Environmental Protection Agency
Emergency and Remedial Response
June 1984

EPA

Superfund Record of Decision:

Ponders Corner Site, WA (IRM)

TECHNICAL REPORT DATA

(Please read Instructions on the reverse before completing)

1. REPORT NO. EPA/ROD/R10-84/002	2.	3. RECIPIENT'S ACCESSION NO.
4. TITLE AND SUBTITLE SUPERFUND RECORD OF DECISION Ponders Corner Site, WA		5. REPORT DATE 06/01/84
		6. PERFORMING ORGANIZATION CODE
7. AUTHOR(S)		8. PERFORMING ORGANIZATION REPORT NO.
9. PERFORMING ORGANIZATION NAME AND ADDRESS		10. PROGRAM ELEMENT NO.
		11. CONTRACT/GRANT NO.
12. SPONSORING AGENCY NAME AND ADDRESS U.S. Environmental Protection Agency 401 M Street, S.W. Washington, D.C. 20460		13. TYPE OF REPORT AND PERIOD COVERED Final ROD Report
		14. SPONSORING AGENCY CODE 800/00

15. SUPPLEMENTARY NOTES

16. ABSTRACT

Drinking water wells in the Tacoma, Washington area were sampled for contamination by purgeable halocarbons. The sampling results showed that Lakewood Water District's production Wells H-1 and H-2 were contaminated with 1,2-(trans)dichloroethylene, trichloroethylene and tetrachloroethylene. These wells were taken out of production.

It was determined that the septic tanks and the ground disposal area of a commercial cleaners were the probable source of well water contamination. Solvents used in the dry cleaning process were disposed of in the septic tank and liquid wastes consisting of solvent-contaminated sludges and water draw-off were disposed on the ground outside the cleaners. The cost-effective initial remedial measure for the site is construction of air stripping towers. The 3-year present worth cost for this remedy is estimated to be $1,163,000 and annual operation and maintenance is estimated to cost $82,000.

17. KEY WORDS AND DOCUMENT ANALYSIS

a. DESCRIPTORS	b. IDENTIFIERS/OPEN ENDED TERMS	c. COSATI Field/Group
Record of Decision Ponders Corner Site, WA Contaminated media: gw, soil Key contaminants: volatile hydrocarbons, organic solvents		

18. DISTRIBUTION STATEMENT	19. SECURITY CLASS *(This Report)* None	21. NO. OF PAGES 36
	20. SECURITY CLASS *(This page)* None	22. PRICE

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RECORD OF DECISION
INITIAL REMEDIAL MEASURE ALTERNATIVE SELECTION

SITE: Ponders Corner, Washington

DOCUMENTS REVIEWED:

I have reviewed the following documents describing the analysis of cost-effectiveness of Initial Remedial Measure alternatives for the Ponders Corner Site:

- "Focused Feasibility Study: Ponders Corner Well Water Treatment Facility, Lakewood, Washington," May 1984.
- The attached "Summary of Remedial Alternative Selection, Ponders Corner, Washington," May 1984.
- Community Relations Responsiveness Summary.
- Staff summaries and recommendations.

DECLARATIONS:

Consistent with the Comprehensive Environmental Response, Compensation, and Liability Act of 1980, and the National Oil and Hazardous Substances Contingency Plan, I have determined that the construction of air stripping towers at Lakewood Wells H-1 and H-2 effectively mitigates and minimizes damage to, and provides adequate protection of public health, welfare, and the environment. I have also determined that the action being taken is appropriate when balanced against the need to use Trust Fund money at other sites. In addition, I have determined that the construction of air stripping towers is more cost-effective than other remedial actions and is necessary to protect public health and welfare and the environment from a potential risk which may be created by a continued shut-down of Wells H-1 and H-2 and, therefore, consistent with Section 101(24) of CERCLA.

ERNESTA B. BARNES
REGIONAL ADMINISTRATOR

JUN 1 1984

DATE

SUMMARY OF REMEDIAL ALTERNATIVE SELECTION
PONDERS CORNER, WASHINGTON

A. Site Location and Description

Lakewood Water District's Production Wells H-1 and H-2 are located in the Ponders Corner neighborhood of Lakewood in Pierce County, Washington, just north and west of McChord Air Force Base and southeast of Interstate 5, as shown in Figures 1 and 2. Lakewood is a predominantly commercial and residential area located south of the City of Tacoma.

Wells H-1 and H-2 make up the Ponders Corner well field. Both wells are approximately 110 feet deep, and together they can supply up to 2,800 gallons per minute (gpm). Before the wells were taken out of production because of contamination, they supplied water to the Ponders/Nyanza Park area and provided over 10 percent of the District's needs.

B. Site History

In July 1981, EPA sampled drinking water wells in the Tacoma, Washington, area for contamination by purgeable halocarbons. The sampling showed that Lakewood Wells H-1 and H-2 were contaminated with 1,2-(trans)dichloroethylene, trichloroethylene, and tetrachloroethylene. In mid-August 1981, Lakewood Water District took Wells H-1 and H-2 out of production, notified its customers of the well contamination, and requested that a water conservation plan be followed.

A subsequent inspection and sampling effort by EPA and the Washington Department of Ecology (WDOE) determined that the septic tanks and the ground disposal areas of a commercial establishment known as Plaza Cleaners were the probable sources of well water contamination. Plaza Cleaners is located several hundered feet north of the wells and across Interstate I-5.

In the past, Plaza Cleaners operated a dry cleaning and laundry business with dry cleaning machines, reclaimers (dryers), and commercial washing machines. Plaza Cleaners processed approximately 6,000 pounds of dry cleaning and 2,000 pounds of laundry per week. Some solvents used in the dry cleaning process were disposed of in the Cleaner's 4,250-gallon septic tank system and were flushed through by approximately 12,000 gallons per day of wastewater from the laundry operation. Also, some liquid wastes containing solvents were deposited on the ground outside the building. The liquid wastes disposed on the ground were solvent-contaminated sludges and water draw-off from the vapor recovery system. This water draw-off contained from 60 to 100 ppm chlorinated solvents and amounted to about 30 gallons per week.

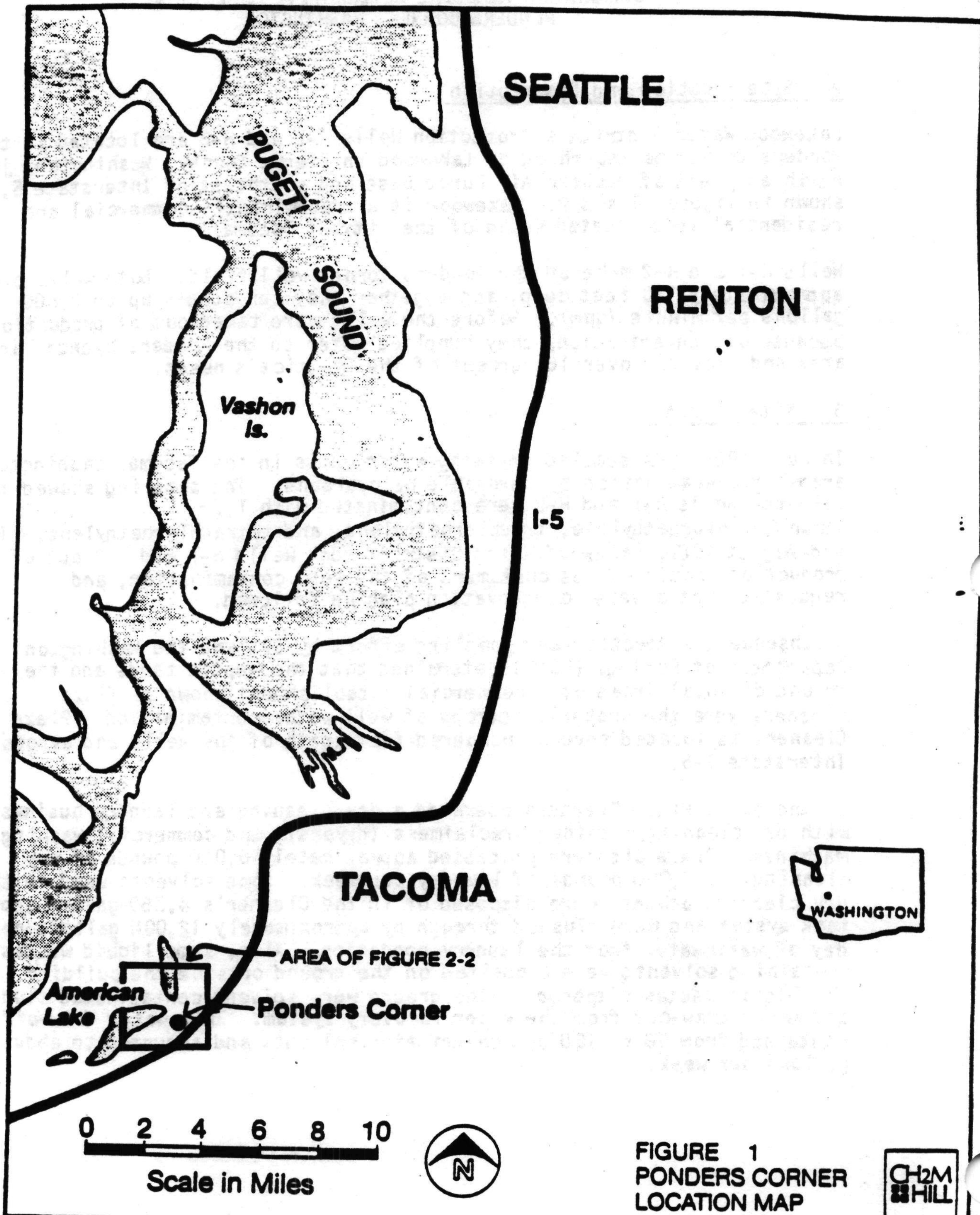
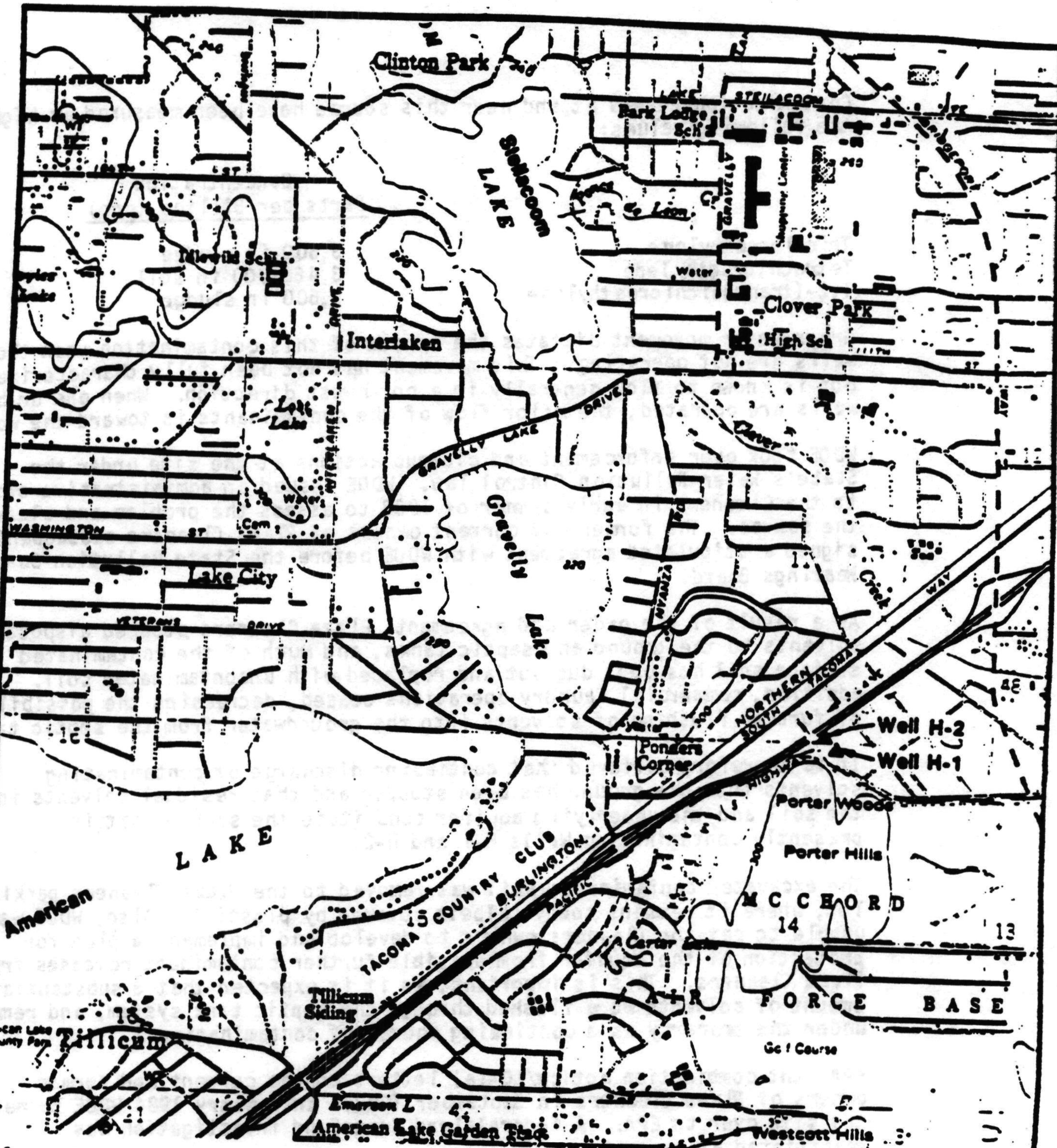


FIGURE 1
PONDERS CORNER
LOCATION MAP

CH2M HILL



SOURCE: USGS 7.5-MINUTE QUADANGLE: STEILACOOM, WASHINGTON

FIGURE 2
VICINITY MAP
PONDERS CORNER F-FS

CH2M HILL

Contamination levels at and near this source have been measured as high as the following values:

	Concentration Parts per Billion (ppb)
Trichloroethylene	3,600 in sludge
Tetrachloroethylene	3,460,000 in soil
1,2-(trans)dichloroethylene	9,600 in sludge

Groundwater movement dictates the spread of this contamination when the wells are not operating. This movement has not been fully characterized but is known to flow generally in a northwest direction. When one or both wells are operated, the major flow of the contaminants is toward the well.

WDOE took over enforcement and cleanup actions at the site under the State's Water Pollution Control law. WDOE issued an administrative order to the Cleaners in early summer of 1983 to assess the problem and clean up the source. The former and current owners of Plaza Cleaners subsequently signed a stipulated agreement with WDOE before the State Pollution Control Hearings Board.

As a result of the order and agreement, Plaza Cleaners stopped disposal of solvents to the ground and septic tanks, and much of the contaminated surface soil has been dug out and replaced with uncontaminated soil. In addition, commercial laundry operations ceased, decreasing the possibility of further flushing of solvents into the groundwater from the septic tanks.

It is therefore believed that continuing discharge of contaminating solvents into the ground has been stopped and that residual solvents in the soil and the underlying aquifer constitute the source that is presently contaminating Wells H-1 and H-2.

The excavated contaminated soil was removed to the Plaza Cleaners parking lot, where it remains today (albeit covered by plastic). Also, WDOE was unable to get the Cleaners owners to develop and implement a plan for protection of the aquifer from possible further contaminant releases from Plaza Cleaners. This is important, as it is expected that a substantial amount of solvents were flushed through the septic tank system, and remain under the property as a continuing source of contamination.

EPA sent combination notice/104(e) letters to the current and former owners of Plaza Cleaners in September 1983. In January 1984 WDOE turned the site over to EPA. A federal-lead Superfund investigation was reinitiated at that time.

C. Current Site Status

During December 1983, a 10-day pumping test was conducted on Well H-2. Sample analysis indicated that the solvent concentrations decreased during the first few days of testing and then tended to level off. Figure 3 shows the data from these tests for tetrachloroethylene and 1,2-(trans)dichloroethylene. Trichloroethylene (TCE) was also detected at less than 50 ppb but was not quantifiable. Subsequently, in February 1984, TCE was quantified at 28 ppb. These data have been used to provide a design basis for influent treatment.

Although the concentrations appeared to level off after several days during the test, individual samples still showed variations from the average. In addition, earlier tests at the source showed much higher concentrations of contaminants and a greater margin for variation. For these reasons, the contamination levels at the 2-day point during the pump test were selected as a conservative design basis contaminant loading for the treatment facility. A TCE level of 40 ppb was selected to provide conservatism above the measured 28 ppb.

Design basis contaminant loadings are therefore as follows:

	ppb
Trichloroethylene	40
Tetrachloroethylene	250
1,2-(trans)dichloroethylene	360

These values are assumed to apply to both wells because the wells are close together and pump from the same aquifer. Either well would therefore receive essentially the same input after long-term pumping.

All members of the chloroethylene series are central nervous system depressants. Acute exposure results in lassitude and mental fogginess. Complaints of mild irritation, lightheadedness, and mild headaches have been reported. Prolonged occupational exposure to trichloroethylene has produced impairment of the peripheral nervous system. The long-term, low-dose effects on the central nervous system, however, have not been well characterized in the scientific literature. Acute exposures can produce damage to liver and kidneys. Trichloroethylene, however, is a less potent renal toxin compared to chloroform or carbon tetrachloride. Long-term toxicity of trichloroethylene appears to depend principally on its metabolic products. As a result, other chemicals that enhance or inhibit its metabolism may act to increase or decrease its toxicity. Similar effects would be expected with the other two chloroethylenes because all three are metabolized by the mixed-function oxidases.

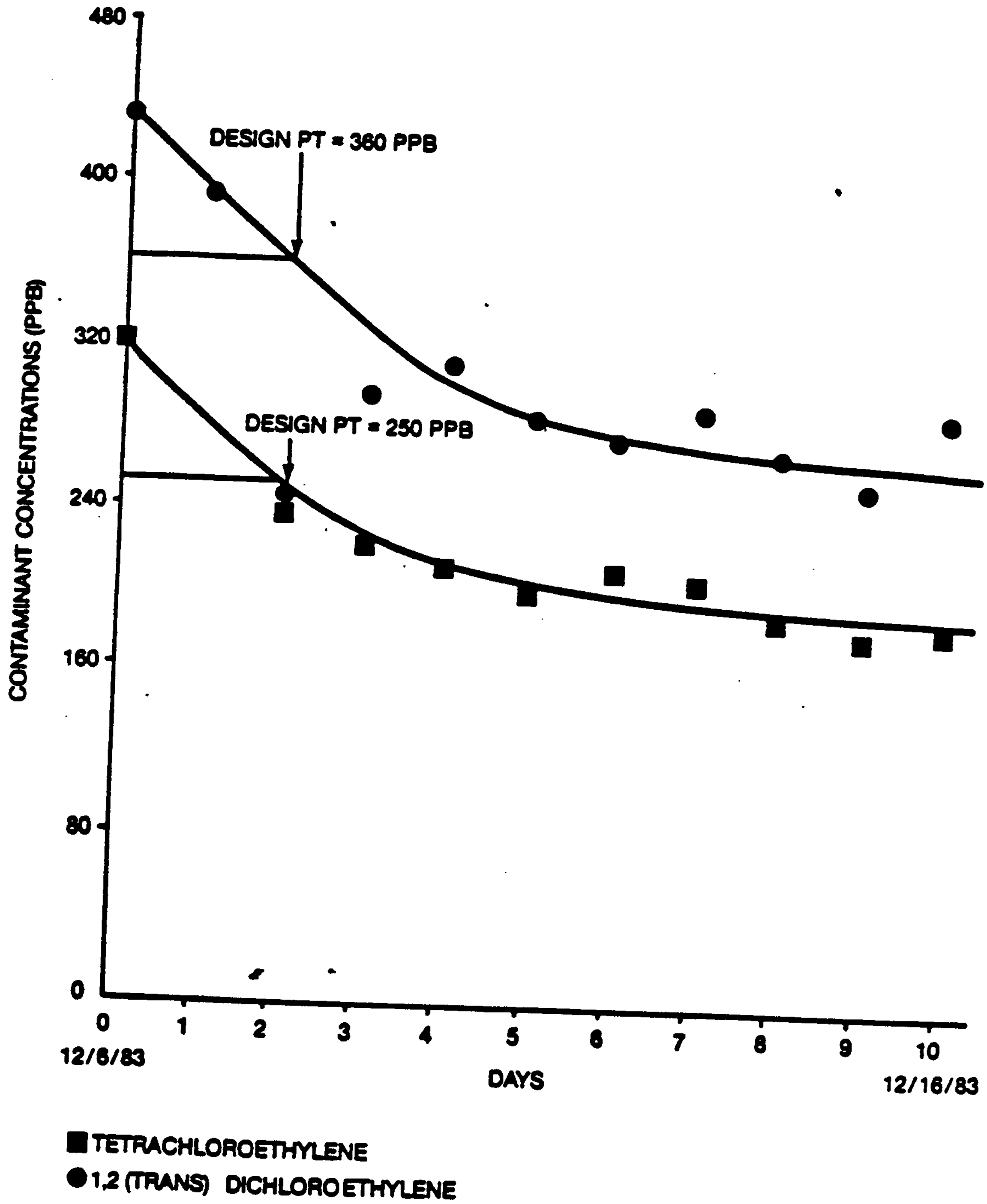


FIGURE 3
PONDERS CORNER
10 DAY PUMP TEST — WELL H2
CONTAMINANT CONCENTRATIONS

Although few studies have been performed, the three chemicals have not been found to be teratogenic in laboratory animals tested. All chemicals appear to require metabolic activation for any mutagenic effect. Technical-grade trichloroethylene, which is mutagenic if metabolically activated, contains epichlorohydrin and epoxibutane, which are more potent mutagens than the pure TCE. 1,2-(trans)dichloroethylene has been found to be nonmutagenic. There is generally insufficient evidence on the mutagenicity of the three chemicals.

Both trichloroethylene and tetrachloroethylene have been shown to be liver carcinogens in at least one strain of mice. No data are available on the carcinogenicity of 1,2-(trans)dichloroethylene.

EPA has developed preliminary risk levels for human carcinogens based on analysis by EPA's Carcinogen Assessment Group. Its estimates for trichloroethylene and tetrachloroethylene are shown in Table 1. For example, a trichloroethylene concentration of 2.7 ppb (with a risk level of 10^{-6}) is expected to increase the number of cancer deaths by one for a million people exposed to the chemical in drinking water over a lifetime.

No data are available to describe the potential carcinogenicity of 1,2-(trans)dichloroethylene. Acceptable drinking water concentrations for noncarcinogenic risks are shown in Table 1 for this chemical.

The concentration design points, reached after 2 days of pumping at Well H-2, are 40, 250, and 360 ppb for trichloroethylene, tetrachloroethylene, and 1,2-(trans)dichloroethylene, respectively. Table 2 shows the contamination levels, the criteria, and comparisons among these values.

TABLE 2
LAKEWOOD WATER DISTRICT WELLS H-1 AND H-2
COMPARISON OF CONTAMINANTS AND CRITERIA
FOR DRINKING WATER
(CONCENTRATION--ppb)

	Criteria[a]	Well Level[b]	Comparison[c]
Trichloroethylene	2.7	40	14.8
Tetrachloroethylene	0.8	250	313
1,2-(trans)dichloroethylene	27	360	13.3

[a]As established by Tacoma-Pierce County Health Department.

[b]Based on levels at 2 days during the 10-day pumping test.

[c]Well level divided by criteria. Factor by which the design point contamination exceeds the criteria.

Table 1
RISK LEVELS ASSOCIATED WITH
DRINKING WATER CONTAMINANTS (ppb)

	Increased Cancer Risk[a]			Considered Acceptable for Human Use		
	10^{-7}	10^{-6}	10^{-5}	1-day	10-day	Chronic
Trichloroethylene	0.27	2.7	27			
Tetrachloroethylene	0.08	0.8	8			
1,2-(trans)dichloroethylene				2,700[b]	270[b]	27[c]

[a]Assumes consumption of 2 liters of drinking water per day over a 70-year period. From References 1, 2, and 3.

[b]Memorandum from William N. Hedeman, Jr., Director, Office of Emergency and Remedial Response, to Lee M. Thomas, Acting Asst. Administrator, Office of Solid Waste and Emergency Response, dated April 2, 1983.

[c]Tacoma-Pierce County Health Department, Washington.

The Tacoma-Pierce County Health Department has established target values for these contaminants at the 10^{-6} level for suspected carcinogens and at 27 ppb for 1,2(trans)dichloroethylene. Based on these thresholds, untreated water from Wells H-1 and H-2 is considered a threat to human health if used for drinking water.

The greatest contamination has been found at 85-95 feet below the surface. A plume of the solvents extends from Plaza Cleaners southeast to Wells H-1 and H-2, several hundred feet away. However, regional groundwater flow is to the northwest. Since H-1 and H-2 have not been pumping (except for a few days) for several years, it is likely that a plume also extends northwest of Plaza Cleaners. The extent of this plume and the levels of contamination are unknown, as there are no monitoring wells in that direction. Construction of those wells will be a part of a future remedial investigation.

In the immediate vicinity of the Ponders well field, a perched aquifer is usually present in Steilacoom gravels above a layer of relatively impermeable Vashon till. The lateral extent and thickness of this till layer are unknown in the area. Shallow wells typically tap this aquifer. However, advance outwash deposits, with an average thickness of about 100 feet, are the most productive aquifers. Wells H-1 and H-2 tap water from the advance outwash deposits.

The surface soil is very permeable. In addition, there appears to be a conduit between the shallow groundwater and the deeper aquifer tapped by H-1 and H-2, as the contaminated wells are only a few hundred feet from the suspected source. Indications are that there is some form of well or gravel pit at the terminus of the septic tank drainfield which allowed contaminated effluent to directly reach the lower aquifer. This will be verified in the remedial investigation.

Approximately 600 customers are normally served by Wells H-1 and H-2. Water is now being pumped from other parts of Lakewood Water District's system to serve these people. However, the pressure is too low to provide adequate fire protection and conservation measures have been put into effect. Also, with heavier pumping of other Lakewood wells, and with H-1 and H-2 shut down, it is possible the contamination is flowing towards the other wells in the system. Therefore, the problem, left unsolved, could eventually affect the remaining 13,000 customers in the Water District.

D. Enforcement

Thus far, only the Plaza Cleaners at 12509 Pacific Highway SW in Lakewood has been identified as a potentially responsible party. During the remedial investigation it is likely that a few additional monitoring wells will be constructed to determine if other responsible parties exist. Virtually all commercial and residential buildings in Lakewood use septic tanks, and it is conceivable that one or more additional (though probably minor) sources could exist.

The only enforcement action taken by EPA thus far has been the issuance of CERCLA notice letters to the former and present owners of Plaza Cleaners. WDOE issued an administrative order and signed a stipulated agreement (discussed previously) with the owners. When the site was turned back to EPA for action, EPA Headquarters, in consultation with WDOE, determined that Fund money would be used for the completion of the Remedial Investigation/Feasibility Study. The Region will decide at a later date whether to attempt cost-recovery.

E. Alternatives Evaluation

The objectives of the proposed project are as follows:

1. Restrict the spread of contamination in the aquifer to reduce ultimate clean-up needs and to protect the quality of water supply from other wells.

2. Restore full water service to the area of the Lakewood Water District that is adversely affected by the shutdown of Wells H-1 and H-2. This includes restoration of normal system pressure, flow, and fire-fighting capability.

3. Facilities to meet these objectives should be operating at the earliest practical date, preferably to meet the 1984 peak demand.

A treatment facility on the combined well output is proposed to meet these objectives. This facility would be operated to purify the well water to drinking water requirements, sized to provide the required capacity and throughput, and operated year-round to control the spread of aquifer contamination.

Nontreatment alternatives such as developing other wells or booster pumps on the existing system will not meet the project objectives. Neither of these approaches would limit the spread of contamination and both could aggravate the problem by drawing the contamination toward the operating wells. Locating and developing new wells could not be completed to meet the schedule objective. A booster pump on another part of the system would have to produce higher than normal operating pressure to deliver the required flows. A detailed distribution system study would be needed to verify the technical acceptability of this approach. Such a study, design, and installation could not be completed in time to meet the schedule objective. For these reasons, nontreatment alternatives are not acceptable.

The treatment system performance criteria are as follows:

Water Supply. Wells H-1 and H-2 have existed for years in the system, are located in the same fenced site, have demonstrated capacity to meet the system's pressure and flow requirements, and are the production wells closest to the source of contamination. Adequate site space is available for a treatment facility. Operation of these wells will therefore meet the District's water supply requirements and will provide the best available means to limit further contaminant spread.

Treated Water Quality. The Tacoma-Pierce County Health Department and State Department of Social and Health Services have established target treated water quality criteria for the contaminants observed in Wells H-1 and H-2 as follows:

1,2-(trans)dichloroethylene	27	ppb
Trichloroethylene	2.7	ppb
Tetrachloroethylene	0.8	ppb

Treatment Capacity. Mr. R. Forster, superintendent of the Lakewood Water District, indicated that historical operation of the system with Well H-1 producing 1,200 gpm and Well H-2 producing 800 gpm for a total of 2,000 gpm would meet the system's peak requirements.

Pumping Plan. This criterion is included to provide a basis for comparing the elements of different system alternatives that depend on the amount of water processed; for example, pumping costs and carbon consumption. The numbers chosen are based on recent historical data for the three peak summer months to supply adequate water to the residents plus a contingency, and on a base flow rate of 1,000 gpm during the rest of the year to restrain contamination spread. Annual treated volume on this basis would be 590 million gallons.

Treatment Facility Life. A treatment facility capable of meeting the water supply and contamination control objectives is needed until a long-range, final remedial action (RA) is effective. The remedial investigation/feasibility study assignment has just been made and is expected to require about a year to complete. Authorization and design of a final RA can be expected to require 6 months or more and construction, another 6 months to a year. A short-term life of 3 years was therefore selected for economic evaluations.

It is also possible that the facilities being considered in this study will become part of the long-term RA and be required to operate for several additional years. A design life of 15 years was therefore selected for the facilities, and operations and maintenance costs were developed for this longer period.

Treatment alternatives considered for this project are:

- No action
- Conventional coagulation, sedimentation, and filtration
- Reverse osmosis

- Ion exchange
- Steam stripping
- Biological treatment
- Activated carbon filtration
- Aeration

No Action. The no-action alternative would involve no treatment facilities and either not operating the wells or operating them into the system or to waste.

Not operating the wells is an unacceptable alternative because this course would not meet the water supply or contamination confinement project objectives. The existing threats to public health and welfare through inadequate water supply and the potential for future contamination of now clean wells would continue.

Operating the wells into the potable water system without treatment is unacceptable on the basis of the resulting threat to public health. Such action would result in drinking water contamination at levels exceeding the accepted criteria for the specific contaminants present by factors between about 13 to 300. Operating the wells to waste would limit the further spread of contamination but would not protect the public health and welfare, which would require restoration of an adequate water supply. Discharge of untreated water to waste would create an added potential threat to public health and the environment in open waterways. WDOE, responsible for such discharges, has advised that some degree of treatment and an NPDES permit would be required for routine discharge to waste from these wells. Obtaining such a permit would require several months. This alternative is therefore unacceptable on the basis of inadequate protection of public health and welfare, potential threat of contamination to a wider area of surface waters and the population, and the inability to respond quickly to mitigate the existing problems.

Conventional Water Treatment, consisting of chemical addition to coagulate colloidal material, sedimentation to partially separate the coagulated material, and filtration to polish the treated water, is used to purify many ground and surface water supplies. This process is not effective in removing the organic solvents found in Ponders Corner well water. The solvents would remain in solution and pass through such a treatment system. This is therefore not a suitable treatment technology for this application.

Reverse Osmosis (RO) can be used to separate dissolved materials in water. In this process pressure is used to force water through a semipermeable membrane that allows the passage of water molecules but prevents the passage of most dissolved materials. Multiple stages may be arranged in series to achieve higher degrees of purity than for a single stage. Membrane processes are somewhat imperfect with respect to organic separations, so the produced water would still contain some organics.

Pretreatment requirements for reverse osmosis are substantial, capital costs are high, and required operating pressures are high. For these reasons, reverse osmosis is not considered a suitable treatment process for this application.

Ion Exchange is an accepted method for removing ions from water. Ion exchange is commonly used to reduce the hardness in water and to remove specific metals. Only charged particles in solution or contaminants that are reactive with the resin can be removed by ion exchange. The feedwater is passed through a bed of resin material, which is typically in the form of small beads, that exchanges ions with those of the contaminant in solution.

Ion exchange would be ineffective in purifying the Ponders Corner well water because the contaminants do not produce ions in solution and will not react with a resin.

Steam Stripping would involve boiling off the solvents in the well water by raising the water temperature with steam. Subsequent cooling of the water would then be needed before use in the water system. This process is typically used in combination with a boiler plant where steam is produced for some other purpose, and the stripping operation adds a small cost increment. For this application, the facilities and fuel costs would be very high, and it is therefore not a suitable alternative.

Biological Treatment has been applied on a limited scale to the cleanup of several contaminated groundwater resources. Specially developed bacteria are cultivated to feed on the specific contaminants in situ or in surface reactors. These processes are typically proprietary and require pilot work and development of the bacterium strain. Experience to date has been with small systems operating at a few gallons per minute. They appear to offer a low-cost cleanup alternative where the contaminants are suitable food for the bacteria, where the contaminants are in the right concentration range for the bacteria, and where cleanup time is not a problem.

Bacteria are not particularly effective on the volatile organics contaminating these wells, the concentration of organics is well below the range needed for operation, and the time to implement such a system would be much longer than desired. Also, no systems have been built that operate at the flow rate required for Ponders Corner.

This alternative is therefore not applicable for treatment of the well water.

Activated Carbon Filtration is an existing, conventional water treatment technology that will remove the organic solvents present in these wells. This technology involves the adsorption of the contaminants on the surface area of carbon particles. The feedwater is passed through a bed of carbon as in a conventional sand filter. Either pressurized or gravity tanks may be used. A gravity system requires repumping the treated water to discharge into the distribution system. For carbon adsorption treatment to produce potable water, a second or lag unit usually operates in series with the primary or lead carbon unit. Carbon treatment systems arranged in this fashion allow the lag carbon vessels to protect against contaminants passing into the water system when their carbon is exhausted and can no longer adsorb the contaminants. This arrangement also enables continuous operation of the treatment system when carbon is exhausted and must be replaced.

Several carbon system suppliers have treatment units for lease or purchase that would meet the performance requirements of this proposed treatment facility. Depending on the specific design and availability of units, installation and startup can be accomplished on a short schedule that could probably meet this project's needs.

Activated carbon filtration can therefore be considered further in the more detailed evaluation of potentially suitable alternatives.

Air Stripping is the technology selected in early 1983 by EPA to treat the well water from the City of Tacoma's Well 12A. Well 12A is contaminated by several organic solvents including those found in the Ponders Corner wells. Air stripping is a well established technology in which the contaminated feedwater is distributed over the top of a loosely packed fill material in a tower. As the water cascades down through the packing, it breaks up into small droplets that provide a large surface area for mass transfer. Air is forced through the packing from the tower base, and volatile organics transfer from the water to the air at the air/water interface. The treated water is collected in a wet well below the tower, chlorinated, and pumped into the distribution system.

Air stripping can therefore be considered further in the more detailed evaluation of potentially suitable alternatives.

It is analyzed below, along with a carbon adsorption treatment system.

CARBON ADSORPTION TREATMENT SYSTEM

The preliminary design of the carbon adsorption system for the Ponders Corner wells is based on the design criteria of 2 to 4 gallons per minute per square foot and 30 minutes empty bed contact time. The system is also designed for lead-lag operation as described above. Hydraulically, the system will produce up to a maximum output of 2,000 gallons per minute. Contaminant loading to the carbon system was based upon an approximate yearly average flow rate of 1.62 mgd and estimated average contaminant concentrations of 250-ppb tetrachloroethylene, 360-ppb 1, 2-(trans)dichloroethylene, and 40-ppb trichloroethylene.

Actual carbon consumption is best determined from treatability tests. In the absence of this information, carbon consumption can be estimated from adsorption data in the literature. There was no information found in the literature on the adsorption of the two major compounds when both are the only contaminants present in water. Therefore, estimates of their adsorption characteristics were made from data on the adsorption of these compounds alone and with one or both compounds in the presence of other similar compounds at the same concentrations as in the Ponders Corners well water. A carbon consumption rate of 0.4 pound per 1,000 gallons was estimated.

To satisfy the stated design criteria for the system characteristics at Ponders Corner and to provide for lead-lag operation of the carbon vessels, twelve 10-foot-diameter vessels with 12-foot-deep carbon beds would be required. These twelve vessels would be arranged in two sets of six parallel vessels in series.

Treated water from the carbon vessels would discharge into a wet well. From the wet well, the water would be pumped and discharged to the Lakewood distribution system. The discharge from the wet well would be chlorinated for disinfection. A process flow diagram of the carbon treatment system is shown in Figure 4.

Both gravity and pressure carbon systems were evaluated and cost estimates prepared. The cost of the carbon system components were based on information obtained from carbon vendors. The results of the cost estimates show that a treatment system employing a pressure or gravity carbon system were approximately the same in cost. Based on this evaluation and cost comparison, final costs are presented for a gravity carbon treatment system because it provides more operational flexibility. Either a gravity or pressure system would be capable of producing water that meets the required water quality criteria. The expected discharge concentrations are shown in Table 3.

A summary of these treatment system costs is given in Tables 4 to 6. The basis for these costs is discussed below.

The treated water from the carbon system will discharge into a wet well before being pumped into Lakewood's distribution system. The required size of the wet well is estimated to be approximately 4,000 to 5,000 gallons. For estimating purposes, a concrete wet well was assumed.

The wet-well pump sizing was based on a maximum flowrate of 2,000 gpm, an average flowrate of 1,000 gpm, and a discharge pressure of approximately 65 pounds per square inch. These design values are preliminary and were used for developing a cost estimate only. The pumping system cost estimate was based on three vertical, 3-stage turbine pumps each sized to deliver 1,000 gpm at 65 pounds per square inch, with 50 hp motors. One of the three pumps would serve as a stand-by pump.

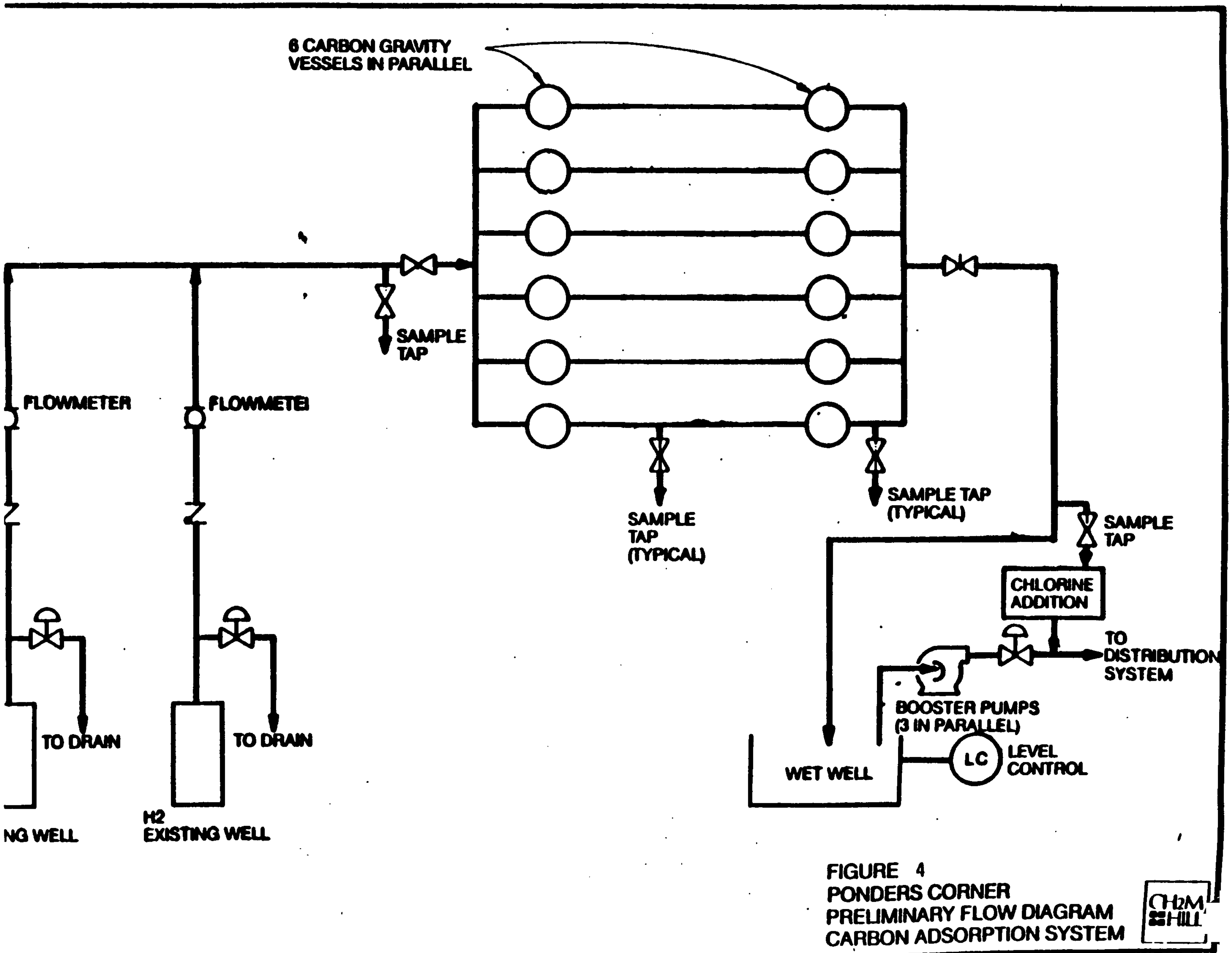


FIGURE 4
PONDERS CORNER
PRELIMINARY FLOW DIAGRAM
CARBON ADSORPTION SYSTEM

Table 3
PONDERS CORNER
ESTIMATED CARBON SYSTEM PERFORMANCE

	Influent Concentration (ppb)	Effluent Concentration (ppb)	Criteria (ppb)
Tetrachloroethylene	250	ND	0.8
1,2-(Trans)Dichloroethyene	360	ND	27
Trichloroethylene	40	ND	2.7

ND--Concentrations less than the lower limit of detection of 0.2 ppb for tetrachloroethylene and trichloroethylene and 5 ppb for 1,2-(trans)dichloroethylene.

Table 4
PONDERS CORNER ACTIVATED CARBON SYSTEM
CAPITAL COSTS

	(Thous. $)
Procurement	
Carbon Vessels	525
Carbon Media	100
Wet Well	11
Relift Pumps	14
Chlorination	6
Subtotal	656
Construction	423
Procurment and Construction	
Subtotal	1,079
Professional Services	108
Total	1,187
Contingencies	
Procurement (20%)	131
Construction (20%)	85
Professional Services (15%)	16
Subtotal	232
Estimated Project Budget	1,419

Table 5
PONDERS CORNER ACTIVATED CARBON SYSTEM
O&M COSTS

	($/year)
Labor	
Operator & Maintenance	6,700
Supervisor/Administration	7,200
Expenses	
Power	39,000
Carbon	224,000
Chemicals	1,000
Lab Tests	8,500
Vehicle	2,500
Estimated Annual O&M Costs	288,900

Notes: Power costs assume $0.034/kWh.
Carbon replacement costs assume $1/lb carbon.
Labor costs assume $16/hour.
Supervision/administration costs assume $50 per hour.
Laboratory tests assume one set of samples per week, four samples per set, $40 per sample.
Chemical costs are for chlorine at $0.25 per pound.

Table 6
PONDERS CORNER ACTIVATED CARBON SYSTEM
PRESENT WORTH COSTS

	(Thous. $)
Project Construction Costs	1,419
Annual O&M Costs	289
First Year Total	1,708
3-Year Present Worth	
Construction	1,419
Salvage	(436)
Present Worth O&M Costs--3 Years	718
TOTAL	1,701
15-Year Present Worth	
Construction	1,419
Salvage	0
Present Worth O&M Costs--15 Years	2,198
TOTAL	3,717

Notes: Salvage value for carbon vessels, pumps, and chlorination system only; straight-line depreciation over 15 years assumed.

Annual costs were discounted at 10 percent.

The cost estimate includes a chlorination system to disinfect the discharge from the wet well. A chlorine residual of 0.2 ppm is required. For design purposes, a chlorine dosage of 1 ppm was assumed. The cost estimate is for a chlorination system that will deliver up to 30-pounds per day of chlorine with a 10 to 1 turn-down ratio. The system includes scales for two 150-pound chlorine cylinders, an injector, and controls to proportion chlorine dosage with flowrate.

Construction costs for Ponders Corner were based on the construction costs for the Tacoma Well 12-A project. Construction costs for Ponders Corner were assumed to be the same percentage of procurement costs as for the Well 12-A project. This method was judged to be a valid approach based on the similar level of complexity of the two projects. Costs for piping, valves, electrical, and instrumentation and controls are included in the construction costs.

Professional services include: design and procurement completion; approval and change coordination; permits, site access, and agency coordination; construction and subcontract administration; overall management, control, and reporting; community relations support; and other related expenses. These costs were estimated from experience with the Well 12-A project. Because the carbon system and air stripping system have similar complexity, professional services costs were assumed to be the same for both systems.

Contingencies of 20 percent for the procurement and construction phases of the project and 15 percent for professional services were used. Contingencies for the carbon system are higher than those used for the air stripping system due to a lesser degree of detail in the estimate.

Yearly operation and maintenance costs include carbon replacement, power, laboratory, and labor costs. Carbon replacement costs were based on an estimated consumption rate of 0.4 pound per 1,000 gallons. Based on a yearly average flow of 1.62 mgd, approximately 224,000 pounds of carbon are required per year. A carbon replacement cost, including supply, regeneration, and disposal services, was quoted by a carbon vendor at $1.00 per pound.

Power costs were based on an average discharge flow rate of 1,500 gpm for 3 months of the year and 1,000 gpm for the remaining 9 months. It was assumed that two 50-hp relift pumps and the 150-hp well pump would be required to provide 1,500 gpm. One 50-hp pump and the 100-hp well pump would be required to provide 1,000 gpm. A power cost of $0.034 per kWh was assumed.

Labor costs assumed 8 hours of operation and maintenance per week for 52 weeks at a labor rate of $16 per hour. Vehicle costs of $6 per hour for the same number of hours per week were also assumed. Supervision and administration costs assumed 12 hours per month at $50 per hour.

The annual cost for operation and maintenance (O&M) of the carbon treatment facilities only is estimated at $273,300. O&M of the wells is estimated at $15,580 a year.

AIR STRIPPING TREATMENT SYSTEM

The preliminary design of the air stripping system for Ponders Corner is based in large part on the pilot work performed for the Tacoma Well 12-A project. From this pilot work and review of the literature, it has been found that gas-to-liquid ratios of 200 to 300-to-1 on a volume basis will achieve the removal rates of chlorinated organic solvents necessary to produce potable water from the groundwaters at Ponders Corner and Well 12-A. Mass transfer coefficients were developed from a model in the literature that was successfully used in the design of the Well 12-A air stripping system.

The air stripping conceptual design for Ponders Corner was based upon tetrachloroethylene, which is the most difficult contaminant to remove. The other contaminants would be removed to levels below the design effluent criteria. Table 7 shows the estimated tower performance for the contaminants present.

TABLE 7
PONDERS CORNER AIR STRIPPING SYSTEM
ESTIMATED TOWER PERFORMANCE

	Initial Concentration (ppb)	Final Design Concentration (ppb)	Criteria (ppb)
Tetrachloroethylene	250	Less than 0.8	0.8
1,2-(Trans)dichloroethylene	360	ND	27
Trichloroethylene	40	ND	2.7

ND--Less than lower limit of detection of 0.2 ppb for trichloroethylene and 5.0 ppb for 1,2-(trans)dichloroethylene.

The preliminary design of the air stripping system calls for two stripping towers in parallel, each capable of treating 1,000 gallons per minute for a total treatment capacity of 2,000 gallons per minute. Each tower would have a packing depth of approximately 25 feet.

Treated water from the stripping towers would discharge into a wet well. From the wet well the water would be pumped into the Lakewood distribution system. Discharge from the wet well would be chlorinated for disinfection. A process flow diagram of the treatment system is shown in Figure 5.

A summary of the costs for the air stripping treatment system is given in Tables 8 to 10. A discussion on the development of these costs is given below. Because of the similarity in size of the Tacoma Well 12-A stripping towers, costs from the 12-A project were used as a basis for some of the costs developed for Ponders Corner.

Each of the two air stripping towers would be 12 feet in diameter with a packing depth of approximately 25 feet. The overall tower height to the top of the discharge stack would be approximately 55 feet but may vary, depending on the height of the stack and final design considerations. Costs for the tower shells were based on the tower costs for the Tacoma Well 12-A project. Towers for the Well 12-A project are 12 feet in diameter with an overall height of approximately 50 feet. Adjustments were made for the greater packing depth required at Ponders Corner, the possible need for an intermediate media support plate, and inflation.

Each tower would require approximately 2,700 cubic feet of media. Several media suppliers were contacted, and cost information varying from approximately $8.00 to $13.50 per cubic foot was received. For purposes of this cost estimate, the higher price quote was used.

One fan for each stripping tower would be required. The fans were sized for an air flow rate of 27,000 cubic feet per minute and a pressure drop of 10 inches of water. The power requirement for each fan at these operating criteria, assuming 70 percent efficiency fans, is 60 hp. Cost for the fans includes silencers, and was based on a fan vendor's information.

As with the carbon adsorption system, this system will require a wet well and pumps for discharge to the Lakewood distribution system. These items will be the same size and capacity as they were for the carbon system. The wet well volume would be 4,000 to 5,000 gallons. Pump costs were based on three vertical turbine pumps, each rated at 1,000 gallons per minute, and a discharge pressure of 65 pounds per square inch. One of the three pumps would serve as a standby.

A chlorination system for treated water disinfection is also included in the cost. It would have the same capacity and components as the chlorination system for the carbon treatment system.

A chlorine solution would be cycled through the towers periodically to clean the packing. The cost of this system is included in the construction cost.

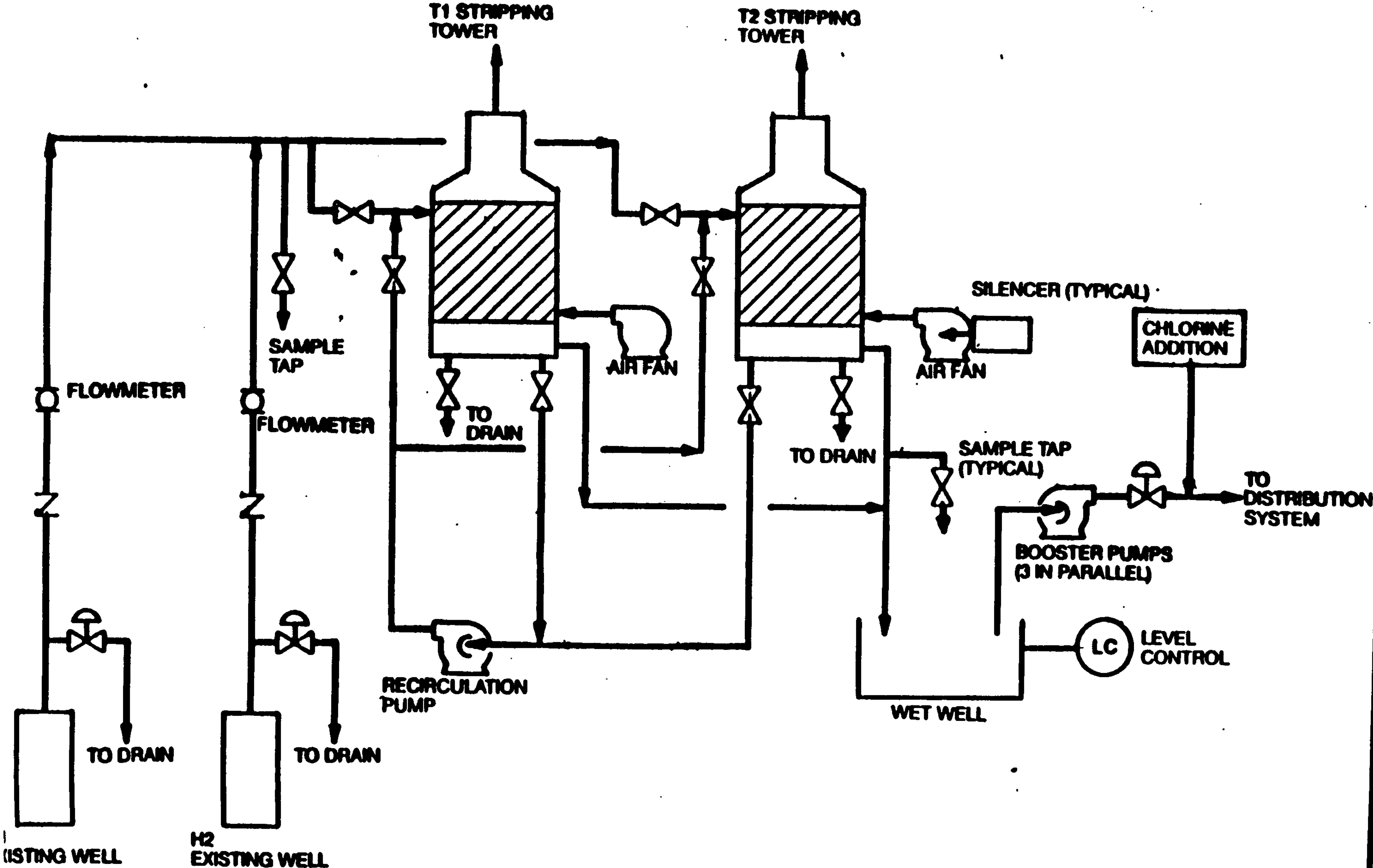


FIGURE 5
PONDERS CORNER
PRELIMINARY FLOW DIAGRAM
AIR STRIPPING SYSTEM

Table 8
PONDERS CORNER AIR STRIPPING SYSTEM
CAPITAL COSTS

	(Thous. $)
Procurement	
Towers	86.5
Media	86.5
Fans/Silencers	21.0
Wet Well	10.7
Relift Pumps	13.8
Chlorination	6.5
Subtotal	225.0
Construction	145.0
Procurement and Construction	
Subtotal	370.0
Professional Services	108.0
Total	478.0
Contingencies	
Procurement (10%)	22.5
Construction (15%)	21.7
Professional Services (15%)	16.2
Subtotal	60.4
Preliminary Estimated Project Budget	$540

Table 9
PONDERS CORNERS AIR STRIPPING SYSTEM
O&M COSTS

	($/year)
Labor	
Operator & Maintenance	6,700
Supervisor/Administration	7,200
Expenses	
Power	56,000
Chemicals	1,000
Laboratory Tests	8,500
Vehicle	2,500
Estimated Annual O&M Costs	81,900

Notes: Power costs assume $0.034/kWh.
Chemical costs are for chlorine at $0.25/pound.
O&M labor costs assume $16/hour, Supervisor/Admin. at $50/hour.
Vehicle costs assume $6/hour.
Laboratory tests assume one set of samples per week, four samples per set, $40 per sample.

Table 10
PONDERS CORNER AIR STRIPPING SYSTEM
PRESENT WORTH COSTS

	(Thous. $)
Project Construction Cost	540
Annual O&M Costs	82
First Year Total	622
3-Year Present Worth	
Construction	540
Salvage	(171)
Present Worth O&M Costs--3 Years	203
TOTAL	572
15-Year Present Worth	
Construction	540
Salvage	0
Present Worth O&M Costs--15 Years	623
TOTAL	1,163

Notes: Salvage value for towers, media, pumps, fans, and chlorination system assumed using straight-line depreciation.

Annual costs were discounted at 10 percent.

Construction costs are based on the construction costs for the Tacoma Well 12-A installation. Professional services costs were also estimated from the Tacoma Well 12-A project. Contingencies of 10 percent for procurement and 15 percent for construction and professional services were used. Operating and maintenance costs for the air stripping system are the same as the O&M costs for the carbon system except that carbon replacement is not required and there is an additional cost for air blower power (two blowers at 60 hp each for 3 months, one blower at 60 hp for 9 months).

Annual operations and maintenance costs for the air stripping treatment facilities only are estimated at $66,320. O&M costs for wells only are estimated at $15,580 a year.

F. Community Relations

Documents made available for public comment included:

"Focused Feasibility Study: Ponders Corner Well Water Treatment Facility, Lakewood, Washington," May 1984.

"Remedial Action Master Plan: Lakewood Water District Wells, Lakewood Washington," November 7, 1983.

"Report of the Groundwater Investigation: Lakewood, Washington, October 1981 to February 1983," February 1983.

"Fact Sheet: Ponders Corner Well Water Treatment Facility," May 1984.

The Focused Feasibility Study is the document we sought comments on. The others were provided for background.

The public was notified of the public comment period, extending from May 7 to May 21, 1984 through several channels. The Lakewood Press, a local paper distributed to all Lakewood residents, was provided information for a story on the proposal in late April. On May 3, 1984 EPA issued a press release discussing the proposed initial remedial measure and announcing the public meeting. A story was subsequently run in the Tacoma News-Tribune (the Tacoma area's largest daily newspaper). Also, several local radio stations ran a story on the wells and announced the meeting.

EPA's contractor, CH_2M Hill, prepared a community relations plan for this project. As part of that effort a mailing list of over 60 persons having an interest in the project was developed. The press release and fact sheet were mailed to those 60 individuals on May 3, 1984.

The public meeting was held at 7:00 p.m. at the Lakewood Branch of the Pierce County Library. Two TV stations and one radio station had crews present and ran subsequent stories in the Seattle and Tacoma areas. Also in attendance were representatives from WDOE, Tacoma-Pierce County Health Department, Lakewood Water District, Tahomans for a Healthy Environment, a Pierce County Council member, the owner of Plaza Cleaners and his attorney, and several residents of Lakewood.

The comments were generally supportive. Some concern was expressed about spending additional money at the site for further investigations, and questions were asked regarding who was going to pay for the project. Some speculation was given on other potential sources. A Community Relations Responsiveness Summary is also attached.

G. Consistency with other Environmental Laws

Both the activated carbon system and the air stripping system alternatives would be in compliance with all environmental laws and regulations. The only environmental law or regulation applicable to the activated carbon system would be the Resource Conservation and Recovery Act regulations dealing with the handling and disposal of hazardous wastes. The carbon would periodically be removed from the system and replaced with clean carbon. The used carbon would contain high amounts of hazardous materials, namely the three solvents absorbed from the well water. The carbon would be disposed of at an EPA approved landfill, incinerated, or regenerated by an approved firm.

The only environmental law or regulation applicable to the air stripping system would be Occupational Safety and Health Administration (OSHA) 8-hour ground level air standards. Listed below are estimates of the 8-hour average levels of contaminants at ground level, emanating from the towers.

Contaminant	Estimated 8 Hour Average	OSHA 8 Hour Standard
1,2 Transdichloroethylene	9.1 ppb	200,000 ppb
Trichloroethylene	0.8 ppb	100,000 ppb
Tetrachloroethylene	3.7 ppb	100,000 ppb

Obviously the contamination levels will only reach a small fraction of the OSHA standard. An air emission permit would be obtained from the Puget Sound Air Pollution Control Agency.

Recommended Alternative

Both an activated carbon system and an air stripping system are technically acceptable and have substantial past operating experience. Either system, properly designed and operated, would produce treated water within the prescribed limits. The treated water from a carbon system would have residual contaminants in the nondetectable range, and treated water from an air stripping system would have residual contaminents at or below the established limits.

An environmental concern with a carbon system is the possible spread of contaminated carbon during the frequent cycles of handling, transport, and offsite regeneration that would be required. Fully contained piping systems would transfer the spent cabron to and from a tank truck used for transport. These systems are used extensively and will normally eliminate spills. Should a spill occur, the contamination will spread only with the carbon since it is bound into the carbon by the adsorption process. Cleanup of such an event would be accomplished by recovering the carbon, and the hazard to the population and workers would be low.

Environmental concerns with an air stripping system are the spread of contaminants through the air discharge and objectionable noise from the fans. Fan inlet silencers will effectively eliminate any increase in noise levels at this site, as indicated by the experience of the EPA's Well 12A facility in Tacoma. Calculations and tests on the 12A air stripping system showed negligible, nonmeasurable air and ground-level concentrations of contaminents. The tower air flow for the Well 12A system and the proposed air stripping system for Ponders Corner are almost identical, and the expected contamination levels at Ponders Corner are about 75 percent of the design loading basis at Well 12A. For these reasons, ground-level concentrations of contaminants similar to Well 12A would be expected for Ponders Corner.

Both systems are capable of being implemented in a short time; the schedule and startup date would be controlled largely by the ability to maintain continuity during design, procurement, and construction.

The cost of a carbon system is estimated to be substantially greater than for an air stripping system. Cost comparisons developed in this study are shown in Table 11.

Table 11
SYSTEM COMPARATIVE COSTS
(Thousands $)

	Carbon	Air Stripping
First Cost	1,419	540
Annual O & M	289	82
First Year Total	1,708	622
3-Year Present Worth	1,701	572
15-Year Present Worth	3,717	1,163

On the basis of these comparisons and the substantial cost difference that exists between these two systems, it is recommended that the air stripping system be selected because it is technically sound, environmentally acceptable, and the most cost-effective solution for this project. Air stripping is the most cost-effective alternative whether the towers are in place only three years, 15 years, or longer.

H. Operation and Maintenance (O & M)

O & M costs for the air stripping system are discussed above in the Carbon Adsorption Treatment System and the Air Stripping Treatment System subparts of the Alternatives Evaluation. The annual O & M cost is estimated at $82,000.

Negotiations with the State on O & M funding are almost complete. For the first year of operation the Lakewood Water District has agreed to pay the O & M costs it would have to pay to operate the wells if they were not contaminated. This amounts to approximately $15,580. This money would come from fees collected to supply the water to its customers. The Washington Department of Ecology has agreed to pay 10% of the remaining O & M costs for the first year out of the State's Superfund. The Lakewood Water District will seek a rate increase to cover 100% of O & M costs for all succeeding years.

Ownership of the treatment system, and liability on the site, is being worked out in a separate agreement with the Lakewood Water District and WDOE. The system will be located on Lakewood Water District property.

I. Schedule

Some key milestones and approximate dates for project implementation are listed below.

Milestone	Target Date
Complete Enforcement Negotiations	Upon completion of RI/FS
Approve Initial Remedial Action (signs ROD)	May 31, 1984
Award Superfund State Contract for Design and Construction	May 31, 1984
Complete Design	June 12, 1984
Award Cooperative Agreement for O&M	August 15, 1984
Start Construction	June 13, 1984
Complete Construction	August 31, 1984 (one tower operational August 1, 1984)

J. Future Actions

An obligation of Fund monies has been made to complete a full RI/FS beginning summer 1984. A scope of work has been approved and CH_2M Hill will begin working on the work plan by June. The remedial investigation will likely include the construction of several additional monitoring wells to determine if any other sources of contamination exist in the area, and to find out how far the contaminant plume now extends. Since Wells H-1 and H-2 have been shut down, it is believed the contamination has been flowing in a different direction. This information is important in designing a final remedial action for the well contamination problem.

In addition, more work is proposed for the Plaza Cleaners site to determine if it is a continuing source of contamination. Specifically, soil samples will be taken and an investigation of the septic tank drainfield is planned. The drainfield, and suspected well at the end of it, have never been found. The soil in the area of the drainfield and well may remain contaminated, even though no solvents now enter the septic tanks.

Following that investigation, a feasibility study will be prepared, assessing various options for remedying the situation. The same process outlined in this Record of Decision will likely be used to select the alternative to be implemented. Negotiations with responsible parties on implementing the remedial action may take place at that time.