932043

FRONTIER CHEMICAL-PENDLETON

Site No. 9-32-043

RECORD OF DECISION

Prepared by
New York State
Department of Environmental Conservation

MARCH, 1992

DECLARATION STATEMENT-RECORD OF DECISION

Frontier Chemical-Pendleton

Pendleton, New York

Site #9-32-043

STATEMENT OF PURPOSE

This Record of Decision (ROD) sets forth the selected Remedial Action Plan for the Frontier Chemical-Pendleton site. This Remedial Action Plan was developed in accordance with the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) of 1980, as amended by the Superfund Amendments and Reauthorization Act (SARA) of 1986, and the New York State Environmental Conservation Law (ECL). The selected remedial plan complies to the maximum extent practicable with the National Oil and Hazardous Substance Pollution Contingency Plan, 40 CFR Part 300, of 1990.

STATEMENT OF BASIS

This decision is based upon the Record of the New York State Department of Environmental Conservation (NYSDEC) for the Frontier Chemical-Pendleton site and upon public input to the Proposed Remedial Action Plan (PRAP) presented by the NYSDEC. A copy of all pertinent documents is on file at the Lockport Public Library, 23 East Street, Lockport, New York. A bibliography of the documents included as a part of the Record is included in Appendix 1.

DESCRIPTION OF SELECTED REMEDY

The selected remedial action plan provides for the protection of human health and the environment by removing exposure to contaminants at the site. The Remedial Plan is technically feasible and it complies with statutory requirements. Briefly, the selected remedial action plan includes the following:

- a grouted sheetpile (or technical equivalent) will be installed around the site to provide a containment boundary for contaminated soils and assist the collection system in maintaining an inward gradient;

- a groundwater collection system will be installed within the contained area to maintain an inward gradient. The collected groundwater will be treated and disposed either on-site or off-site;
- contaminated sediments from Quarry Lake will be dredged, stabilized and placed on the site within the containment area. Previously dredged sediments stockpiled on-site will be similarly placed;
- a multilayered synthetic geomembrane (or technical equivalent) cap will be installed over the containment area;
- physical controls will be installed to control both surface drainage and overflow from the lake;
- a monitoring system will be installed to monitor the effectiveness of the remedy.

DECLARATION

This selected Remedial Action Plan is protective of human health and the environment. The remedy selected will meet the substantive requirements of Federal and State laws, regulations and standards that are applicable or relevant and appropriate to the remedial action. The remedy will satisfy, to the maximum extent practicable, the preference for remedies that reduce toxicity, mobility or volume. This preference will be met by containing the contaminants within the process/fill area and by dredging and stabilizing the sediments from Quarry Lake. The potential long term environmental and human health threats associated with the site will be significantly reduced by removing the exposure to contaminants at the site.

3-2-92

Date

Edward O. Sullivan
Deputy Commissioner
Office of Environmental Remediation
New York State Department of
Environmental Conservation

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Section 1 - Site Location & Description

The Frontier Chemical-Pendleton site is located on Townline Road in the Town of Pendleton, Niagara County, New York. This inactive site is currently listed as site number 9-32-043 on the registry of Inactive Hazardous Waste Disposal Sites in New York State. The site as listed is approximately 22 acres in size. The area evaluated during site investigations is approximately 75 acres in size and is bounded by Townline Road to the west, an abandoned railroad right-of-way to the southeast and Bull Creek to the north (see Figures 1 and 2). A lake approximately 15 acres in size (Quarry Lake, a former clay quarry) is located in the south-central portion of the site. The area around the site is residential/agricultural. The nearest residences are located less than 100 feet from the site. There is one drinking water well located more than 900 feet from the site.

Section 2 - Site History

The site was originally used as a clay brick and tile manufacturing facility. Frontier Chemical Waste Process, Inc. (Frontier), obtained the property and operated the site as an industrial waste treatment facility from 1958 to 1974. The waste treatment involved lime neutralization of plating wastes, pickle liquors and other liquid acid wastes from the plating and metal finishing industries. The treatment operations were carried out in the process area of the site, between Quarry Lake and the abandoned railroad. Resulting mixtures from the waste treatment process were discharged into Quarry Lake for settling of the neutralization products. Other operations performed at the site included chemical oxidation, chemical product recovery, incineration and distillation. Various drummed and tanked wastes were stored on-site for transfer. Much of the process area was filled and graded following termination of the waste processing and treatment operations between 1974 and 1977.

In 1980, two retention ponds were constructed for the rehabilitation of Quarry Lake. This was accomplished by batch-treating lake water in the ponds with a 50% caustic solution and discharging (via a direct pipeline) the resultant liquid to the Town of Wheatfield Sewage Treatment Plant. The use of the ponds ceased in the mid-1980s.

In 1987 remedial work commenced on the sludges in Quarry Lake. The sludges were to be placed in a naturally clay-lined landfill in the southwest corner of the lake. The lake was drained and the sludges from the southern basin were dredged and stockpiled along the shores. The work stopped in 1988 when an oily, chemical-smelling leachate from the area of the old brick plant began filling the excavation. Seepage was reduced by the construction of a temporary clay cutoff wall. No further remedial work was performed at the site.

Section 3 - Current Status

A Remedial Investigation (RI) was performed at the site in 1990-91 by URS Consultants for the New York State Department of Environmental Conservation (NYSDEC). The results and findings of the RI, for each aspect of the site, are outlined below.

A. Soil/Fill Contamination:

The source of contamination at the site is the 7.4-acre process/fill area south of Quarry Lake. This area contains metal sludge spoils, construction and demolition (C&D) debris and black, dry or sludge-like material. In addition, there are containers, tanks, railroad cars and pieces of equipment strewn throughout the area.

A number of organic and inorganic compounds were found in the soil in the process/fill area. Metals found at elevated levels (i.e., above 1 part per million (ppm)) included arsenic, cadmium, chromium, copper, lead and mercury. Chromium concentrations were highest in the area where lake sediments/metal sludge spoils had been deposited in the process area. The organic compounds included volatile organics, polyaromatic hydrocarbons (PAHs), chlorinated hydrocarbons, PCBs and pesticides. The highest concentration of organics was 1,635 ppm of the BTX (benzene, toluene, xylene) group of compounds. (See Table 1 for soil/fill data)

In general, contamination is limited to the process/fill area and has not spread appreciably to the surrounding soil. Based on the soils analysis, the process area can be divided into distinct sub areas, depending on the type and level of contamination. These sub areas would be the "hot spot area" and "non-hot spot area" (see Figure 3).

B. <u>Quarry Lake Water</u>:

Quarry Lake is a water-filled, man-made excavation. The lake is underlain by a layer of low-permeability clay. In some areas the clay layer may be thin or nonexistent where excavations for the lake were the deepest. The volume of water in the lake is 37 million gallons. Groundwater from the process area flows into the lake at less than 20 gallons per day (gpd). A water balance for the lake is shown on Figure 4. The lake is classified as Class D.

Results of analysis performed on Quarry Lake water show that the lake water is relatively uncontaminated. A few organic contaminants were detected at low levels (1,2 dichloroethene and toluene at 4 parts per billion (ppb)). (See Table A-3 for the analytical results) These concentrations do not exceed the water quality standards for a Class D water body. The metal concentrations are also low, with only iron exceeding the water quality standard for a class D water body.

C. <u>Quarry Lake Sediments</u>:

The sediments in Quarry Lake are contaminated primarily with inorganic compounds but also contain some low levels of various organics. The lake is divided by the remnants of a berm constructed in the mid-1980s into northern and southern basins (see Figure 3). The southern basin was dredged in 1988 and the dredge spoils were deposited on the process area. The concentration of metals is higher in sediments of the northern basin. Sediments in this basin have not been dredged. These sediments contained elevated concentrations of cadmium, chromium and cyanide. The highest concentrations of cadmium and total chromium are 86.9 and 1,100 ppm respectively. (See Table 2 for sediment data)

D. Bull Creek

Water and sediment samples were taken from Bull Creek, a Class C stream along the northern border of the site. A total of seventeen organic compounds were found in the water samples; however, thirteen of these were detected only in the upstream sample. All compounds were found at levels of 26 ppb or less. The water quality standards for eight of these compounds were exceeded in these samples. Eleven organic compounds, mostly PAHs, were detected in the stream sediment samples. Although these compounds were found on site, they may be attributable to an off-site source (i.e., Townline Road and/or the railroad ROW). A benthic survey, performed during the RI, indicated that the overall impact of the site on the water quality of Bull Creek is negligible.

E. Groundwater:

Three principal hydrologic units were defined at the site. These are an upper water-bearing zone, a clay confining unit (intermediate water bearing zone) and a lower aquifer. Groundwater in the upper water-bearing zone is perched and appears to flow in a radial pattern away from the process area. The horizontal flow is of low volume. Numerous organic contaminants were detected in the groundwater within the upper zone in the process area. The compounds of greatest significance, due to their frequency and concentration, were chlorinated hydrocarbons and BTX compounds. The highest BTX compounds concentration found in this zone was toluene at 260 ppm. The highest chlorinated hydrocarbon was dichloroethane, at a concentration of 243.6 ppm. Concentrations of these organic compounds exceeded ground water standards. The concentrations of many metals and cyanide from wells within the process area also exceeded groundwater standards. Wells screened in the upper zone and located outside the process area were free of organic compounds. These wells did contain low levels of inorganic compounds, such as iron and chromium, at concentrations in excess of water quality standards.

Within the clay confining unit, groundwater flow is generally vertical and downward. There is almost no horizontal component of groundwater flow in this unit due to the low hydraulic conductivity of the clay (on the order of 1 E-8 cm/sec). The maximum concentration of organics within this unit was tetrachloroethene at 14 ppb; however, the concentration exceeded groundwater standards. The most contaminated well within this unit, located within the process/fill area hot spot, had a total organics concentration of 288.9 ppb. In addition, concentrations of antimony, iron, magnesium and manganese exceeded groundwater standards. These organic and inorganic compounds were found in the groundwater within the process/fill area. The groundwater in wells outside this area did not exceed the groundwater quality standards. In the residential area around the site there are no wells in use at this depth. There is no potential for exposure to the low levels of contaminants in the water in the unit.

In the lower aquifer organics were detected at levels generally much lower than that found within the upper water bearing zone.. The concentration of acetone (a volatile organic) was the highest at 250 ppb. Concentrations of all other organics were less than 50 ppb; however, these concentrations exceeded groundwater standards. Several metals were also detected within this unit; however, the concentrations did not exceed the background levels found.

All three units are contaminated; however, most of the contamination is within the upper water-bearing unit in the process area. (See Table 3 for groundwater data) The groundwater is apparently being contaminated by contact with chemicals in the process area and the lake sediments. Fortunately, the upper water bearing zone transmits water only very slowly and contaminated groundwater has been confined to the area near the process area. Most of the local residents are served by a municipal water supply system. The closest well used for drinking water purposes is located more than 900 feet from the site. Water from the well was sampled and analyzed and found to be free of contaminants. A monitoring well was installed between the site and the general location of this drinking water well. No contaminants were detected in samples from the monitoring well.

F. **Risk Assessment**:

A baseline human health risk assessment was performed as part of the RI. The purpose of this assessment was to determine the potential impact of contamination at the site in the absence of remedial measures. The assessment determined the cancer risk probabilities for carcinogenic compounds and the chronic risk hazard indices for non-carcinogenic compounds due to exposure from the site. Potential risks to site users were determined for the following scenarios: nearby residents exposed through inhalation of vapors or fugitive dust; trespassers exposed through ingestion of surface soils, inhalation of vapors or fugitive dust and dermal absorption of surface soil and near surface groundwater. The risks for future users, both residents and trespassers, of the site, in the absence of remedial action were also evaluated. (See Table 4 for the summary of risks)

The risk assessment indicates that under existing (i.e., no action) site conditions for the population use scenarios cited above, the site does not pose an unacceptable carcinogenic risk as defined by the U.S.E.P.A. remediation guideline of 1.0 E-04 to 1.0 E-06 probable risk range. (Note: 1.0 E-06 means one additional cancer per one million people and 1.0 E-04 means one additional cancer per 10,000 people, over their lifetimes) The total risk to residents near the site is 2.12 E-06 (i.e., 2.12 additional cancers per one million people exposed to present site conditions per the scenarios cited above. This total risk is well within EPA's guidelines).

On the other hand the chronic (non-carcinogenic) risks were found to be significant. In two out of three no-action scenarios the total hazard index exceeds an index value of one (1). (The resident value is 12.6 and the resident/trespasser value is 13.1) Chromium and cadmium are the primary source of this risk. U.S.E.P.A. guidance recommends that, at this level, consideration should be given to mitigating site conditions.

Section 4 - Enforcement Status

In September 1984 the NYSDEC and Frontier executed an administrative Consent Order (Consent Order No. 84-118) which provided for Frontier's implementation of a site closure plan. The Consent Order called for Frontier to pump water from Quarry Lake, revise the closure plan to respond to deficiencies identified by NYSDEC, and commence implementation of the closure plan. Frontier violated the Order by failing to pump water from Quarry Lake within the specified time frame, failing to revise the closure plan as specified by NYSDEC, and failing to implement the closure plan.

Because of Frontier's violations of Consent Order No. 84-118, another Consent Order (No. 85-135) was executed. This Consent Order required Frontier to perform a field investigation of the site and implement the Remedial Action Plan for the closure of Quarry Lake. Frontier violated this Consent Order by failing to complete the field investigation in accordance with the schedule set forth in the Order. Further, Frontier did not complete the Remedial Action Plan for closure.

In March 1988, Consent Order No. 87-91A was executed between NYSDEC and Frontier. This Consent Order called for Frontier to initiate and complete the actions required under Consent Order No. 85-135 (i.e., the site field investigation and closure of Quarry Lake). Frontier violated this Order by not completing the field investigation within the time frames established in the Order. Further, Frontier did not complete the closure of Quarry Lake.

Frontier has failed to abide by the terms of three separate Consent Orders for this site. For this reason, the NYSDEC performed the Remedial Investigation/Feasibility Study (RI/FS) with money from the State Superfund. When the Record of Decision (ROD) is issued for this site, Frontier will be given the opportunity to perform the remediation required by the ROD. If Frontier is unable or unwilling to perform the remediation, NYSDEC will implement the remediation, using State Superfund monies. Frontier, or their successors, will be required to reimburse NYSDEC for the amount spent on the RI/FS and remediation.

Section 5 - Goals for the Remedial Actions

The Frontier Chemical-Pendleton site is located in an agricultural/residential area. There are homes located less than 100 feet from the site. The presence of contaminated sludge piles raises the possibility of human contact with wind borne contaminated soils. Present or future use of the unremediated site poses a potential for human exposure to contaminants and a chronic health risk. The remedial action implemented must eliminate the potential for exposure to the chemical wastes at the site.

The following remedial action objectives have been established for the Frontier Chemical-Pendleton site:

1. Reduce or eliminate the potential for human contact with contaminated soil, fugitive dust, groundwater, sediment and surface water.
2. Dispose of, or otherwise treat the wastes in a manner consistent with all State and Federal Applicable or Relevant and Appropriate Requirements (ARARs).
3. Restore the site to a condition allowing use with few restrictions.

Section 6 - Description and Evaluation of the Alternatives

Remedial technologies ranging from no action to excavation and incineration, were evaluated in the Feasibility Study (FS) for the site. (See Table 5 for listing of technologies) These technologies were evaluated for each aspect of the site (i.e., process/fill, sediment, groundwater, surface water). The technologies were screened to determine those that were technically feasible, protective of human health and the environment and cost effective. The screened technologies were developed into alternatives for detailed evaluation. The alternatives are described below:

Alternative 1: "No Action" alternative involving no activities, short-term or long-term at the site.

Alternative 2: "Institutional Action" alternative involving installation of additional monitoring wells, long-term groundwater monitoring and site use/access restrictions.

Alternative 3a: "Containment" alternative, providing for a multilayered synthetic geomembrane cap and grouted sheetpile (or their technical equivalents), to contain the contaminated process/fill area; groundwater collection and treatment; and placement of untreated dredged sediments over the contaminated fill area under the cap. Other elements common to Alternatives 3 through 6 include physical controls (diversion of runon/runoff, control of lake discharge, berm closure and improveent to ditch on Townline Road to handle drainage), sediment dredging, additional monitoring wells and long-term groundwater monitoring. (See Figure 5)

Alternative 3b: This alternative is the same as Alternative 3a, except that the lake sediments will be solidified prior to placement over the site. (See Figure 5)

Alternative 4: "Hot Spot Treatment with Ex-Situ Solidification", involves ex-situ solidification of the hot-spot contamination area, sediment dredging, solidification and placement of lake sediments on the site, installation of a partial sheetpile along the lake, collection and treatment of groundwater entering the excavated areas and a soil cap. Common elements include physical controls, sediment dredging and groundwater monitoring. (See Figure 6)

Alternative 5: "Hot Spot Treatment with In-Situ Solidification", is similar to Alternative 4 and differs only in the method of treatment of the hot spot area. Alternative 5 involves in-situ solidification of the hot-spot contamination area, sediment dredging, solidification and placement of lake sediments on the site, a soil cap, and installation of a partial sheetpile along the lake. Physical controls, sediment dredging and groundwater monitoring are common elements. (See Figure 7)

Alternative 6: "Full Treatment with Solidification and Hot Spot Thermal Desorption" is a full soil/fill treatment option. The hot-spot area will be excavated and treated through thermal desorption to remove organic contaminants, while the non-hot-spot area undergoes in-situ solidification. Installation of a partial sheetpile along the lake and placement of dredged sediments after solidification in a cell constructed in the northern basin of Quarry Lake, groundwater collection and treatment and installation of a soil cap would also be included. Physical controls, sediment dredging and groundwater monitoring are common elements. (See Figure 8)

The remedial alternatives for each operable unit are discussed below relative to the evaluation criteria. The evaluation criteria discussed below are self explanatory, with the exception of "Compliance with SCGs." SCGs are the New York State Standards, Criteria and Guidelines that are appropriate for the site. There are three general categories for SCGs (modeled after the Federal ARARs - Applicable or Relevant and Appropriate Requirements): Chemical specific, location specific and action specific. Chemical specific SCGs would include surface and groundwater standards for the chemicals of concern at the site. Location specific SCGs would deal with any special requirements that may be necessary due to the location of the site (e.g., Federal and State permits for altering wetlands). Action specific SCGs would be any requirements that would have to be met during implementation of the remedy (such as the requirements of the Resources Conservation and Recovery Act).

Alternative 1 - No Action:

Short-Term Impacts and Effectiveness: No construction is required to implement this alternative; therefore, there are no associated increased short term risks to the community, environment or workers.

Long-Term Effectiveness and Permanence: This alternative is neither an effective nor permanent remedy for the risks posed by the contaminants at the site. The identified human health risks would not be addressed. Future use of the land would be severely restricted due to the potential for exposure to the contaminants.

Reduction in Toxicity, Mobility and Volume in Hazardous Waste: This alternative does not reduce the toxicity, mobility nor the volume of hazardous waste at the site.

Implementability: The no action alternative is easily implemented compared to the other alternatives.

Compliance with SCGs: This alternative will not result in compliance with chemical-specific SCGs nor any appropriate agency advisories, guidelines or objectives. It would be in compliance with location-specific SCGs restricting activities in wetlands, but not other location-specific SCGs.

Overall Protection of Human Health and the Environment: This alternative provides no protection for human health or the environment and does not address the risks posed by contaminants at the site. These risks may increase due to deterioration of existing on-site conditions

Cost: There is no cost associated with this alternative. (See Table 6 for costs)

Alternative 2 - Institutional Control:

Short-Term Impacts and Effectiveness: There would be minimal construction required to implement this alternative. Therefore, there would be negligible associated increased short term risks to the community, environment or workers.

Long-Term Effectiveness and Permanence: This alternative is neither an effective nor permanent remedy for the risks posed by the contaminants at the site. The identified human health risks to a user/trespasser would be addressed by continued site restrictions. However, the health risks to residents and environmental effects may worsen due to the deterioration of the existing on-site conditions. Future land use would be permanently restricted over the entire site due to the potential for exposure to the contaminants.

Reduction of Toxicity, Mobility and Volume of Hazardous Waste: This alternative does not reduce the toxicity, mobility or volume of hazardous waste at the site.

Implementability: This alternative is easily implemented since no technical or administrative difficulties are posed by the continuation of the monitoring program.

Compliance with SCGs: Implementation of this alternative will not result in compliance with chemical specific SCGs. It would be in compliance with location-specific SCGs restricting activities in wetlands, but not other location-specific SCGs.

Overall Protection of Human Health and the Environment: This alternative provides insufficient protection for human health or the environment.

Cost: The cost associated with this alternative is $684,000. (See Table 6)

Alternative 3 - Containment:

Short-Term Impacts and Effectiveness: This alternative will produce short-term risks from volatile and fugitive dust emissions during dredging and placement (under Alternative 3a) or treatment of sediments (under Alternative 3b) and grading for the cap. These risks are easily controlled, and control efforts would not impact community lifestyle. Both the remedial action and the efforts to control these risks are expected to extend past two years.

Long-Term Effectiveness and Permanence: This alternative would provide for long term, permanent reduction in the human health and environmental risks posed by the site. Although treatment would be applied to the groundwater only, this activity combined with containment and capping of the process/fill area, groundwater controls and dredging of the lake sediments would provide an effective long term remedy. For Alternative 3b solidification of the lake sediments will further prevent migration of the contaminants by immobilizing them. Solidification of the sediments will also strengthen the subbase for the cap. Future land use under either 3a or 3b would be somewhat restricted in that there could be no subsurface work performed in or near the containment area after remediation is completed.

Reduction of Toxicity, Mobility and Volume of Hazardous Waste: The mobility of the hazardous waste would be significantly reduced by containing the process/fill area reducing groundwater movement. Some reduction in toxicity and volume of the hazardous waste would result from the collection and treatment of groundwater. Under Alternative 3b, the mobility of contaminants in the lake sediments would be further reduced through solidification. In addition, the solidified sediments spread over the site would reduce the amount of infiltration to the site due to their lower hydraulic conductivity.

Implementability: The technologies of this alternative are very effective in meeting the performance goals. However, under Alternative 3a, the physical characteristics of the lake sediments would make direct placement on the site difficult. Technologies, vendors and equipment for treatment and construction activities should be readily available without significant delay. The organic and inorganic compounds in the groundwater can effectively be removed using existing treatment methods. Construction of a groundwater treatment plant is included as part of this alternative.

Compliance with SCGs: This alternative meets most chemical-specific SCGs in the process/fill area. Groundwater within the contained area will continue to contain contaminants above groundwater standards for a number of years. In addition, the groundwater in the clay confining unit and the lower water bearing zone will still contain low levels of contaminants in excess of groundwater standards. There is no current exposure route to these aquifers.

Any future potential exposure would be limited by land use restrictions. This alternative (both 3a and 3b) will meet the action-specific SCGs.

Overall Protection of Human Health and the Environment: Implementation of this alternative would remove the human exposure pathway to the contaminants and will be protective of human health and the environment.

Cost: The cost of implementing Alternative 3a is $11,496,000 ($8,417,000 capital cost; $3,079,000 present worth of Operation and Maintenance(O&M)). The cost of implementing Alternative 3b is $16,189,000 ($13,110,000 capital cost; $3,079,000 present worth of O&M) (See Table 6)

Alternative 4 - Hot Spot Treatment with Ex-Situ Solidification:

Short-Term Impacts and Effectiveness: Ex-situ treatment of contaminated fill/soil at the site will disturb areas of the site containing the highest concentration of contaminants and present the highest short term risks due to emissions of dust and volatiles. Emissions from these activities can be controlled using existing technologies to minimize the impact on the workers and nearby residents. Dredging and treatment of lake sediments and grading for the cap can produce a risk to the community which can be easily controlled with proper management and design. Remediation time is expected to exceed two years.

Long-Term Effectiveness and Permanence: The hot spot contamination areas will be treated (solidified) with this alternative. Solidification of inorganic waste is considered a permanent remedy. Treatability studies have been performed on both the lake sediments and process/fill area soils. Results of these studies indicate that solidification is effective in immobilizing the metal contaminants in these media. Solidification would provide long-term protection to human health and the environment against the risks associated with contact with the metal contaminants in the process/fill area and lake sediments. However, this technology is not accepted by EPA for treatment of the organic contaminants. Future use of the site would be somewhat limited (i.e. there could be no subsurface work performed in or neat the treated fill area after remediation) Fairly extensive long term monitoring will be required to ensure that migration of contaminants does not occur.

Reduction in Toxicity, Mobility and Volume of Hazardous Wastes: This alternative would significantly reduce the mobility of hazardous wastes at the site. This alternative would not reduce the toxicity or volume of wastes because wastes are neither destroyed nor removed.

Implementability: Treatability studies have been performed to determine the type and amount of solidifying agent necessary to immobilize the contaminants and best meet performance goals at the site. The alternative will require intrusive activities within the area of the highest contamination. This work may require additional measures to control dust and volatile emissions which could produce delays. The technologies for this alternative are available for site-specific application.

Compliance with SCGs: This alternative meets must chemical, location and action-specific SCGs within the process/fill area with the exception of treatment for organic contaminants in both soil and groundwater. Groundwater in the clay confining unit and lower water bearing zone will still contain contaminants in excess of groundwater standards. There is no current exposure route for these contaminants. Future exposure would be limited by land use restrictions.

Overall Protection of Human Health and the Environment: This alternative will eliminate all routes of exposure to the contaminants at the site. It is protective of human health and the environment.

Cost: The cost of implementing this alternative is $16,298,000 ($14,820,000 capital cost; $1,478,000 present worth of O&M). (See Table 6)

<u>Alternative 5 - Hot-Spot Treatment with In-Situ Solidification</u>:

Short-Term Impacts and Effectiveness: Intrusive activities will disturb areas of the site containing the highest concentrations of contaminants. Dust emissions and contaminant volatilization may potentially have a negative impact on both the community and the environment. However, readily available methods for controlling both dust and contaminant emissions should provide adequate control. The time required for full implementation of this alternative is longer than two years. It is expected that the risk due to emissions will be lower using in-situ methods of solidification as opposed to ex-site methods. This is because there would be no excavation of the contaminated material using in-situ methods.

Long-Term Effectiveness and Permanence: The hot spot contamination areas will be treated (solidified) with this alternative. Solidification of inorganic waste is considered a permanent remedy. Treatability studies have been performed on both the lake sediments and process/fill area soils. Results of these studies indicate that solidification is effective in immobilizing the contaminants in these media. Solidification would provide long term protection to human health and the environment against risks associated with contact with the contaminated soil/fill. Combined with lake sediment solidification, containment and capping of the process/fill area, this alternative would provide an effective long term remedy. This alternative will require future site restrictions in that no subsurface work could be performed in or near the treated fill area. Fairly extensive long term monitoring of the groundwater will be necessary to ensure that migration of contaminants does not occur.

Reduction in Toxicity, Mobility and Volume of Hazardous Waste: This alternative will significantly reduce the mobility of hazardous waste at the site. The alternative will not reduce the toxicity or volume because the wastes are neither destroyed nor removed, but rather immobilized.

Implementability: The technologies for this alternative are well established and commercially available. This method will use methods which would result in lower dust and volatile emissions. Unknown subsurface conditions (i.e. the presence of boulders or debris) could cause delays due to interference with the injection or mixing of the immobilizing agents.

Compliance with SCGs: This alternative will meet most chemical, location and action-specific SCGs within the process/fill area with the exception of treatment for organic contaminants in both soil and groundwater. Groundwater in the clay confining unit and the lower water bearing zone will still contain contaminants in excess of groundwater quality standards. There is no current exposure route to these contaminants. Any future exposure would be limited by land use restrictions.

Overall Protection of Human Health and the Environment: The combination of media-specific remedial technologies should stop almost all contaminant migration from the site. Further, the alternative will remove the exposure pathways of the contaminants to the nearby community and the environment. Therefore, this alternative is protective of human health and the environment.

Cost: The cost of implementing this alternative is $22,659,000 ($21,611,000 capital cost; $1,048,000 present worth of O&M). (See Table 6)

Alternative 6 - Full Treatment with Solidification and Hot-Spot Thermal Desorption:

Short-Term Impacts and Effectiveness: Several of the components of this alternative (hot-spot excavation, thermal desorption, in-situ solidification) are intrusive activities that will disturb areas of the site with high concentrations of contaminants. These activities may potentially affect both the community and the environment due to dust emissions or volatilization of contaminants during excavation and soil mixing. Mitigative measures are available for controlling both dust and contaminants. Implementation of this alternative and the mitigative efforts required to control short-term risks are expected to take more than two years.

Long-Term Effectiveness and Permanence: Excavation of hot-spot areas and thermal desorption of organic contaminants would result in a permanent remediation of the highly contaminated material. Solidification of wastes in the non-hot-spot areas would significantly reduce the mobility of the contaminants. Future land use would be somewhat limited (i.e. there could be no subsurface work performed in or near the fill area after remediation) Periodic monitoring will be required to ensure the integrity of the solidified waste, the soil cap and the containment of contaminated groundwater.

Reduction in Toxicity, Mobility and Volume of the Hazardous Waste: This alternative reduces both the toxicity and volume of organic contaminants in the most contaminated areas on-site by excavating and treating them. Mobility of metal contaminants in the remaining areas is reduced by treatment with in-situ solidification.

Implementability: Implementation of this alternative could be affected by several factors. Problems may be created by the waste buried at the site, which includes drums, scraps, debris, and highly contaminated areas. Monitoring will be required to assess the effectiveness of the alternative.

Compliance with SCGs: This alternative was designed to meet or exceed all SCGs associated with the process/fill area. Groundwater in the clay confining unit and the lower water bearing zone will still contain contaminants in excess of groundwater quality standards. There are no current exposure route to these contaminants. Any future exposure would be limited by land use restrictions.

Overall Protection of Human Health and the Environment: This alternative meets all specific remedial action requirements that were designed to reduce potential health risks associated with migration of contaminants from the site. This alternative addresses all contaminated media at the site including the soil/fill, groundwater, surface water and sediments. The alternative would be protective of human health and the environment.

Cost: The cost of implementing this alternative is $38,913,000 ($37,435,000 capital cost; $1,478,000 present worth of O&M). (See Table 6)

Section 7 - Summary of the Government's Decision

Upon review of the site data and evaluation of the available alternatives, the State has identified a proposed remedial action for this site. The proposed remedial alternative is Alternative 3b: Containment, with solidification of the lake sediments. The alternative will include the following:

- a grouted sheetpile, or technical equivalent, will be installed around the site to provide a containment boundary for contaminated soils and to assist the collection system in maintaining an inward groundwater gradient;

- a groundwater collection system will be installed within the contained area to collect contaminated groundwater and create an inward groundwater gradient. The collected groundwater will either be treated on-site or at a licensed off-site location, whichever is more cost effective;

- contaminated sediments within Quarry Lake will be dredged. These sediments will be solidified and placed over the site within the containment area. Previously dredged sediments will be similarly placed;

- a multi-layered synthetic geomembrane (MSG) cap, or technical equivalent, will be installed over the containment area;

- physical controls will be installed to control both surface drainage and overflow from the lake. The ditch on Townline Road will be improved to handle this drainage;

- monitoring wells will be installed to monitor the effectiveness of the remedy.

The total cost of this remedy is $16,189,000. (Note: This cost includes construction of a groundwater treatment plant. If off-site treatment of collected groundwater is more cost effective, the total remedy cost will decrease).

During design of the remedy, an evaluation will be made to assess the feasibility of consolidating the 7.4 acre process/fill area into a smaller one. Consideration will be given to reducing both remedial costs and overall size of areas requiring future use restrictions. Furthermore, to the extent practicable, consideration will be given to restoring some of the consolidated areas back to wetland conditions that existed prior to site development. Such action may serve to extend the size and value of designated wetland TE-6 that exists adjacent to and northeast of the process/fill area.

APPENDIX 1

Administrative Record

1. Hydrogeologic Investigation, Pendleton Quarry Lake, prepared for Frontier Chemical Waste Process Inc. by Golder Associates, Ltd., October, 1989

2. Citizen Participation Plan for the Frontier Chemical-Pendleton site, prepared by NYS Department of Environmental Conservation, March, 1990.

3. Work Plan for the Remedial Investigation/Feasibility Study (RI/FS) at the Frontier Chemical-Pendleton site, prepared by URS Consultants, May, 1990.

4. Health and Safety Plan for the RI/FS at the Frontier Chemical-Pendleton site, prepared by URS Consultants, May, 1990.

5. Quality Assurance Project Plan and Field Sampling Plan for the Frontier Chemical-Pendleton site, prepared by URS Consultants, May, 1990.

6. Work Plan for the Second Phase RI, at the Frontier Chemical-Pendleton site, prepared by NYS Department of Environmental Conservation, December, 1990.

7. Remedial Investigation Report for the Frontier Chemical-Pendleton site, prepared by URS Consultants, June, 1991.

8. Draft Final Feasibility Study for the Frontier Chemical-Pendleton site, prepared by URS Consultants, January, 1992.

9. Proposed Remedial Action Plan for the Frontier Chemical-Pendleton site, prepared by NYS Department of Environmental Conservation, January, 1992.

10. Transcript of the public meeting regarding the PRAP for the Frontier Chemical-Pendleton site, prepared by DePaulo-Crosby, Freelance Reporters, February, 1992.

APPENDIX 2

Responsiveness Summary for Comments Received During Public Comment Period for the Frontier Chemical-Pendleton Proposed Remedial Action Plan

A public meeting was held on January 22, 1992 to present the Frontier Chemical-Pendleton Proposed Remedial Action Plan (PRAP). The public comment period on the PRAP ran from January 17, 1992 to February 17, 1992. During this time period, three letters regarding the PRAP were received. This responsiveness summary addresses the concerns and questions raised at both the public meeting and the letters regarding the PRAP. A transcript of the public meeting is part of the Administrative Record for this Record of Decision.

1. A number of questions were raised at the public meeting regarding the start of remedial design and construction for the remedy at this site. This question was also raised in letters from Town Supervisor Shirley Conner, Assemblyman Murphy and Senator Daly. The State is required, under Title 13 of the Environmental Conservation Law to give the Responsible Party(s) for the site an opportunity to implement the remedy specified in this ROD. The Responsible Party(s) must perform this work under a Consent Order with the Department. It is the Department's policy to have the remedy implemented by the Responsible Party(s). If the Responsible Party(s) is(are) unwilling or unable to implement this remedy, the State will pursue its options to assure site cleanup, including the option to implement remediation using funds from the State Superfund.

   Design of the remedy will take approximately one year to complete. Implementation of the remedy will last at least two years. The start date of these tasks cannot be determined at this time, because it depends on the willingness of the Responsible Party to perform the work.

2. Q: What is the expected lifetime of the sheet piling to be installed around the site?

A: The sheet pile is expected to have a useful life in excess of thirty five years. If, during Remedial Design (RD), it is determined that a slurry wall would be cheaper to install than sheet pile, then a slurry wall will be installed. The Record of Decision has been revised to provide for this evaluation. The effectiveness of the containment system (either sheetpile or slurry wall) will be re-evaluated every five years.

3. Q: Were disposal trenches, buried barrels, construction/demolition debris outside the contained area found at the site?

A: None of this material was found at the site.

4. Q: How long will Frontier be given to respond to the State regarding performance of the Remedial Design/Remedial Action (RD/RA)?

A: There are no specific time frames in the State regulations for a responsible party to respond. The responsible party will be given a reasonable amount of time to indicate their willingness to perform the RD/RA.

5. Q: Could Frontier Chemical be sold as a means of avoiding responsibility for this site?

A: No. Past, current and future owners of Frontier Chemical and this site can be held liable for this site.

6. Q: How could the site be used after remediation?

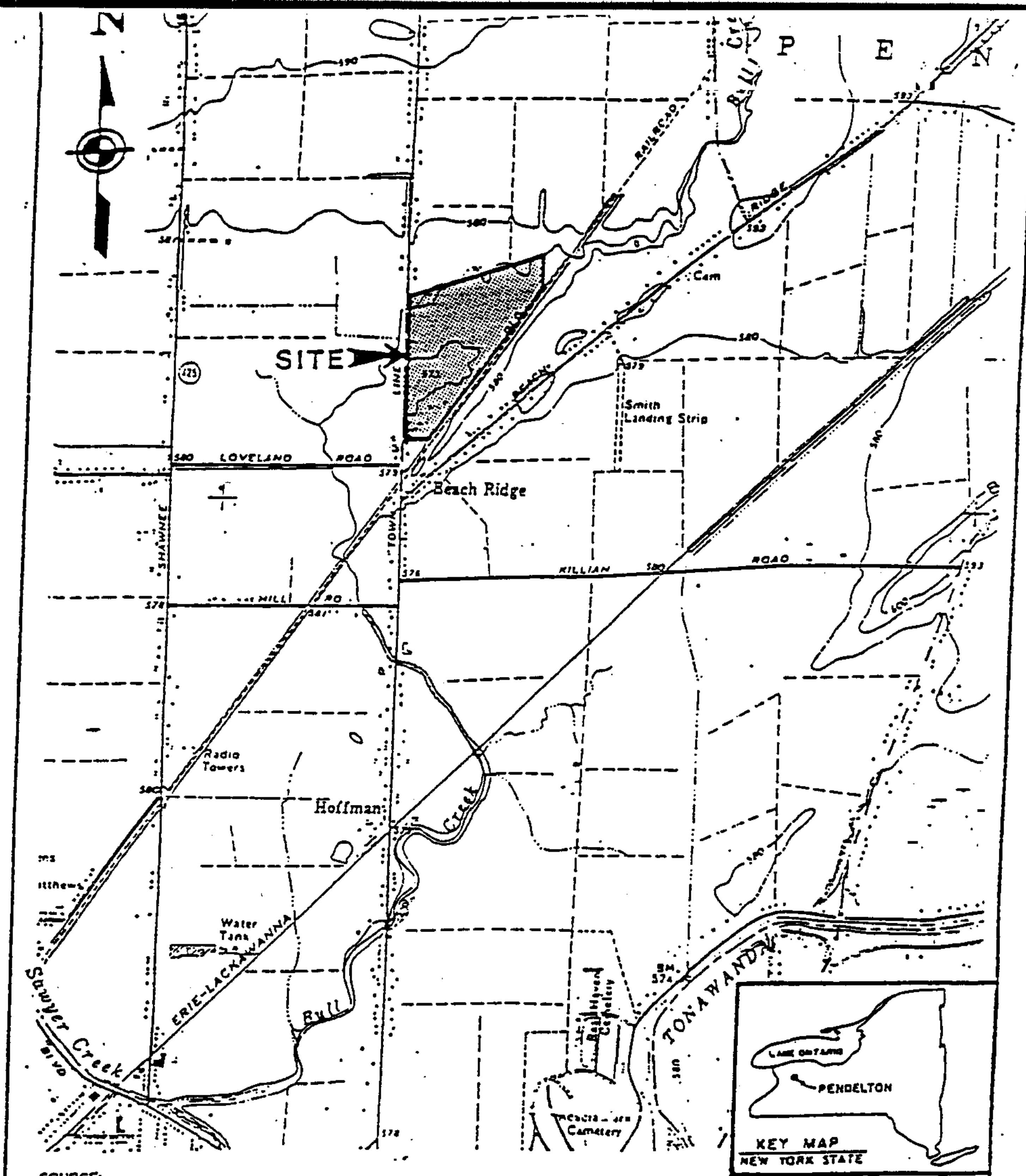
A: The following site restrictions would be placed on the site after remediation: there would be a prohibition of construction on the contained process/fill area with emphasis placed on any activity that could affect the integrity of containment. After the remedy is implemented the subsurface could not be punctured in any way, so as to avoid seepage of water into the site. Also, the ground surface would not likely have the structural integrity to support any type of building. In addition, installation of groundwater wells in the immediate area would have to be prevented, due to the low levels of contaminants in the lower aquifer. The site could be used as a recreational facility.

7. Q: Would Quarry Lake be pumped out in order to dredge the bottom?

A: Possibly, if mechanical dredging is cheaper and easier to implement than hydraulic dredging. This will be determined during Remedial Design.

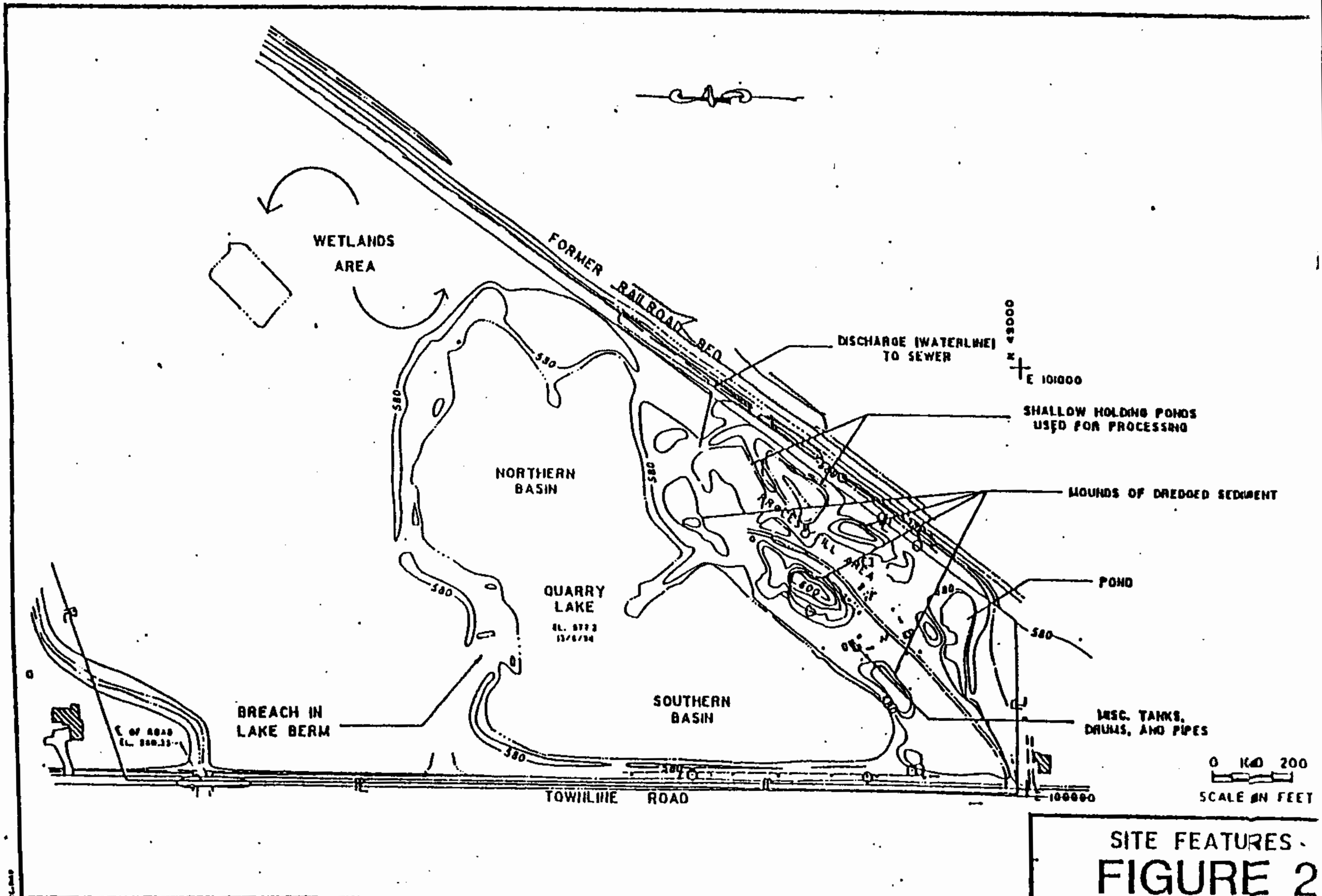
8. Q: Will the residents living near the site be affected by the remediation?

A: All potential adverse effected of the remediation to the residents near the site will be kept to a minimum. Measures will be implemented to restrict the migration of contaminants from the site during remediation. The primary means of migration is from dust. It is relatively easy to control dust migration during remediation. These control measures include wetting the area under construction and the use of chemical dust suppressants, such as calcium chloride. Both will prevent the generation of dust. Air monitoring for particulates and volatiles will be routinely performed to ensure the health and safety of both the residents near the site and the workers performing the remediation.



SOURCE:
USGS TOPOGRAPHIC 7.5 MINUTE
QUADRANGLE, TONAWANDA EAST, N.Y. 1965

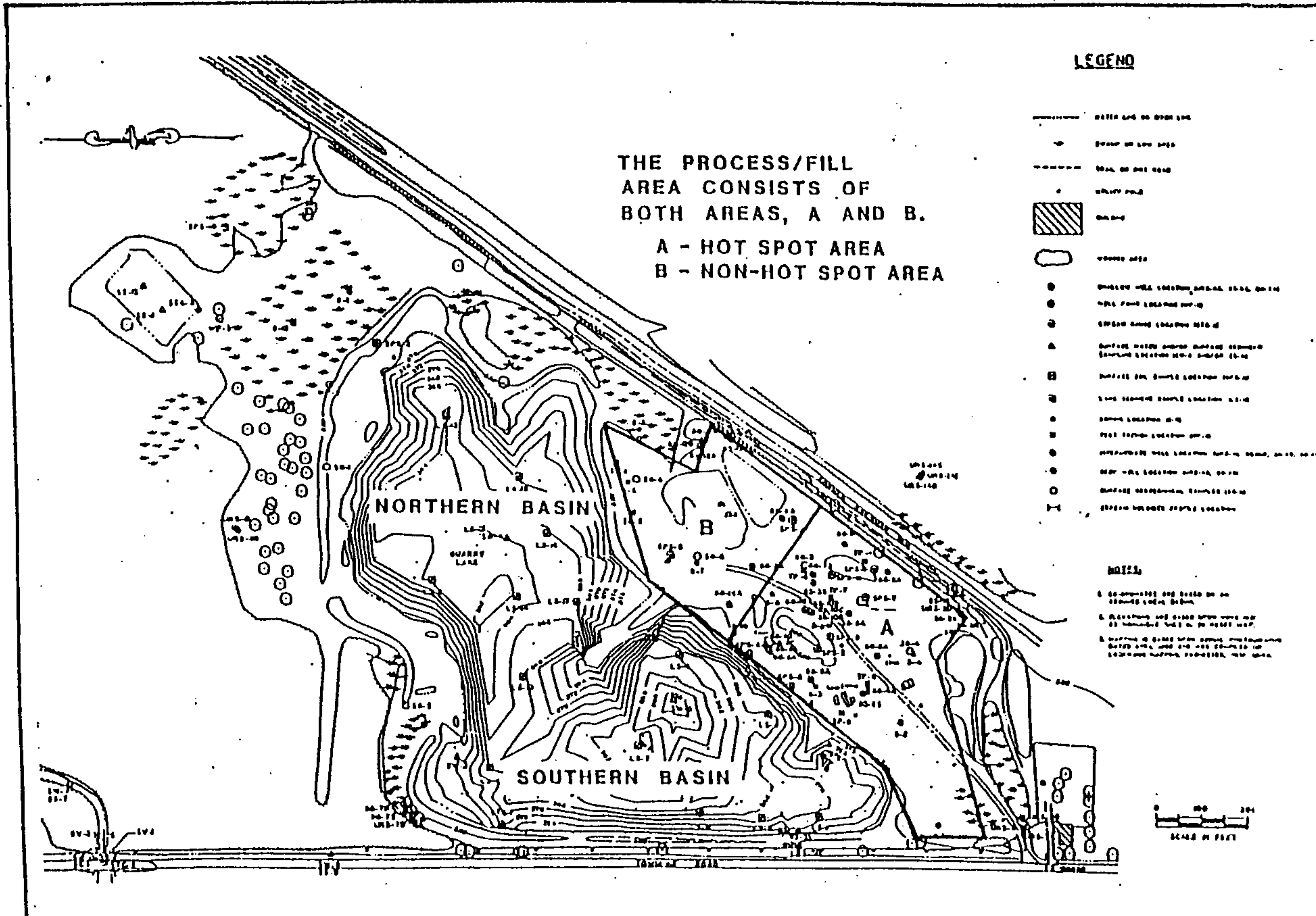
FIGURE 1



SITE FEATURES

FIGURE 2

A-3776A

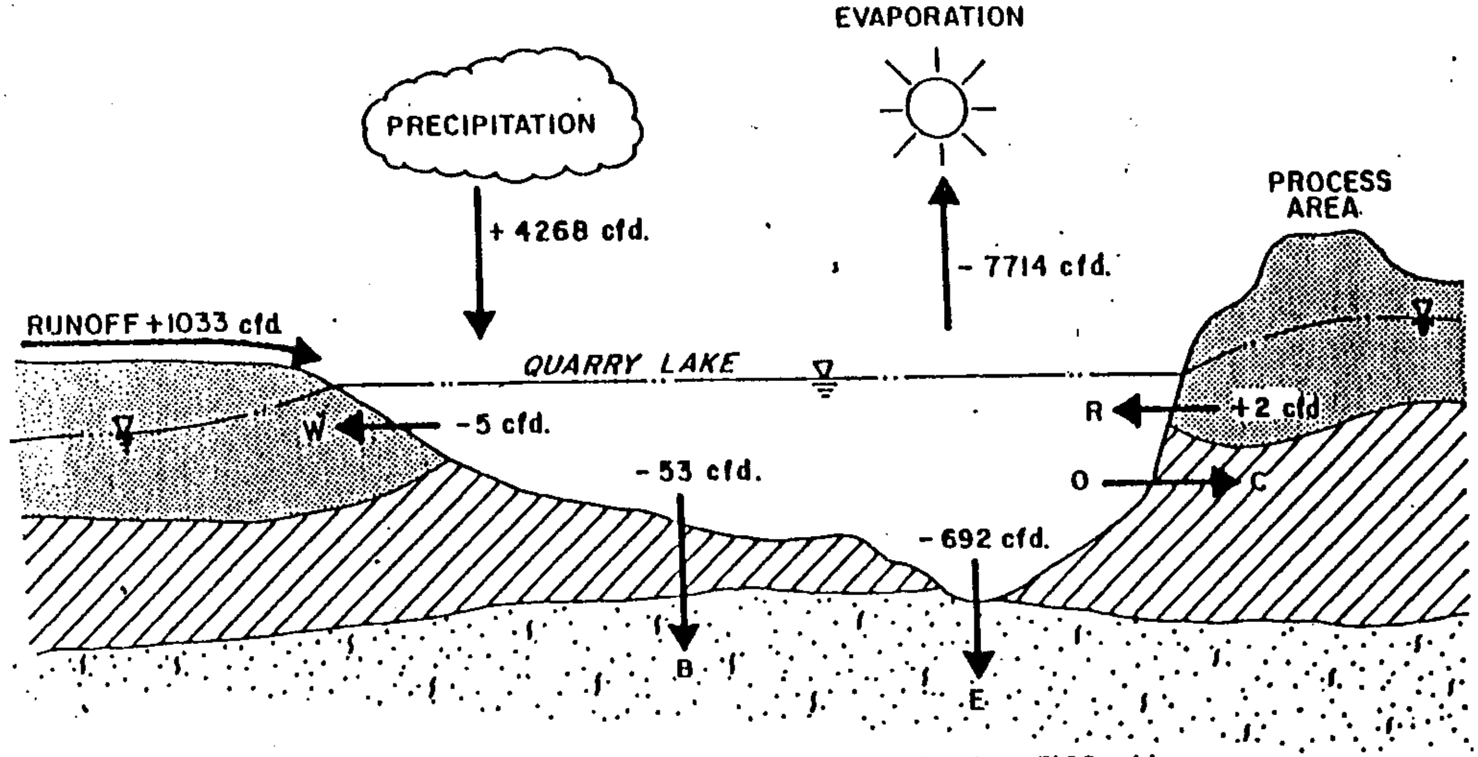


URS

REGIONS OF CONTAMINATION

FIGURE 3

A-3382



CALCULATED BALANCE OF FLOW = -3168 cfd.
OBSERVED LAKE BALANCE (7/11/90 - 8/9/90) = -2890 cfd.
ALL VALUES GIVEN IN ft^3/DAY (cfd.)

HYDROGEOLOGIC UNITS

- UPPER WATER BEARING ZONE
- CLAY CONFINING UNIT
- LOWER AQUIFER
- WATER TABLE SURFACE

KEY

R - RECHARGE FROM PROCESS AREA MOUND
W - FLOW THROUGH WEATHERED CLAY
C - FLOW THROUGH CLAY LAYER
B - FLOW THROUGH CLAY LINED BOTTOM
E - FLOW THROUGH EXCAVATED AREA OF LAKE BOTTOM

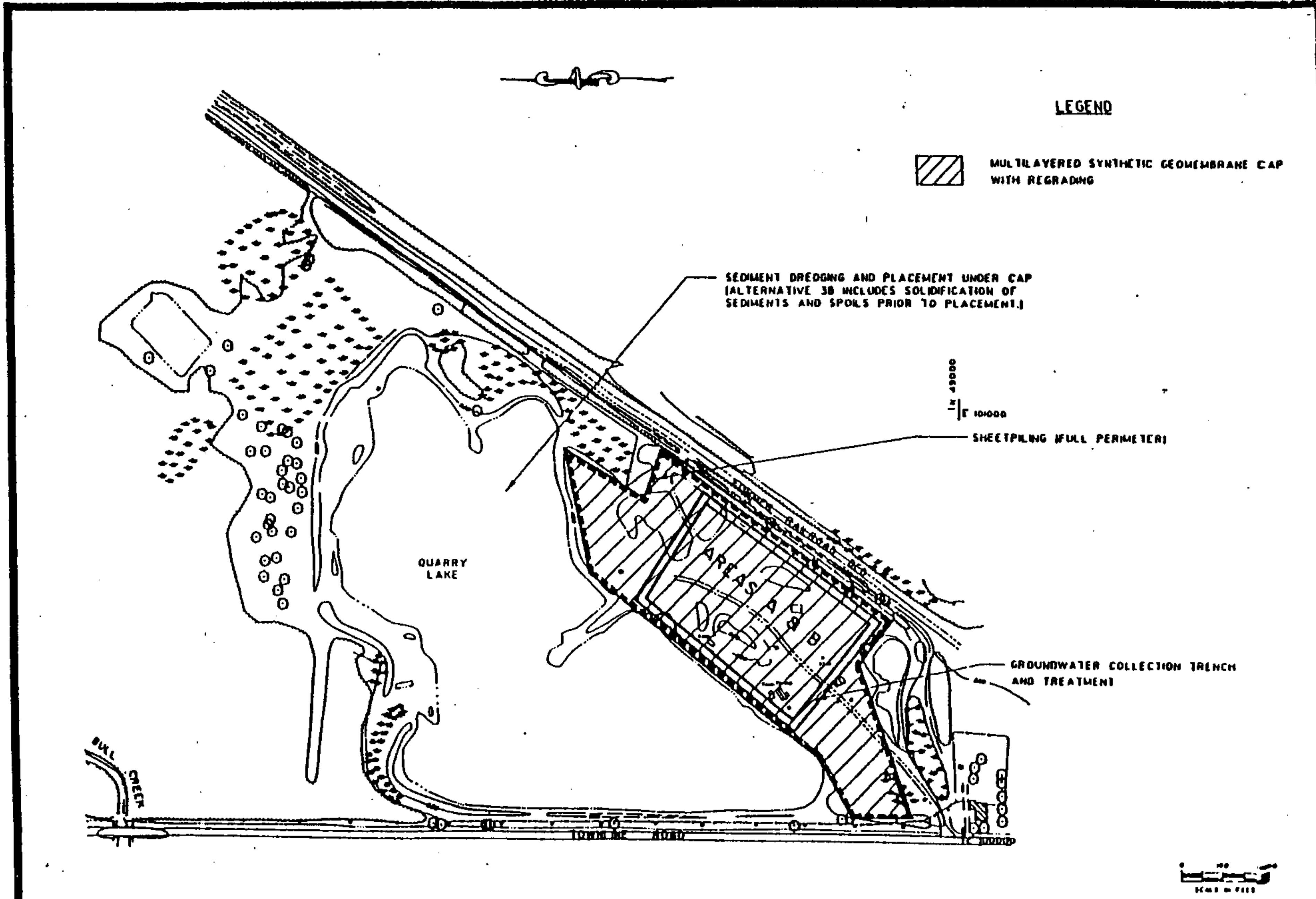
NOT TO SCALE

QUARRY LAKE WATER BALANCE 7/11/90 - 8/9/90

FIGURE 4

AC-378A

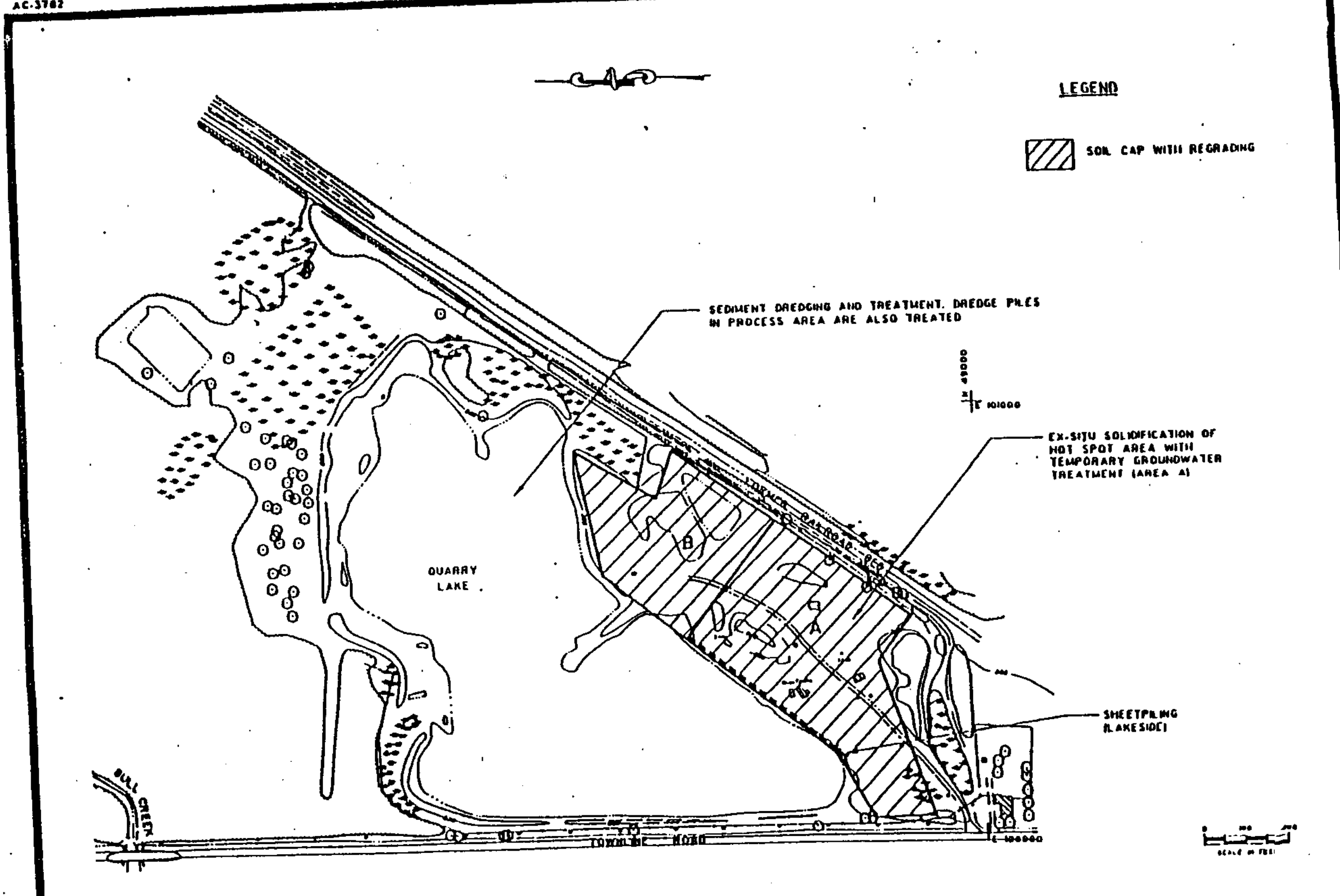
1/03/92



FRONTIER CHEMICAL
ALTERNATIVES 3A & 3B

FIGURE 5

AC-3782

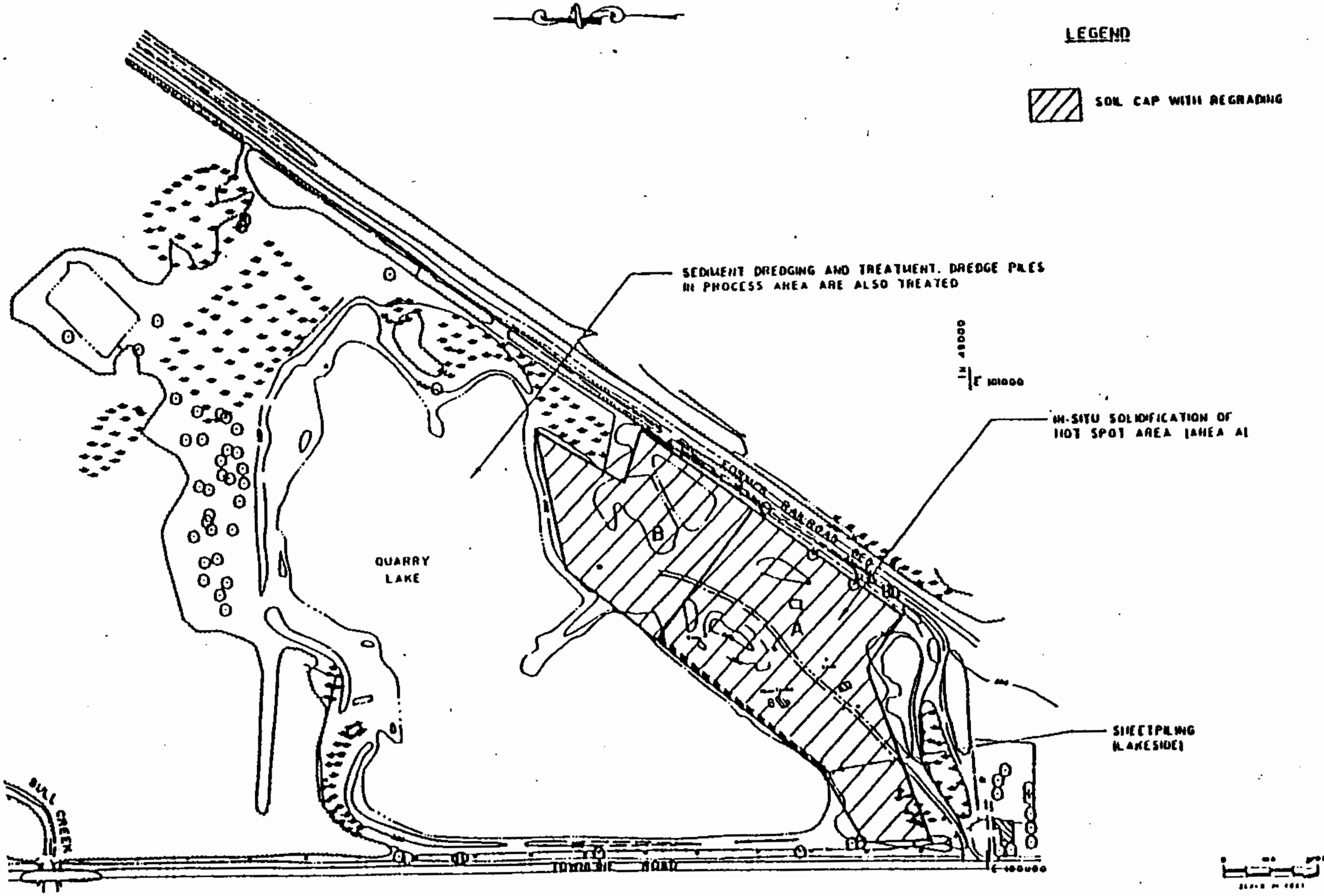


FRONTIER CHEMICAL
ALTERNATIVE 4

FIGURE 6

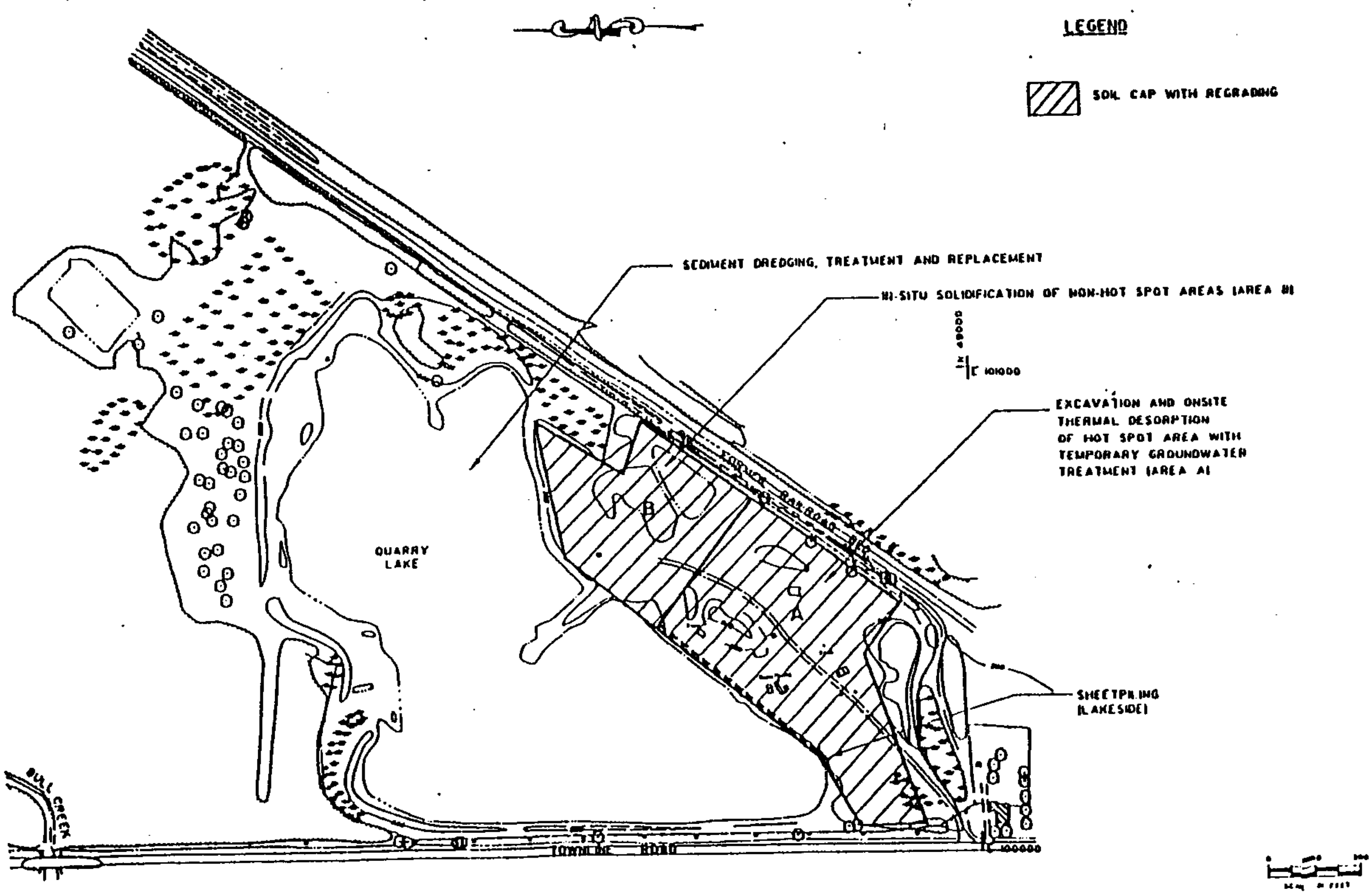
AC-3912

1:100 7/12/91



FRONTIER CHEMICAL
ALTERNATIVE 5

FIGURE 7



FRONTIER CHEMICAL
ALTERNATIVE 6

FIGURE 8

ORGANIC COMPOUNDS DETECTED IN SUBSURFACE FILL MATERIALS
(15 Samples Within Known Area of Fill)

Compound	Maximum Concentration (ppb)	Location of Maximum Detection	Total No. of Detections
Vinyl Chloride	130	B-9	2
Methylene Chloride	810	T-7	1
Carbon Disulfide	6	B-4	3
1,1 Dichloroethene	10	B-4	1
1,1 Dichloroethane	5,700	T-7	8
1,2 Dichloroethene (total)	8,900	B-3	11
1,2 Dichloroethane	68	B-4	2
2-Butanone	5	T-3	1
1,1,1-Trichloroethane	51,000	T-5	10
Trichloroethene	33,000	T-7	12
Benzene	15,000	B-3	11
4-Methyl-2-Pentanone	99,000	B-3	5
Tetrachloroethene	160,000	T-5	12
Toluene	1,600,000	T-5	10
Chlorobenzene	7,100	B-2	2
Ethylbenzene	42,000	B-3	10
Total Xylenes	120,000	B-3	11
Phenol	13,000	B-3	4
1,4-Dichlorobenzene	18,000	T-7	3
1,2-Dichlorobenzene	120,000	T-5	7
4-Methylphenol	13,000	B-3	4
Nitrobenzene	120,000	T-5	1
Isophorone	1,900	T-4	3
2-4-Dimethylphenol	2,100	B-3	1
Benzoic Acid	320	B-10	1
1,2,4-Trichlorobenzene	89,000	B-8	8

Table 1 (continued)

Compound	Maximum Concentration (ppb)	Location of Maximum Detection	Total No. of Detections
Naphthalene	7,700	B-8	9
2-Methylnaphthalene	6,100	B-8	7
Acenapthylene	480	B-1	2
Acenapthene	190	B-1	1
Dibenzofuran	330	B-1	3
Diethylphthalate	490	T-8	5
Fluorene	500	B-1	3
n-Nitrosodiphenylamine	3,700	T-4	2
Phenanthrene	4,600	B-1	11
Anthracene	780	B-1	4
Di-n-butylphthalate	920	B-8	10
Fluoranthene	5,500	B-1	7
Pyrene	4,500	B-1	14
Butylbenzylphthalate	2,300	B-8	2
Benzo(a)anthracene	1,600	B-2	3
Chrysene	2,400	B-1	7
bis(2-Ethylhexyl)phthalate	95,000	B-8	7
di-n-octylphthalate	450	T-4	2
Benzo(b)fluoranthene	2,200	B-1	8
Benzo(k)fluoranthene	460	B-1	4
Benzo(a)pyrene	1,300	B-2	5
Ideno(1,2,3-cd)pyrene	2,000	B-1	4
Dibenz(a,h)anthracene	800	B-1	3
Benzo(g,h,i)perylene	1,900	B-1	4
Heptachlor	1.6	B-4	1
Aldrin	11	URS-2D	2
gamma-Chlordane	25	B-1	1
Aroclor-1242	3,300	B-2	1

Table 1 (continued)

Compound	Maximum Concentration (ppb)	Location of Maximum Detection	Total No. of Detections
Aroclor-1254	9,200	B-3	3
Aroclor-1260	6,200	T-8	9
Total Phenols	94,200	B-3	15

Table 1 (continued)

COMPARISON OF METALS CONCENTRATIONS BETWEEN SUBSURFACE SOIL AND FILL MATERIALS

	Conc. in Fill (15)++			Conc. in Soil (5)++		
Analyte	Min	Max	Mean+	Min	Max	Mean+
Aluminum	11,200	24,000	18,840	21,000	28,500	26,620
Antimony	ND	7.8	6.1	ND	5.1	5.2
Arsenic*	2.5	36.0	8.3	ND	4.0	2.4
Barium	88.9	218	149	126	276	190
Beryllium	0.79	2.6	1.11	0.86	1.5	1.14
Cadmium *	0.69	93.3	22.9	ND	0.49	0.41
Calcium	16,400	182,000	63,767	52,400	99,400	72,320
Chromium *	28.8	941	335	28.7	34.4	30.6
Cobalt	3.6	21.7	13.4	11.4	15.4	13.9
Copper *	29.0	372	110	20.2	28.2	24.7
Iron	11,500	42,500	27,613	25,400	38,200	29,920
Lead *	29.6	120	67.5	8	16	10.7
Magnesium	4,690	32,500	13,063	13,400	14,600	13,980
Manganese	217	1,150	602	453	674	521
Mercury *	ND	1.1	0.78	ND	ND	0.1
Nickel	13.6	119	48.2	27.1	34.3	30.2
Potassium	1520	4840	3163	3,930	6,290	4,600
Selenium	ND	1.2	0.56	ND	ND	0.5
Silver	ND	ND	1	ND	ND	1
Sodium	329	1,390	725	511	567	541
Thallium	ND	0.64	0.55	ND	0.27	0.85
Vanadium	15	75	39.6	35.5	52	40.7
Zinc	80.2	282	157.5	57.9	73.1	66.6
Cyanide	ND	17.8	4.9	ND	ND	2

++ All values given in ppm (mg/kg)

Lead * Indicate maximum concentration found in fill is at least one order of magnitude greater than the mean concentration of soil samples.

+ One-half the contract required detection limit was used for calculation of the arithmetic mean for non detected analytes

ORGANIC COMPOUNDS DETECTED IN LAKE SEDIMENT
(17 TOTAL SAMPLES)

Compound	Maximum Concentration (ppb)	Location of Maximum Concentration	Total No. of Detections*		
			East Basin	West Basin	Total
Carbon Disulfide	2	LS-14/LS-17	3	0	3
1,1-Dichloroethane	2	LS-5	1	1	2
1,2-Dichloroethene (Total)	36	LS-14	3	5	8
2-Butanone	8	LS-16	2	0	2
Trichloroethene	20	LS-5	0	4	4
Benzene	1	LS-5	0	1	1
4-Methyl-2-Pentanone	0.8	LS-4	0	1	1
2-Hexanone	1	LS-4	0	1	1
Tetrachloroethene	4	LS-7	0	3	3
Total Xylenes	2	LS-5	0	1	1
1,2-Dichlorobenzene	50	LS-5	0	2	2
Benzoic Acid	50	LS-6	0	2	2
1,2,4-Trichlorobenzene	100	LS-6	0	2	2
2-Methylnaphthalene	11	LS-6	0	2	2
Acenaphthene	9	LS-2	0	1	1
Dibenzofuran	5	LS-2	0	1	1
Flourene	11	LS-2	0	1	1
Phenanthrene	86	LS-2	0	2	2
Anthracene	20	LS-2	0	1	1
Di-n-butylphthalate	87	LS-17	5	1	6
Fluoranthene	120	LS-2	2	4	6
Pyrene	97	LS-2	1	5	6
Butylbenzylphthalate	17	LS-5	0	6	6
Di-n-octylphthalate	57	LS-12	1	5	6
Benzo(b)fluoranthene	110	LS-14	1	3	4
Benzo(k)fluoranthene	49	LS-2	0	2	2
Benzo(a)pyrene	30	LS-6	0	2	2
Ideno(1,2,3-cd)pyrene	18	LS-6	0	1	1
Aroclor-1254	300	LS-5	0	2	2
Total Phenols	1.06	LS-6	3	7	10

LAKE SEDIMENTS AND BACKGROUND SURFACE AND SUBSURFACE SOILS

Analyte	Conc. in Lake Seds (17)*			Mean Conc. Subsurface Soil+	Mean Conc. in Backgrnd. Surface Soils+
	Min.	Max.	Mean+		
Aluminum	16,400	31,300	23,424	26,620	30,333
Antimony	ND	ND	6	5.2	6
Arsenic	2	5.5	3.6	2.4	3.0
Barium	96.5	206	149	190	151
Beryllium	ND	1.4	0.99	1.14	1.2
Cadmium*	ND	86.9	19.9	0.41	1.8
Calcium	24,900	61,300	43,365	72,320	3,610
Chromium*	27.4	1,100	230	30.6	44.6
Cobalt	9.9	24.1	16.6	13.9	13.8
Copper	19.9	253	82.0	24.7	38.4
Iron	22,000	53,500	34,171	29,920	34,100
Lead	ND	40.4	16.7	10.7	20.3
Magnesium	7,480	17,200	13,931	13,980	7,867
Manganese	391	746	567	521	281
Mercury	ND	ND	0.1	0.1	0.11
Nickel	24.9	93.2	50.0	30.2	40.2
Potassium	2,630	6,280	4,869	4,600	3,777
Selenium	ND	ND	0.5	0.5	0.53
Silver	ND	ND	1	1	1
Sodium	360	705	482	541	328
Thallium	ND	0.31	0.48	0.85	1
Vanadium	31	76.7	48.7	40.7	45.1
Zinc	51.9	194	104	66.6	140
Cyanide*	ND	22.9	3.6	2	1.58

* All values given in ppm (mg/kg)

Cadmium* Indicates maximum concentration found in lake sediments is at least one order of magnitude greater than either the mean concentration in surface or subsurface soil

+ One-half the contract required detection limit was used for calculation of the arithmetic mean for samples with non-detected analytes

Summary of Groundwater Treatment Design Data

Parameter	Type	Units	Design Concentration (Influent)
Vinyl Chloride	VOC	µg/L	800
Methylene Chloride	VOC	µg/L	5,600
Acetone	VOC	µg/L	20,400
1,1-Dichloroethane	VOC	µg/L	400
1,2-Dichloroethene (Total)	VOC	µg/L	21,000
Chloroform	VOC	µg/L	800
1,2-Dichloroethane	VOC	µg/L	88,700
2-Butanone	VOC	µg/L	70
1,1,1-Trichloroethane	VOC	µg/L	1,900
Trichloroethene	VOC	µg/L	13,500
Benzene	VOC	µg/L	3,300
4-Methyl-2-Pentanone	VOC	µg/L	3,100
Tetrachloroethene	VOC	µg/L	3
Toluene	VOC	µg/L	92,800
Chlorobenzene	VOC	µg/L	60
Ethylbenzene	VOC	µg/L	150
Total Xylenes	VOC	µg/L	1,200
Phenol	SEMI	µg/L	6,700
bis(2-Chloroethyl)ether	SEMI	µg/L	60
1,4-Dichlorobenzene	SEMI	µg/L	5
Benzyl Alcohol	SEMI	µg/L	90
1,2-Dichlorobenzene	SEMI	µg/L	5
2-Methylphenol	SEMI	µg/L	500
4-Methylphenol	SEMI	µg/L	1,700
Nitrobenzene	SEMI	µg/L	200
Isophorone	SEMI	µg/L	30
2,4-Dimethylphenol	SEMI	µg/L	40
Benzoic Acid	SEMI	µg/L	500
Bis(2-chloroethoxy)methane	SEMI	µg/L	70
1,2,4-Trichlorobenzene	SEMI	µg/L	5
Naphthalene	SEMI	µg/L	80
4-Chloroaniline	SEMI	µg/L	8
2-Methylnaphthalene	SEMI	µg/L	6
Phenanthrene	SEMI	µg/L	5
Di-n-butylphthalate	SEMI	µg/L	5
Fluoranthene	SEMI	µg/L	5
Pyrene	SEMI	µg/L	5
Butylbenzylphthalate	SEMI	µg/L	5
bis(2-Ethylhexyl)phthalate	SEMI	µg/L	40
Total Volatiles	*VOC*	µg/L	*253,783*
Total Semivolatiles	*SEMI*	µg/L	*10,064*
Total Organics		µg/L	*263,847*

Summary of Groundwater Treatment Design Data

Parameter	Type	Units	Design Concentration (Influent)
Aluminum	MCP	µg/L	4,000
Antimony	MCP	µg/L	40
Arsenic	MCP	µg/L	30
Barium	MCP	µg/L	200
Cadmium	MCP	µg/L	10
Calcium	MCP	µg/L	430,000
Chromium	MCP	µg/L	77,900
Cobalt	MCP	µg/L	30
Copper	MCP	µg/L	80
Iron	MCP	µg/L	12,500
Lead	MCP	µg/L	10
Magnesium	MCP	µg/L	947,000
Manganese	MCP	µg/L	1,000
Nickel	MCP	µg/L	200
Potassium	MCP	µg/L	63,200
Selenium	MCP	µg/L	3
Sodium	MCP	µg/L	1,450,000
Vanadium	MCP	µg/L	200
Zinc	MCP	µg/L	80
Cyanide	MCP	µg/L	1,000
Phenols	MCP	mg/L	30
Bicarbonate	MISC	mg/L	500
BOD	MISC	mg/L	900
COD	MISC	mg/L	1,200
Chloride	MISC	mg/L	900
Hardness	MISC	mg/L	5,400
Ammonia, as N	MISC	mg/L	20
Total Kjeldahl Nitrogen, as N	MISC	mg/L	40
Alkalinity	MISC	mg/L	500
Acidity	MISC	mg/L	400
Nitrate-Nitrogen	MISC	mg/L	1
Oil and Grease	MISC	mg/L	20
TOC	MISC	mg/L	900
TSS	MISC	mg/L	2,000
TDS	MISC	mg/L	8,000
Sulfate	MISC	mg/L	4,300
pH Units	MISC	mg/L	7

TABLE 4

Summary of Risks

Pathway	Number	Carcinogenic Risk	Chronic Risk
Trespasser Ingestion of Surface Soil	1	3.67E-06	7.06E-02
Trespasser Dermal Contact with Surface Soil	2	6.66E-06	1.28E-01
Tresp. Dermal Contact with Shallow Groundwater	3	5.01E-05	1.20E-01
Trespasser Inhalation of Vapors	4	2.05E-09	5.84E-07
Resident Inhalation of Vapors	5	3.20E-09	9.13E-07
Trespasser Inhalation of Fugitive Dust	6	2.55E-08	1.45E-01
Resident Inhalation of Fugitive Dust	7	2.12E-06	1.26E+01
User Ingestion of Surface Soil	8	7.36E-06	1.42E-01
User Dermal Contact with Surface Soil	9	3.67E-05	7.06E-01
User Dermal Contact with Shallow Groundwater	10	9.73E-05	2.50E-01
User Inhalation of Vapors	11	7.98E-09	2.27E-06
User Inhalation of Fugitive Dust	12	1.02E-07	6.03E-01
User Ingestion of Lake Water while Swimming	13	0.00E+00	1.60E-06
User Dermal Contact with Lake Water (Swimming)	14	0.00E+00	2.26E-04

Scenario	Pathways	Sum Carc. Risk	Sum Chronic Risk
Trespasser - NO ACTION	1-4, 6	6.05E-05	4.64E-01
Resident - NO ACTION	5, 7	2.12E-06	1.26E+01
User - FUTURE USE	8-14	1.41E-04	1.70E+00
Resident/Trespasser - NO ACTION	1-7	6.26E-05	1.31E+01
Resident/User - FUTURE USE	5,7-14	1.44E-04	1.43E+01

TABLE 5

TECHNOLOGY SCREENING SUMMARY

ENVIRONMENTAL MEDIA	REMEDIAL ACTION OBJECTIVES	GENERAL RESPONSE ACTION	REMEDIAL TECHNOLOGIES	PROCESS OPTIONS
SOIL, WASTE, AND FILL	NO ACTION	NO ACTION	NO ACTION	NO ACTION
	PREVENT HUMAN CONTACT	INSTITUTIONAL ACTION	INSTITUTIONAL ACTION	DEED RESTRICTIONS
				LONG TERM MONITORING
		CONTAINMENT	CAPPING	RCRA CAP
				6 NYCRR PART 360 CAP
				MSG CAP
				SOIL CAP
	PREVENT EROSION OF ON-SITE SURFICIAL SOILS INTO LAKE AND BULL CREEK	PHYSICAL CONTROLS	EROSION CONTROLS	VEGETATION
				BERMS AND DITCHES
		CONTAINMENT	CAPPING	(see above)
	PREVENT MIGRATION OF CONTAMINANTS INTO GROUNDWATER	EXCAVATION AND TREATMENT	BIOLOGICAL TREATMENT	BIOLOGICAL TREATMENT
			PHYSICAL/CHEMICAL TREATMENT	SOLIDIFICATION/STABILIZATION
				SOIL WASHING
			THERMAL TREATMENT	INCINERATION
				LOW TEMPERATURE THERMAL DESORPTION
		IN-SITU TREATMENT	BIOLOGICAL TREATMENT	BIOLOGICAL INJECTION
			PHYSICAL/CHEMICAL TREATMENT	CHEMICAL TREATMENT
				IN-SITU SOLIDIFICATION
				IN-SITU VITRIFICATION
		CONTAINMENT	SECURE CELL LANDFILL	ON-SITE RCRA CELL

TABLE31.WK1

15-May-91

Table 5 (continued)

TECHNOLOGY SCREENING SUMMARY

ENVIRONMENTAL MEDIA	REMEDIAL ACTION OBJECTIVES	GENERAL RESPONSE ACTION	REMEDIAL TECHNOLOGIES	PROCESS OPTIONS
GROUNDWATER	NO ACTION	NO ACTION	NO ACTION	NO ACTION
	PREVENT HUMAN CONTACT	INSTITUTIONAL ACTION	INSTITUTIONAL ACTION	DEED RESTRICTIONS
				LONG TERM MONITORING
	PREVENT MIGRATION OF CONTAMINATED GROUNDWATER	CONTAINMENT	VERTICAL BARRIERS	SHEET PILING
				SLURRY WALL
		COLLECTION	GROUNDWATER COLLECTION	SUBSURFACE COLLECTION TRENCHES
				WITHDRAWAL WELLS
		TREATMENT	OFF-SITE TREATMENT	POTW
				COMMERCIAL FACILITY
			ON-SITE TREATMENT	SITE-SPECIFIC PROCESS OPTIONS
SURFACE WATER	NO ACTION	NO ACTION	NO ACTION	NO ACTION
	PREVENT HUMAN CONTACT	INSTITUTIONAL ACTION	INSTITUTIONAL ACTION	DEED RESTRICTIONS
				LONG TERM MONITORING
				RESIDENT RELOCATION
	PREVENT OFFSITE WATER FROM ENTERING SITE	DIVERSION OF RUNON	DIVERSION	TRENCHES
				BERMS
	PREVENT ONSITE WATER FROM LEAVING SITE	DIVERT/COLLECT RUNOFF	COLLECTION	DRAINAGE DITCHES
			CONTROL OVERFLOW	BERMS/V-NOTCH WEIR

TABLE31.WK1

Table 5 (continued)

TECHNOLOGY SCREENING SUMMARY

<table>
<tr><th>ENVIRONMENTAL MEDIA</th><th>REMEDIAL ACTION OBJECTIVES</th><th>GENERAL RESPONSE ACTION</th><th>REMEDIAL TECHNOLOGIES</th><th>PROCESS OPTIONS</th></tr>
<tr><td rowspan="13">SEDIMENTS</td><td>NO ACTION</td><td>NO ACTION</td><td>NO ACTION</td><td>NO ACTION</td></tr>
<tr><td rowspan="3">PREVENT HUMAN CONTACT</td><td rowspan="2">INSTITUTIONAL ACTION</td><td rowspan="2">INSTITUTIONAL ACTION</td><td>DEED RESTRICTIONS</td></tr>
<tr><td>LONG TERM MONITORING</td></tr>
<tr><td>CONTAINMENT</td><td>CELL CONSTRUCTION</td><td>DREDGE AND CONSTRUCT RCRA PART 360 CELL FOR SEDIMENT</td></tr>
<tr><td rowspan="9">PREVENT MIGRATION OF CONTAMINANTS</td><td rowspan="4">DREDGING AND TREATMENT</td><td rowspan="3">PHYSICAL/CHEMICAL TREATMENT</td><td>SOIL WASHING</td></tr>
<tr><td>CHEMICAL TREATMENT</td></tr>
<tr><td>SOLIDIFICATION</td></tr>
<tr><td>THERMAL TREATMENT</td><td>INCINERATION</td></tr>
<tr><td rowspan="4">IN-SITU TREATMENT</td><td rowspan="4">PHYSICAL/CHEMICAL TREATMENT</td><td>IN-SITU CHEMICAL TREATMENT</td></tr>
<tr><td>IN-SITU SOLIDIFICATION</td></tr>
<tr><td>IN-SITU STABILIZATION</td></tr>
<tr><td>IN-SITU VITRIFICATION</td></tr>
<tr><td colspan="4"></td></tr>
<tr><td rowspan="5">AIR</td><td>NO ACTION</td><td>NO ACTION</td><td>NO ACTION</td><td>NO ACTION</td></tr>
<tr><td rowspan="3">PREVENT HUMAN CONTACT</td><td rowspan="3">INSTITUTIONAL ACTION</td><td rowspan="3">INSTITUTIONAL ACTION</td><td>DEED RESTRICTIONS</td></tr>
<tr><td>LONG TERM MONITORING</td></tr>
<tr><td>RESIDENT RELOCATION</td></tr>
<tr><td>PREVENT INHALATION OF FUGITIVE DUST</td><td>CONTAINMENT</td><td>CAPPING</td><td>SEE PROCESS OPTIONS FOR SOIL/WASTE/FILL</td></tr>
</table>

TABLE 6

FRONTIER CHEMICAL - PENDLETON SITE
COST ESTIMATES FOR REMEDIAL ALTERNATIVES

ITEM	ALTERNATIVE 1	ALTERNATIVE 2	ALTERNATIVE 3a	ALTERNATIVE 3b	ALTERNATIVE 4	ALTERNATIVE 5	ALTERNATIVE 6
CAPITAL COSTS							
1. MSG CAP			$3,001,000	$3,001,000			
2. SOIL CAP					$1,594,000	$1,594,000	$1,594,000
3. EXCAVATION AND ON-SITE THERMAL DESORPTION (HOT SPOT)							$19,056,000
4. IN-SITU SOLIDIFICATION (HOT SPOT)						$13,727,000	
5. IN-SITU SOLIDIFICATION							$6,097,000
6. EX-SITU HOT SPOT SOLIDIFICATION					$5,124,000		
7. PHYSICAL CONTROLS			$178,000	$178,000	$178,000	$178,000	$178,000
8. SHEET PILING (ALL)			$2,321,000	$2,321,000			
9. SHEET PILING (LAKESIDE)					$389,000	$389,000	$389,000
10. SEDIMENT DREDGING			$691,000	$691,000	$691,000	$691,000	$691,000
11. SEDIMENT TREATMENT (EX-SITU SOLIDIFICATION)				$4,693,000	$4,693,000	$4,693,000	$4,693,000
12. LAKE CELL							$2,586,000
13. AIR EMISSIONS CONTROL			$297,000	$297,000	$699,000	$297,000	$699,000
14. GROUNDWATER COLLECTION			$477,000	$477,000			
15. GROUNDWATER TREATMENT			$1,410,000	$1,410,000	$1,410,000		$1,410,000
16. GROUNDWATER MONITORING WELLS		$42,000	$42,000	$42,000	$42,000	$42,000	$42,000
TOTAL CAPITAL COST	$0	$42,000	$8,417,000	$13,110,000	$14,820,000	$21,611,000	$37,435,000
OPERATIONS AND MAINTENANCE COSTS							
1. GROUNDWATER MONITORING		$68,000	$68,000	$68,000	$68,000	$68,000	$68,000
2. MSG CAP			$43,000	$43,000			
3. SOIL CAP					$43,000	$43,000	$43,000
4. GROUNDWATER TREATMENT - LONG TERM (30 YEARS)			$215,000	$215,000			
5. GROUNDWATER TREATMENT - TEMPORARY (2 YEARS)					$215,000		$215,000
TOTAL ANNUAL O & M COST	$0	$68,000	$326,000	$326,000	$326,000	$111,000	$326,000
PRESENT WORTH OF O & M COST (@ 10% PER YEAR FOR 30 YEARS)	$0	$642,000	$3,079,000	$3,079,000	$1,478,000	$1,048,000	$1,478,000
PRESENT WORTH OF TOTAL COST (CAPITAL PLUS O & M)	$0	$684,000	$11,496,000	$16,189,000	$16,298,000	$22,659,000	$38,913,000