may elect to use a fine filtration cartridge. Filtr-Gard is suitable for most applications where dirt or cloudiness in water is a problem.

Stainless steel mounting bracket. corroding bracket supports filter to reduce stress.

CHOOSE FROM FOUR CARTRIDGES

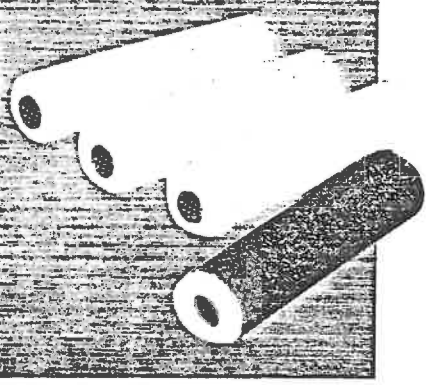
1. Fine Filtration
Uniquely spun filter cartridge* is excellent for laboratory use, deionizer prefiltration, or other applications where high clarity water is a must. Nominal particle removal rating is 5 microns.

2. Medium Filtration
Medium spun filter cartridge* provides water of good clarity, and the filter lasts longer than fine filter above. Use for drinking water, aquariums, making ice cubes, other household uses. Nominal particle removal rating is 35 microns.

3. Coarse Filtration
Coarse spun cartrige* is used where removal of very small particles and high clarity is not necessary, but long cartridge life and low cost are important. Good filtering action for average household water uses. Nominal particle removal rating is 60 microns.

4. Extra Coarse Filtration
A work horse for really turbid or dirty water. Washable, reusable ceramic cartridge provides the longest cartridge life at the lowest cost. Nominal particle removal rating is 300 microns.

*Cartridge is constructed of polypropylene. Ideal for all well water applications because they are highly resistant to microbiological attack. All cartridges measure 3½" by 10" long.



Culligan®

Ask your neighbors about service from the Culligan Man.

Every Culligan water conditioner comes with an exclusive feature you simply don't get with off-brands sold door-to-door or in retail stores. The extra feature is the Culligan Man. He provides prompt, efficient, factory-trained service to make sure your Culligan water conditioner works properly. Ask your neighbors about Culligan. Then call and say, "Hey Culligan Man!"

CULLIGAN
S.W. WA WATER TREATMENT
1321 S. Gold
Centralia, WA 98531
736-0157

No. 8177-87

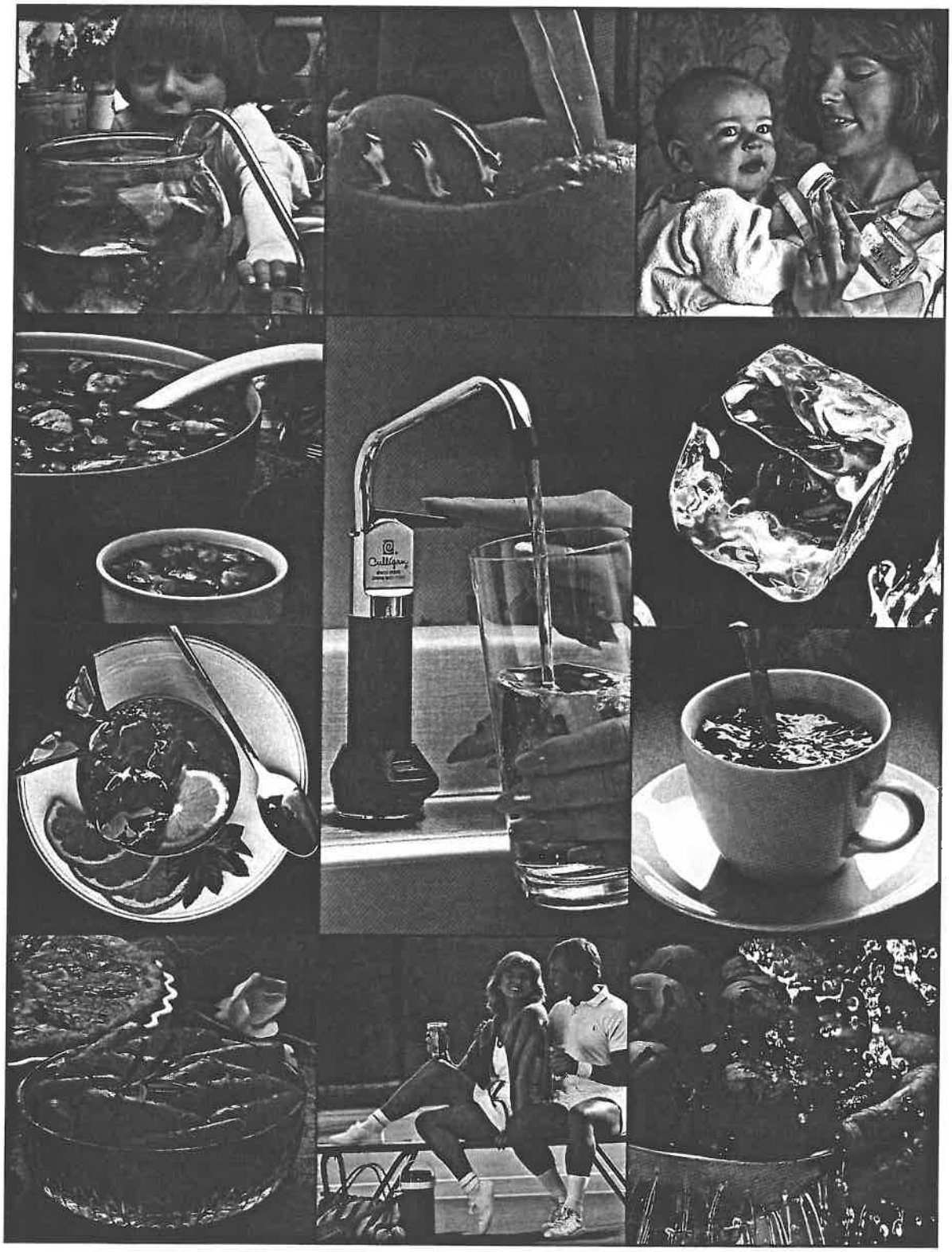
12/82 Printed in U.S.A.

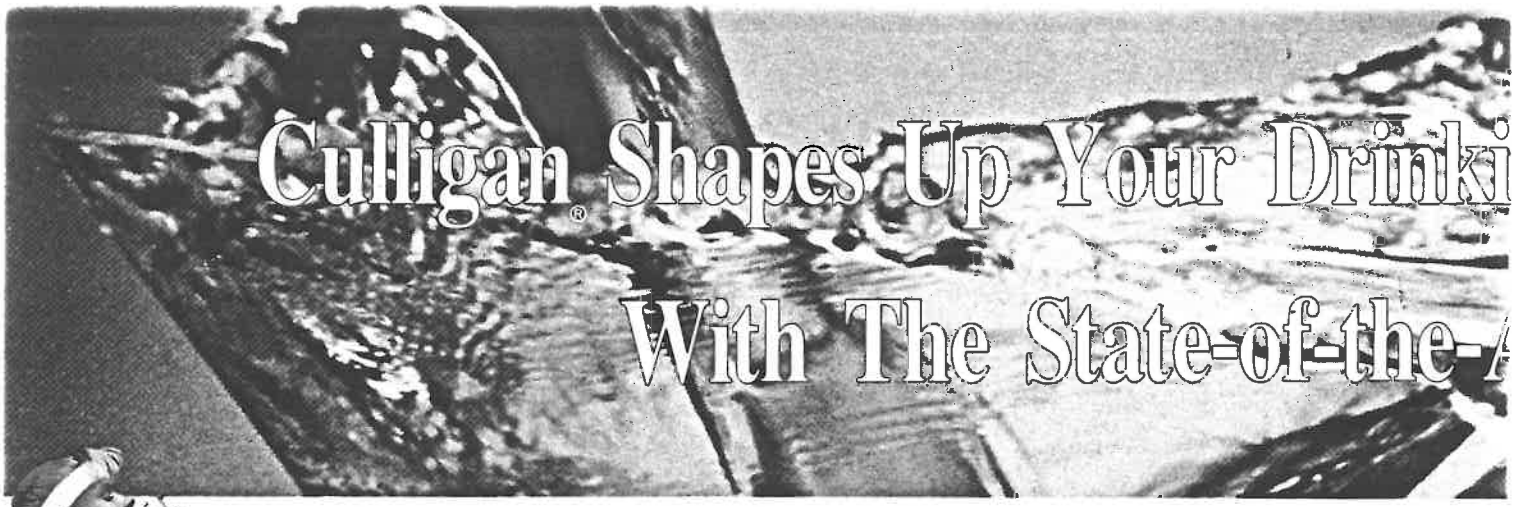
- OPTIONS 1C, 2C & 3C -

Culligan® Aqua-Cleer® Premier™

Reverse Osmosis Drinking Water System

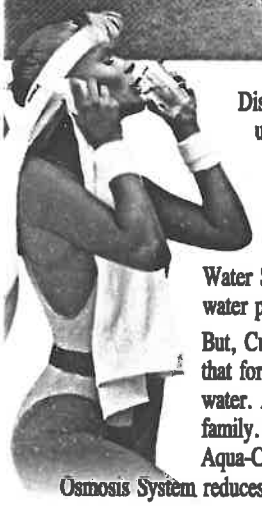
Another Exclusive Product Innovation
From the Water Quality Experts at Culligan





Culligan® Shapes Up Your Drinki

With The State-of-the-A



Dissolved solids and other unwanted substances can leave a bad taste or a funny odor in your tap water. The Culligan® Aqua-Cleer Premier Reverse Osmosis Drinking Water System shapes up drinking water problems in one easy workout.

But, Culligan can do much more than that for the quality of your drinking water. And for the well-being of your family. The highly efficient Aqua-Cleer Premier Reverse Osmosis System reduces the level of contaminants you may not even see, taste, or smell.

When you consider the presence of unwanted substances in your drinking water, consider this statistic: In a lifetime, your body requires 16,000 gallons of water to keep it running as it should. With water that important to good health, it makes good sense to trust your water to the experts at Culligan.

Concerned about your drinking water? You've got a couple of choices

1. Buy bottled drinking water. But you'll have to lift heavy bottles. Store them. Return them. And, keep track of confusing monthly bills.

2. Or, you can simply buy or rent an Aqua-Cleer Premier Reverse Osmosis Drinking Water System. This under-the-sink system turns ordinary drinking water into crystal clear Culligan water. And, it's as easy as turning on your tap.

Triple-Filtered, Triple-Sure

Unlike smaller water systems that depend on only one filter, the Culligan Aqua-Cleer Premier Drinking Water System offers you the assurance of triple-filtration.

1 Fine Filtration

This first-stage Culligan filter reduces sediment, sand, dirt, and other suspended particles as small as 5 microns — 15 times smaller than the diameter of a human hair.

2 Carbon Adsorption

After fine filtration, the water flows into a high-quality granular activated carbon filter. This second filter screens out chlorine, unpleasant tastes and unwanted odors.

3 Reverse Osmosis

Here, water passes through a semi-permeable membrane to reduce dissolved solids including sodium, asbestos, lead, arsenic, nitrates, and some organics. These contaminants are left behind and flushed down the drain. Triple-filtered water now flows into the storage container.

250 Gallons a Month

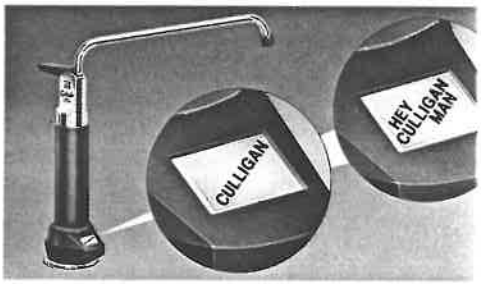
The Aqua-Cleer Premier Reverse Osmosis Drinking Water System gives you crystal clear drinking water with tap water convenience. Each day, it produces an average of 5 to 8 gallons of delicious, triple-filtered Culligan water. With quantities like this, you won't have to buy bottled drinking water again. And, with all this Culligan water on tap, you can use it freely for a variety of other uses. . .

- better tasting coffee, tea, juice, soups & sauces
- healthier house plants
- reduced clogging in steam irons, vaporizers and humidifiers
- cleaner water for rinsing contact lenses
- crisper vegetables and fruits
- fresher tasting foods

Exclusive Premier Features

Aqua-Cleer Sentry Water Quality Monitor

The Aqua-Cleer Sentry is an innovative device which continuously monitors the level of the total dissolved solids (TDS) in your drinking water. When the water quality is high, a constant "Culligan" displays on the LCD readout window. When the TDS level begins to exceed suitable limits, the LCD flashes "Hey Culligan Man"®. You will always know at a glance that your Premier System is producing the high-quality water your family deserves.



Automatic Shut-Off Valve

This inventive mechanism automatically halts the water flow through your Premier System when it senses that the reservoir tank is full. This ingenious feature then instinctively allows processing to resume once water is drawn from the tank. This state-of-the-art product increases filter life and reduces maintenance requirements.

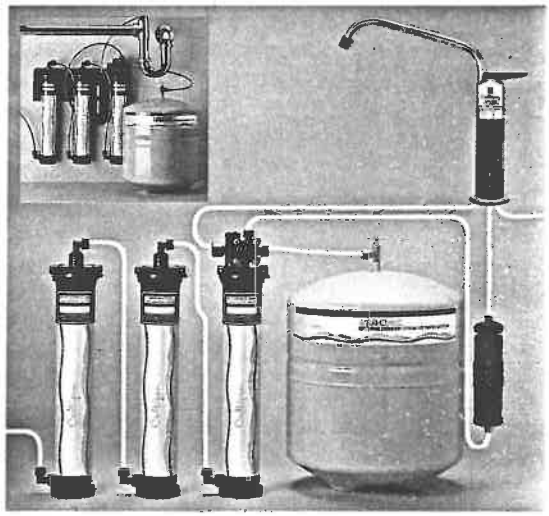
Installation Is Simple

The Aqua-Cleer Premier System can be quickly installed in your home using existing water lines. It installs easily under your sink or in other out-of-the way places, such as a basement. This reverse osmosis water system is available exclusively through your local Culligan dealer. And with Culligan in-home service, you can be sure your system will provide excellent quality drinking water for many years to come. Even if you move, you're never far from one of the 1,350 Culligan dealers worldwide.

Culligan backs up your purchase with a five-year limited warranty. The entire system, excluding expendable filter cartridges and reverse osmosis module, is warranted against defects for 5 years from the date of sale. See printed warranty for full details. *It is important that this product be maintained according to the manufacturer's instructions including replacement of filters.*

Free Water Analysis

Call a participating Culligan dealer today and a Culligan water expert will give you a free, quality analysis of your drinking water.



This system offers high reduction of the following contaminants:

- Total dissolved solids
- Hexavalent chromium
- Trivalent chromium
- Arsenic
- Barium
- Cadmium
- Fluoride
- Lead
- Mercury
- Selenium
- Nitrate
- Asbestos

The substances removed by this system are not necessarily in your water.

Let Culligan install an Aqua-Cleer Premier Reverse Osmosis Drinking Water System in your home for a continuous supply of crystal clear drinking water.

Culligan®

THE CULLIGAN PROMISE

At Culligan, we understand that a water quality improvement system is an investment in your family's well-being. That's why our 1,350 dealers worldwide don't just sell products—they sell water quality you can count on.

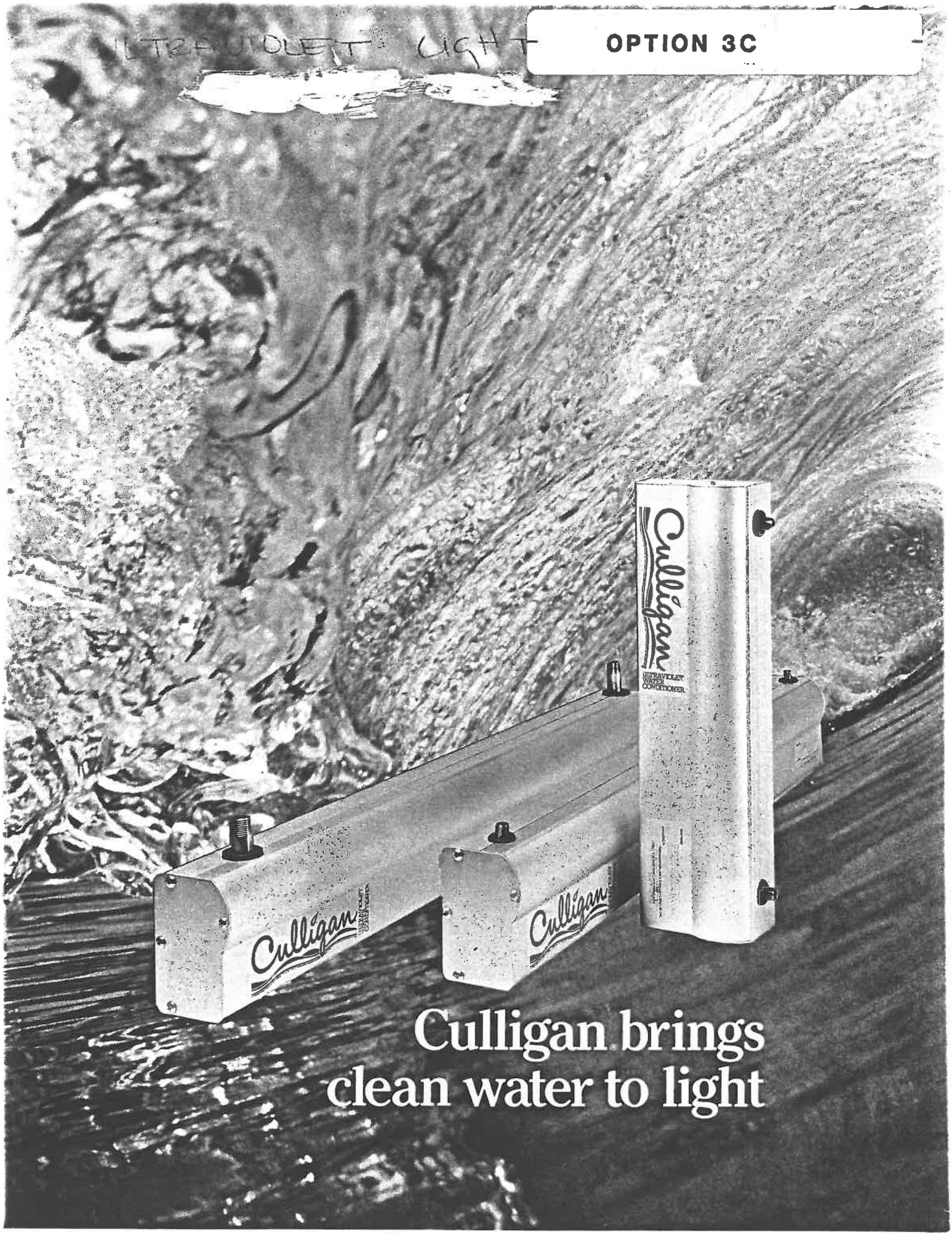
We stand behind our products with comprehensive warranties and our unequalled Culligan service. No matter where you live, you can depend on Culligan expertise to work for you — today and tomorrow.

The 800 Culligan Dealers in the United States and Canada are always ready to solve your water treatment problems.

For crystal clear drinking water with tap water convenience, call ...

Culligan®

OPTION 3C

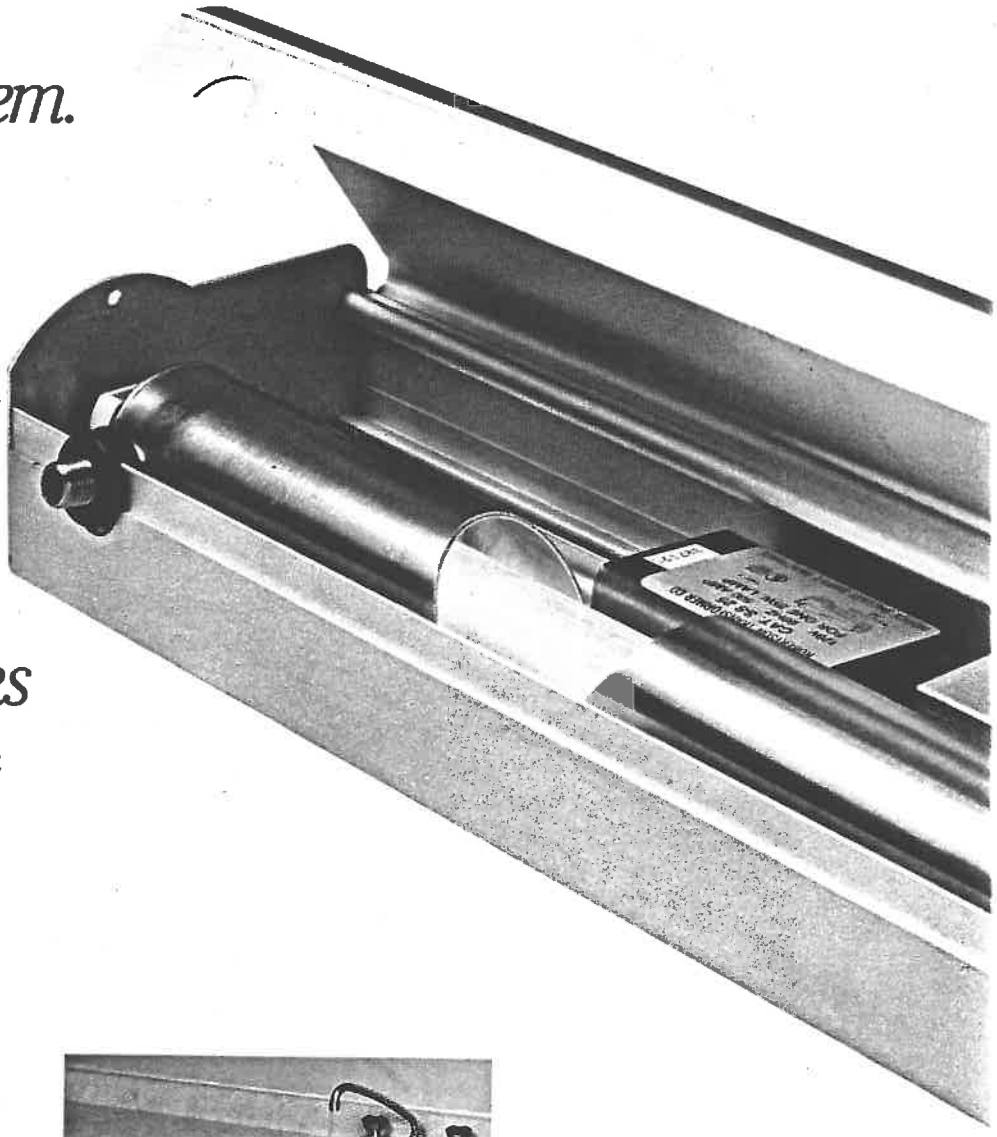


Culligan brings clean water to light

The Culligan® Ultraviolet System.

Disinfect your water without chemicals. The Culligan Ultraviolet System does it naturally. Its ultraviolet protection provides effective control of bacteria and viruses in your water. Just by using the same energy found in nature.

- No more messy chemicals to mix
- Minimum maintenance and attention
- No chlorine or other chemical taste



The way it works

A special lamp emits waves of ultraviolet light. These light waves penetrate the membrane of the bacteria and kill it. In this way, virtually all microbiological organisms are eliminated.

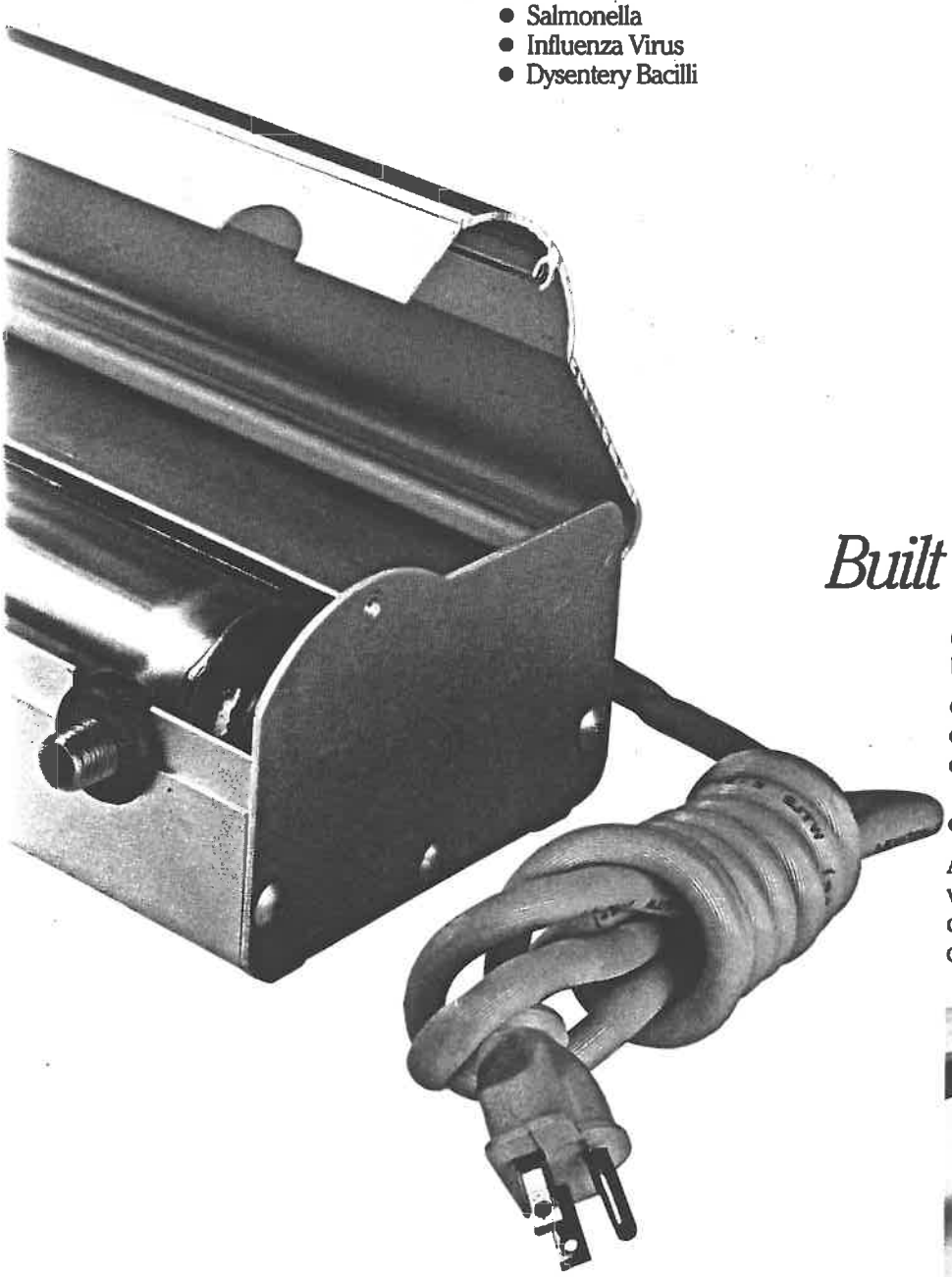
Easy installation for this Culligan compact

The Culligan UV System is a perfect fit for any household. It's easily installed and compact to fit under the sink or other small spaces or where the water enters the house.

Highly effective against bacteria

With the proper pre-treatment, a Culligan UV System will kill 99.97% of the following sickness-causing bacteria:

- Escherichia Coli
- Salmonella
- Influenza Virus
- Dysentery Bacilli
- Staphylococcus Aureus
- Bacteria Phage (E. Coli)
- Legionella Pheunophila
- Hepatitis Virus
- Pseudomonas Pyocyanea
- Neurospora Crossa

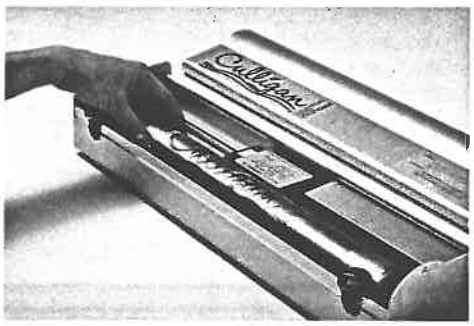


Built right to last long

Culligan quality is built in to every UV System.

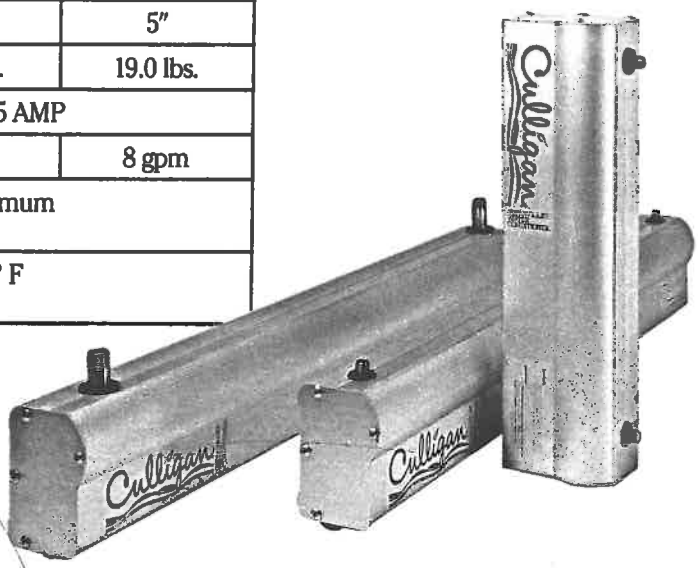
- Sturdy, stainless steel construction
- No moving parts to wear out
- Low operating cost (uses less energy than a 40W bulb)
- Easy to service

And when you need to replace the ultra-violet cell, it's easy to do. Simply open the cover, twist the cell a quarter turn and lift out. The new cell slides right into place.



Specifications

	S-2A	S-5A	S-8QA
Length	18¼"	36¼"	36¼"
Width	3⅛"	3⅛"	3⅛"
Height	5"	5"	5"
Weight	6.2 lbs.	12.3 lbs.	19.0 lbs.
Electrical	118v 60HZ 0.5 AMP		
Capacity	2 gpm	5 gpm	8 gpm
Operating pressure	120 psi maximum		
Operating temperatures	35°–100° F		



Required Water Analysis

In order to provide effective control of bacteria, your water must be tested prior to installation to meet the following standards:

Total Iron	<0.3 ppm (0.3 mg/l)
Hydrogen Sulfide	<0.05 ppm (0.05 mg/l)
Suspended Solids	<10.0 ppm (10.0 mg/l)
Turbidity	<5 NTU
Color	None

NOTICE Most community water sources provide adequate control of microbiological organisms. If you are concerned about the quality of your water supply, your Culligan dealer will gladly assist you in securing a water analysis from an independent certified laboratory or you may contact your local municipal or private water utility, or your County Health Department for information.

NOTE: Operational, maintenance and replacement requirements are essential for this product to perform as advertised.

Take care with

Culligan

THE CULLIGAN PROMISE

At Culligan, we understand that a water improvement system is an investment in your family's well-being. That's why our 1350 dealers worldwide don't just sell products—they sell water quality you can count on. We stand behind our products with written warranties and our unequaled Culligan service. No matter where you live, you can depend on Culligan expertise to work for you —today and tomorrow.

Cat. No. 8195-42

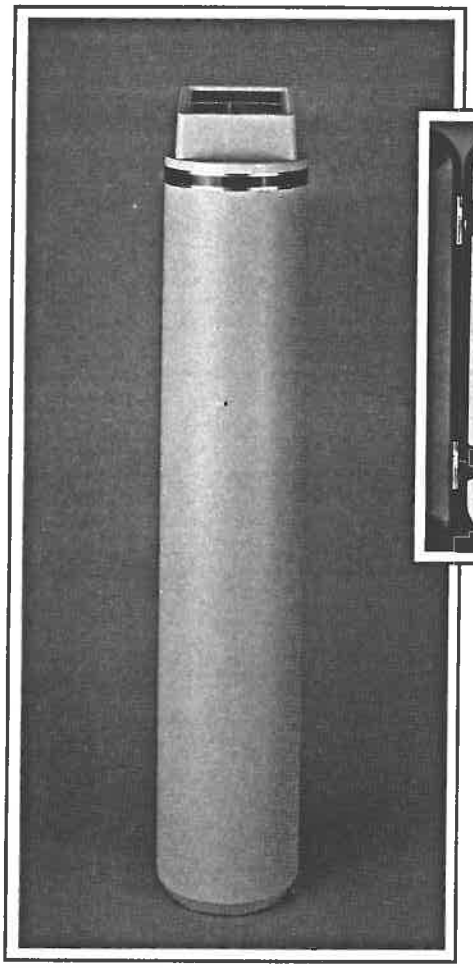
Printed in USA 4/88

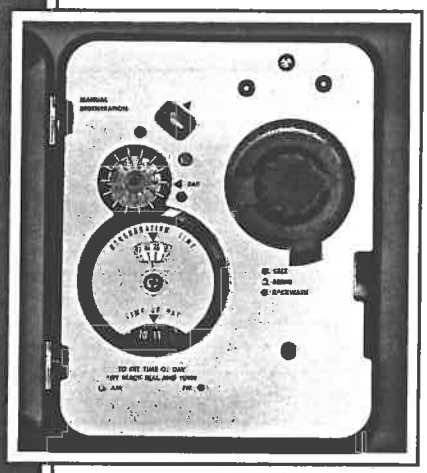
ECO WATER™
SYSTEMS

PROBLEM SOLVERS

PWX™
ALL PURPOSE WATER FILTER
FOR IRON, TASTE AND ODOR, TURBIDITY AND ACID.

OPTION 4E





14 DAY, EASY-TO-SET CONTROLLER/TIMER

- Allows regeneration on selected days and every other day regeneration
- Easy to set time of day
- Regeneration time selection
- Adjustable length of regeneration cycles
- Manual regeneration lever

PWX ALL PURPOSE WATER FILTER

THE PWX FILTER USED IN CONJUNCTION WITH THE PROPER FILTER BED CAN EFFECTIVELY TREAT THESE PROBLEMS IN WATER

IRON
Clear up rust water, eliminating red stains on plumbing fixtures and laundry, and iron scaling in pipes and appliances.

TASTE and ODOR
Eliminate tastes and odors in water such as chlorine, metallic, swampy, and rotten egg.

TURBIDITY
Clear up water that has become dirty or cloudy from dirt, sand, silt and organic matter.

ACID
Neutralize acid water to prevent acid etching of chrome, glassware and china, and to prevent blue-green staining of fixtures.

PWX SERIES ALL PURPOSE FILTER

APPLICATIONS

TYPE OF WATER CORRECTION	RECOMMENDED FILTER BED	LIMITATIONS
IRON (CLEAR WATER OR RED WATER)	FERRITE OR MANGANESE GREEN SAND	20 ppm (1¼ CUBIC FT. BED)
TASTES AND/OR ODORS	ACTIVATED CARBON	VARIABLE. DEPENDENT ON INCOMING WATER QUALITY.
TURBIDITY DIRT, SAND, SILT, ETC.	FILTER AGGREGATE	100 NTU's
ACID	NEUTRALITE	6.0 TO 6.8 pH

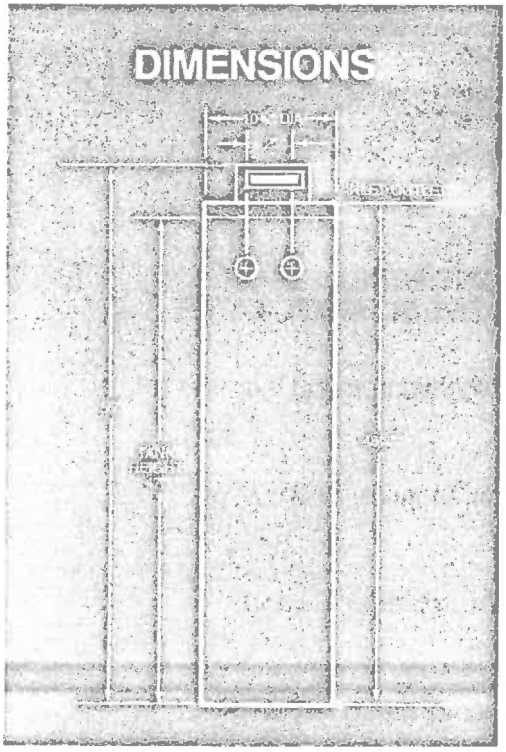
ALL PURPOSE FILTER FEATURES:

- Valve and timer protected by translucent cover
- LIFECO™ non-corrosive filter tank—strongest in the industry
- Internal riser pipe
- 3 cycles provides clean water immediately after regeneration
- Design coordinated with other Refiner products
- 24 volt electrical system

SPECIFICATIONS

AMOUNT OF MINERAL	MAX 1¼ Cubic FT
APPLICATIONS	FOR HOME AND FARM USE*
BACKWASH FLOW RATE REQUIRED	5 GPM
WATER PRESSURE LIMITS	20 - 125 PSI
WATER TEMPERATURE LIMITS	35 - 100° F
RECOMMENDED QUANTITY OF GRAVEL	17 LBS
RECOMMENDED QUANTITY OF FILTER SAND	10 LBS
ELECTRICAL RATING	24 V, 60 HZ

*Flow rates are dependent upon type of mineral used. Generally these flows range from 4 to 9 GPM.



ECO WATER™ SYSTEMS
P.O. Box 64420
St. Paul, MN 55164
891 Rowntree Dairy Road
Woodbridge, Ontario
L4L 4E4

0750063 PRINTED IN U.S.A.

Aquafine®

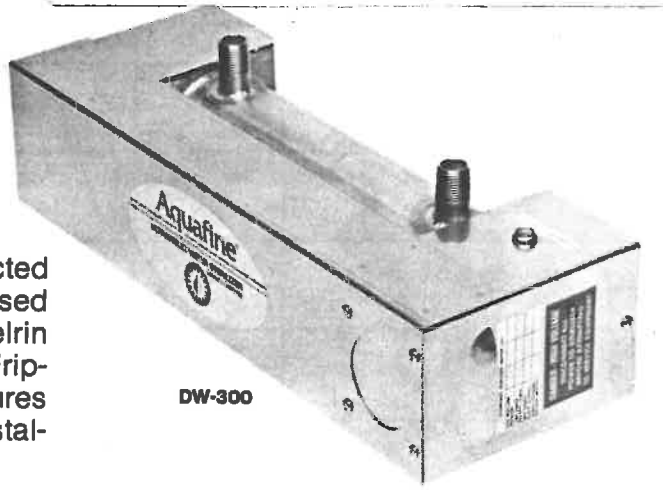
Ultraviolet Sterilizers for Bacteria-Free Potable Water

OPTION 4E

Aquafine Refuses to cut corners

What can be more important to good health, indeed, to life itself, than the quality of water. That's why Aquafine won't compromise on the quality of its product.

The sterilizer chamber and cabinet are constructed of 304 stainless steel. The ultraviolet lamp is housed within a specially fused quartz sleeve. Two Delrin compression nuts with EPDM o'rings provide a drip-tight seal around the quartz sleeve. Standard features include reversible drain and cleaning ports. Installation is simple and fast.



DW-300

SP-1/SP-2

What is Ultraviolet Energy?

Ultraviolet energy is radiated by low pressure mercury lamps. These germicidal lamps are made of a special hard glass that allows the transmittance of shortwave ultraviolet energy, predominantly the 254 nm wavelength. This light ray has the unique ability to kill all microorganisms in which it comes in contact.

How does Ultraviolet kill bacteria?

The ultraviolet rays strike the bacteria, virus, yeast, molds or algae, and break through the outer membrane. They penetrate the heart of the organism (known as the DNA) and destroy it.

Why Ultraviolet?

Ultraviolet safely and efficiently replaces chemical sterilization. Ultraviolet eliminates corrosive action of added chemicals. With Aquafine Ultraviolet Sterilizers your bacteria-free water is completely unchanged in PH, color, taste, odor and temperature.

DW-100

DW-400

25230 West Avenue Stanford, Valencia, California 91355 (805) 257-4770 Telex 651398
Outside California (800) 423-3015 FAX: (805) 257-2489

Technical Specifications

MODEL #	SP - 1	SP - 2	DW - 100	DW - 300	DW - 400
* Maximum Capacity Clear Fresh Water	1 GPM 3.8 LPM	3 GPM 11.4 LPM	5 GPM 19.0 LPM	7 GPM 26.6 LPM	15 GPM 57.0 LPM
Shipping Weight	7 lbs. 3.18 kg	7 lbs. 3.18 kg	17 lbs. 7.71 kg	18 lbs. 8.17 kg	30 lbs. 13.62 kg
No. of UV Lamps	1	1	1	1	1
Lamp Part Number	3010	3011	3070	3050	3084
Total Amps @ 120 VAC	.16	.43	.48	.37	.60
Total Watts	19	52	58	40	70
Inlet/Outlet (size)	3/8" FPT	3/8" FPT	3/4" FPT	1/2" NPT	3/4" NPT
Overall Dimensions (inches) including mounting brackets	14 x 5¼ x 3½	14 x 5¼ x 3½	30 x 5 x 4	16½ x 6 x 4	35½ x 6 x 4
Sterilizer Chamber (wetted parts) matl.	GE type 314 Quartz Glass	GE type 314 Quartz Glass	304 s.s.	304 s.s.	304 s.s.
Cabinets Housing Material	304 s.s.	304 s.s.	304 s.s.	304 s.s.	304 s.s.
Running Time Meter	N/A	N/A	N/A	Standard	Standard
S-254 Sensor	N/A	N/A	N/A	Opt.	Opt.
UV dosage* uw seconds/cm²	>16,000	>16,000	>16,000	>16,000	>16,000

*After 8000 hrs. operation based on a coefficient of absorbtion of .06.

Operational Guidelines

Operating Pressure
120 PSIG Operating
180 PSIG Test

Water Temperature Range
35°F to 100°F (2°C to 38°C)

Ambient Temperature Range
25°F to 130°F (0°C to 54°C)

General Notes

1. Flow capacity is based on a 99% plus bacterial reduction.
2. Ultraviolet lamps are rated at 8,000 hours of continuous operation for maximum rated flow.
3. Pressure drop-less than 2 PSI at rated flow.
4. Specify voltage and frequency requirements at time of order. *
5. Standard 5 year warranty on the sterilizer chamber.

* Some models also available in 12 volt D.C.

Distributed by:

ECOTECH
SYSTEMS & SERVICES
RICHARD TOMSINSKI
1•800•232•6326
Olympia (206) 459-7530
Tacoma (206) 566-9878
P.O. Box 5184
Olympia, WA 98503

Bacteria Destruction Chart

Amount of germicidal ultraviolet energy necessary for complete destruction of various organisms measured in microwatt seconds per cm².

Bacteria Organisms

Bacillus Anthracis.....8700
S. enteritidis.....7600
Escherichlia Coli.....6600
Mycobacterium Tuberculosis.....10000
Pseudomonas Aeruginosa.....10500
Pseudomonas Fluorescens.....6600
Salmonella.....10000

Virus

Bacteriophage (E. Coli).....6600
Influenza.....6600

Protozoa

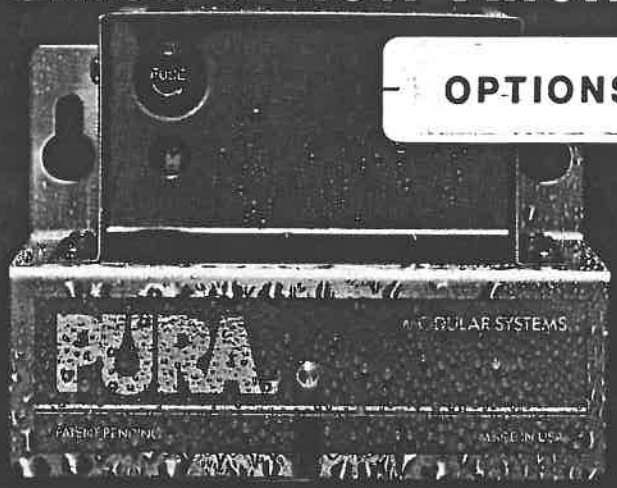
Chlorella Vulgaris (Algae).....22000

Yeast

Brewer's Yeast.....6600
Baker's Yeast.....8800
Common Yeast Cake.....13200

Emerging From the Depths of Unclean Water Comes a New Alternative...

OPTIONS 4E, 5E & 6E



Why Ultraviolet?

Pura's systems incorporate ultraviolet disinfection which kills bacteria and viruses without the use of harsh chemicals at a greater than 99.9% efficiency. Ultraviolet disinfection is a simple method of providing safe drinking water.

Ultraviolet + Filtration?

Pura's unique modular design allows a variety of filter and ultraviolet combinations for effective purification. Pura's extensive line of filtration products (i.e. GAC, carbon block, ceramic, sediment, and activated alumina) provide a practical solution to even severe water problems.

Uses?

Pura's compact size permits flexibility for unlimited applications including: homes, offices, hotels, laboratories, marine and recreation vehicles (12 volt), water coolers and vending machines. A compact countertop model is also available. Pura Systems can be used anywhere pure, disinfected water is needed.

Why Pura?

Pura offers high quality products at an exceptionally low cost. Pura serves dealers with complete sales aids, literature, and technical support to ensure profitable sales and customer satisfaction.

Pura Modular Systems encompass all disinfection and filtration needs for complete water treatment, simply and effectively.

Simple
Effective
PURA

PURA INC. / 1140 So. Aviation Drive / [illegible]

Sold by:

ECOWATER® SYSTEMS

ECOTECH SYSTEMS & SERVICES
RICHARD TOMSINSKI
1•800•232•6326
Olympia (206) 459-7530
Tacoma (206) 566-9878
P.O. Box 5184
Olympia, WA 98503

WATER QUALITY SPECIALISTS *Trusted since 1925*
Including Non-Chemical & Salt-Free Systems
IRON • ODOR • BACTERIA • STAINING • SCALING
CORROSION • RUST • TASTE

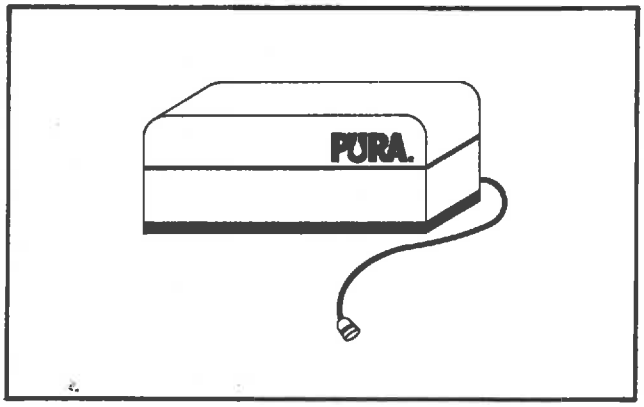
Water Quality Member

PURA. SYSTEMS

Portable/Countertop 1 gpm

Pura's convenient countertop unit with a 1-gpm flowrate and high-impact plastic case can be quickly attached to any faucet with effortless maintenance. This handy unit has an extended lamp life and comes standard with a Deluxe Carbon Block (DCB) filter. This compact system is perfect for travel, portable, and non-plumbing installations. Low-voltage operation (12 volt) makes it safe and efficient.

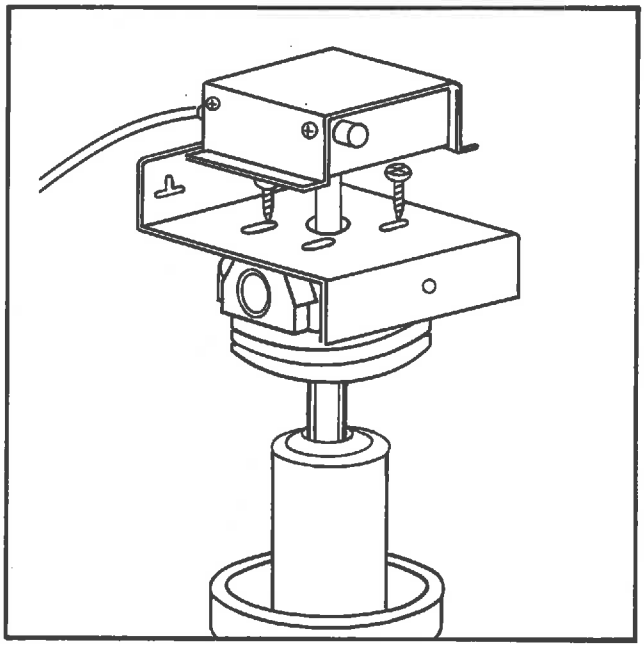
Portable-Countertop



UVB (1, 2, or 3) 1 gpm

Pura's simple UVB system has a 1-gpm flowrate and 10" UV lamp. A #10-size granulated-carbon (GC) filter and plumbing kit are also provided. The UVB (B—for blue housing series) also comes in double and triple versions, for added filter capacity. This is an excellent choice where low-flow water is needed.

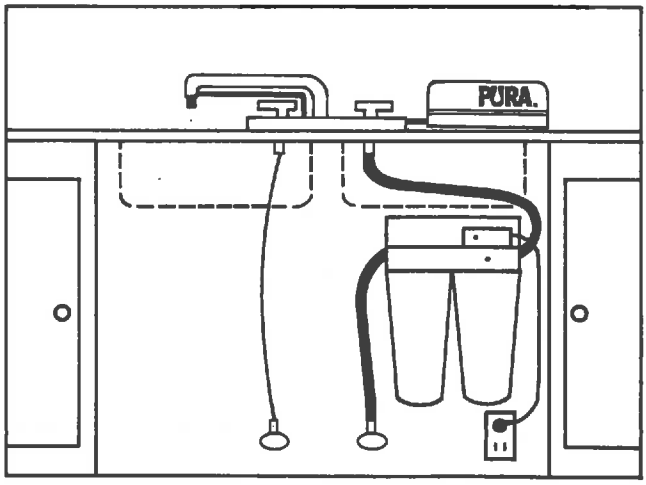
Ultraviolet and Filtration "All-In-One"



UVCL (1, 2, or 3) 2 gpm

Pura's attractive UVCL unit with a 2-gpm flowrate has a 12" UV lamp in a sleek, clear housing, making inspection quick and easy. A Deluxe Carbon Block (DCB) filter is also standard as well as the plumbing installation kit. The UVCL model is the most popular version for point-of-use applications.

Typical installations



UV20 (1, 2, or 3) 10 gpm

Pura's effective UV20 system handles a higher 10 gpm. Designed principally for point-of-entry, the UV20 can efficiently disinfect water for an entire house. This system is UV only in the single model. Double and triple models are also available with filtration.

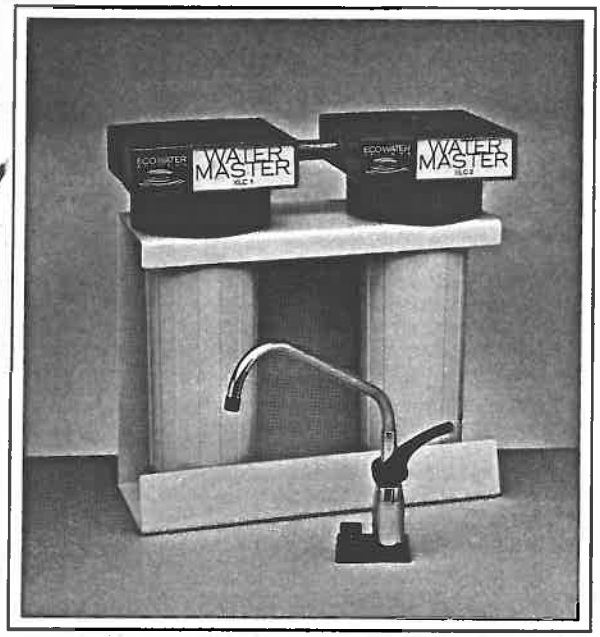
OPTIONS 4E & 6E

WATER MASTER™

ECOWATER™ SYSTEMS

FOR ALL YOUR HIGH QUALITY WATER NEEDS

- Drinking Water
- Baby Formula
- Cooking
- Baking
- Beverages



EFFECTIVELY REMOVES

- **Chemical Contamination**
- **Tastes and Odors**
- **Petroleum Solvents**

THE WATER MASTER™ SYSTEM
Utilizes a special XLC activated carbon absorbtion filtration process that absorbs chemical contaminants from water

Provides high quality drinking water from your tap water for only pennies per gallon

WATER MASTER™ SYSTEM

ECOWATER™ SYSTEMS

Good taste starts with high Quality water—right from the tap

Now you and your family can have good tasting, high quality water anytime you want without the inconvenience of waiting for bottled water deliveries or lugging heavy containers. That's because EcoWater Systems high quality drinking water products put plentiful, high quality water on tap right at your own kitchen sink.

For just a fraction of the cost of bottled water, EcoWater Systems high quality drinking water products provide 100's of gallons of fresh-tasting water a month.

And you can be sure that high quality water is just what you're getting. EcoWater Systems drinking water products do more than just the softening and simple filtration of water by reducing most of the impurities that could be in ordinary tap water. Chlorine and sediment are effectively reduced along with chemicals such as PCBs, THMs, and pesticides, etc.

Because of this special system, the drinking water itself is not only better-tasting, it also helps to improve the flavor of coffee, tea, juices, soups, vegetables—any type of food or beverage prepared with water.

TYPICAL CONTAMINANTS REDUCED OR REMOVED BY THESE CARTRIDGES

Chlorine	Carbon Tetrachloride	1,1,2-Trichloroethane
Chloroform	Lindane	1,2,3-Trichloropropane
Bromoform	1,1,1-Trichloroethane	Odors
Chlorodibromomethane	1,2-Dichloroethane	PCBs
Bromodichloromethane	Trans-1,2-Dichloroethylene	Petroleum solvents
TCE	1,2-Dichloropropane	Pesticides
PCE	1,1-Dichloroethylene	Herbicides
EDB	1,1-Dichloroethane	THMs
DBCP	Cis 1,2-Dichloroethylene	

XLC Cartridge Filter Elements

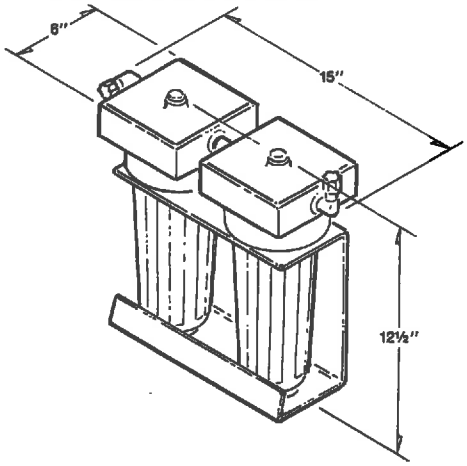
The Water Master System is designed for water applications that have organic contamination problems. It can effectively treat water with objectionable tastes or odors and remove chemical contaminants.

The Water Master System utilizes a special combination of XLC cartridge filter elements. The flow of water through these filter elements is in a series configuration. The first filter in the series is the XLC 1 cartridge of molded block type pulverized activated carbon. This filter element has excellent sediment removal in the 1-2 micron retention range, and serves as a pre-filter for initial removal of contaminants.

The second filter in the series is the XLC 2 cartridge canister type filter containing granulated activated carbon with a unique down-flow filter design that provides more effective removal and retention of contaminants without the filter plugging problem so common with other systems.

Specifications:

• Dimensions



• Operational

Feed Water Pressure Limits 20-125 PSI

Feed Water Temperature Limits 35-100°F

Maximum Filtered Waterflow Rate 1.0 GPM

Filtration Retention Rating 2 Microns

Battery Power 4 "AA" Alkaline Requirement

The Water Master System design incorporates dual action series carbon filtration as the heart of the system. The quality water monitor faucet tells you immediately when the effective life of the XLC carbon cartridge filters has been reached. This unique monitor faucet meters the flow of filtered water and displays a green light to indicate high quality filtered water. The light changes to red when the effective life of the XLC carbon cartridges has been reached indicating time for filter replacement.

The microprocessor controlled monitor faucet also senses time and will change the indicator light from green to red at the end of the 6 month service life of the XLC cartridge elements.

Operational, maintenance, and replacement requirements are essential for the product to perform as advertised.

Do not use this product where the water is microbiologically unsafe or with water of an unknown quality without adequate disinfection before or after the unit.

0602237 (4/88)

ECOWATER® SYSTEMS

ECOTECH SYSTEMS & SERVICES
RICHARD TOMSINSKI
1•800•232•6326
Olympia (206) 459-7530
Tacoma (206) 566-9878
P.O. Box 5184
Olympia, WA 98503

GUIDELINES ON WATER SYSTEM HOME TREATMENT DEVICES
STATE OF WASHINGTON - DEPARTMENT OF HEALTH

APPENDIX E

DEPARTMENT OF SOCIAL AND HEALTH SERVICES
Home Treatment Units
(for individual drinking water services intended to remove primary or health related (organic) contaminants)

Subject: Home Treatment Units for Individual Homes on Public Water Systems

Purpose: This guideline is intended to provide direction to DSHS staff, local health department staff, and other interested parties regarding the use of home treatment units for individual drinking water services for removal of primary or health related contaminants such as synthetic organic chemicals.

GUIDELINE

Background:

1. The general position of the Department is not to approve home treatment units for use on public water systems. Also, their use on private residences is not endorsed by the Department.

2. Home treatment unit applications shall include whole house or point-of-use devices described as faucet add-on units, by-pass units, and batch treatment units.

3. Home treatment unit designs shall include granular activated carbon, pressed carbon filters, spool filters, membrane filters, precoat filters, and reverse osmosis units.

4. The basis for the Department position is:

   a. The difficulty and cost associated with pre-design studies required to size and select home treatment units.

   b. The lack of laboratories certified to test for the presence of Giardia, organic contaminants, and other health related contaminants of concern.

   c. The difficulty encountered by the average homeowner in providing maintenance, repair, replacement, and monitoring of home treatment units.

   d. Concern regarding the potential for degraded bacteriological water quality due to microbiological growth in the treatment unit.

   e. A false sense of security on the part of the homeowner.

5. The only exception to this policy shall be situations where an engineering report prepared in accordance with WAC 248-54 and approved by the Department recommends home treatment units for individual drinking water services which are on a public water system. The Department will have the ultimate responsibility for design and specification review.

Engineering Report Review Criteria:

1. The home treatment units shall be selected and sized on a rational design basis to treat all water used in the home. Point-of-use installations of home treatment units may be considered for use if it can be demonstrated to the Department's satisfaction that the treatment unit is intended to remove only aesthetic contaminants.

2. Thorough testing of the raw water quality to define the contaminant loading shall be conducted by the purveyor prior to the selection of a home treatment unit. Desired treated water quality shall be specified by the Department. Disinfection of treated water shall be required.

3. The home treatment unit selected shall have been tested and certified by the National Sanitation Foundation (NSF) in conformance with NSF Standard Number 53 - Drinking Water Treatment Units - Health Effects.

4. The economic analysis comparing water treatment alternatives shall include costs associated with the purchase and installation of the units as well as the maintenance, repair, replacement, and monitoring of home treatment unit performance.

5. The individual homeowner shall not be responsible for the operation and maintenance of the home treatment unit. The water purveyor shall be responsible for maintenance, repair, replacement, and monitoring schedules shall be specified.

6. The purveyor shall submit periodic (to be prescribed) reports to the Department documenting the performance of the home treatment units.

Approved by: _____ Date: 4/23/85

Addendum to Guideline on Home Treatment Units (4/23/85)

GRANULAR ACTIVATED CARSON WHOLE HOUSE TREATMENT UNITS FOR ETHYLENE DIBROMIDE REMOVAL

SUBJECT: Recommendations for granular activated carbon (GAC) whole house treatment units for individual homes on public water systems for ethylene dibromide (EDB) removal.

PURPOSE: To provide technical information to DSHS staff and other interested parties regarding the design, maintenance and monitoring of granular activated carbon home treatment units for removal of EDB from drinking water.

DSHS POSITION: Point of use treatment units designed to remove EDB from water used only for cooking and drinking purposes are not recommended by DSHS for individual homes on public water systems.

However, DSHS can accept, in some instances, whole house GAC treatment units for removal of EDB from drinking water for individual homes on public water systems. This position applies only to situations where an engineering report prepared in accordance with WAC 248-54 and approved by DSHS recommends home treatment units for individual drinking water services on a public water system.

BACKGROUND: The Water Supply and Waste Section has been in contact with several states where drinking water supplies contain EDB. These states are Florida, Connecticut, Massachusetts and California.

In these states, bottled water is being recommended as a short term solution to EDB contamination. Long term corrective solutions include connections to alternate community water supplies, development of new water sources or treatment.

Comparative studies of treatment options (GAC, PAC, air stripping, etc.) have shown that granular activated carbon poses the most economical and effective process to remove EDB from drinking water.

Whole house GAC units are being recommended by state health agencies in Florida, Connecticut and Massachusetts for individual home treatment instead of point-of-use devices. Whole house units are sized to treat water for all household uses. Whole house treatment is primarily recommended due to concerns about health effects from absorption or inhalation of EDB during bathing and/or showering.

Two states, Florida and Connecticut, have developed specifications for whole house GAC treatment units to remove EDB from drinking water. Field and laboratory studies were conducted to develop the specifications. The EDB removal efficiency (to .02 ppb) of representative treatment units has been verified by the Florida Department of Environmental Regulation.

COSTS: Costs per home treatment system in Florida were bid at approximately $1300; this fee included installation and maintenance (one media replacement).

In Washington, the cost per home treatment unit including installation and one media replacement is estimated to be $1500 - 2000. Media replacement costs are estimated to be approximately $200 - 300 per exchange. Disposable filter cartridge and u.v. bulb replacement would be included (at no additional cost) as part of the media replacement service.

Monitoring costs were not included in the previous considerations and would be an added expense. The James M. Montgomery Laboratory in Pasadena, California is the only laboratory on the West Coast known to certified by EPA for EDB analysis. Montgomery Laboratory charges $250 per EDB sample analyzed by gas chromatography/mass spectrometry (GS/MS); for analysis by GC only, the charge is $75/sample. An additional fee of $100 (per sample) is charged for "dirty" samples (i.e., samples which require extensive preparation prior to EDB analysis). Montgomery Laboratory reduces the above charges by 5% when more than 10 samples are submitted at one time.

DESIGN SPECIFICATIONS

The following specifications are based upon information obtained from Florida and Conneticut. These specifications include recommended media volume, system layout, disinfection methods and maintenance and monitoring schedules.

I. Water Quality

Finished water quality shall conform to the minimum water quality standards established in WAC 248-54-175.

In addition, finished water quality shall not exceed the health action level of 0.02 ppb established for EDB in drinking water in Washington.

II. Adsorption System

A. Media Volume

A filter system containing two cubic feet of GAC media is the minimum recommendation per individual household.

B. Flow Rates

Maximum and average flow rates shall ensure adequate GAC media contact time to meet water quality requirements specified in I. An empty bed contact time of five minutes is recommended, but satisfactory performance has been noted at contact times of one minute for short durations of flow.

C. GAC Media

GAC media shall meet the American Water Works Association (AWWA) Standard for granular activated carbon AWWA B604-74 with the exception of Adsorptive Capacity. The standard includes but is not limited to:

1. Impurities - shall not be present in quantities capable of causing adverse health effects in consumer of treated water.

2. Moisture - shall not exceed eight per cent by weight of listed container contents.

3. Apparent Density - shall not be less than 0.36 g/ml.

4. Particle Size Distribution - should range between U.S. Standard sieve sizes No. 8 and No. 50.

5. Abrasion Resistance - retention of average particle size of granular activated carbon shall not be less than 70% as determined by either the stirring abrasion test or the Ro-Tap abrasion test.

6. Adsorptive Capacity - the Iodine Number shall not be less than 900 or the GAC of equal adsorptive capacity. The iodine number requirement is based upon information obtained from the Florida Department of Environmental Regulation.

The AWWA Standard should be consulted for more detailed information.

D. Filter and Other System Components, Materials

All GAC filter and other system components and materials shall meet applicable AWWA, American Public Works Association, or National Sanitation Foundation Standards.

E. Basic System Components

The system shall consist of the following components:

1. Water Meter - The water meter should be of the flow totalizing type to measure flow in terms of gallon per minute and total gallons of flow.

2. Prefilter - A five micron (maximum) prefilter shall be installed to reduce particulate matter reaching the GAC filter. Disposable cartridge filters or washable reusable media type filters are acceptable.

Installation of additional equipment prior to the five micron filter will be required if treatment for iron, manganese, or other constituent is determined to be necessary.

3. GAC filter - The GAC filter system shall provide a minimum of two cubic feet of filter media. A 5:1 length to diameter ratio of the GAC unit is recommended. Representative dimensions for 1 ft^3 and 2 ft^3 GAC media are listed below:

Volume of Filter Media (cubic feet)	Filter Diameter (inches)	Filter Height (inches)
1 (per each filter)	8	40
2	10	50

For other media volumes, diameters and heights may be determined by using the following formulas:

$D = \frac{4V}{5\pi}$ and $H = 5D$ where D = diameter in feet, and H = height in feet.

4. Pressure Gauges - Pressure gauges shall be installed before and after the prefilter and after the GAC filter for identification of prefilter or GAC filter clogging.

5. Sampling taps - Sampling taps to evaluate water quality shall be provided before and after the GAC filter.

6. Valves - Gate valves shall be installed before and after the prefilter and after the disinfection unit to allow isolation of system components for maintenance, repair, or replacement.

   Installation of a flow regulating valve may be required on some systems (wells with high pumping rates) to ensure adequate GAC media contact time.

7. Disinfection - Continuous disinfection following GAC filtration shall be provided either by chlorination or ultraviolet sterilization.

F. System Component Layout

Possible granular activated carbon adsorption system schematics are shown in Figure 1. A bypass may be established whereby water is diverted around the GAC adsorption system. The bypass shall be plumbed such that untreated water is provided only to outside taps (for watering lawns, etc.).

G. Plans and Specifications

The water purveyor shall in accordance with WAC 248-54-095 submit to the Department for review and approval complete plans and

specifications fully describing the proposed home treatment adsorption system prior to installation of any portion of said system.

III. Monitoring

Monitoring of home treatment unit performance shall be provided by the purveyor. Sample collection, transportation and analysis shall be in accordance with EPA/State approved methods. All samples shall be analyzed at EPA/State certified laboratories.

Proposed EDB monitoring schedules shall be submitted to the Department for review and approval with the plans and specifications.

The minimum recommended frequency of monitoring treated water for EDB per individual household is: one sample within 24 hours following installation (or media replacement) and one sample for every 15,000 gallons treated thereafter. For a family of 4 with average water usage rates (45 gpcd), samples would be taken approximately every 3 months. When sufficient data has been gathered to determine long term EDB removal efficiency, EDB monitoring frequency may be reduced.

Bacteriological monitoring of treated and untreated water for total coliform shall be conducted on a monthly basis.

Additional monitoring may be required by the Department.

IV. Operation, Maintenance, Reporting

Operation and maintenance of the home treatment units will be the responsibility of the purveyor. All operation and maintenance shall be in accordance with the treatment unit manufacturer's/vendor's recommended schedules and procedures.

Operation and maintenance schedules shall be submitted for Departmental approval with plans and specifications. Monthly operations reports will be prepared and submitted to the Department in a format mutually agreed upon by the purveyor and the Department.

V. GAC Media Replacement

Replacement of GAC media shall be required such that the water quality requirements of section I will be met at all times of system operation.

Frequency of media replacement will be site specific, because influent concentrations of EDB and total water usage will vary between individual households. Periodic monitoring of treated water for EDB along with records on volume of water treated should provide sufficient information to indicate when the media needs to be replaced. Replacement of filter media on a minimum of six month intervals after installation is required.

If frequent monitoring is unattainable or cost prohibitive, more frequent media replacement will be required. In these cases, a more conservative replacement schedule, such as every 3-4 months, should be implemented.

VI. Disposal of Spent Carbon

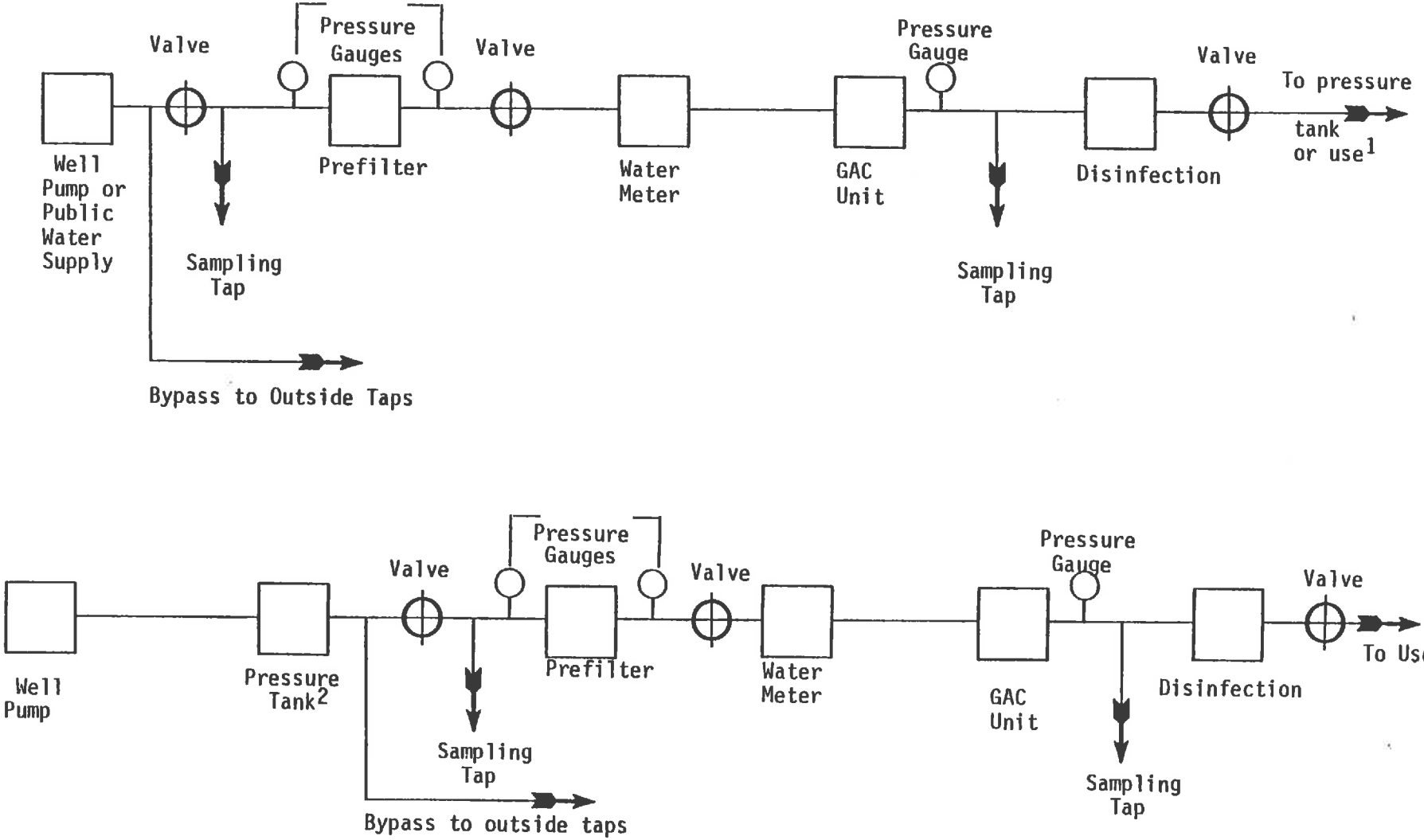
Disposal of spent carbon shall be the responsibility of the purveyor. Disposal shall be in accordance with WAC Chapters 173-301 and 173-303. Regeneration of GAC is encouraged only where engineering analysis has indicated regeneration to be an economical and feasible alternative to replacement.

VII. References

A file of references used to prepare this guideline is available in the Technical Service's office in Olympia.

Approved By: Bill Leech Date: 6/7/85

FIGURE 1 : Granular Activated Carbon Adsorption System



FOOTNOTES:

1. May need to repump to pressure tank.
2. Maximum and minimum operating pressures of pressure tank should be taken into consideration when selecting downstream treatment equipment.

NSF LISTINGS

Drinking Water Treatment Units
and Related Products, Components and Materials

January 1,1991