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Environmental Protection
Agency

Office of
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Remedial Response

EPA/ROD/R05-85/025
September 1985

EPA

Superfund Record of Decision:

Charlevoix, MI
(Second Remedial Action, 09/30/85)

TECHNICAL REPORT DATA
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16. ABSTRACT

The City of Charlevoix is located on the shores of Lake Michigan in Charlevoix County. The City's single municipal well supplies potable water to a year-round population of 3500 which increases to approximately 5,000 during the summer tourist season. In September 1981, while conducting tests for trihalogenated methane compounds, the Michigan Department of Public Health (MDPH) detected trichloroethylene (TCE) ranging in concentrations from 13 to 30 ppb in the Charlevoix water supply. Data from the monitoring program showed gradually rising levels of TCE and perchloroethylene (PCE) in the raw water. In June 1984, a Record of Decision was signed which approved an initial remedial measure (IRM) for an alternate water supply to replace the contaminated municipal well. The selected IRM consisted of a Lake Michigan water intake structure and a water filtration/flocculation treatment plant.

The selected remedial action involves discharging the TCE and PCE plumes, under natural flow conditions, to Lake Michigan. The aquifer would be useable after 50 years. During that 50-year purging period, institutional restrictions on the installation of private wells in the contaminated aquifer will be enforced by local health officials. In addition, long-term monitoring of the plumes will continue. The estimated annual O&M costs for monitoring are $17,000.

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a. DESCRIPTORS	b. IDENTIFIERS/OPEN ENDED TERMS	c. COSATI Field/Group
Record of Decision Charlevoix, MI Contaminated Media: gw Key contaminants: trichloroethylene (TCE), VOCs, perchloroethylene (PCE)		

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RECORD OF DECISION
REMEDIAL ACTION SELECTION

Site Charlevoix Municipal Well
Charlevoix, Charlevoix County, Michigan

Documents Reviewed

This Record of Decision is based on the following documents describing the analysis of cost-effectiveness of remedial action alternatives for the Charlevoix Municipal Well site:

- Feasibility Study, Charlevoix Municipal Well, Charlevoix, Michigan U.S. EPA, June 10, 1985
- Remedial Investigation Report, Charlevoix Municipal Well, Charlevoix, Michigan, U.S. EPA, February 7, 1985
- Summary of Remedial Alternative Selection (attached)
- Memorandum from Robert B. Schaefer, Regional Counsel and Basil G. Constantelos, Director, Waste Management Division to Valdas V. Adamkus, Regional Administrator
- Memorandum from James Mayka, Chief, Michigan Technical Programs Unit, Solid Waste Branch to Jack Kratzmeyer, Remedial Project Manager, Waste Management Division, August 2, 1985

Description of Selected Remedy

This Record of Decision recommends a remedy consisting of three distinct elements:

(1) Allow the contaminant plumes to discharge under natural flow conditions to Lake Michigan.

(2) Continue long-term monitoring of the plumes during the natural purging period.

(3) Institutional restrictions on the installation of private wells in the contaminated aquifer will be enforced by local health officials.

Declarations

Consistent with the Comprehensive Environmental Response Compensation and Liability Act of 1980, and the National Contingency Plan (40 CFR Part 300), I have determined that the actions described above represent a cost-effective remedial action and provide adequate protection of public health, welfare and the environment. The State of Michigan has been consulted and

agrees with the approved remedy. In addition, the action will require future operation and maintenance activities to ensure the continued effectiveness of the remedy. These activities will be considered part of the approved action and eligible for Trust Fund monies for a period not to exceed 1 year.

Sept. 30, 1985
Date

Alan Levin (Acting)

Valdas V. Adamkus
Regional Administrator
U.S. EPA, Region V

Summary of Remedial Alternative Selection
Charlevoix Municipal Well

Site Location and Description

The City of Charlevoix is located on the shores of Lake Michigan in the northwest section of the lower peninsula of Michigan in Charlevoix County (see Figure 1). The City's single municipal well supplies potable water to a year-round population of 3500 which increases to approximately 5,000 during the summer tourist season. The City requires an average water supply of 0.76 MGD (million gallons/day), with a maximum demand of 2.0 MGD during peak periods. The municipal well is located in an urban setting. The primary use of the surrounding area is for residential, recreational and commercial purposes. A major portion of the City's income is derived from tourism.

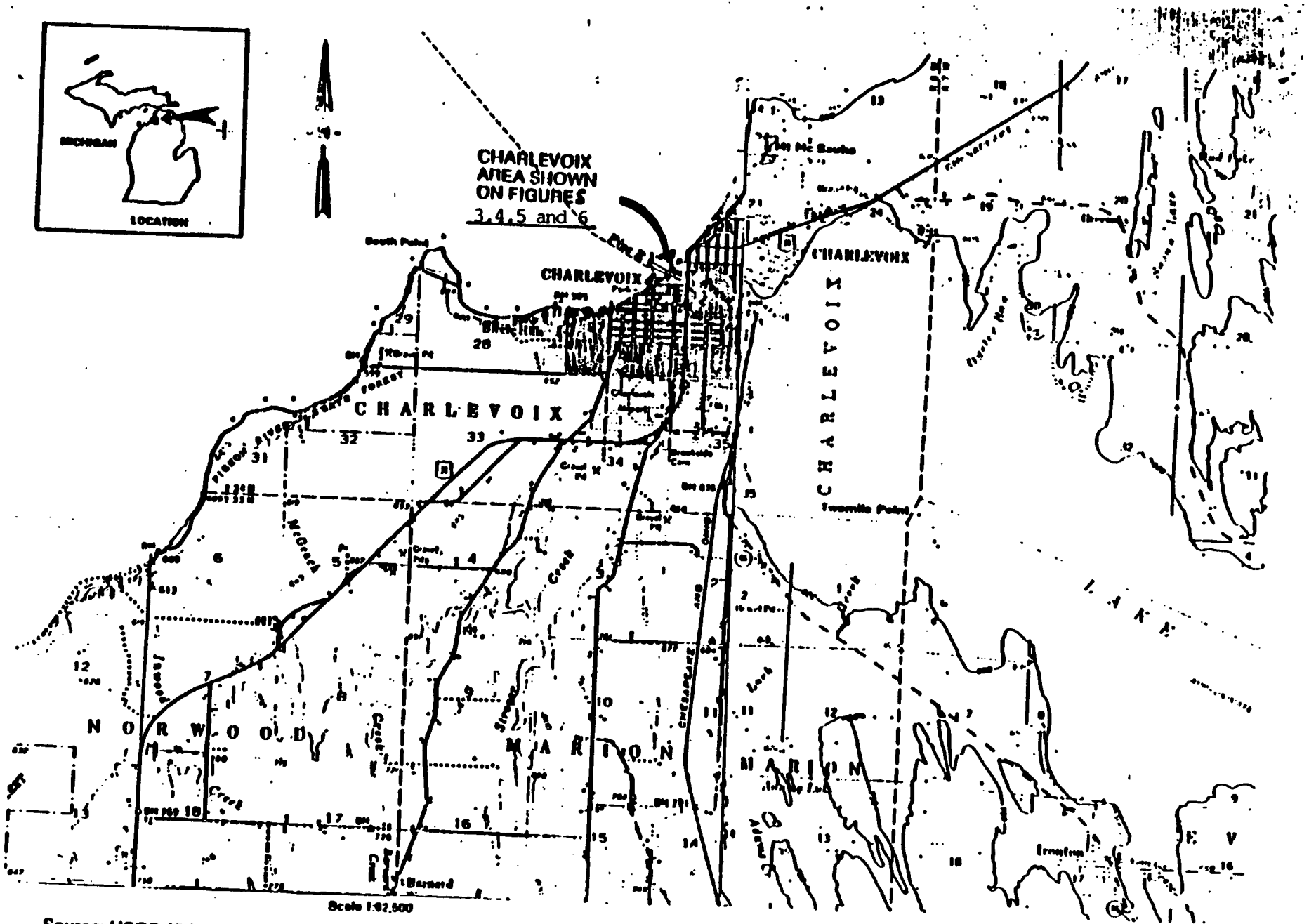
The City's municipal well consists of a shallow large-diameter clear well connected to two 225-foot-long horizontal flumes which are buried beneath the Lake Michigan beach parallel to the shoreline (see Figure 2 for detail). The flumes collect ground water and lake water and channel it into the well, where is it then pumped into the distribution system. Approximately half of the water entering the flume comes from Lake Michigan, and the remainder from shallow ground water sources. The collection flumes are located in a discharge area for the shallow glacial drift aquifer. In the vicinity of the flumes, the aquifer consists of sand with varying amounts of silt and gravel.

Site History

In September 1981, while conducting tests for trihalogenated methane compounds in the City's chlorinated water supply, the Michigan Department of Public Health (MDPH) detected trichlorethylene (TCE) ranging in concentrations from 13 to 30 parts per billion (ppb) in the Charlevoix water supply. A monitoring program was begun and continued to detect gradually rising levels of TCE in the raw water.

In December 1982, concentrations of TCE exceeded 100 ppb. At that point, the City installed a temporary diffused aeration system in the municipal well to remove some of the volatile organic chemicals (VOCs). The aeration system is able to remove 30 to 40 percent of the TCE, and it presently holds the concentration of TCE in the water supply system to below 50 ppb.

Several studies and investigations have been conducted in the area. In November 1981, the City of Charlevoix drilled four of the eventual six monitoring wells that it would install in its effort to identify the source and extent of TCE contamination in the aquifer. The four wells were placed around the City's pump house in hopes of intercepting the TCE contamination and establishing its direction of approach. Sampling results from these monitoring wells (Well # T2, 36 ppb TCE) verified that the source of TCE contamination in the municipal well was ground water rather than surface



Source: USGS 15 MINUTE QUADRANGE:
CHARLEVOIX AND BAYSHORE

FIGURE 1
TY MAP
OIX SITE

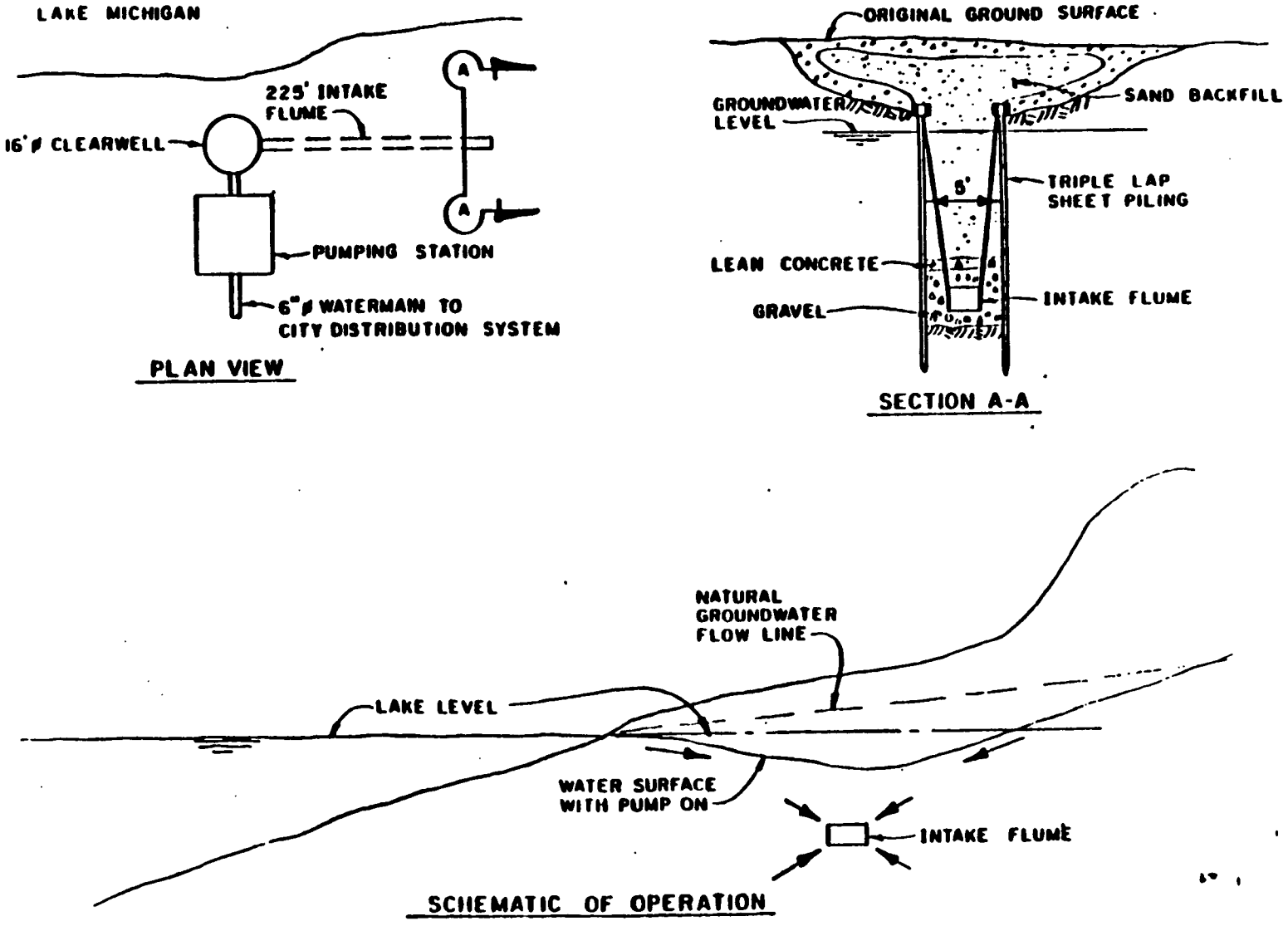


FIGURE 2.
CITY INTAKE FLUME
CHARLEVOIX SITE

water. The EPA Technical Assistance Team (TAT) conducted a hydrogeologic study in June and July, 1982. The TAT developed an additional nine ground water monitoring wells in the vicinity of the municipal well. Although sampling of the test wells found varying amounts of TCE, the source of contamination could not be located. Also, during the TAT study perchloroethylene (PCE) was detected in a number of the monitoring wells, although PCE had not been measured in the water supply.

The U.S. Environmental Protection Agency (EPA) began its Remedial Investigation (RI) during September 1983. Twelve additional borings were drilled in December 1983. Analysis of water samples taken from these monitoring wells located areas of high concentration for both TCE and PCE. The exact sources of TCE and PCE were not known, but suspected areas were more closely defined (see Figures 3 and 4) by the data from the RI. The data collected in December 1983 indicated that concentrations of TCE in the ground water moving toward the municipal well were much higher than previously measured. The additional threat posed by the higher concentrations resulted in a decision by EPA to conduct a Focused Feasibility Study (FFS) to evaluate potential remedies for the contaminated water supply, while work on the remedial investigation continued. In June 1984, a Record of Decision (ROD) was signed which approved an initial remedial measure (IRM) for an alternate water supply to replace the contaminated municipal well. The selected IRM consists of a Lake Michigan water intake structure and a water filtration/flocculation treatment plant. Construction of the IRM is expected to be completed by December 1986. After completion of the water treatment plant, the City will have a clean water supply, and the existing municipal well will be physically abandoned.

Current Site Status

The second major phase of RI field work began in July 1984 and included soil borings, monitoring well installation, ground water sample collection and air monitoring. The objective of this phase of RI work was to locate and identify the source of TCE and more extensively map the PCE plume. The results from December 1983 indicated that the highest concentrations of TCE in the ground water occurred in the vicinity of the Charlevoix Middle School.

The results were less conclusive regarding the origin of the PCE contamination, but indicated an area upgradient of the intersection of Hurlbut and State Streets (see Figure 4). There are a number of former, or currently operating commercial facilities upgradient where PCE may have been used, including dry cleaners and the Charlevoix airport. An area of PCE contamination in soils underlying a former dry cleaner was discovered by MDNR in 1983, but appears unrelated to the PCE plume. MDNR is presently evaluating whether to address PCE contamination from this, and other suspected sources through its State Superfund program (Act 307).

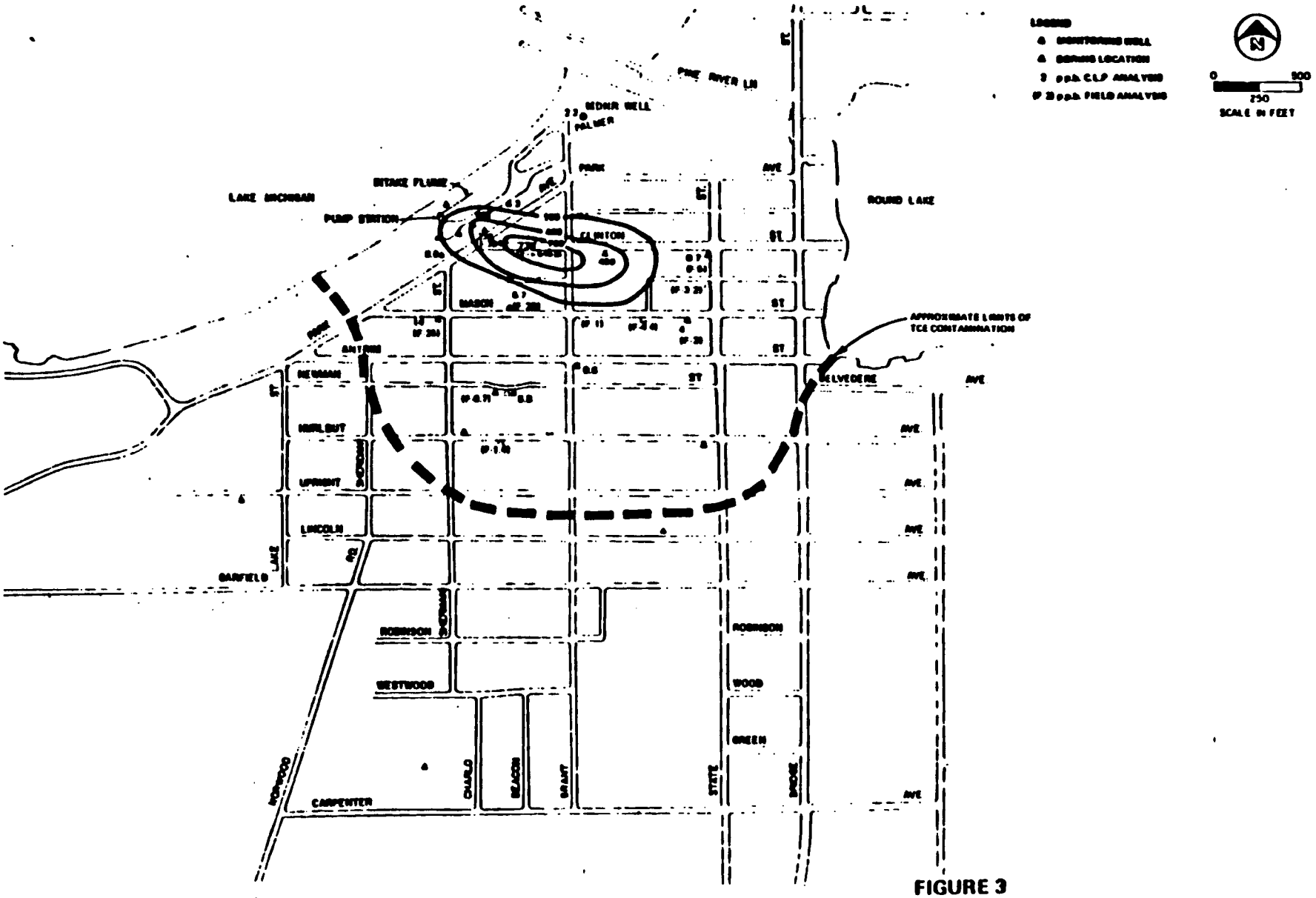


FIGURE 3
TRICHLOROETHYLENE CONCENTRATIONS
DECEMBER 1983
CHARLEVOIX SITE

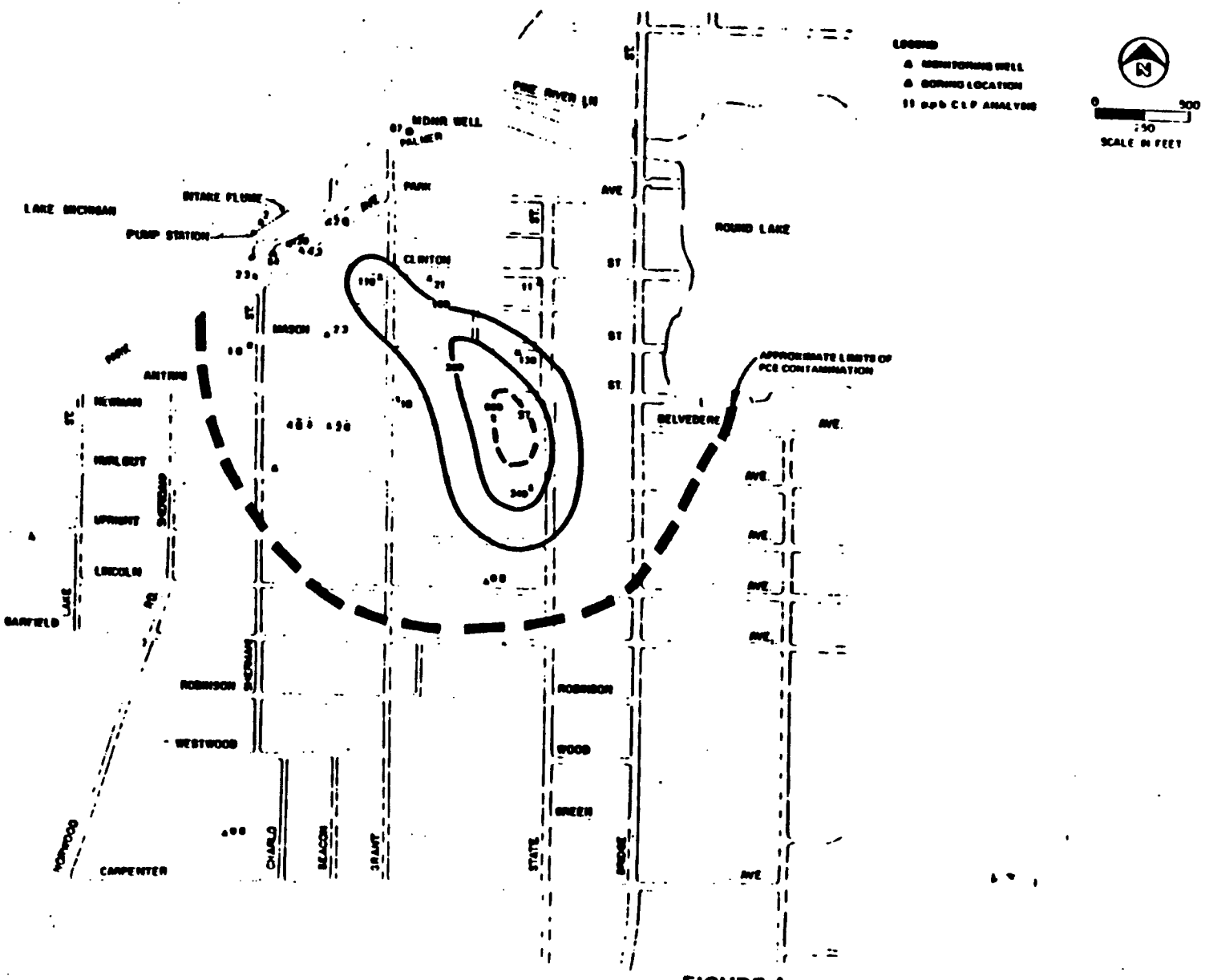


FIGURE 4
PERCHLOROETHYLENE CONCENTRATIONS (PPB)
DECEMBER 1983
CHARLEVOIX SITE

Although extensive soil borings were completed in the Middle School area during Phase II of the RI, a discrete source of contamination such as an underground tank or buried drums was not found. In addition, no contamination was detected in any of the soil samples taken from the borings in the unsaturated zone above the water table. These results indicate that there is no current, identifiable source of contamination and that the origin of the contaminated ground water was either a single spill or a source that was subsequently removed.

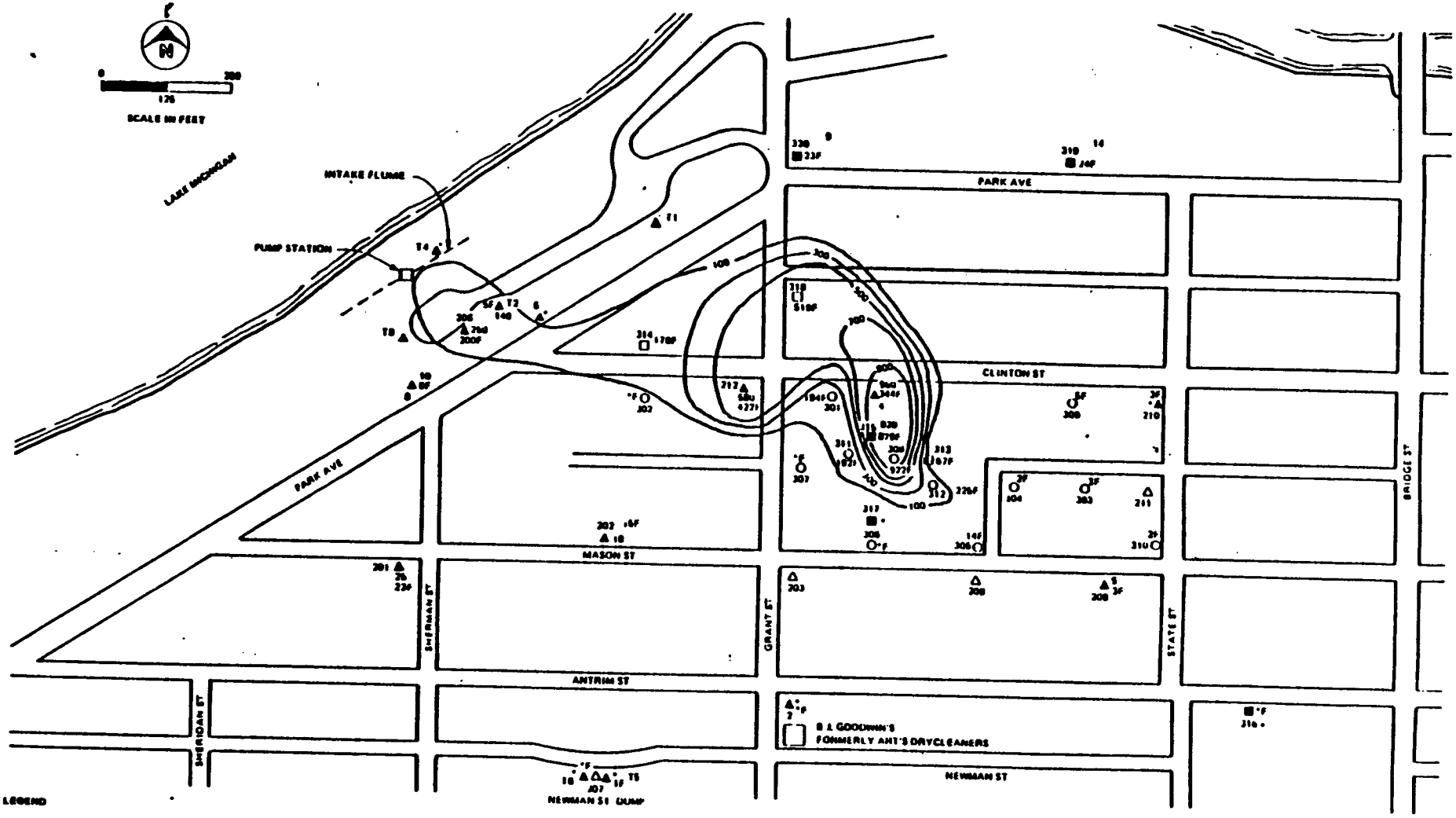
There was fill material found in soil samples collected from borings in the area of the school playground to depths of up to 14 feet. The existence of this fill was confirmed in discussions with Charlevoix School District personnel. At one time, a wing of the Middle School was located in the area where the playground is now located. This wing was demolished in the mid-1950's. The fill material was deposited in the basement of the old wing. A new wing was added to the school in the late 1950's. TCE may have been spilled during the demolition or construction activities. TCE was commonly used as a degreasing solvent in the 1950's and may have been used with the construction equipment. The total estimated mass of TCE in the ground water plume is 95 kilograms (16 gallons of 100 percent TCE), indicating that a small spill could have been the source of the contamination.

However, the data obtained during the RI has permitted an estimate of the extent of ground water contamination to be made. The areal extent of TCE contamination greater than 100 ppb is approximately 243,000 ft^2 or approximately 5.6 acres. (Figure 5). The area contaminated with TCE at concentrations above the 10^{-6} excess lifetime cancer risk level (2.7 ppb) is approximately 3,000,000 ft^2 or 70 acres. The volume of water contaminated with TCE at concentrations greater than 2.7 ppb is 393 million gallons. PCE contamination greater than 25 ppb covers an area approximately 350,000 ft^2 or approximately 8.0 acres. (Figure 6). The southern end of the plume is undefined, so that only rough estimates of volume can be made. An estimate of the volume of water contaminated with PCE above the 10^{-6} risk level (.88 ppb) is 260 million gallons.

The area and volume of water contaminated with TCE and PCE at concentrations above the 10 ppb but less than 100 ppb is difficult to define because ground water samples taken from nearly every boring and monitoring well detected some level of contamination. As shown in Figures 5 and 6 there are two separate contaminant plumes, one of TCE and one of PCE. Each plume consists of that single contaminant. No other compounds have been consistently detected.

Enforcement

In August 1983, reacting to the continued presence of TCE in the City's water supply, MDPH issued a Department Order (order) to the City. The



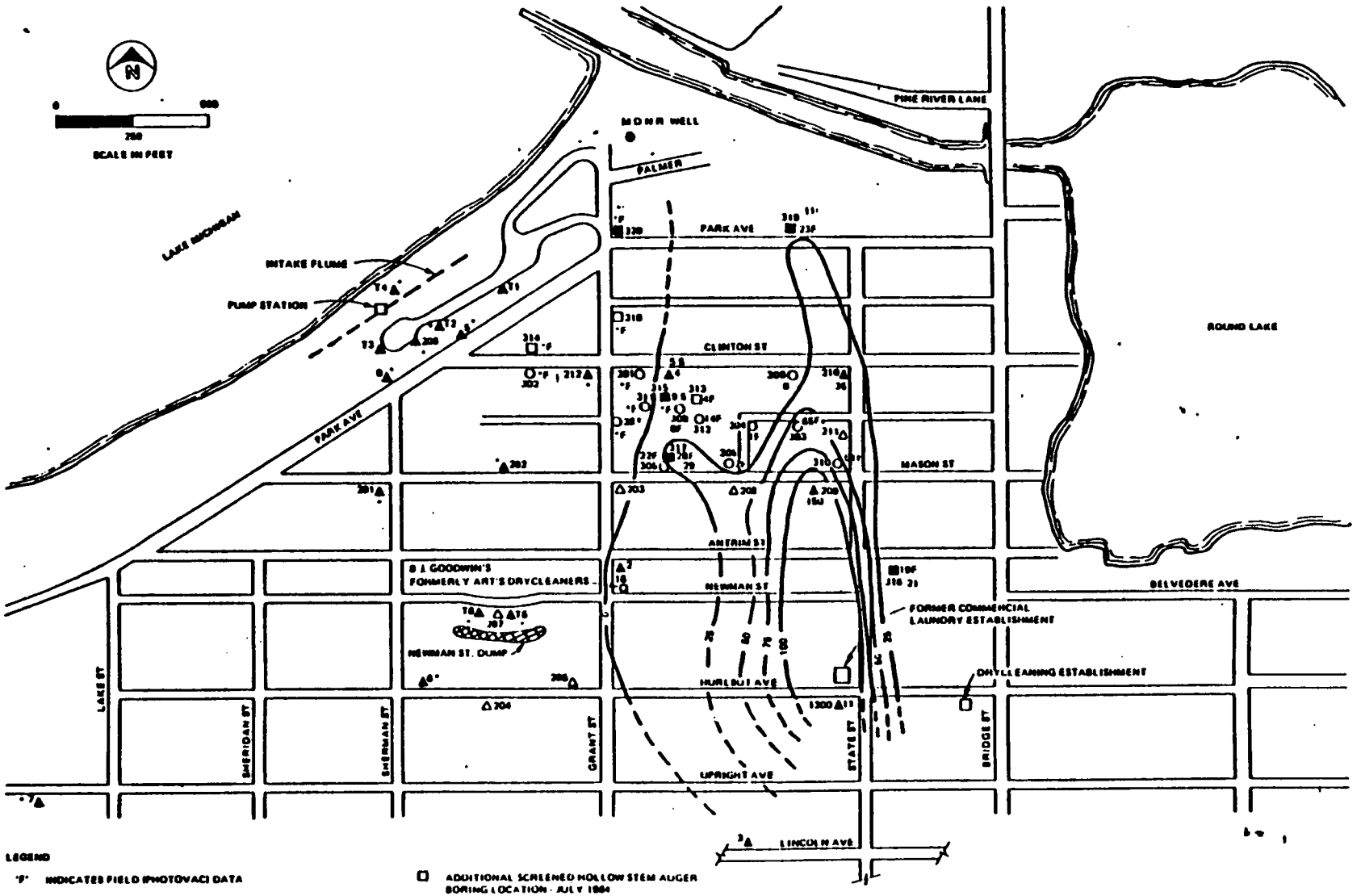
LEGEND

- "F" INDICATES FIELD (PHOTOVAC) DATA
- "ND" INDICATES TCE NOT DETECTED
- ▲ EXISTING MONITORING WELL LOCATION - INSTALLED BEFORE JANUARY 1984
- △ BORING LOCATION COMPLETED DEC. 1983
- ○ ADDITIONAL SHALLOW BORING LOCATION - JULY 1984
- □ ADDITIONAL SCREENED HOLLOW STEM AUGER BORING LOCATION - JULY 1984
- ■ ADDITIONAL MONITORING WELL LOCATION - JULY 1984

CONTOUR INTERVAL = 200 ug/l

THE HIGHEST CONCENTRATION WAS PLOTTED FOR WELLS SAMPLED IN BOTH JULY AND AUGUST
ALL CONCENTRATIONS LISTED IN ug/L

FIGURE 5
TCE CONCENTRATION MAP – JULY 1984
CHARLEVOIX, MICHIGAN RI



LEGEND

- "P" INDICATES FIELD (PHOTOVAC) DATA
- "--" INDICATES PCE NOT DETECTED
- ▲ EXISTING MONITORING WELL LOCATION
- △ BORING LOCATION COMPLETED DEC 1983
- ○ ADDITIONAL SHALLOW BORING LOCATION - JULY 1984
- □ ADDITIONAL SCREENED HOLLOW STEM AUGER BORING LOCATION - JULY 1984
- ■ ADDITIONAL MONITORING WELL LOCATION JULY 1984

CONTOUR INTERVAL = 25 ug/L
THE HIGHEST CONCENTRATION WAS PLOTTED FOR WELLS SAMPLED IN BOTH JULY AND AUGUST
ALL CONCENTRATIONS LISTED IN ug/L

FIGURE 6
PCE CONCENTRATION MAP - JULY 1984
CHARLEVOIX, MICHIGAN RI

order required the City to commit by January 1, 1984 to a definite water supply alternative to replace or treat the contaminated municipal well. The issuance of this order coincided with EPA's initiation of a RI/FS. The January 1984 deadline did not allow sufficient time for EPA to perform the prerequisite field studies and alternatives evaluation prior to any Federal funding of a remedial solution to the water supply problem.

A November 17, 1983 meeting between EPA, MDPH and the City produced an agreement to delay the compliance date of the MDPH order until May 1, 1984 to allow sufficient time for EPA to complete the necessary remedial investigations. When EPA informed the MDPH in early May 1984 that the FFS would be completed on May 14, 1984 the MDPH decided to adjourn the hearing until late June 1984. At the hearing it was agreed that the compliance date for the order be extended to January 1, 1987. Completion of the water treatment plant is scheduled for December 1986.

In January 1985 EPA issued a combination Section 106 notice letter and 104(e) information request to the Charlevoix Middle School. This action was taken after the results from the RI indicated that the highest concentrations of TCE in the ground water occurred in the vicinity of the Middle School. The Middle School's response to the information request provided a great deal of detailed information, but was of little assistance in determining the specific source of contaminants.

Alternatives Evaluation

Based on the findings of the remedial investigation and risk assessment, the objective of remedial action at the site was identified as minimizing the potential risk to the public from direct consumption of the contaminated ground water through inadvertent use of private wells by individuals unaware of the hazard. This objective is consistent with the Agency's previous decision to permanently relocate the municipal water supply source.

The data gathered during the RI indicate that there is not a current identifiable source of contamination, and that the origin of the contaminated ground water was likely a single spill incident or a source that was subsequently removed. Because the source(s) of TCE and PCE contamination are believed to no longer exist, only remedial actions for management of migration of contaminated ground water were evaluated.

General response actions were identified which could meet the stated objective of remedial action. These include:

- No action,
- Limited action, which includes ground water monitoring and restrictions on ground water use after construction of the water treatment plant is completed,
- Extraction of the contaminated ground water by pumping, and
- Treatment of extracted contaminated ground water.

Containment of the contaminated ground water by physical barriers such as slurry walls was also considered as a general response action, but was not

retained because it does not adequately meet the objective of protecting against future use of the contaminated ground water. Although it would prevent further migration of the plumes, which might limit the number of homes ultimately located above the contaminated ground water, it would not reduce the risk for the homes already located above the existing plumes.

A number of technologies were considered for each general response action that had been identified:

- No action
- Limited action:
  - Ground water monitoring
  - Institutional restrictions on use of ground water
- Extraction of contaminated ground water:
  - Extraction wells
  - Extraction wells in combination with shallow injection wells
- Treatment of contaminated ground water:
  - Granular activated carbon adsorption
  - Air stripping
  - Steam stripping
  - Physical/chemical treatment
  - Biological treatment
  - Chemical oxidation

Each of the potential remedial technologies was screened based on: (1) appropriateness for physical site conditions, (2) impact of chemical and physical characteristics of contaminants on effectiveness (3) reliability, and (4) relative cost.

The use of shallow injection wells in combination with extraction wells was eliminated as a contaminated ground water extraction method because of relative cost; a treatment system similar to that required for surface discharge would be needed prior to reinjection.

Steam stripping was eliminated as a treatment method, since both TCE and PCE are compounds that are readily stripped using only air stripping, so that the increased capital and operation costs to heat the air are not warranted. Physical/chemical treatment was not considered to be effective for treatment of dissolved VOCs. Any removal through a conventional physical/chemical treatment plant would probably be due to volatilization, which in effect would produce an uncontrolled release of VOC emissions.

The use of biological treatment as a stand-alone treatment technology was eliminated because of limited experience with this method. Also site conditions, and in particular, the organic content of the soils and the concentration of TCE and PCE are not conducive for effective biological breakdown. Another general consideration is that the final breakdown product of TCE and PCE is vinyl chloride, which is more hazardous than either TCE or PCE. However in this case, there is a low probability of

biological breakdown of the PCE and TCE to vinyl chloride during the natural purging process because of the sandy soils and lack of the necessary biological substrate to foster biological degradation.

Chemical oxidation was eliminated because of concern over its effectiveness in this application. In actual practice, oxidation reactions are not always complete which can result in the formation of new compounds that are just as hazardous as the original compounds.

After the initial screening process, four alternatives were judged to meet the objectives of the remedial action and were evaluated further:

ALTERNATIVE #1 - Limited Action

ALTERNATIVE #2 - Ground water Pumping with discharge to Lake Michigan

ALTERNATIVE #3 - Ground water pumping with air stripping treatment

ALTERNATIVE #4 - Ground water pumping with Carbon Adsorption treatment

ALTERNATIVE 1:

The Limited Action alternative would not involve actual clean-up of the contaminated ground water. The contaminated ground water plumes would be allowed to continue to migrate naturally and disperse into Lake Michigan. Based on the physical properties of the shallow sand and gravel aquifer and the contaminants, it is estimated that under natural flow conditions the contaminated ground water would be purged in approximately 50 years.

During this period the plumes would be monitored through a semi-annual ground water and lake water sampling program. In addition, institutional restrictions on the development of ground water in the area of the contaminant plumes would have to be implemented.

Table 1

Cost for Limited Action

Capital Cost	$ 0
Annual O & M	$ 17,000
30-year Present Worth	$160,000

ALTERNATIVE 2:

Alternative 2 consists of the installation of extraction wells to pump the contaminated ground water and convey it to Lake Michigan for direct discharge. The purpose of the pumping alternative is to speed up the natural flushing process and shorten the estimated 50 year period that the aquifer would be

unusable under Alternative 1. A pumping scheme was analyzed which would maximize the rate of flushing and consequently minimize cleanup time. We have estimated the maximum rate of pumping that the aquifer can maintain without substantial drawdowns. At that rate (750 gpm), pumping would be necessary for 30 years to reduce the TCE and PCE concentrations in the aquifer to the 10^{-6} cancer risk level (2.7 ppb and 0.8 ppb respectively). In this application, the contaminant transport and resulting decrease in ground water concentration with time is limited by the rate of desorption of PCE, which is more tightly bound to the soil. Consequently, PCE is released more slowly from the aquifer materials.

Monitoring requirements would be similar to those necessary for Alternative 1, with the exception that the time period would be reduced to 30 years. In addition, the same institutional restrictions on the development of ground water would be necessary.

Alternative 2 would result in a concentrated point source discharge of untreated contaminated ground water to Lake Michigan. The overall additional cancer risk presented by this discharge from; (1) water ingestion and skin absorption during swimming, and (2) fish consumption was found to exceed a 10^{-5} risk which is unacceptable. Consequently, the use of ground water pumping will require treatment prior to discharge to Lake Michigan.

ALTERNATIVE 3:

Alternative 3 consists of the ground water pumping system described in Alternative 2, followed by treatment with air stripping prior to discharge to Lake Michigan.

Since air stripping is designed to remove VOCs from water by transferring them to an air stream, this alternative would create a source of VOC air emissions. Treatment of the air stripper tower vapor exhaust for removal of TCE and PCE with a nonregenerable carbon system has been included in Alternative 3. A nonregenerable system was selected over a regenerable carbon system because of the relatively low contaminant concentrations, less complexity, and relative equal total costs. Table 2 gives the cost information for this alternative.

Table 2

Ground Water Pumping with
Air Stripping Treatment

Capital Cost	$1,600,000
Annual O & M	$210,000-520,000
30-year Present Worth	$4,800,000

There is a range for annual O & M costs because the TCE and PCE concentrations from the extraction well system, which affect vapor phase carbon usage, will decline with time.

ALTERNATIVE 4:

Alternative 4, like Alternative 3, relies on treatment of the contaminated ground water from the extraction well system prior to discharge to Lake Michigan. Treatment of the contaminated ground water would be provided by a carbon adsorption system. The carbon system would consist of four carbon columns arranged in two parallel flow streams. Two columns are used in each flow stream so that the carbon in the lead column can be fully exhausted, which optimizes carbon usage. The costs for Alternative 4 are summarized in Table 3.

Table 3

Ground water Pumping with
Carbon Adsorption Treatment

Capital Cost	$2,100,000
Annual O & M	$150,000-400,000
30-year Present Worth	$4,400,000

Summary:

Alternative 1 allows the TCE and PCE plumes to continue to migrate naturally and disperse to Lake Michigan. We estimate that under natural flow conditions, the aquifer would purge itself of contaminants in 50 years. The results of the endangerment assessment indicate that the only significant risk to public health or the environment resulting from Alternative 1 is that posed by direct consumption of the contaminated ground water from future wells located directly in the contaminant plumes. Therefore, Alternative 1 includes provisions for institutional restrictions on the installation of private wells in the area of the TCE and PCE plumes. Given that an alternate water supply will be available after completion of the IRM, the likelihood of future demand on the contaminated aquifer for potable water is not high.

Alternative 1 also includes a semi-annual ground water sampling and analysis program so that the plume can be monitored throughout the natural purging period. Alternative 1 has the lowest cost.

Alternatives 2,3 and 4 all utilize ground water pumping to reduce the time period required for ground water cleanup. Alternative 2 does not include treatment of the extracted contaminated ground water. The extraction wells would be discharged directly to Lake Michigan. Introduction of the untreated contaminated ground water into Lake Michigan as a concentrated point source discharge would result in a significant risk to public health from exposure to surface water during swimming and from fish consumption. Overall, the excess lifetime cancer risk for Alternative 2 is greater than that for Alternative 1.

Alternatives 3 and 4 would reduce the time required to return the aquifer to a useable state from 50 to 30 years. However, this incremental time benefit would be achieved at a significantly higher cost than that required for Alternative 1. Also during the 30 year pumping period, the same

instutitional controls on ground water use necessary for Alternative 1 would be required for Alternatives 3 and 4.

Summary of Costs

	Alternative 1	Alternative 3	Alternative 4
Capital Cost, $	0	1,600,000	2,100,000
Present Worth of O&M, $	160,000	3,150,000	2,300,000
Present Worth, $ (thirty years)	160,000	4,750,000	4,400,000

Community Relations

Copies of the Feasibility Study (FS) were made available to the community on June 10, 1985. Three locations served as repositories within the City: Charlevoix City Hall, District Health Department No. 3 and the Charlevoix Public Library. The EPA placed an advertisement in the local newspaper on June 3, 1985, which announced the availability of the study and the start of the 3-week public comment period.

A public meeting was held on June 27, 1985 at the Charlevoix City Hall. Only six residents attended the meeting. Representatives of the EPA, MDNR and local government were present. The EPA presentation explained the purpose of the FS, presented the results of the endangerment assessment under the no action alternative, and described the alternative recommended by EPA. Questions regarding the project were also answered. There were no formal public comments made. The public comment period ended on July 1, 1985. There were also no written comments submitted.

Consistency With Other Environmental Laws

The NCP [40 CFR 300.68] establishes the procedures for determining appropriate remedial actions at Superfund sites. Generally EPA will implement remedies that meet the standards of applicable or relevant Federal public health or environmental laws.

Other environmental laws and guidance which may be applicable and/or relevant to the remedial alternatives evaluated in the FS are the Clean Water Act, Clean Air Act, the Resource Conservation and Recovery Act (RCRA), EPA's Ground Water Protection Strategy (August 1984), and the Great Lakes Water Quality Agreement.

The Resource Conservation and Recovery Act (RCRA) is not considered to be applicable to the remedial alternatives considered in the FS because of the lack of a hazardous waste "regulated" unit. RCRA was intended to regulate facilities used for the treatment, storage and disposal of hazardous waste. Such a facility does not exist at Charlevoix. However, though not applicable, the RCRA Subpart F ground water protection standards are considered relevant in determining the appropriate level of cleanup since the major portion of the aquifer underlying the community is contaminated with TCE and PCE. However, certain procedural aspects of implementing RCRA Subpart F ground water protection standards have not been used because they were developed for hazardous waste facilities. Specifically, the RCRA ground water protection standards process of establishing an Alternate Concentration Level (ACL) has not been used to develop the remedial action alternatives. Instead, a risk management approach supported by the endangerment assessment in the

FS, prepared as outlined in the "Guidance on Feasibility Studies Under CERCLA" has been used. The immediate goal of protecting human health and the environment is the same, only the procedural aspects differ. EPA's Ground Water Protection Strategy has divided ground water into three major classes based on an aquifer's use and its vunerability to contamination. Guidelines on implementing the classification system will be released by June 1986. For ground water defined as Class I under the Ground Water Protection Policy (aquifer of drinking water quality, currently used as the sole source of drinking water) the Maximum Contaminant Level (MCL) standards promulgated under the Safe Drinking Water Act (SDWA) would be the applicable standard for cleanup of an aquifer that presently provided a public water supply.

When an aquifer (current or potential source of drinking water) has been contaminated, an ACL under the RCRA Subpart F ground water protection standards can be established as an alternative cleanup level to the MCL. An ACL can be established at a relatively high level if consumption of the ground water is prevented by institutional controls. Alternatives 1, 3 and 4 include institutional controls on the installation or use of private wells within the City limits. Therefore, the point of use of the ground water is at Lake Michigan, where the ground water is purged naturally under Alternative 1, or discharged after treatment for Alternatives 3 and 4. The risk to human health and aquatic life from these discharges to Lake Michigan has been evaluated in the endangerment assessment in the FS. For Alternative 1 the excess lifetime cancer risk at the point of use is 3×10^{-8}. Under Alternatives 3 and 4 the excess risk is 1.5×10^{-8}. The increased cancer risks resulting from these alternatives at the point of use are not considered unacceptable.

The current RCRA procedures for establishing an ACL were not intended to implement corrective action for ground water where contamination cannot be attributed to individual facilities. Since the remedial action alternatives considered here include institutional control on the use of the contaminated ground water, formal procedures to establish an ACL under RCRA Subpart F are not considered appropriate. However, the principles of the RCRA ground water protection standards have been met by the risk management approach presented in the FS.

The Great Lakes Water Quality Agreement of 1978 commits the United States to require that releases of toxic substances meet certain criteria. Neither TCE, nor PCE is classified as a "Persistent Toxic Substance" under the Agreement, as their half-lives in water are much shorter than eight weeks (TCE <1 day, PCE <20 days). The projected release levels, under the most conservative conditions, are estimated to be 4 to 6 orders of magnitude below known acute and chronic toxicity levels for freshwater aquatic life, and 2 to 4 orders of magnitude below the 10^{-6} cancer risk level for ingestion. Thus, Alternative 1 is consistent with Articles II and III, as well as Annexes 11 and 12.

As part of Alternatives 3 and 4 contaminated ground water would be withdrawn by ground water extraction wells. The ground water would be discharged to

Lake Michigan after treatment. The Clean Water Act provisions for regulating the discharge of wastewaters are administered by the State through the National Pollutant Discharge Elimination System (NPDES) program. Under that program, the State establishes effluent discharge limits based on two different criteria: 1) ambient water quality, and 2) technology. Water quality based effluent limits would be derived for each contaminant by reviewing acute and chronic toxicity data and then calculating allowable levels in the receiving surface water. In addition, for toxic pollutants, the best available technology economically achievable (BATEA) must be used. For the treatment of VOC-contaminated ground water air stripping and carbon adsorption would be considered as options for BATEA.

Alternative 3 would result in an air emission of VOCs. Michigan's State Implementation Plan, required by Section 110 of the Clean Air Act includes rules addressing the control of new sources of carcinogenic VOC emissions. These rules require application of best available control technology (BACT) to the new source of carcinogenic emissions. The cost of vapor-phase carbon adsorption control (BACT) on the emissions from the air stripper has been included in Alternative 3.

Recommended Alternative

It is the recommendation of this document, based on the evaluation of the cost and effectiveness of each proposed alternative, and State and Federal environmental requirements that Alternative 1, Limited Action be selected as the cost-effective alternative.

The NCP proposed rule [40 CFR 300.68(i)(1)] states that the appropriate extent of remedy should be determined by the lead agency's selection of a cost-effective remedial alternative which effectively mitigates and minimizes threats to and provides adequate protection of public health, welfare and the environment. The NCP further directs that in selecting the appropriate extent of remedy, the lead agency should consider cost, technology, reliability, administrative and other concerns, and their relevant effects on public health, welfare and the environment [300.68(i)(2)].

Table 4 provides summary information comparing the alternatives for these criteria to permit the selection of a "cost-effective alternative" as defined in the NCP.

Alternative 1 allows the TCE and PCE plumes to discharge under natural flow conditions to Lake Michigan. The aquifer would return to a useable state after 50 years. During that 50 year purging period, institutional controls preventing the installation and use of private wells in the contaminated area would be required. The necessary institutional mechanism is already in place. The District Health Department #3 administers an existing well permiting program in Charlevoix County, and has expressly prohibited the installation of new wells in the City of Charlevoix since the discovery of the TCE and PCE contamination.

Alternatives 3 and 4 were developed with the intent of reducing the 50 year period required for ground water cleanup. The analysis indicates that even with aggressive pumping of the ground water, the aquifer could not be restored to safe levels for consumption for 30 years. In addition, during the 30 year period that ground water pumping would continue, the same

institutional controls required for Alternative 1 would be needed. The results of the endangerment assessment indicate that the only significant risk to public health or the environment resulting from Alternative 1 is that posed by the potential future use of the contaminated ground water. Alternative 1 includes provisions for institutional restrictions on the installation of private wells in the area of the TCE and PCE plumes. Since the IRM will provide an alternate water supply, the likelihood of future demand on the contaminated aquifer for potable water is not high.

Alternative 1 consists of long-term monitoring of the TCE and PCE plumes during the time period that the plumes are allowed to purge to Lake Michigan under natural flow conditions. The monitoring program will include 10 observation wells selected from the existing monitoring well network. The selected wells will be sampled semi-annually. In addition, surface water samples will be taken from Lake Michigan and Round Lake. To prevent inadvertent use of the contaminated ground water during the natural purging period, the installation of private wells within the City limits will be officially restricted. The institutional control is already in place in the form of the District Health Department #3's well permitting program.

The concentrations of TCE and PCE expected in the nearshore surface waters of Lake Michigan as a result of the continued release of the contaminant plumes under the natural flow conditions of Alternative 1 are 0.008 ppb and 0.01 ppb respectively. This is a conservative estimate based on the "average" values of TCE and PCE in the area-wide plumes, rather than the much lower concentrations measured in the ground water adjacent to Lake Michigan. The Federal criteria for the protection of freshwater aquatic life above which acute effects in aquatic life could occur are 45,000 ppb for TCE and 5,280 ppb for PCE. These are orders of magnitude higher than the estimated concentrations for TCE and PCE in the lake water. The criterion for long-term protection of aquatic life from PCE is 840 ppb. EPA has not established a long-term criterion for TCE. A comparison of the acute and chronic standards to the expected concentrations of TCE and PCE, clearly indicates that Alternative 1 will not adversely affect aquatic life in Lake Michigan.

The estimated annual cost for the monitoring proposed in Alternative 1 is $17,000. The 30-year present worth value for the selected alternative is $160,000.

We recommend that EPA fund 90 percent of the first year's monitoring cost. The State will provide the 10% match for the first year operation and then will assume all operation and maintenance (O&M) costs for the life of the project.

Since the school might be considered as a political subdivision of the State, under Section 104c(3)C of CERCLA the State could be responsible for at least 50 percent of the costs of the remedial action. However, the Office of Emergency and Remedial Response determined that Charlevoix would not be considered as a 50 percent State match site, since the contamination on the school property could have been the result of unauthorized, illegal dumping.