915141

Entered

FINAL

REMEDIAL INVESTIGATION/FEASIBILITY STUDY
IROQUOIS GAS/WESTWOOD PHARMACEUTICALS SITE #915141

FEASIBILITY STUDY

VOLUME II ADDENDUM

February 1994

Prepared by:
GeoTrans, Inc.
Sterling, Virginia

FINAL REMEDIAL INVESTIGATION/FEASIBILITY STUDY VOLUME II ADDENDUM February 1994

Iroquois Gas/Westwood Squibb
Feasibility Study Addendum
Volume II Addendum

Prepared for:

Westwood Squibb
100 Forrest Avenue
Buffalo, New York 14213

Prepared by:

GeoTrans, Inc.
46050 Manekin Plaza
Suite 100
Sterling, Virginia 20166

GeoTrans Project No. 7647-032

February 2, 1994

TABLE OF CONTENTS

Page

LIST OF FIGURES

LIST OF TABLES

Abbreviations

ACLs	Alternative Cleanup Levels
ARARs	Applicable Relevant and Appropriate
BAT	Best Available Technology
BCT	Best Conventional Technology
BPJ	Best Professional Judgment
BTEX	Benzene, Toluene, Ethylbenzene, and Xylenes
CAA	Clean Air Act
CPAHs	Carcinogenic Polycyclic Aromatic Hydrocarbons
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Register
CWA	Clean Water Act
DOT	Department of Transportation
EPA	Environmental Protection Agency
FS	Feasibility Study
IG/WS	Iroquois Gas/Westwood Squibb
MCLs	Maximum Contaminant Levels
MCLGs	Maximum Contaminant Level Goals
NCP	National Contingency Plan
NPDES	National Pollution Discharge Elimination System
NYSDEC	New York State Department of Environmental Conservation
PAHs	Polycyclic Aromatic Hydrocarbons
POTW	Publicly Owned Treatment Works
RAOs	Remedial Action Objectives
ROD	Record of Decision
SCGs	Standards, Criteria, and Guidelines
SDWA	Safe Drinking Water Act
SPDES	State Pollution Discharge Elimination System
SWDA	Solid Waste Disposal Act
TAGM	Technical and Administrative Guidance Memorandum
TBC	To Be Considered
UIC	Underground Injection Control

1 IDENTIFICATION OF ADDITIONAL APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS FOR SEDIMENTS

Additional **chemical specific and** location-specific applicable or relevant and appropriate requirements (ARARs) have been developed for sediments at the Iroquois Gas/Westwood Squibb (IG/WS) site. Only ARARs which are in addition to, or different from, those previously presented in the IG/WS Feasibility Study (FS) are presented in this addendum. A summary of chemicals detected in sediments is presented in Table 1-1. **Sediment cleanup criteria are outlined in a New York State Department of Environmental Conservation (NYSDEC) guideline entitled "Clean-up Criteria for Aquatic Sediments" and dated December, 1989. These guidelines, which have not been officially promulgated, outline recommended clean-up levels for sediments based on their organic carbon content and equilibrium partitioning theory. Levels are given for both in aquatic toxicity and a human health residue basis. Levels in excess of aquatic toxicity limits would be expected to harm benthic organisms, while those in excess of human health residue levels would be expected to bioaccumulate in aquatic animals to levels exceeding human health tolerance, action level, or cancer risk dose. Table 1-2 presents sediment clean-up criteria normalized to organic carbon content. Table 1-3 presents sediment criteria for metals. Table 1-4 presents sediment criteria for Benzo(a)pyrene for several different organic carbon contents. These sediment criteria are considered TBCs.** Several location-specific ARARs dealing with flood plains and streams which were not previously applicable for onsite soils and groundwater are potentially applicable for sediments. Several new state ARARs dealing with streams and rivers have also been added to the list of potential location-specific ARARs. These are presented in Table 1-5.

Table 1-1. Chemicals of potential concern detected in sediments (µg/kg).

Compound	Minimum Detected	Geometric Mean	Maximum Detected
ORGANICS			
Acetone	22	7.6	22
Benzoic Acid	110	NA	170
2-Butanone	915.8	16.8	2,200
Butylbenzylphthalate	100	150	260
4-Chloroaniline	180	NC	180
Di-n-butyl phthalate	89	190	410
Dibenzofuran	180	1,300	44,000
Ethylbenzene	13	3.7	13
bis(2-Ethylhexyl)phthalate	130	470	7,000
Methylene Chloride	4	3.3	4
Benzo(a)anthracene	360	5,000	160,000
Benzene(a)pyrene	550	5,400	150,000
Benzo(b)fluoranthene	420	4,300	140,000
Benzo(k)fluoranthene	240	4,300	32,000
Chrysene	410	5,400	160,000
Dibenz(a,h)anthracene	330	1,500	18,000
Indeno(1,2,3-c,d)pyrene	150	2,800	53,000
Acenaphthylene	86	1,200	31,000
Acenaphthene	94	3,000	530,000
Anthracene	97	2,600	300,000
Benzo(g,h,i)perylene	270	4,300	72,000
Fluoranthene	370	6,400	390,000
Fluorene	87	2,200	280,000
2-Methlynaphthalene	94	2,800	960,000

Table 1-1 Chemicals of potential concern detected in sediments ($\mu g/kg$) (continued).

Compound	Minimum Detected	Geometric Mean	Maximum Detected
Naphthalene	170	3,100	1,400,000
Phenanthrene	230	8,500	800,000
Pyrene	770	14,000	450,000
Trichloroethene	2	3.2	4
INORGANICS			
Aluminum	6,570	13,000	31,800
Antimony	1.7	0.9	1.7
Arsenic	8.5	14	26.6
Barium	45.3	220	1,510.5
Beryllium	0.7	0.4	6.8
Cadmium	1	1	3.5
Calcium	21,500	62,000	204,000
Chromium	10.7	44	139.1
Cobalt	2.8	8.1	20.8
Copper	25	92	229
Cyanide	0.9	1.1	18.7
Iron	6,830	22,000	82,600
Lead	48.5	340	1,504.5
Magnesium	6,480	16,000	47,100
Manganese	137	650	4,200
Mercury	0.1	0.1	0.6
Nickel	9.3	24	71.2
Potassium	945.5	2,000	5,340

Table 1-1 Chemicals of potential concern detected in sediments (µg/kg) (continued).

Compound	Minimum Detected	Geometric Mean	Maximum Detected
Selenium	0.5	1	4.5
Silver	1	0.3	2.4
Sodium	261	150	844
Thallium	0.3	0.2	0.3
Vanadium	6.3	21	38.4
Zinc	113	390	2,440.5

Note: Nondetected values are assumed to be one-half the detection limit for calculation of the Geometric Mean.
NC is not calculated

Table 1-2. Sediment Clean-up Criteria for a Variety of Environmental Protection Objectives (criteria are normalized to grams of organic carbon content, gOC).

Compound	Log K_{ow}	Aquatic Toxicity Basis		Human Health Residue Basis	
		AWQS[1], ug/L	Sediment Criterion ug/gOC	AWQS, ug/L	Sediment Criterion ug/gOC
Acenapthene	4.33		730[2]		
Benzo(a) anthracene	6.04			0.0012[3]	1.3
Benzo(a)pyrene	6.04			0.0012[3]	1.3
Benzo(b) fluoranthene	6.04			0.0012[3]	1.3
Benzo(k) fluoranthene	6.04			0.0012[3]	1.3
Bis(2-ethylhexyl) phthalate	5.3	0.6[3]	119.7		
Chrysene	6.04			0.0012[3]	1.3
Indeno(1,2,3-c,d) pyrene	6.04			0.0012[3]	1.3
Phenanthrene	4.45		139[2]	0.0012[3]	
Trichloroethylene (Trichloroethene)	2.29			11[3]	2

[1] Ambient water quality standard or guidance value in TOGS 1.1.1 or other water quality criterion.
[2] EPA proposed interim sediment criteria, taken from an EPA briefing document for the EPA Science Advisory Board.
[3] Current NYS AWQS or guidance value in TOGS 1.1.1.
Source: Clean-Up Criteria for Aquatic Sediments (NYSDEC, December, 1989)

Table 1-3. Sediment Criteria for metals (ug/kg).

	Background[1]	Criteria[2]	Limit of Tolerance[3]
Arsenic	12	5.0 (4.0-5.5)	33
Cadmium	2.5	0.8 (0.6-1.0)	10
Chromium	75	26 (22-31)	111
Copper	65	19 (15-25)	114
Iron	59000	24000 (20000-30000)	40000
Lead	55	27 (23-31)	250
Manganese	1200	428 (400-457)	1100
Mercury	0.6	0.11 (0.10-0.12)	2
Nickel	75	22 (15-31)	90
Zinc	145	85 (65-110)	800

[1] Upper 95% confidence limit of pre-industrial concentrations in Great Lakes sediments.
[2] Values in parentheses are 'no-effect' and 'lowest-effect' levels, respectively.
[3] Concentration which would be detrimental to the majority of species, potentially eliminating most.

Source: Clean-Up Criteria for Aquatic Sediments (NYSDEC, December, 1989)

Table 1-4. Sediment Criteria for Benzo(a)pyrene in 1% and 3% Organic Carbon Content Sediment.

Compound	Sediment Criteria, ug/kg
	Human Health Residue Basis
Benzo(a)pyrene	
1% OC	13[1]
3% OC	39[1]

[1] Based on current NYS AWQS or guidance value in TOGS 1.1.1.

Source: Clean-Up Criteria for Aquatic Sediments (NYSDEC, December, 1989)

Table 1-5. Location-Specific ARARs.

Location	Citation	Requirement	Applicable/Relevant and Appropriate	Comment
Federal				
Flood Plain	Executive Order No. 11988, Protection of Floodplain 16 USC 661 et seq. 40 CFR Part 6, Appendix A and 40 CFR 6:302	Actions that will occur in a flood plain and relatively flat areas adjoining inland and coastal waters and other flood plain areas must avoid adverse effects.	No/No	The site is not located within a flood plain area.
100-Year Flood Plain	40 CFR 264.18(b); 40 CFR 761.75	RCRA treatment, storage, or disposal facility must be designed, constructed, operated, and maintained to avoid washout within 100-year flood plain.	No/No	No part of the site is located within a 100-year flood plain.
Rivers and Harbors Act of 1899	33 USC Sect. 403			
Navigable Waters	Section 10 Permit 33 CFR Parts 320-330	Requires permit for structure or work in or affecting navigable water.	Yes/Yes	Structure or work may affect navigable water during some remedial actions.
Area Affecting a Stream or River	Fish and Wildlife Coordination Act 16 USC 661 et seq. 33 CFR Parts 320-330 40 CFR 6:302	Action to protect fish or wildlife from diversion, channeling, or other activity that modifies a stream or river and affects fish or wildlife.	Yes/Yes	**Capping, excavation and possibly channeling may affect the creek during remedial actions.**

Table 1-5. Location-Specific ARARs (continued).

Location	Citation	Requirement	Applicable/Relevant and Appropriate	Comment
State				
Protected Streams	6 NYCRR Section 608.2	Regulates disturbance of protected streams.	Yes/Yes	Stream area may be disturbed during some remedial actions.
Navigable Waters	6 NYCRR Section 608.4	Regulates excavation or placement of fill in navigable waters.	Yes/Yes	Excavation of sediment may occur during some remedial actions.

2 IDENTIFICATION AND SCREENING OF REMEDIAL ACTION AND TECHNOLOGIES

The objective of this section of the addendum to the FS is to select, from available technologies, remedial technologies consistent with CERCLA, SARA, and the National Oil and Hazardous Substance Pollution Contingency Plan (NCP) to develop remedial alternatives encompassing Scajaquada Creek sediments. The technology screening includes the following steps and will be addressed in this section:

1. Development of remedial action objectives (RAOs) specifying the media of interest, exposure pathways, and remediation goals for the contaminants of concern.

2. Identification of areas and volumes of contaminated media.

3. Development of general response actions that address the remedial action objectives.

4. Identification of potential remedial technologies and the initial screening of these technologies based primarily on their ability to be technically implemented.

5. Final screening of remaining technologies on the basis of effectiveness, implementability, and relative cost during which representative process options and technologies are selected for the development and evaluation of remedial alternatives.

2.1 REMEDIAL ACTION OBJECTIVES

The primary goals of the RAOs for the IG/WS Site are to protect human health and the environment from potential contaminants and to remediate the contaminated media as required by ARARs. In developing the RAOs for the sediment immediately adjacent to the IG/WS Site the following observations were made based on information gathered during the remedial investigation (RI) and ARAR identification in Section 1:

- **Historical contaminant sources in addition to the IG/WS Site were present, continuing sources include**

urban runoff and other unidentified discharges. NYSDEC sampling in August 1993 indicated contaminant concentrations throughout the stream length, with locally elevated concentrations near the IG/WS site. Containment or removal of sediments from the small section of the creek adjacent to the site will reduce overall contaminant loading in the creek and reduce risk. Any remediated area of the creek would be recontaminated somewhat; consideration of Scajaquada Creek as a whole would be more effective for remedial purposes. Any such consideration is beyond the scope of this study.

- The depth to the clay layer underlying the contaminated sediments has been measured at two feet below the sediment surface at several locations. It is assumed for purposes of this study only that contamination is confined above the clay layer to an average depth of two feet with lateral extent to the creek bank and up and downstream 100 feet beyond the limits of the RI sample locations.
- The target chemicals of concern identified in the risk assessment are PAHs.
- The sediment is located on property **whose ownership is assumed to be the City of Buffalo.**

The specific goals and objectives of the remedial actions at the IG/WS Site in accordance with the CERCLA/SARA requirements and the preceding assumptions are as follows:

- Isolate the IG/WS Site from the creek.
- Isolate, treat, remove or contain contaminated sediments adjacent to the IG/WS Site in order to (a) minimize the potential for ingestion, dermal contact, and inhalation of materials containing concentrations of PAHs in excess of ARAR values, and (b) reduce the potential for further migration of contaminants.

2.2 AREA AND VOLUME OF CONTAMINATED MEDIA

Creek sediment sampling during the RI indicated the presence of contaminants. The types and volumes of contaminants identified are consistent with the use of the adjacent site as a former MGP facility.

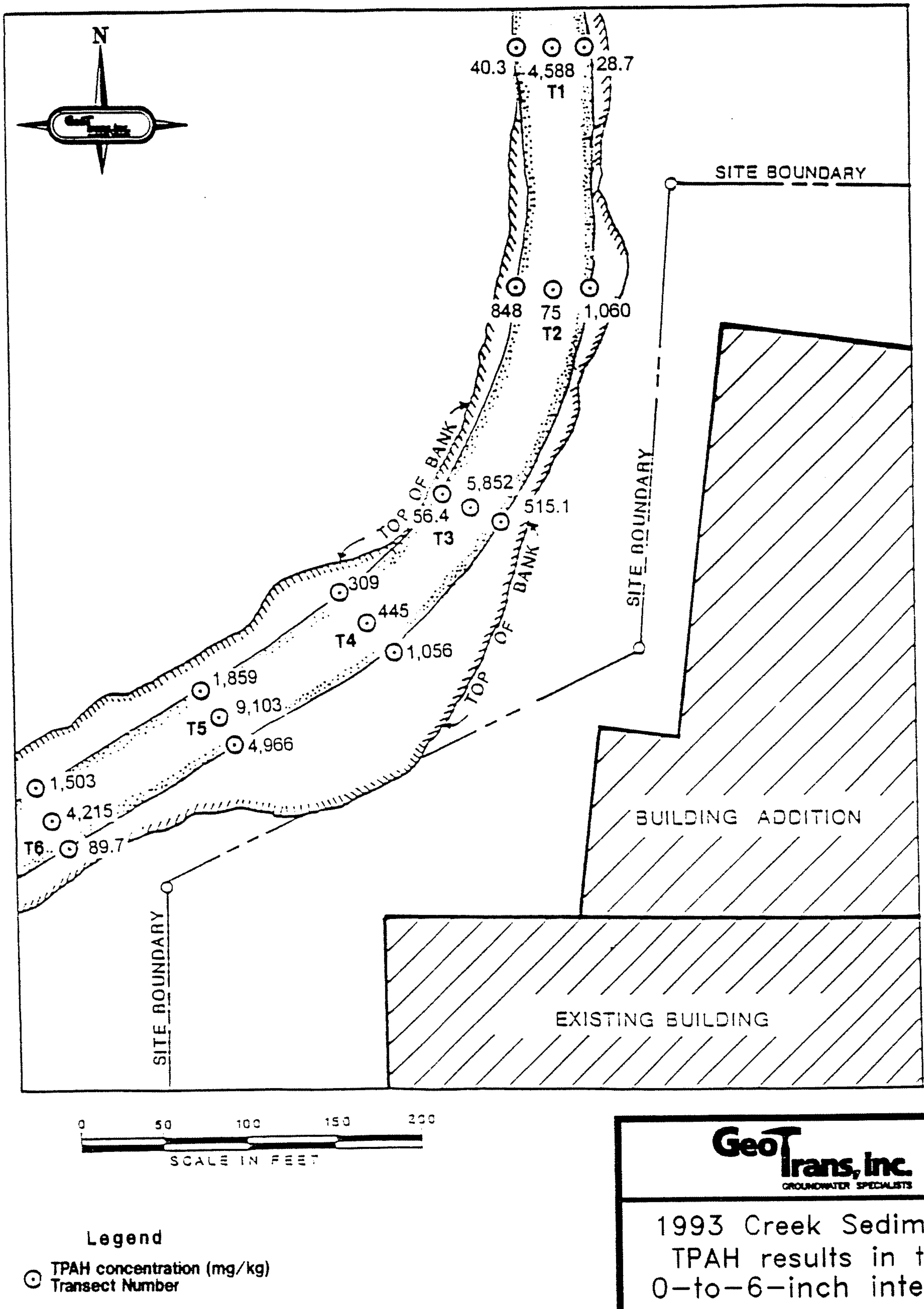
Sediment contamination likely occurred from former direct discharges to the creek and accidental spills and leaks in and around plant operation areas, as well as from **contaminated groundwater and possible NAPL discharges to the creek and urban runoff.** Figure 2-1 and 2-2 are maps showing 1993 creek sediment sample locations and results.

Assuming contaminated sediments to be considered for this FS include an area extending 100 feet upstream and downstream from transects T1 and T6 and an average width of 10 feet beyond the average creek bed, the area to be considered is approximately 6,000 square yards. Assuming an average contaminated sediment depth of two feet, the volume to be considered is approximately 4,000 cubic yards.

2.3 GENERAL RESPONSE ACTIONS

General response actions are defined as remedies that meet the remedial action objectives. Identification of general response actions is necessary prior to development of a list of potential technologies and process options applicable to remediation of the creek sediment at the IG/WS Site. The following is a list of the general response actions that have been identified for the site:

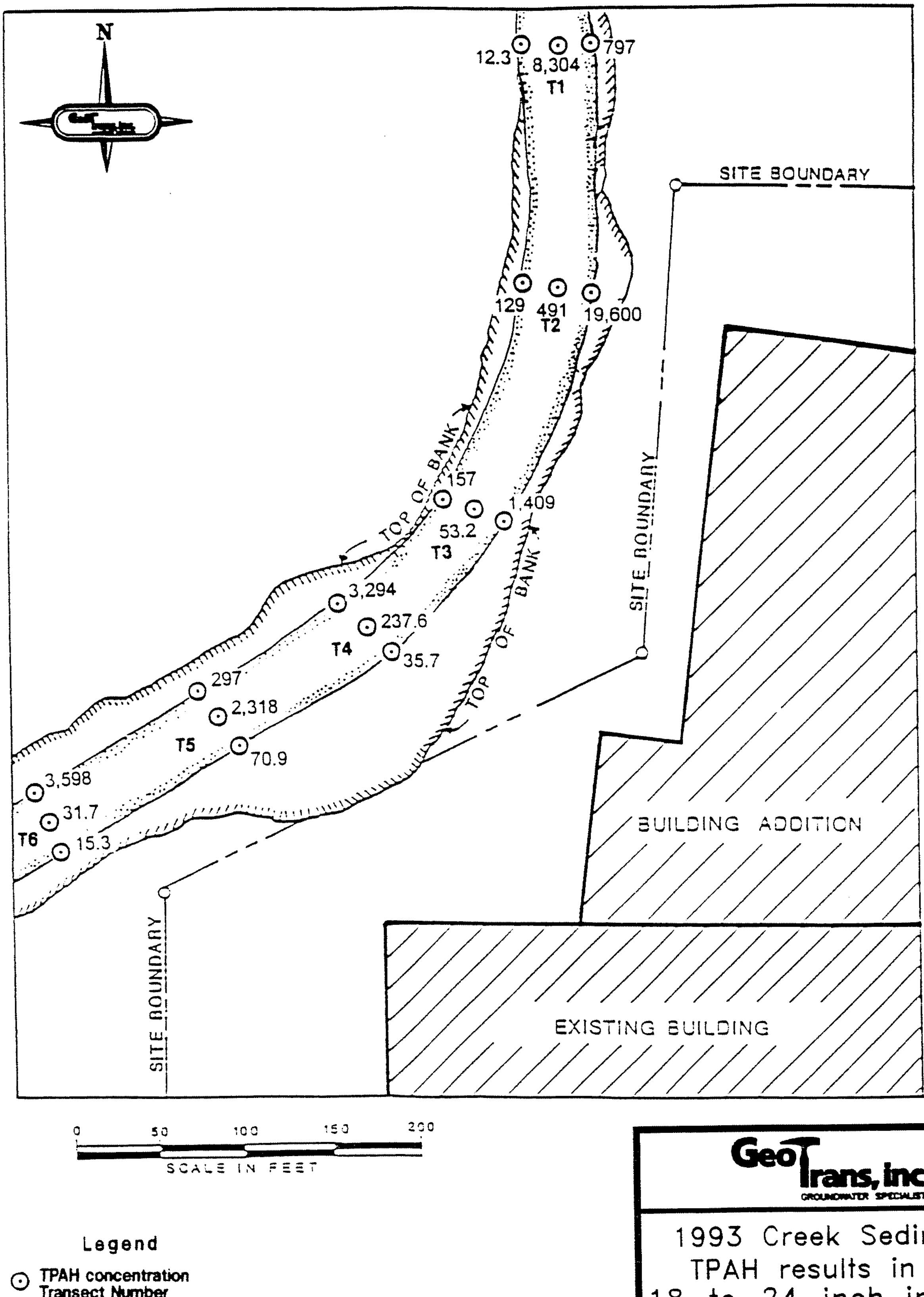
- No action: The site is left in its existing state and no funds are expended for monitoring, control, or cleanup of the contamination.
- Institutional control/monitoring: Restrictions are established and implemented to control public and environmental contact with the contaminants (i.e., site access and use restrictions).
- Containment: Direct physical or chemical isolation of the contaminants.
- Removal: Excavation or extraction of the contaminated media and removal from the immediate area.



GeoTrans, inc.
GROUNDWATER SPECIALISTS

1993 Creek Sediment TPAH results in the 0-to-6-inch interval

PREPARED BY : T.B.	DATE : 7/22/96	FIGURE
CHECKED BY : T.B.	REVISED : 7/27/96	2-1
DRAWN BY : JPM	DRAWING NO : 87047-002/OA/0	



GeoTrans, inc.
GROUNDWATER SPECIALISTS

1993 Creek Sediment TPAH results in the 18-to-24-inch interval

PREPARED BY : T.B.	DATE : 7/22/96	FIGURE
CHECKED BY : T.B.	REVISED : 7/27/96	2-2
DRAWN BY : JPM	DRAWING NO : 57647-CS/OA/4	

- Onsite treatment: Application of biological, chemical, physical or thermal processes to reduce the toxicity, mobility, or volume of the contaminated material.
- Offsite treatment: Similar to onsite treatment, except that the contaminated media are transported to an offsite facility for treatment.
- In-situ treatment: In-place treatment to render the contaminated material less harmful.
- Offsite disposal/discharge: Transport of the contaminated material to an offsite disposal facility.

Table 2-1 describes the general response actions and their associated potential remedial action technologies applicable to the remediation of sediment.

2.4 INITIAL TECHNOLOGY SCREENING

The screening of technologies follows the conceptual development of potentially applicable processes and precedes the final screening and detailed analysis of alternatives. Following screening, technologies are identified and combined into alternatives, although specific details of the alternatives may not be defined. The initial set of alternatives developed shall include appropriate remedial technologies that are representative of the general response actions. During the screening, the extent of remedial action (e.g., quantities of media to be affected), the sizes and capacities of treatment units, and other details of each alternative should be further defined, as necessary, so that screening evaluations can be conducted.

The objective of initial remedial technology screening is to narrow the list of potential technologies that will be evaluated in detail. In some situations, the number of viable alternatives to address site problems may be limited so that screening may be unnecessary or minimized. At this initial stage, cost will not be used to guide the initial development and screening of remedial technologies or alternatives. Because the purpose of the screening evaluation is to reduce the number of technologies that will

Table 2-1. General response actions and associated potential remedial action technologies for sediment.

General Response Action	Potential Remedial Action Technology
No Action	No Action
Institutional Control/Monitoring	Site Access and Use Restrictions
Containment	Capping
Removal	Excavation and dredging Coffer dam installation, dewatering, and excavation
Onsite Treatment	Biological Chemical Thermal Physical/Chemical
Offsite Treatment	Thermal Biological
In-Situ Treatment	Biological Chemical Physical/Chemical Thermal
Onsite Disposal	Disposal
Offsite Disposal	Disposal

undergo a more thorough and extensive analysis, technologies should be evaluated more generally in this phase than during the detailed analysis.

A key aspect of the initial technology screening evaluation is determination of the technical implementability of each technology in protecting human health and the environment. This screening is accomplished by use of information from the RI on contaminant types, concentrations, and site characteristics. Based on CERCLA guidance, the following is a list of reasons why screening technologies and process options may be rejected:

- Technology/process option would not be a practical method for the volume or area of contaminated media that is to be remediated.
- Technology/process options would not be an effective method for the remediation of all of the contaminants due to the characteristics or concentrations of contaminants present at the site.
- Technology/process options would not be feasible and/or effective due to site conditions. These include site location and size, surrounding land use, site weather, geology, hydrogeology, and characteristics of the contaminated media.
- Technology/process option could not be effectively administered.
- Technology has not been proven effective on site contaminants or media.
- Extremely high costs relative to other equally effective technologies.

Table 2-2 presents the initial screening of remedial technologies for the sediments.

2.5 SUMMARY OF THE PROCESS OPTIONS THAT PASSED THE INITIAL TECHNOLOGY SCREENING

Descriptions of process options that pass initial screening are listed in Table 2-3. According to the initial screening results, these

Table 2-2. Initial screening of remedial technologies and process options for sediment.

Technology	Process Option	Process Description	Comments
No action	None	Site is left in its existing state.	RETAINED. Required by the National Oil and Hazardous Substances Pollution Contingency Plan as a baseline alternative.
Site access and use restrictions	Deed covenant	Land use restrictions would be recorded in the property deeds to prohibit activities that might disturb contaminated subsurface materials.	RETAINED. Limited application. Difficult to implement in a creek bed. Would not reduce or control contaminant migration. Would be used with other technologies such as capping. Several property owners including the city or state would be involved.
	Fencing and signage	Site would be fenced and warning signs posted. Long-term maintenance and security would be required.	RETAINED. Limited application. Would not reduce or control contaminant migration. Fence could only extend to creek bank. Would be used with other technologies, such as capping.
Environmental monitoring	Monitoring	Sediment and/or surface water monitoring.	RETAINED. Would be used in conjunction with other technologies.
Capping	Native soil	Placement and compaction of uncontaminated native soil over the contaminated area.	REJECTED. Ineffective due to lack of erosion control.
	Clay	Placement and compaction of clay over the contaminated area.	REJECTED. Ineffective due to lack of erosion and moisture control.
	Concrete	Installation of concrete over contaminated sediment to line creek bank.	RETAINED. Maintenance required.
	Synthetic membrane	Placement of low permeability synthetic membrane followed by rip-rap over the contaminated area.	RETAINED. Long-term reliability of membrane is unknown. Maintenance required.
Removal	Excavation and dredging	Removal of source area material by conventional earth-moving equipment and dredges.	RETAINED. Would be used in conjunction with treatment or disposal technologies. Requires restoration of the site and sediment control.
	Coffer dam installation, pumping, and excavation	Dewatering the creek bed prior to excavation.	RETAINED. Used with treatment or disposal technologies. Prevents surface water contamination. More exact removal possible.

Table 2-2. Initial screening of remedial technologies and process options for sediment (continued).

Technology	Process Option	Process Description	Comments
Onsite biological treatment	Landfarming	Contaminated material is first excavated and then spread over a controlled area. The material is then tilled concomitantly with moisture and nutrient addition to allow microbial destruction of the contaminants. May require seeding with appropriate microorganisms.	RETAINED. The moisture content of the material would make implementation onsite difficult. Landfarming has been effective in full-scale applications for PAH- and BTEX-contamination.
	Composting	Contaminated material is placed in piles 3 to 6 feet high and aerated by turning or forced aeration. May occur in an enclosed vessel. Nutrients and moisture are added as necessary.	**RETAINED. The moisture content of the material would make implementation difficult. Effective in treating organics.**
	Bioreactor	Contaminated material is placed in a bioreactor with sufficient water to create a slurry. The slurry is seeded with microorganisms, then aerated and mixed. Nutrients are added as necessary.	**RETAINED. Effective in testing organics. More effort required than other biological options.**
Onsite chemical treatment	Oxidation	An oxidizing agent (e.g., hydrogen peroxide, hypochlorite, ozone) is added to the material. The contaminants are then oxidized to either intermediate compounds or ultimately to carbon dioxide and water.	REJECTED. Not a proven in application to PAH-contaminated material. May result in degradation of non-targeted compounds. Contaminants may degrade into products more toxic than their precursors. Hydrogen peroxide may decompose before reaching targeted compounds.
	Reduction	A reducing agent is added to the material to lower the contaminant's oxidation state and render it less toxic or more treatable.	REJECTED. Effectiveness in treating organics has not been proven. Most commonly used in treating heavy metals.
Onsite thermal treatment	Rotary kiln incinerator	Solid waste is fed into the upper end of a kiln, which rotates to mix the waste with combustion air as it passes through the kiln.	RETAINED. Refractory lining permits high operating temperatures. No moving parts within the combustion zone. Low thermal efficiency and high capital costs.
	Multiple hearth furnace	Solid waste is fed into the furnace roof from the top and pushed through drop holes into a series of vertically stacked refractory hearths.	REJECTED. Not recommended for hazardous wastes, due to low operating temperatures. Extensive materials handling required to sort/size debris contained in source areas. Space onsite might be too limited for temporary storage, materials handling requirements, and incineration equipment.
	Fluidized bed incinerator	Wastes are injected above a preheated granular bed, which is fluidized by bubbling air through a distributor plate located below the bed.	RETAINED. Refractory lining permits high operating temperatures. No moving parts within the combustion zone. Low thermal efficiency and high capital costs.

Table 2-2. Initial screening of remedial technologies and process options for sediment (continued).

Technology	Process Option	Process Description	Comments
Onsite thermal treatment (continued)	Circulating bed incinerator	Similar to fluidized bed incineration, but the fluid moves at much higher velocities. Fluidized material is recirculated through the feed section.	RETAINED. Advantages similar to the fluidized bed, but less susceptible to corrosion. It also has a less complicated scrubber system and can maintain close temperature control, which permits heat recovery.
	High-temperature fluid waste reactor	Waste is destroyed in a reactor consisting of a tubular core of refractory material that emits radiant energy supplied by large electrodes in the jacket of the vessel.	REJECTED. Process has only been tested on a pilot-scale system. Full-scale technology not yet available. High energy consumption and extensive exhaust emission cleanup requirements.
	Infrared incinerator	Waste is conveyed by a temperature-resistant alloy belt through two heating modules. In the first module, the contaminants are combusted by infrared radiant heat provided by horizontal rows of electric powered silicon carbide rods at temperatures up to 1850° F. The infrared or gas-fired secondary combustion chamber is capable of reaching temperatures of 2300° F.	RETAINED. Full-scale system has been used on a CERCLA site.
	Molten salt incinerator	Wastes and air are injected into a bed of molten alkali metal salts, where the contaminants are destroyed by a combination of incineration, absorption, and chemical reaction.	REJECTED. Pilot scale only. Has been used successfully on highly toxic inorganic or halogenated organic wastes, but no full-scale demonstrations have been completed on PAH-contaminated material.
	Thermal extraction	Low temperature thermal pretreatment in which contaminated material is heated under anaerobic conditions to extract the contaminants in a vapor stream. Has been used (pilot scale) to remove oil from tar sands.	REJECTED. Still experimental for the removal of contaminants from material. Contaminants in source areas are already relatively concentrated. Extracted contaminants still require treatment or disposal.
	Vitrification	Wastes and glass are heated in a closed container to an extremely high temperature that melts the mix. The resulting mass is then quickly cooled and a glass-like solid is formed. Pretreatment of wastes may be required.	REJECTED. Due to extremely high costs, this technology is only applicable to radioactive or extremely dangerous wastes.

Table 2-2. Initial screening of remedial technologies and process options for sediment (continued).

Technology	Process Option	Process Description	Comments
Onsite physical/ chemical treatment	Lime-fly ash pozzolan solidification process	Wastes are mixed with a siliceous-and-aluminous material (pozzolan) and with a lime-fly ash mixture to produce a strong and low-permeable solid.	REJECTED. Oil and grease interfere with bonding. Not proven to decrease the mobility of PAHs.
	Pozzolan-portland cement solidification processes	Wastes are mixed with a siliceous-and-aluminous material (pozzolan) and with portland cement to produce a strong and low-permeable solid.	REJECTED. This process will increase the volume of waste by as much as 100 percent. More expensive than the lime-fly ash pozzolan process, but less subject to leaching. Impurities such as metal salts, organic matter, and fine silts may increase setting times.
	Organic contaminant solidification/ stabilization processes	Organic wastes are blended with synthetic binders (many processes use proprietary chemicals) and the waste/binder material is mixed with either lime-fly ash or fly ash-cement to produce a strong low-permeability solid.	REJECTED. Process is applicable to organic wastes. Still a relatively new process. Not proven to decrease the mobility of PAHs.
	Microencapsulation	Heated dried wastes are mixed with an asphalt bitumen, paraffin, or polyethylene matrix resulting in a solid waste mass for landfill disposal.	REJECTED. Method is only applicable to small quantities of hazardous wastes that are complex and difficult to treat.
	Surface encapsulation	Includes several processes in which wastes are isolated by sealing them in an organic binder or resin.	REJECTED. High cost compared to other solidification techniques. Usually applied to very soluble toxic wastes.
Offsite thermal treatment	RCRA-approved offsite incinerator	Destruction of contaminants by incineration in an offsite RCRA-approved commercial incinerator.	RETAINED. Proven technology for destruction of organic contaminants.
	Coal fired utility boiler/ recycling facility	Wastes are fed into a coal fired utility boiler along with the fuel (also asphalting or brickmaking).	RETAINED. Provides good mixing and long residence times.
Offsite biological treatment	Approved offsite facility	Destruction of the contaminants by biodegradation.	REJECTED. This type of treatment facility is not currently available.
In-situ biological treatment	Bioremediation	Enhancement of indigenous microbial activities by injecting oxygen and nutrients into the subsurface. Additional hydrocarbon degrading microorganisms may also be added if necessary.	REJECTED. Implementation of oxygen or nutrient injection in sediment is infeasible due to location and fine-grained nature of material. However, some natural degradation will occur with no active remediation.

Table 2-2. Initial screening of remedial technologies and process options for sediment (continued).

Technology	Process Option	Process Description	Comments
In-situ chemical treatment	Oxidation	An oxidizing agent is applied to or injected into the source area. The media within the source area is then cultivated to promote contact between the oxidizing agent and the waste. Wastes are subsequently oxidized to less toxic byproducts.	REJECTED. Not a proven in application to PAH-contaminated material. May result in degradation of non-targeted compounds. Some contaminants produce degradation products more toxic than their precursors, since the source areas consist of a non-homogeneous mixture of coal tar, soil, agent, and the contaminants.
In-situ physical/ chemical treatment	Stabilization	Powdered activated carbon or another chemical agent is mixed with the material in place. Contaminant adsorbs onto agent, or reacts with it, thereby restricting migration of the contaminant.	REJECTED. Not proven, especially with regard to long-term effectiveness on organic contaminants. Periodic reapplication of the agent is required.
	Soil flushing	A flushing solution (solvent or surfactant) is used to flood the site or is injected into the contaminated area. Sorbed contaminants are solubilized, emulsified, or chemically react with the flushing solution and thus become mobile. The contaminated elutriate is collected by pumping or through an underdrain system.	REJECTED. Limited by site conditions, including waste location and type and hydrogeology.
In-situ thermal treatment	Vitrification	An array of electrodes is inserted into the subsurface, and an electric potential is applied between the electrodes. The flowing current then heats the adjacent soils and causes the silicates to melt. The contaminants are either trapped within the melted mass as it cools or they volatilize. Contaminants that volatilize are captured by an off-gas treatment system.	REJECTED. Pilot-scale application has only been tested on radioactive and inorganic wastes.
Onsite disposal	Onsite landfill	Permanent onsite storage facility.	REJECTED. Would require long-term operation and maintenance and security. Not desirable in an urban area.
Offsite disposal	RCRA solid waste landfill/recycling facility	Disposal of dewatered waste in a solid waste landfill (as a special waste).	RETAINED. Would be used in conjunction with removal, may require pretreatment.
	RCRA hazardous waste landfill	Disposal of contaminated waste in a RCRA-approved hazardous waste landfill.	RETAINED. Would not directly reduce toxicity or mobility of the contaminants or volume of the contaminated material. Additional remedial action might ultimately be required. This process option is retained only for material which cannot be effectively treated by other technologies.

Table 2-3. Process descriptions of remedial technologies passing initial screening for sediment.

Remedial Technology	Process Option
No Action	None
Site Access and Use Restrictions	Deed Covenant Fencing and Signage
Environmental Monitoring	Monitoring
Capping	Concrete, Synthetic Membrane
Removal	Dewatering prior to excavation, excavation and dredging
Onsite Thermal Treatment	Rotary Kiln, Fluidized Bed, Circulating Bed, Infrared
Offsite Thermal Treatment	Utility Boiler/Recycling Facility, Incinerator
Onsite Biological Treatment	Landfarming, **Composting, Bioreactor**
Offsite Disposal	Solid Waste Landfill, Hazardous Landfill

technologies are potential remedial components for the treatment of contaminated sediments and are evaluated further in the final screening.

2.6 FINAL SCREENING OF RETAINED PROCESS OPTIONS FOR THE REMEDIATION OF THE SEDIMENT

This section describes the final screening of technologies and process options that were retained in the initial screening for the remediation of the source areas/soil. The final screening is conducted on the basis of the effectiveness, implementability, and relative cost of each process option. The effectiveness of a process option is determined by considering the following:

- Can the process option effectively handle the volume of media to be treated?
- Can the process option achieve the remedial action objectives?
- Is the process option a proven and reliable method with respect to the contaminants and site conditions?
- What are the impacts to human health and the environment using the construction and implementation phases and can these impacts be minimized?
- Cost

After evaluation of each of the process options listed in Table 2-3, process options were grouped as viable options for use in this FS. Table 2-4 presents final screening of remedial technologies for sediments.

Each technology is evaluated for the extent to which it will eliminate significant threats to public health and the environment through reductions in toxicity, mobility, and volume of hazardous wastes at the site, and to comply with ARARs. Both short-term and long-term effectiveness are evaluated; short-term referring to the construction and implementation period, and long-term referring to the operational period after the remedial action is in place and demonstrated to be effective.

Table 2-4. Final screening of remedial technologies for the sediment.

General Response Action	Remedial Technology	Process Option	Effectiveness	Screening Criteria Implementability	Relative Cost
No action	None	None*	Would not meet remedial action objectives.	Not applicable.	None.
Institutional control/monitoring	Site access and land use restrictions	Deed covenants*	Would be effective in conjunction with other remedial technologies, such as capping. **Will not meet remedial action objectives alone.**	Would require long-term security activities and coordination of several property owners.	Low capital. Low maintenance.
		Fencing and signage*	Would be effective in conjunction with other remedial technologies, such as capping. Fence could only extend to creek limits. **Will not meet remedial action objectives alone.**	Would require long-term security and maintenance activities.	Low capital. Low maintenance.
	Environmental monitoring	Monitoring*	Would be effective in evaluating the effectiveness of remedial actions, such as capping. **Will not meet remedial action objectives alone.**	Implementation is easy and has already begun. Conventional technology. Equipment, personnel, and services readily available.	Low capital. Low maintenance.

* Process option selected for alternative development.

Table 2-4. Final screening of remedial technologies for the sediment (continued).

General Response Action	Remedial Technology	Process Option	Screening Criteria Effectiveness	Screening Criteria Implementability	Relative Cost
Containment (continued)	Capping (continued)	Concrete	Would effectively minimize the potential for direct contact with contaminated material, if properly maintained. Moderately effective in reducing migration. Potential for cracking due to freeze-thaw and drying action.	Easily implementable. Conventional technology. Equipment, personnel, and services readily available. Requires restrictions on future land use and long-term maintenance.	Moderate capital. Moderate maintenance.
		Synthetic membrane - rip-rap*	Would effectively minimize the potential for direct contact with contaminated material, if properly maintained. Causes less back disruption than concrete capping. Susceptible to tearing or puncture. Long-term reliability of the membrane uncertain.	Implementable. Equipment, personnel, and specialty services are readily available. Requires restrictions on future land use and long-term maintenance.	Moderate capital. Moderate maintenance.
Removal	Excavation	Excavation and recycling*	Proven, reliable technology. Would effectively reduce the potential threat to human health and the environment. Main short-term impact is the release of contaminated sediment into the surface water. Sediment traps would be required.	Easily implementable. Conventional technology. Equipment, personnel, and services readily available.	Moderate capital.
		Coffer dam installation, pumping, and excavation.	Proven technology. Would provide more exact removal. Surface water would be protected.	Implementable. Specialty services required. Would be done at low flow. High volume pumps required.	High Capital

* Process option selected for alternative development.

Table 2-4. Final screening of remedial technologies for the sediment (continued).

General Response Action	Remedial Technology	Process Option	Effectiveness	Screening Criteria Implementability	Relative Cost
Onsite treatment	Biological	Landfarming*	Not proven for coal tar contaminated soil but effective for general TPH removal. Will require pilot testing.	Extended time required for treatment.	Moderate capital. Moderate maintenance.
		Composting	Will require pilot testing; not proven for coal tar contaminated soil.	Extended time required for treatment.	Moderate capital and maintenance cost, higher than landfarming.
		Bioreactor	Will require pilot testing; not proven for coal tar contaminated soil.	Extended time required for treatment.	High capital. Moderate maintenance.

* Process option selected for alternative development.

Table 2-4. Final screening of remedial technologies for the sediment (continued).

General Response Action	Remedial Technology	Process Option	Effectiveness	Screening Criteria Implementability	Relative Cost
	Thermal	Rotary kiln	Effective and proven method for destruction of organic contaminants. Short-term impacts would include noise and potential air emissions. Relatively low thermal efficiency.	Implementable. Extensive performance and permitting requirements must be met. Might not be acceptable in a residential area. Small volume of material does not justify implementation.	High capital. Moderate maintenance.
		Fluidized bed	Effective and proven method for destruction of organic contaminants. Short-term impacts would include noise and potential air emissions. Low operational temperature.	Implementable. Same as above.	High capital. Moderate maintenance.
		Circulating bed	Effective and proven method of destruction of organic contaminants. Short-term impacts would include noise and potential air emissions. Efficient heat recovery.	Implementable: Same as above.	High capital. Moderate Maintenance.
Onsite treatment (continued)		Infrared	Effective and proven method of destruction of organic contaminants. Short-term impacts would include noise and potential air emissions. Low particulate emissions.	Implementable. Same as above.	High capital. Moderate maintenance.
Offsite treatment	Thermal	RCRA incinerator	Effective and proven method for destruction of organic contaminants. Transportation to offsite facility required. Short-term impacts include dust and noise associated with waste excavation.	Implementable. Permit may be required for transport. Facility must be in compliance with RCRA and state regulations.	Very high capital. Low maintenance.

* Process option selected for alternative development.

Table 2-4. Final screening of remedial technologies for the sediment (continued).

General Response Action	Remedial Technology	Process Option	Effectiveness	Screening Criteria Implementability	Relative Cost
Offsite treatment (continued)	Thermal (continued)	Coal fired utility boiler recycling facility*	Effective and proven method for destruction of organic contaminants. Transportation to offsite facility required. Short-term impacts include dust and noise associated with waste excavation and increased traffic at the site.	Implementable. Facility to accept material must be located. Utility, asphalt plant or brick facility. Material must pass TCLP analysis. Pretreatment may be required.	Moderate capital. Low maintenance.
Offsite disposal	Offsite disposal	RCRA solid waste landfill/recycling facility	Proven, effective method of disposing of treated soils and decontaminated rubble. Transportation to offsite facility required.	Implementable. Treatment of material may be required to decharacterize before transport and disposal due to TCLP.	Moderate capital. Low maintenance.
		RCRA hazardous waste landfill	Proven, effective method of disposing of some contaminated materials. Would be used in conjunction with other technologies. Transportation offsite required.	Implementable. Permitting may be required for transport. Facility must be in compliance with RCRA and receiving state regulations.	High capital. Low maintenance.
In-situ treatment	In-situ biological treatment	Bioremediation*	Proven effective for light PAHs in soil. However, PAHs will require long-term degradation.	Implementable. Includes natural biodegradation of contaminant following removal of contaminant sources from IG/WS and other sites. Part of no action technology.	No cost. Moderate maintenance.

* Process option selected for alternative development.

Implementability is a measure of both the technical and administrative feasibility of constructing, operating, and maintaining a remedial action alternative. Technical feasibility refers to the ability to construct, reliably operate and meet technical specifications or criteria, and the availability of specific equipment and technical specialists to operate necessary process units. It also includes operation, maintenance, replacement, and monitoring of technical components of an alternative, if required, into the future after the remedial action is complete. Administrative feasibility refers to compliance with applicable rules, regulations and statutes and the ability to obtain approvals from other offices and agencies. Additionally, it reflects the availability of treatment, storage, and disposal services and capacity.

Determination that technology is not technically feasible and not available for implementation will preclude it from further consideration unless steps can be taken to change the conditions responsible for the determination. Technologies that are clearly ineffective or unworkable at the site are eliminated in the initial screening process. Because of this, the evaluation is based primarily on the institutional aspects of implementability, which take into account the following:

- Can the necessary approvals for the implementation of the process be obtained from the governmental agencies which are to oversee the remediation of the site?
- Are the necessary skilled personnel and equipment available to implement the technology?

Cost plays a limited role in the screening of process options. Relative capital and O & M costs were used rather than detailed estimates. The cost analysis is made on the basis of engineering judgment, and each process was evaluated as to whether costs were high, low, or medium relative to other process options.

The results of the final screening and descriptions of the process options selected for use in the development of the remedial action alternatives for the sediment are listed in the following subsections.

2.6.1 <u>No Action</u>

If a "no action" remedial alternative is selected, the sediment will be left in its existing state. No additional funds would be expended to remediate, monitor, or control the contaminated source areas. No action would fail to meet the goals of the remedial action objectives, as it would not reduce the potential for contaminated material to migrate from the site, or minimize or eliminate the potential hazards associated with the contamination at the site. No action is selected as a technology to be used in remedial alternatives due to CERCLA guidance for comparison purposes.

As the sediment along the entire length of the Scajaquada Creek is likely contaminated by many sources, the effectiveness of remedial action on a short length of the creek is doubtful at best.

2.6.2 <u>Institutional Controls/Monitoring</u>

Site access, land use restriction deed covenants, and monitoring are all institutional controls that affect the remediation of sediment. The institutional controls are employed as portions of all active alternatives. Land use restrictions could be placed on the creek to limit future use of the site by either recording deed restrictions which state that contaminants were disposed of or have migrated onto the area, or that use restrictions have been imposed on the area. Such use restrictions would substantially limit any intrusive activities, such as dredging, boring, or excavating that would involve disturbing the subsurface sediment. They also would take the form of signage on fencing to prevent and warn trespassers of potential hazards at the site. Land use restrictions would require the cooperation of the creek owner(s).

Land use restrictions would limit future use of the site until potentially hazardous materials and all contaminated materials were treated or removed from the site (40 CFR 265.119). These restrictions would have to be carried out by several property owners. When used in conjunction with other remedial action technologies, land use restrictions can be effective in attaining remedial action objectives. In order to effectively enforce land use restrictions, long-term security measures would have to be implemented. Construction of a fence around the contaminated areas and periodic site inspections are examples of security measures that are partially in place and can be implemented at a low cost. The effectiveness of the fence would be limited by the creek and restrictions would have to be maintained by property on both sides of the creek, the city of Buffalo, and/or the State of New York.

Depending on the selected remedial alternative, sediment monitoring would involve possible investigative and confirmatory sampling. Sampling would be performed in order to ensure that the remedial action objectives were being met and would be used in conjunction with other technologies, such as excavation (sediment confirmation sampling) or capping (sediment monitoring).

Sediment monitoring is a proven, reliable method for assessing the degree of contamination and the effectiveness of remedial actions. Samples have been collected on several occasions, and the equipment and personnel necessary to implement additional monitoring are available. Low construction costs are associated with implementing a monitoring program.

2.6.3 Containment: Capping

Capping consists of placing a permanent layer or layers of low permeability material over the contaminated sediment areas. Restrictions on future site use to prevent damage to the cap and a sediment monitoring program to monitor the effectiveness of the cap would be required. The restrictions would have to be arranged with several property owners. In addition, for the cap to remain effective over an extended period, cap inspection and maintenance programs would have to be implemented.

Two capping technologies were retained after the initial screening. Since both options are approximately equal in protectiveness, the synthetic membrane was selected as the representative option for development and evaluating the alternatives in Section 3 on the basis of site considerations, low maintenance, and ease of installation. It should be noted that, if capping were selected as a remedial technology, either of the capping technologies could be implemented during the remedial action.

The cap would consist of a synthetic membrane (HDPE or PVC) covered by geotextile for protection. Rip-rap would be placed over the cap anchor trenching to prevent erosion and for protection. Capping is a proven and conventional practice for the long-term containment of hazardous wastes. However, this process does not treat or destroy the contaminants, nor does it reduce the toxicity or volume of the contaminated material. Capping would minimize the potential for direct contact with the contaminated material, as long as the cap was properly maintained. It would also minimize migration of contaminants.

The equipment and services necessary to carry out this technology are readily available. **This type of application was conducted by the U.S. Army Corps of Engineers in Calumet Harbor, Illinois.** Access to the creek would have to be improved on both banks to construct the cap. A road in the bank would be cut and covered with gravel to prevent erosion. The construction would cause short term sediment loading in the creek. The costs involved in implementing a capping technology vary depending on the complexity of the cap and the material used to construct it. However, capping construction and O&M costs are much lower, on the average, than the costs of excavation and subsequent treatment or disposal.

2.6.4 Removal: Sediment Excavation

This technology involves using mechanical excavation processes including small dredges, truckhoes and loaders to remove the contaminated material. The material to be removed would include the creek sediment down to the underlying clay layer, approximately two feet. Sediment would be removed initially to lined, bermed staging areas along the creek bank for transport to the sediment storage pad above the bank.

Excavation is an effective and proven method for material removal. Generally, removing the sediment would seem to have several advantages, including reduction of potential future human and environmental contact with the contaminants and minimization of future migration of the contaminants into the environment. Given the widespread contamination from multiple sources, the source would not necessarily occur here. This remedial technology is selected for alternative assembly, since it is to be used in conjunction with the application of treatment or disposal technologies. Potential short-term risks associated with excavation involve worker exposure to the contaminants. The community and the environment may also be exposed to volatilized contaminants and contaminants transported by surface water. Controls to limit sediment migration in surface water would need to be implemented. These could include lining and berming temporary sediment storage areas and installing floating booms with weighted sediment netting placed directly downgradient to promote settling. However, some suspended material would pass through any sediment trap placed in the creek. The suspended material could cause short-term degradation of the surface water downgradient from the site to the Black Rock Canal or Niagara River depending on flow conditions. Potential short-term impacts during excavation include destruction of vegetation of the creek bank, noise, and exhaust emissions from the construction equipment. The alternative of dewatering the area to excavate would limit surface water contamination and allow an excavation and confirmation sampling process to provide more controlled removal of the sediment; however, the cost of diverting the creek is extremely high for the minimal environmental benefit in comparison with standard excavation and dredging.

The equipment, services, and personnel are readily available for excavation. Access to the creek banks would have to be improved similarly to capping. Arrangements must be made for the temporary storage and subsequent transport, treatment, and disposal of the excavated material. Temporary storage for dewatering would be set up on the creek bank. Material would be stockpiled and free water allowed to drain through sediment filtration prior to transport off the creek bank. Kiln dust or other material may be added for easier handling. Excavation could best be accomplished during periods of low flow. Excavation activities will be designed to not affect the structural integrity of the bridges over the creek. The costs associated with implementation of this technology, not including disposal costs, are moderate.

2.6.5 Onsite Treatment

2.6.5.1 Biological

This technology involves the bacterial degradation of organic contaminants. **Landfarming, composting and bioreactor technologies** passed the initial technology screening. **Landfarming is the most applicable due to its lower cost and greater environmental remediation utility.**

Landfarming has not been proven effective in treating PAH-contaminated solids. Pilot testing would be required to evaluate whether the pure phase coal tars and four- and five-ring PAHs could be successfully remediated/degraded to clean-up levels by the biological treatment process option. The time required to treat the contaminated materials is excessive compared to other treatment technologies. Long-term biological treatment onsite might also not be acceptable in a residential area. Additionally, treatment space is limited at the site. The material would require dewatering before treatment could be conducted. Landfarming will not be used for alternative assembly due to its unproven record for PAH treatment and site applicability.

2.6.5.2 Thermal

This remedial technology consists of incinerating the contaminated media in a mobile incinerator temporarily located at the site. Four onsite incineration process options passed the initial screening: rotary kiln, fluidized bed, circulating bed, and infrared. Each of these technologies is described briefly on Table 2-2. Although onsite thermal incineration is a proven and effective technology for converting hazardous organic contaminants into nonhazardous components through the application of thermal energy, none of the process options that pass the initial screening has been selected for the development and evaluation of technologies in Section 3 for the following reasons:

- Onsite incineration might not be acceptable in a residential area.
- Offsite incineration in a coal-fired utility boiler or recycling facility is equally effective and available at a significantly lower cost, especially for small volumes of material.

2.6.6 <u>Off-Site Treatment: Thermal</u>

This technology involves transport of the contaminated material to an offsite RCRA incinerator facility or, if the material passes TCLP testing, to an approved offsite coal-fired utility boiler or recycling facility such as a brick or asphalt plant for thermal destruction. Pretreatment could possibly be accomplished if approved by NYS DEC to meet TCLP limits.

Thermal treatment is an effective and proven method for the destruction of organic compounds. Incineration of the contaminated media would result in a reduction of long-term risks to the public health and the environment. Short-term risks include potential worker exposure and potential releases of fugitive dust and volatile organics during the loading and transport of material, and increased traffic in the area of the site with subsequent increases in dust and noise.

The cost to transport and incinerate the contaminated soil by fuel blending at an electric station would be moderate. Incremental maintenance costs associated with this technology would be very low. The associated costs are expected to be substantially less than the cost of transporting and incinerating the material at a RCRA incinerator; therefore, thermal treatment by fuels blending at a utility boiler or similar facility is selected for alternative assembly.

2.6.7 Offsite Disposal

Offsite disposal involves the transport of material from the site to an approved landfill offsite. Two options passed the initial screening, disposal in a RCRA Subtitle D solid waste landfill, and disposal in a RCRA Subtitle C hazardous waste landfill. Both options were retained through initial screening. Material passing TCLP testing could be shipped to a solid waste landfill as a special waste. Contaminated material that could not be treated to pass TCLP testing could be sent to a hazardous waste landfill as a CERCLA hazardous substance.

Offsite disposal is a conventional and proven remedy, however, the volume and toxicity of the material are not affected. The short-term impacts of shipping material to a landfill would be similar to offsite thermal treatment. Based on the low benzene concentrations in the sediment, the material will likely be characterized as nonhazardous. If any material does not pass TCLP testing, it may be pretreated to nonhazardous standards. Therefore, disposal in a solid waste landfill is selected for alternative assembly. Disposal in a RCRA Subtitle C landfill will not be necessary and will not be used for alternative assembly.

Implementation of this process option ordinarily is routine. It should be possible to obtain the necessary approvals for any materials shipped to a landfill, as long as the shipment complies with Department of Transportation (DOT) regulations. The construction costs to implement this option would be moderate. Since there would not be any contaminated material left at the site based on the assumption, O&M costs would be negligible.

2.7 SUMMARY OF THE REPRESENTATIVE PROCESS OPTIONS SELECTED BY THE FINAL SCREENING

Table 2-5 summarizes the representative remediation alternatives chosen to remediate contaminated creek sediment.

Table 2-5. Process options selected for alternative development during the final sediment technology screening.

Remedial Technology	Process Option
No Action	None
Site Access and Land Use Restrictions	Fencing, Signage, Deed Covenants Restrictions
Environmental Monitoring	Monitoring
Capping	Synthetic Membrane - Rip-Rap
Removal	Excavation
Offsite Thermal Treatment	Industrial High Efficiency Boiler/Electric Utility or Recycling Facility
Offsite Disposal	Subtitle D Landfill

2.8 REFERENCES

Gas Research Institute (GRI), 1987. Management of Manufactured Gas Plant Sites, Volume I, Wastes and Chemicals of Interest, October, 1987.

40 CFR 265.119

Vance, D.B., 1993. Remediation by In-situ Aeration; the National Environmental Journal, 3(4):59-62.

USEPA Remediation Technologies Screening Matrix Reference Guide.

3 DEVELOPMENT AND EVALUATION OF ALTERNATIVES

The technologies and process options that appear to be the most applicable to the contaminants in sediments were identified in Section 2.

CERCLA guidance recommends that to the extent practicable, at least one remedial alternative be developed under each of the following categories:

1. A no action alternative.
2. A treatment alternative that reduces the toxicity, mobility, or volume of the contaminants or contaminated media.
3. An alternative that involves containment of the waste with little or no treatment.
4. An alternative that completely and permanently treats the waste and eliminates the need for long-term monitoring.

The above categories have been established to facilitate developing an adequate range of remedial alternatives.

The four alternatives developed for this feasibility study to address (in varying degrees) the RAOs and meet SARA guidance categories are as follows:

1. No action.

1A. In-situ biodegradation, restrictions, monitoring.

2. Capping sediment.

3. Excavating sediment with disposal offsite in a Subtitle D landfill.

4. Excavating sediment with disposal offsite by thermal treatment.

The technologies included in each of these alternatives are presented in Table 3-1. All the alternatives, other than the no action, include access restrictions and long-term monitoring. Alternatives 3 and 4, if necessary, will include modified landfarming to pretreat material to nonhazardous levels.

Table 3-1. Range of alternatives.

General Response Action	Technology	Process Option	Area Impacted	Alternatives 1	1A	2	3	4
No Action			Sediment	X	X			
Institutional Controls	Fencing		Selected Areas		X	X	X	X
	Land Use Restrictions		Sediment		X	X	X	X
Monitoring	Environmental Monitoring	Sediment Sampling	Sediment, Surface Water		X	X	X	X
Containment	Capping	Synthetic	Sediment			X		
Removal	Removal	Excavation	Sediment				X	X
Disposal	Offsite Disposal	Subtitle D Landfill	Sediment				X	
Treatment	Offsite Thermal	Coal Fired Utility Boiler/ Recycler	Sediment					X

The specific objectives satisfied by each alternative, and the SARA guidance categories fulfilled by each alternative, are summarized in Table 3-2.

Following the development of the remedial alternatives, an evaluation of each alternative is performed. Each remedial alternative is evaluated on its ability to:

- Be protective of human health and the environment
- Attain ARARs (or provide the basis for invoking a waiver)
- Be cost effective
- Utilize permanent solutions and alternative treatment technologies or resource recovery technologies to the maximum extent practicable
- Satisfy the preference for treatment that reduces toxicity, mobility, or volume as a principal element

In order to address the CERCLA requirements listed above and the technical considerations that have proven to be important for selection among remedial alternatives, in conformance with the RI/FS guidance, the following evaluation criteria have been used in this FS:

1. Short-term effectiveness. Addresses the impacts of the alternative during the construction and implementation phase until remedial response objectives have been met. Alternatives are evaluated with respect to their effects on human health and the environment during implementation of the remedial action and until protection is achieved.

2. Reduction of toxicity, mobility, and volume. Addresses the statutory preference for selecting remedial actions that employ treatment technologies that permanently and significantly reduce toxicity, mobility, or volume of the hazardous substance as their principal element. This preference is satisfied when treatment is used to reduce the principal threats at the site through destruction of toxic contaminants, irreversible reduction in contaminant mobility, or reduction of total volume of contaminated media.

Table 3-2. Compliance of alternatives with SARA guidance and remedial action objectives.

	Alternatives				
	1	1A	2	3	4
SARA Guidance Categories					
1. No Action Alternative	Yes	Yes	No	No	No
2. Alternative that reduces the toxicity, mobility, or volume of the contaminants or contaminated media.	No	No	Yes	Yes	Yes
3. Alternative that involves containment of the waste with little or no treatment.	No	No	Yes	Yes	No
4. Alternative that completely and permanently treats the waste and eliminates the need for long term monitoring.	No	No	No	No	Yes
Remedial Action Objectives					
1. Remove or contain contaminated materials in order to a) minimize the potential for direct contact with the contaminants, and b) reduce the potential for further migration of contaminants.	No/ No	**No/ No**	Yes/ Yes	Yes/ Yes	Yes/ Yes
2. Prevent or minimize the potential for future inhalation, ingestion, or dermal contact with contaminants in excess of NYS standards or ACLs.	No	**No**	Yes	Yes	Yes

3. Long-term effectiveness and permanence. Addresses the results of a remedial action in terms of the risk remaining at the site after response objectives have been met. The primary focus of this evaluation is the effectiveness of the controls that will be applied to manage risk posed by treatment residuals or untreated wastes.

4. Compliance with ARARs. This evaluation is used to determine how each alternative complies with federal and state ARARs, as defined in CERCLA Section 121.

5. Overall protection of human health and the environment. Provides a final check to assess whether each alternative meets the requirement that it be protective of human health and the environment. The overall assessment of protection is based on a composite of factors assessed under other evaluation criteria, especially long-term effectiveness and permanence, short-term effectiveness, and compliance with ARARs.

6. Implementability. Addresses the technical and administrative feasibility of implementing an alternative and the availability of various services and materials required during its implementation.

7. Cost. The cost estimates for the FS are expected to provide an order-of-magnitude evaluation for comparison of alternatives and are based on the site characterization developed in the RI. Construction cost, annual cost, a present worth analysis, and a cost sensitivity analysis are part of this evaluation.

8. State acceptance. Addresses the technical and administrative issues and concerns that NYSDEC may have regarding each of the alternatives. NYSDEC will review the draft FS, and its comments will be incorporated into the final FS, as appropriate.

9. Community acceptance. Public concerns or comments will be addressed.

Descriptions of the alternatives and detailed evaluations of the alternatives using the first seven of the evaluation criteria identified above are presented in the following subsections. The description of each of the alternatives is sufficiently detailed to present a conceptual design that integrates the technologies and process options described in Section 2 into a complete alternative. According to the RI/FS guidance, state and community acceptance criteria (evaluation criteria 8 and 9) will be evaluated following comment on the RI/FS report. A comparative analysis of the alternatives, using the first seven evaluation criteria, is presented in Section 4 along with the cost sensitivity analysis.

The FS cost estimates are order-of-magnitude level estimates, which are defined by the American Association of Cost Engineers as an approximate estimate made without detailed engineering data. Examples include an estimate from cost capacity curves and estimates using scale-up or scale-down factors and/or approximate ratio estimates. It is normally expected that an estimate of this type would be accurate to +50% and -30% for given unit quantities. The actual cost of the project would depend on the final scope of the remedial action, the schedule of implementation, actual labor and material costs at the time of implementation, competitive market conditions, and other variables that may significantly impact the project costs. A summary of the procedures, elements, and assumptions used in preparing the cost estimate for each alternative is presented in Table 3-3.

3.1 ALTERNATIVE 1: NO ACTION (Alternative 1A: Restrictions and Monitoring)

The no action alternative would not involve any remedial actions and the creek sediment would remain in its present condition. No funds would be expended for monitoring, control, or cleanup of the sediment. This alternative, which is required by the NCP and SARA, is a baseline to which the effectiveness of other alternative remedies is compared. This alternative would fulfill only Category 1 of the SARA guidance categories. A slightly more active alternative (1A) would involve use and access restrictions and fencing constructed along the top of the creek bank from the footbridge and to railway trestle to limit any exposure to the sediment and continued sediment monitoring to check the effectiveness of natural biodegradation of site contaminants following removal of sources at IG/WS and other sites.

3.1.1 Short-Term Effectiveness

Since no activities would occur, protection of the community and workers would not be required. Environmental impacts due to construction or implementation would be avoided, because there would not be any activities performed at the site. In particular activities that would

Table 3-3. Basis for cost estimates.

Cost Estimate Procedure

- Estimation of Capital Cost
- Estimation of Operation and Maintenance Costs
- Present Worth Analysis

Definition of Elements

- Construction Cost (materials, labor, and equipment)
  - Construction (direct cost)
  - Equipment (direct cost)
  - Site Preparation (direct cost)
  - Engineering and Design (percent of total direct costs)
  - Services during Construction (percent of total direct costs)
  - Licenses and Permits (percent of total direct costs)
  - Transportation of construction materials

- Operation and Maintenance Costs
  - Continued Monitoring
  - Routine Maintenance
  - Transport and Disposal

- Present Worth Analysis
  - Capital Costs Occur in Year 0
  - Operation and O&M Costs Occur for the Life of Remedial Action
  - Discount Rate

Assumptions

- Cost Estimates: +50% to -30% accuracy: 1993 dollars
- Economic Life of Remedial Action: 30 years
- Discount Rate: 5% per RI/FS guidance

Contingencies and Allowances (per RI/FS guidance)

• Bid Contingency	- 10 to 15% of construction subtotal, covers unknowns such as adverse weather, strikes, unfavorable market conditions, etc.
• Scope Contingency	- 15 to 20% of construction subtotal, covers change orders, reflects specialized nature of work and lack of precise definition of scope of work.
• Permitting and Legal	- Up to 5% of construction total cost.
• Construction Services	- 10% of construction total cost, includes construction management, onsite observation, waste cleanup validation, change order negotiations, and engineering and design modifications during construction.
• Engineering Design	- 8% of construction total cost.

disturb and suspend the sediment, possibly resulting in the spread of contaminants, would be avoided.

3.1.2 Reduction in Toxicity, Mobility, or Volume

Remedial activities would not occur, so there would not be an active reduction in toxicity, mobility, or volume of contaminants. The original type and quantity of hazardous material would remain in-situ, except to the extent that the contaminants are removed by natural mechanisms.

3.1.3 Long-Term Effectiveness

Because remedial actions would not occur, the risks identified in the risk assessment would remain. In addition, since no controls would be implemented, the criterion addressing the effectiveness, adequacy, and reliability of controls is not applicable to Alternative 1. Alternative 1A includes access controls which could be maintained.

3.1.4 Compliance with ARARs

This criterion refers to the three types of ARARs which the alternative should address: Chemical-specific, location-specific, and action-specific.

- Chemical-Specific ARARs. Containing contaminants in concentrations in excess of acceptable risk based levels would remain.
- Location-Specific ARARs. ARARs related to working in a waterway do not apply in the no action alternative.
- Action-Specific ARARs. Since no remedial activities would occur, there are no action-specific ARARs.

3.1.5 Overall Protection of Human Health and the Environment

Since no remedial activities occur, no risks are reduced or eliminated in Alternative 1. Therefore, this alternative may not be protective of human health and the environment. Alternative 1A limits exposure to the contaminants by access restrictions.

3.1.6 Implementability

Implementability includes technical feasibility, administrative feasibility, and the availability of the required services and materials. Since no remedial activities would be implemented under the no action alternative, these criteria are not applicable. Alternative 1A includes fencing and use and access restrictions which would have to be implemented by several property owners not within the control of Westwood.

3.1.7 Costs

There would not be any costs incurred because no remedial activities would be performed for Alternative 1. Alternative 1A would have costs of $19,200 for construction of fencing and $52,100 for continued sediment monitoring over a 30-year period as indicated in Table 3-4 for a total cost of $71,300.

3.2 ALTERNATIVE 2: CAPPING SEDIMENT

Alternative 2 would consist of the following process options and technologies:

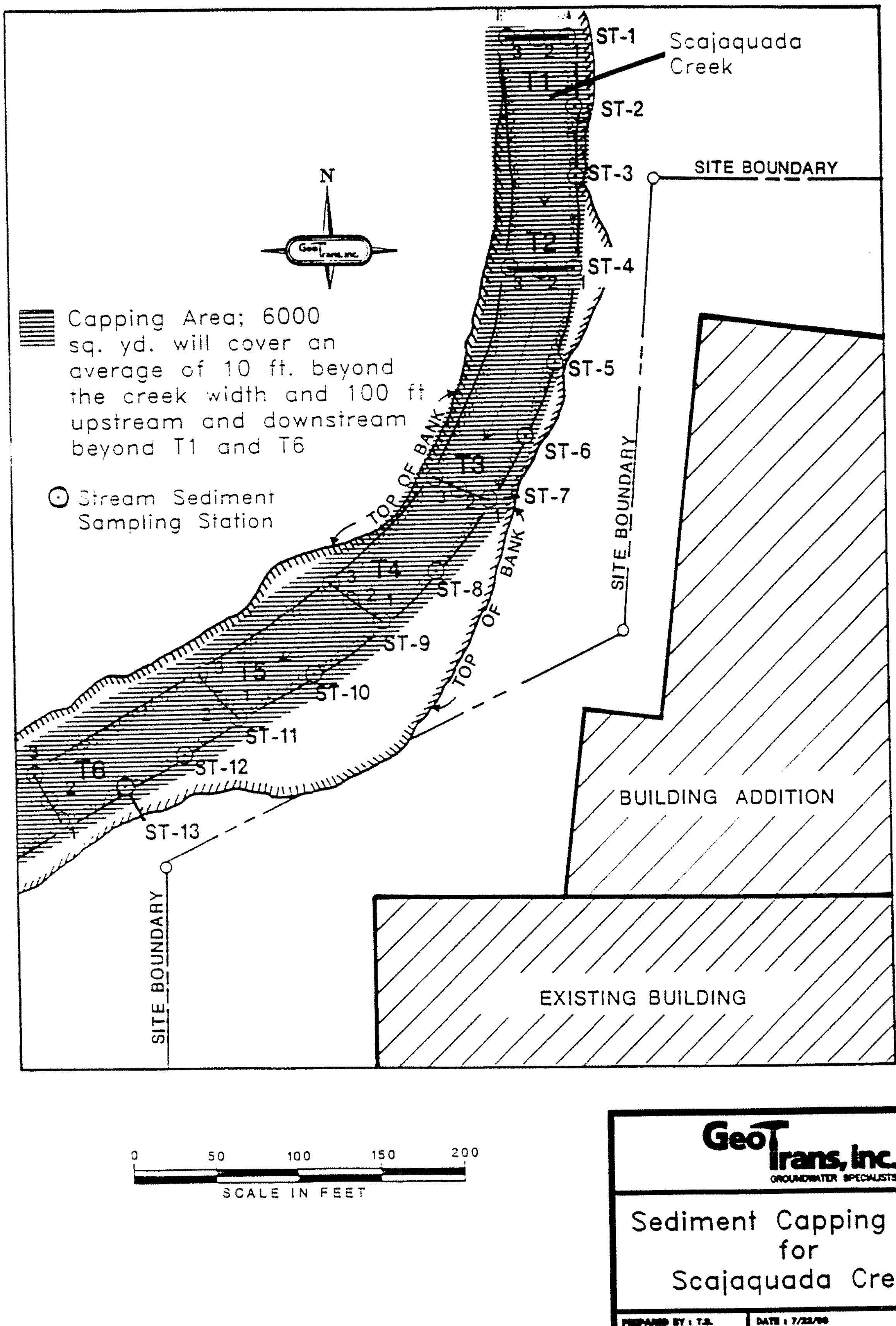
- Capping above sediment.
- Monitoring and use restrictions, land use restrictions, and fencing.

Capping is used to isolate the sediment to prevent exposure and surface water interaction, control erosion, and mitigate volatilization from contaminated waste. Figure 3-1 shows the areas that need to be capped. The size of the capped area is estimated to be 6,000 square yards.

XR-5 liner manufactured by Seaman Corporation or equivalent is to be used for capping the sediment. The liner would be installed in approximately 80 foot wide by 200 foot length sections. Liner would be welded together from a floating platform and sunk into position using ballast bags. The liner would extend up the creek bank and the outer 3 to 5 feet would be buried in a trench configuration to prevent cap movement. Working on the sediment and specifically anchoring the cap will promote potential contaminated sediment migration and surface water degradation.

Table 3-4. O & M costs and total present worth estimate - Alternative 1A - No Action (Monitoring and Restrictions) (1993 $).

Item	Quantity	Units	Unit Cost	Total Cost
SURFACE WATER MONITORING				
Sample Collection				
First Year (semiannually)	10/yr	MANDAYS	$600.00	$6,000
Years 2-5 (annually)	5/yr	MANDAYS	$600.00	$12,000
Years 6-30 (biannually)	5/2yr	MANDAYS	$600.00	$37,500
Sample Analysis/Report				
First Year (semiannually)	2/yr	EA	$2,000.00	$4,000
Years 2-5 (annually)	1/yr	EA	$2,000.00	$8,000
Years 6-30 (biannually)	1/2yr	EA	$2,000.00	$25,000
TOTAL O&M COSTS Present Worth Annual Interest Rate 5.0 %				$52,100
TOTAL CONSTRUCTION COSTS (Fence)	1,200	FT	$16.00	$19,200
TOTAL PRESENT WORTH	ALTERNATIVE 1A			$71,300



GeoTrans, inc.
GROUNDWATER SPECIALISTS

Sediment Capping Area for Scajaquada Creek

PREPARED BY : T.S.	DATE : 7/22/96	FIGURE
CHECKED BY : T.S.	REVISED : 7/27/96	3-1
DRAWN BY : JPM	DRAWING NO : B/A/7047-042/OA/8	

Berming and other controls will be used to limit short term impacts. XR-5 liner is compatible to oils, acids, alkalis, fuels, and methane in addition to long-term UV resistance with no aging and no environmental stress cracking. In addition, XR-5 has the tensile, puncture, and abrasion strength of unsupported materials to fit in this sediment capping application. Similar projects by Seaman Corporation had been performed for industrial pollutants in several waterways, **for example Calumet Harbor at Lake Michigan in Illinois**. The XR-5 has a specific gravity of approximately 1.3; this property will ease installation for capping the sediment in the creek. Rip-rap will be placed over the liner as ballast stone and along the creek bank to prevent erosion.

During and following implementation of the alternative, the effectiveness of the system would be monitored periodically. Initially, surface water sample collection/analysis for turbidity would be conducted to monitor short term affects. Close visual monitoring in the early stages of the project would be necessary to ensure that the sediment was being contained and erosion along the anchor trenches was not a problem. Following implementation, monitoring of sediment downgradient of the cap would begin on a semiannual basis and would shift to annually or biannually thereafter.

To further protect the public from contact with the contaminants and maintain the integrity of the sediment containment system, the creek banks would be lined with a chain link fence with warning signage. Land use restrictions would be instituted to prevent intrusive activities that could damage the containment system. Future use restrictions would also be instituted for the creek area. These restrictions would be written into the property deed by the property owner.

Alternative 2 would fulfill to the limited extent of the cap the objectives of Category 3 of the SARA guidance categories. The overall impact on contaminant conditions in the creek sediments as a whole would be minimal. The cap would prevent human contact with the contaminants in that area.

3.2.1 Short-Term Effectiveness

3.2.1.1 Protection of the Community and Workers

Construction hazards including using heavy machinery and working on a floating platform would be associated with the construction of the cap. Fencing or temporary barriers would be installed around the site to protect the community during construction by preventing access by unauthorized personnel. Monitoring and control of volatile organic vapor releases by air movement or deodorizing scent would be required of the construction contractor to prevent disturbance of the community. The creek level is approximately 20 feet lower in elevation than the main plant area surface elevation, and the slope of the creek bank is fairly steep. An access ramp will be cut into the bank to allow equipment and materials to the work area. A site safety plan, required to be followed, would be prepared prior to initiating construction. In conformance with OSHA regulations, site workers are required to meet Health and Safety training and medical monitoring and wear appropriate protective equipment.

3.2.1.2 Environmental Impacts

The only environmental impact expected during the construction of this alternative would be sediment disturbance associated with preparation of the area and the anchor trenches. Care would be taken to minimize disturbance of the sediment to prevent contaminating surface water by setting up bermed areas to temporarily place the sediment while anchoring the cap.

3.2.1.3 Time to Achieve Remedial Response Objectives

The remedial objectives for the source areas would be achieved after the cap has been installed. The installation of the cap is estimated to take two to three months. The remedial action objectives for the sediment would be achieved when cap installation is complete and use restrictions have been established. Additional sources should be identified by NYSDEC to provide a more complete understanding of sediment contamination.

3.2.2 Reduction in Toxicity, Mobility, or Volume

3.2.2.1 Treatment

No contaminated media are treated under this alternative.

3.2.2.2 Reduction in Toxicity, Mobility, or Volume

Since this alternative does not involve treatment technologies, it would not directly and substantially reduce the toxicity, or volume of the contaminated media. The mobility of the contaminants in sediment under the cap would be reduced by the containment system. Mobility of contaminants elsewhere in the creek sediment are not reduced. The toxicity of contaminants is expected to be gradually reduced over time by natural biological mechanisms.

3.2.2.3 Amount of Material Contained

The area capped would be approximately 6,000 square yards.

3.2.3 Long-Term Effectiveness

3.2.3.1 Residual Risk

Isolating the sediment would minimize the potential for contact with contaminants in those areas only. Instituting land use restrictions would provide protection against the potential for future exposure to contaminated sediment. Sediment monitoring would verify that no new exposure routes were created by continued migration of contaminants. Sampling of sediment downgradient will be accomplished to determine if contaminant concentrations are increasing after a baseline contaminant concentration is established by NYSDEC. Therefore, despite the fact that the contaminants would not be treated or destroyed, the residual risks associated with this alternative would be slightly reduced in the area adjacent to the IG/WS Site.

3.2.3.2 Adequacy and Reliability of Controls

The cap would be the main control in this alternative, while land and surface water use restrictions and monitoring would play subordinate roles.

The cap would adequately reduce the potential for contact with source area contaminants adjacent to the site. However, contaminated sediment elsewhere in the creek could migrate and settle in the capped area. Land use restrictions would limit future use of the creek so that the containment system would not be breached and contaminated subsurface sediment would not be disturbed. Monitoring would be necessary for the life of the alternative. The cap would require maintenance for the life of the alternative.

3.2.3.3 Permanence of Remedy

The cap should last for over 30 years, especially if special precautions were taken to ensure durability. The cost of repairing or replacing damaged caps, if necessary, would be relatively low. It is expected that the monitoring would serve for the entire life of the remedy. Migration of upstream contaminated sediment over the 30 year period will likely return contamination to the capped area. Future further remediation may be required to address the sediment that settles on the cap after the initial remediation.

3.2.4 <u>Compliance with ARARs</u>

3.2.4.1 Chemical-Specific ARARs

Sediments containing contaminants would remain untreated in the subsurface, but contact in this area would be prevented by the cap.

3.2.4.2 Location-Specific ARARs

Variances for construction in a waterway need to be obtained to allow the capping.

3.2.4.3 Action-Specific ARARs

During installation of the caps, protection of the workers would comply with OSHA standards. Prevention of airborne contamination by dust control and capping would maintain air quality as required by the Clean Air Act. Air quality would be monitored during all construction activities in the work zone and at the perimeter of the zone. Control action such as dust suppression, odor control or air movement would be incorporated where required.

3.2.5 Overall Protection of Human Health and the Environment

This alternative would offer limited protection to both human health and the environment by minimizing potential contact and migration of contaminants from the sediment in the capped area. This protection would be achieved at the end of the construction period of three months. The residual risks posed by contaminated material remaining within the sediment under the cap would not be significant, since potential exposure routes would be minimized as long as the cap system was properly maintained, use restrictions were observed, and sediment monitoring was continued. Risks from contaminated sediment outside of the cap and contaminant sources will remain.

3.2.6 Implementability

3.2.6.1 Technical Feasibility

Technical feasibility is evaluated on the basis of three parameters: ability to construct the alternative, the reliability of the technologies used, and ease of undertaking additional remedial actions.

- Ability to construct the alternative. All the construction required by this alternative would be basic heavy construction and should not pose any significant problems. Synthetic liner used in this type of application is available.

- Reliability of the technology. Capping is an effective alternative. Capping creek sediment has been successfully accomplished at several sites.

- Ease of undertaking additional remedial actions. Future remedial actions may be necessary in the capped area to remove migrating sediment. Remediation of the entire creek may be required in the future.

3.2.6.2 Administrative Feasibility

Installing this capping system will require access to private and state or city property. Use restrictions would also require city or state cooperation and might be difficult to implement.

3.2.6.3 Availability of Services and Materials

The materials, equipment, and personnel required to construct the cap would be readily available in Buffalo.

3.2.7 Costs

Tables 3-5 and 3-6 provide summaries of the construction and O&M costs for Alternative 2. The construction costs, including direct and indirect construction costs, would be approximately $330,400 (Table 3-4). Continued monitoring and cap maintenance contribute to the O&M costs and result in costs of $57,900 for 30 years (Table 3-5). The present worth analysis yields a total of $388,300 for this alternative.

3.3 ALTERNATIVE 3: EXCAVATION OF SEDIMENT AND DISPOSAL IN A SUBTITLE D LANDFILL

Alternative 3 would consist of the following process options and technologies:

- Removal of sediment
- Disposal of sediment excavated from the creek in a Subtitle D Landfill
- Monitoring; use and access restrictions

The contaminated sediment in the Scajaquada Creek would be excavated as shown on Figure 3-2. Excavated material separation and storage areas would also be set up when remediation begins.

In this alternative, it is assumed that sediment would be excavated to a depth of two feet. Excavation extent could be revised, based on field observation and sampling during implementation of this remedial action. Excavation of "hot spots" only could be considered; however, analysis to date has indicated relatively homogenous contaminant concentrations.

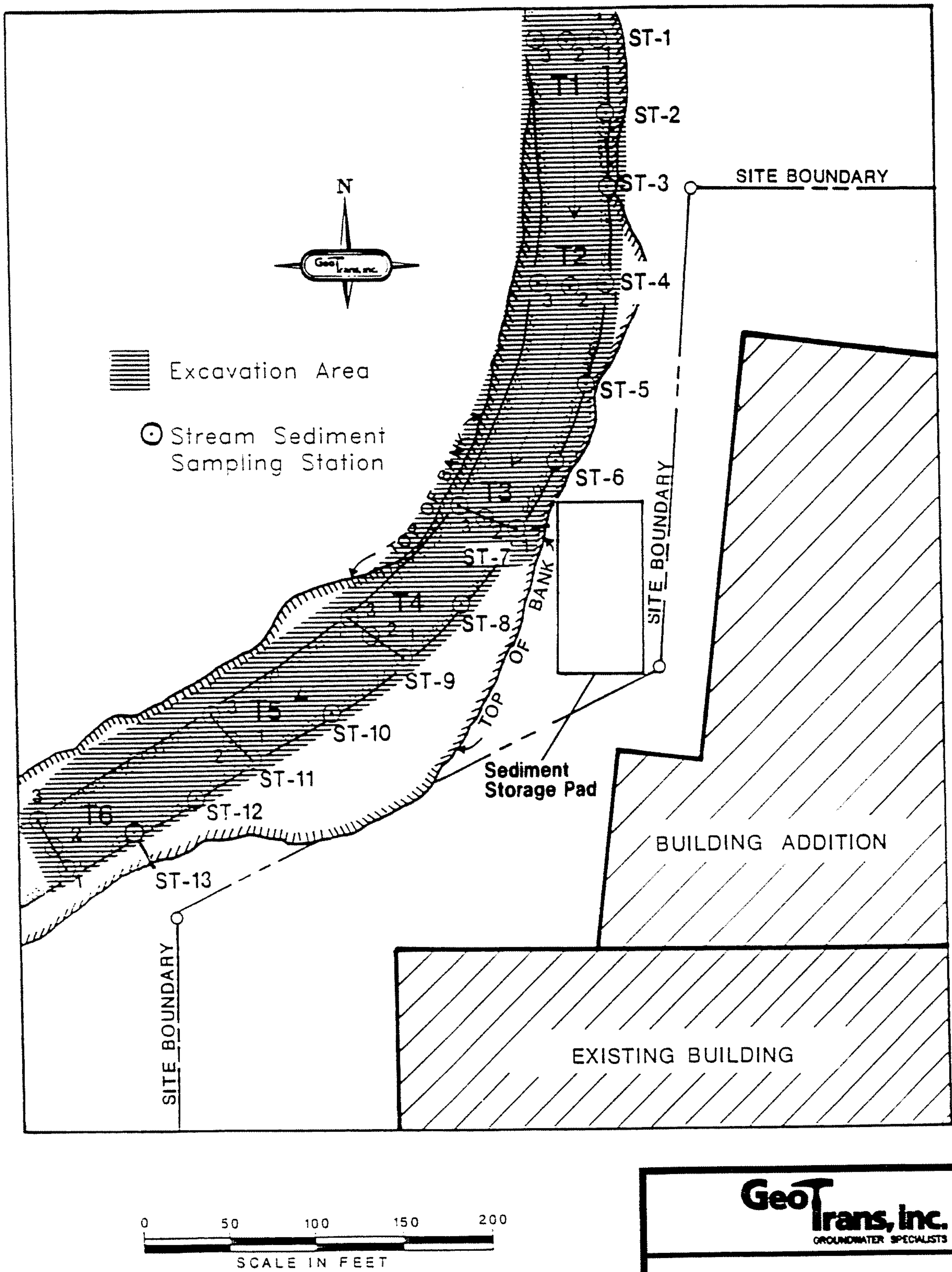
Table 3-5. Construction cost estimate - Alternative 2 - Cap sediment (1993 $)

Item	Quantity	Units	Unit Cost	Total Cost
FENCING				
Chain Link Fence (8' high)	1200	LIN FT[1]	$16.00	$19,200
Gate (34' opening)	2	EA	$1,200	$2,400
CAPPING	6,000	SQ YD	$18.00	$108,000
GRADING (Creek Banks)	6,000	SQ YD	$ 4.00	$24,000
RIP RAP	2,000	CU YD	$15.00	$30,000
DECONTAMINATION				
Area Construction & Equipment Rental	1	LS[2]	$5,000	$5,000
Operation	60	DAY	$200.00	$12,000
MOBILIZATION/DEMOBILIZATION				$20,000
	Construction Subtotal: $215,400			
CONTINGENCIES				
Bid Contingencies				$21,000
Scope Contingencies				$31,000
	Contingencies Subtotal: $52,000			
ALLOWANCES				
Permitting/Legal				$8,000
Engineering				
Design				$25,000
Construction Services				$30,000
	Allowances Subtotal: $63,000			
TOTAL CONSTRUCTION COSTS:	ALTERNATIVE 2			$330,400

Note: [1] Lin FT is linear feet.
[2] LS is lump sum.

Table 3-6. O & M costs and total present worth estimate - Alternative 2 - Cap sediment (1993 $).

Item	Quantity	Units	Unit Cost	Total Cost
SURFACE WATER MONITORING				
Sample Collection/Cap Inspection				
First Year (semiannually)	10/yr	MANDAYS	$600.00	$6,000
Years 2-5 (annually)	5/yr	MANDAYS	$600.00	$12,000
Years 6-30 (biannually)	5/2yr	MANDAYS	$600.00	$37,500
Sample Analysis/Report				
First Year (semiannually)	2/yr	EA	$2,000.00	$4,000
Years 2-5 (annually)	1/yr	EA	$2,000.00	$8,000
Years 6-30 (biannually)	1/2yr	EA	$2,000.00	$25,000
CAP REPAIR (year 15)				$12,000
TOTAL O&M COSTS Present Worth Annual Interest Rate 5.0 %				$57,900
TOTAL CONSTRUCTION COSTS				$330,400
TOTAL PRESENT WORTH	ALTERNATIVE 2			$388,300



GeoTrans, inc.
GROUNDWATER SPECIALISTS

Sediment Excavation Area

FIGURE 3-2

Monitoring would be conducted for volatile emissions during excavation and materials handling. If necessary, workers would be required to wear appropriate respiratory protection and steps would be taken to reduce volatile emissions by enclosing the work areas. Berms would be constructed to control surface runon and runoff. Excavation would occur during a low water period. Downgradient berms and temporary storage for dewatering with sediment filtration equipment would be installed. Floating booms with hanging sediment removal filters would be installed in the creek to provide a settling zone to minimize contaminant migration beyond the area in question during excavation. These measures would minimize possible migration of the contaminants into the surface water.

A sediment storage pad would be set up on city property above the creek bank and would be bermed with synthetic liner (20 mil, or thicker, PVC or PE). All water that collected on the pads (from precipitation or from sediment excavated) would be treated onsite through granular activated carbon and discharged to the city sewer. All stored materials would be covered by a 10 mil PVC or PE liner. This 50 by 100 foot pad would serve as a staging area for preparation of material either by dewatering or pretreatment for transportation and disposal.

Sediment in the accessible Scajaquada Creek area that contained concentrations of contaminants in excess of the RAOs for carcinogenic and total PAHs would be excavated and treated at an onsite land treatment facility located on the property. The volume of such sediment is conservatively estimated to be 4,000 cubic yards. The extent of contamination is assumed for cost estimating purposes to extend 100 feet up- and downgradient of the RI samples, or **about** 200 ft north and south of the current property boundary.

The material would be prepared for transportation by adding fly ash or other similar material so that no free liquid was present. The material would then be transported to a permitted RCRA Subtitle D landfill for disposal. The excavated material will likely be non-hazardous prior to treatment; however, if it fails TCLP testing, a RCRA permit or variance would be required to pretreat the material likely by modified landfarming prior to disposal.

Air quality would be monitored during all construction activities in the work zone and at the perimeter of the zone. Control action such as dust suppression, odor control or air movement would be incorporated.

Alternative 3 should fulfill the objectives of Category 2 of the SARA guidance categories for the sediment. Removal and treatment of the sediment would permanently reduce the toxicity, mobility, and volume of contaminants in these materials in the creek sediments adjacent to the site at least temporarily.

3.3.1 Short-Term Effectiveness

3.3.1.1 Protection of the Community and Site Workers

Normal construction hazards would be associated with the excavation of the creek sediment. Some of the remedial activities to be conducted on property would require erection of temporary barriers to prevent unauthorized access to the work areas. Excavating the creek sediment will cause releases of contaminated sediment to the surface water. Controls would be put in place to limit the impact. Contaminants (especially volatile organic contaminants) could be released if pretreatment activities are required. Monitoring and control of releases would be required of the construction contractor during activities in the area of the site. Releases of volatile organics during pretreatment of the sediment would be controlled, if necessary, to comply with applicable air quality regulations. These releases are not anticipated to be significant, based on existing data. A site safety plan, would be prepared prior to initiating activities and compliance enforced. In conformance with OSHA regulations, site workers are required to meet health and safety training, medical monitoring, and appropriate protective equipment levels.

3.3.1.2 Environmental Impacts

Disturbing the sediment during excavation will mobilize a significant amount of contamination into the surface water. Suitable controls would be implemented to prevent releases of contaminants out of the excavation zone. Suitable runon and runoff controls would also be implemented during excavation to prevent transport of contaminants by surface runoff.

Releases of volatile organics are not anticipated to be significant, based on existing data and would be controlled, if necessary, to comply with applicable air quality regulations. The sediment filtration and settling zone to be set up will effectively reduce sediment loading in the creek, however, as with any such system set up on a creek, some short-term degradation of downgradient surface water will occur.

3.3.1.3 Time to Achieve Remedial Action Objectives

The remedial action objectives for the sediment would be accomplished when all removal and treatment of the sediment is completed. The removal and disposal is estimated to take 6 to 8 months.

3.3.2 Reduction in Toxicity, Mobility, or Volume

3.3.2.1 Treatment

No treatment except possibly pretreatment by volatilization landfarming would be conducted. The pretreatment, if necessary would reduce leachable benzene concentrations to meet TCLP limits.

3.3.2.2 Reduction in Toxicity, Mobility or Volume

This remedy would reduce the mobility of the contaminants through emplacing the sediment in a secure landfill. **The locally most contaminated sediments would be removed from the creek.** No reduction in toxicity or volume would occur except for possibly minor pretreatment. The amount of material to be excavated and immobilized is minor, compared with the volume of contaminated sediment in the creek. Removing the sediment from the creek may not improve conditions in the creek greatly.

3.3.2.3 Amount of Material Treated

The volume of sediment material that would be treated is approximately 4,000 cubic yards.

3.3.3 Long-Term Effectiveness

3.3.3.1 Residual Risk

Removing the sediment would temporarily eliminate the potential for direct contact with contaminants only in these areas. Such actions would also eliminate these areas as continuing sources of contamination. The risk associated with potential future use of contaminated sediment as defined in the risk assessment, would be reduced by removal of the contaminated sediments. The residual risks associated with this alternative would be minimal in this area. Contaminated sediment and sources would remain in other areas of the creek.

3.3.3.2 Adequacy and Reliability of Controls

Since contaminated sediment would be removed and disposed, long-term controls or monitoring would not be required in these areas. Improvements in surface water quality depend on removal of contaminant sources and remediation of the creek sediments in other areas that have been contaminated by other contaminant sources.

3.3.3.3 Permanence of Remedy

The sediment removed for treatment would be permanently removed and emplaced in a secure landfill. If the contaminant sources and other sediment contamination are remediated, the area will not be recontaminated.

3.3.4 Compliance with ARARs

3.3.4.1 Chemical-Specific ARARs

Sediment containing contaminants in concentrations in excess of NYS guidance limits would be removed and treated. Confirmation sampling would be used to verify removal of contamination under this alternative.

3.3.4.2 Location-Specific ARARs

Section 8.3 of the FS discussed potential location-specific ARARs for the IG/WS sediment variances would be obtained to perform remedial tasks in the waterway.

3.3.4.3 Action-Specific ARARs

During installation of the controls, protection of the workers would comply with OSHA standards. Prevention of airborne contamination by emission control measures in the area of the site would maintain air quality as required by the Clean Air Act.

3.3.5 Overall Protection of Human Health and the Environment

This criterion assesses the overall protectiveness offered by an alternative. The evaluation considers the adequacy of protection, elimination of risk, and achievement of the four previous evaluation criteria.

This alternative would offer protection to both human health and the environment in the excavation area by removing the sediment containing concentrations of contaminants in excess of the cleanup criteria. Protection would be achieved at the end of the remediation period of 6 to 8 months for the sediment. The short-term risks posed by this remediation could include significant impact to surface water.

3.3.6 Implementability

3.3.6.1 Technical Feasibility

Technical feasibility is evaluated on the basis of three parameters: ability to construct the alternative, the reliability of the technologies used, and ease of undertaking additional remedial actions.

- Ability to construct the alternative. All the construction required by this alternative would be basic heavy construction. **A small dredge may be necessary**. Possible difficulties include surface water contamination.

- Reliability of the technology: Excavation is a frequently used alternative that has proven effective. Landfilling is a commonly used, acceptable technology.

- Ease of undertaking additional remedial action. It is not anticipated that any future remedial actions in the excavated area would be necessary unless remediation of the entire creek was implemented.

3.3.6.2 Administrative Feasibility

Access to private and City of Buffalo property will be necessary to excavate the sediment. Land use restrictions would also be required and are not expected to be difficult to implement.

3.3.6.3 Availability of Services and Materials

The construction services to implement this alternative are easily obtained. Remedial contractors are also available with the experience necessary to implement these remedial actions.

3.3.7 Costs

Table 3-7 provides a summary of the construction costs for Alternative 3. The construction costs, including direct and indirect construction costs, would be approximately $1,090,600. As all sediment contamination will be removed under this alternative; no long term monitoring or operation and maintenance will be required.

3.4 ALTERNATIVE 4: SEDIMENT EXCAVATION AND OFFSITE DISPOSAL BY THERMAL TREATMENT

Alternative 4 would consist of the following process options and technologies:

- Excavation, temporary storage and offsite thermal treatment of sediment; and
- Monitoring land use restrictions, and fencing.

The contaminated material in the Scajaquada Creek would be excavated as shown on Figure 3-2. Excavated material separation and storage areas would also be set up when remediation begins. Excavation, pretreatment, and associated effects would be equivalent to the description in Alternative 3.

The excavated sediment would be transported to an offsite disposal facility (coal-fire utility burner) or recycling facility. Transportation would conform to all Department of Transportation regulations. Prior to

Table 3-7. Construction cost estimate - Alternative 3 - Excavate sediment and disposal in a Subtitle D landfill (1993 $).

Item	Quantity	Units	Unit Cost	Total Cost
FENCING				
Chain Link Fence (8' high)	1200	LIN FT	$16.00	$19,200
Gate (34' opening)	2	EA	$1,200.00	$2,400
EXCAVATION (including dewatering)	4,000	CU YD	$90.00	$360,000
SEDIMENT CONTROL	1	LS	$70,000	$70,000
STOCKPILE	50,000	SF	0.50	25,000
DECONTAMINATION				
Area Construction & Equipment Rental/Operation	1	LS	$20,000	$20,000
Transportation (20 mi.)	240	TRIP	100	$24,000
LANDFARM DISPOSAL	4000	CY	$75.00	$300,000
MOBILIZATION/DEMOBILIZATION				$40,000
	Construction Subtotal:		$860,600	
CONTINGENCIES				
Bid Contingencies				$50,000
Scope Contingencies				$100,000
	Contingencies Subtotal:		$150,000	
ALLOWANCES				
Permitting/Legal				$20,000
Engineering				
Design				$20,000
Construction Services				$40,000
	Allowances Subtotal:		$80,000	
TOTAL CONSTRUCTION COSTS:	ALTERNATIVE 3			$1,090,600

leaving the loading area, the exterior of the trucks would be decontaminated using a high-pressure steam cleaner, if necessary.

Fencing, monitoring, and use restriction would also be implemented. In order to protect the public from contact with the contaminants, the work area would be enclosed with a chain link fence.

Alternative 4 would fulfill the objectives of Categories 2 and 3 of the SARA guidance categories for the creek sediment. Excavation and removal would prevent human contact with the sediment contaminants.

3.4.1 Short-Term Effectiveness

3.4.1.1 Protection of the Community and Workers

Normal construction hazards would be associated with the sediment excavation. Fencing or temporary barriers would be installed around the site to protect the community during construction by preventing access to unauthorized personnel. Sediment excavation will cause releases of contaminated sediments to the surface water. Control of these releases were previously discussed with Alternative 3 and would be required of the construction contractor. A site safety plan would be prepared prior to initiating construction and compliance enforced. In conformance with OSHA regulations, site workers are required to meet health and safety training, medical monitoring and appropriate protective equipment levels.

3.4.1.2 Environmental Impacts

The excavation of sediment will mobilize a significant amount of contamination into the surface water. The excavation would be accomplished during a low water period; downgradient berms and sediment filtration would be used to prevent contaminant migration during excavation.

3.4.1.3 Time to Achieve Remedial Response Objectives

The remedial objectives for the sediment would be achieved after the excavation, estimated to take six to eight months.

3.4.2 Reduction in Toxicity, Mobility, or Volume

3.4.2.1 Treatment

The contaminated media treated under this alternative would be excavated sediment. Any water generated would be treated onsite until the effluent met the requirements of the pretreatment agreement with the city. The excavated sediment would be dewatered then thermally treated in fuel blending or a recycling facility.

3.4.2.2 Reduction in Toxicity, Mobility, or Volume

The volume of contaminated sediment will be reduced at the site and if burned in fuels blending, would be destroyed. However, the reduction is minor compared to contaminant volume in the entire creek. **The locally most contaminated sediment would be removed from the creek.**

3.4.2.3 Amount of Material Contained or Treated

The volume of sediment removed from the site would be an estimated 4,000 cubic yards.

3.4.3 Long-Term Effectiveness

3.4.3.1 Residual Risk

Excavating and thermal treatment of the sediment materials would eliminate the potential for direct contact with contaminants in concentrations exceeding the cleanup criteria for PAHs in these areas. These actions would also eliminate these areas as continuing sources of contamination. Contaminated sediment and sources would remain in other areas of the creek **at lower levels.**

3.4.3.2 Adequacy and Reliability of Controls

Since contaminated sediments would be removed and treated, long-term controls or monitoring would not be required in these areas. The usefulness of the remedy depends on the cleanup of other sources of contamination on the creek.

3.4.3.3 Permanence of Remedy

The sediment removed for offsite treatment would be permanently remediated.

3.4.4 Compliance with ARARs

3.4.4.1 Chemical-Specific ARARs

Sediment would be removed based on NYS soil standard guidance. Verification sampling would confirm the removal.

3.4.4.2 Location-Specific ARARs

Variances for the remedial activity taking place in a waterway will be obtained.

3.4.4.3 Action-Specific ARARs

During installation of the controls, protection of the workers would comply with OSHA standards. Activities would conform to RCRA standards. Water generated would meet the discharge standards agreed to in the pretreatment agreement with the City of Buffalo, as is required by the National Pretreatment Standards of the Clean Water Act.

3.4.5 Overall Protection of Human Health and the Environment

This alternative would offer protection to both human health and the environment by eliminating potential contact with the sediment by removal and eliminating migration of contaminants. The residual risks posed by contaminated material remaining in the excavated area would not be **significant.**

3.4.6 Implementability

3.4.6.1 Technical Feasibility

Technical feasibility is evaluated on the basis of three parameters: ability to construct the alternative, the reliability of the technologies used, and ease of undertaking additional remedial actions.

- Ability to construct the alternative. All the construction required by this alternative would be basic heavy construction and should not pose any particular problems.
- Reliability of the technology. Excavation is an effective and frequently used alternative. A utility boiler or recycling facility in the Buffalo area has not yet been selected to take the material; however, the presence of facilities within a 100 mile radius is very likely.
- Ease of undertaking additional remedial action. It is not anticipated that any future remedial actions in the excavated area would be necessary unless remediation of the entire creek was implemented.

3.4.6.2 Administrative Feasibility

Access to private and City of Buffalo or state property would be necessary to excavate the sediment. Land use restrictions would also be required and are not expected to be difficult to implement.

3.4.6.3 Availability of Services and Materials

The materials, equipment, and personnel required to do the soil excavating would be readily available in Buffalo.

3.4.7 Costs

Table 3-8 provides a summary of the construction costs for Alternative 4. The construction costs, including direct and indirect construction costs, would be approximately $1,387,600 (Table 3-8). Continued monitoring and O&M is not necessary as the contamination is removed under this alternative. The estimated cost for transportation and thermal treatment of the sediment is approximately $150 per cubic yard ($100 per ton). This cost is a conservative estimate, it could possibly be reduced by up to 50 percent if a nearby competitive facility were located. This would reduce the total alternative cost by $300,000. If excavated sediment is sent to a RCRA permitted incineration facility instead of coal fired utility burner or soil recycler, the unit price of incineration per cubic yard of soil will be approximately $1,500. For offsite solid waste landfill which likely could not accept much of the soil the unit price of

Table 3-8. Construction cost estimate - Alternative 4 - Excavating sediment with offsite thermal treatment/recycler (1993 $).

Item	Quantity	Units	Unit Cost	Total Cost
FENCING				
Chain Link Fence (8' high)	1200	LIN FT	$16.00	$19,200
GATE	1	LS	$2,400	$2,400
EXCAVATION (including dewatering)	4,000	CU YD	$90.00	$360,000
SEDIMENT CONTROL	1	LS	$70,000	$70,000
HDPE LINER (60 mil) for Stockpiling	50,000	SQ FT	$0.60	$30,000
TRANSPORTATION (@ 200 miles)	240	TRIP	$900.00	$216,000
OFFSITE THERMAL TREATMENT/RECYCLER				
Incineration (As fuel at utility/recycling)	4,000	CU YD	$100	$400,000
DECONTAMINATION				
Area Construction & Equipment Rental/Operation	1	LS	$20,000	$20,000
MOBILIZATION/DEMOBILIZATION				$40,000
	Construction Subtotal:		$1,157,600	
CONTINGENCIES				
Bid Contingencies				$50,000
Scope Contingencies				$100,000
	Contingencies Subtotal:		$150,000	
ALLOWANCES				
Permitting/Legal				$20,000
Engineering				
Design				$20,000
Construction Services				$40,000
	Allowances Subtotal:		$80,000	
TOTAL CONSTRUCTION COSTS:	ALTERNATIVE 4			$1,387,600

disposal per cubic yard of sediment will be approximately $75, and for an RCRA permitted landfill, approximately $275 per cubic yard ($183 per ton).

4 COMPARATIVE EVALUATION OF ALTERNATIVES

The purpose of this section is to compare the remedial alternatives on the basis of the evaluation criteria developed and discussed in Section 3. These criteria include overall protection of human health and the environment; short-term effectiveness; reduction of toxicity, mobility, or volume; long-term effectiveness and permanence; compliance with ARARs; implementability; and cost. In order to facilitate the comparison of the alternatives, a summary of the detailed evaluation performed in Section 3 is provided in Table 4-1.

The no action alternative (Alternative 1) is not included in the comparisons in the following sections, since it would not meet any of the remedial action objectives. All four of the remaining alternatives (including Alternative 1A) would meet the goals and objectives of the remedial action as stated in Section 3. A cost sensitivity analysis of the alternatives is included at the end of this section.

4.1 OVERALL PROTECTION OF HUMAN HEALTH AND THE ENVIRONMENT

The excavation/offsite disposal of Alternative 4 offers the most long-term effectiveness for sediment volume reduction, as the sediments are removed and contaminants are destroyed thermally. The excavation in Alternatives 3 and 4 will mobilize contaminants into the surface water; although controls will be implemented, some migration of contaminants may occur. The alternative incorporating capping (2) would not immediately remove long-term residual risk; however, to a limited effect it would protect human health and the environment by minimizing the potential for contact in the area under consideration (land use restrictions would be required to maintain the caps).

Monitoring and use restrictions would be incorporated with all alternatives.

4.2 SHORT-TERM EFFECTIVENESS

Normal construction hazards would be associated with the implementation of all four alternatives. All four alternatives would use referencing and temporary barriers to prevent unauthorized access and would

Table 4-1. Comparative evaluation of remedial action alternatives.

	Alternative			
Criteria	**1A**	**2**	**3**	**4**
Overall protection of human health and the environment.	Would not eliminate residual risks, but would limit access to the area.	Would not permanently eliminate residual risk, but would minimize the potential for contact with sediment wastes.	Would permanently eliminate residual risk associated with wastes containing concentrations of contaminants in excess of cleanup levels in the excavated area.	Would permanently eliminate residual risk associated with wastes containing concentrations of contaminants in excess of cleanup levels in the excavated area.
Short-term effectiveness: protection during remedial action/ environmental impacts.	Not applicable.	Site access would be limited during the remedial action to protect the public. Fugitive dust and volatile emissions would be monitored and controlled (as necessary) to protect the public and the environment during construction. Sediment contamination of surface water would be controlled. OSHA regulations would be followed to protect onsite workers.	Site access would be limited during the remedial action to protect the public. Surface water contamination would be monitored and controlled (as necessary) to protect the public and the environment during construction. OSHA regulations would be followed to protect onsite workers.	Site access would be limited during the remedial action to protect the public. Surface water contamination and runoff during excavation and materials handling would be monitored and controlled. OSHA regulations would be followed to protect onsite workers.

Table 4-1. Comparative evaluation of remedial action alternatives (continued).

	Alternative			
Criteria	**1A**	**2**	**3**	**4**
Time until remedial action objectives are achieved.	Remedial action objectives would be achieved when access is restricted within 1 month.	Engineering design and construction of the cap, establishing land use restrictions and monitoring to verify that the contaminant was being contained would require approximately 2 years.	Engineering design, excavation and landfilling offsite would require approximately 8 months.	Engineering design, excavation and incineration would require approximately 8 months.
Reduction of toxicity, mobility or volume treatment.	No treatment would be implemented. Natural biodegradation would reduce toxicity.	No treatment would be implemented. Natural biodegradation would reduce toxicity.	Sediment would be removed from the site but not treated.	Sediment removed would be treated. Treatment would be irreversible, and no wastes would be generated. The sediment would be thermally treated to destroy organic contaminants.
Reduction of toxicity, mobility or volume.	None.	The mobility of the sediment contaminants would be reduced.	The mobility of the contaminated sediment would be reduced by landfilling. The volume and toxicity of contaminants remaining at the site would be reduced.	The toxicity and mobility of the contaminants in the sediment removed by excavation would be reduced. The toxicity, mobility, and volume of the contaminated sediment would be completely eliminated by thermal destruction or landfill of the organic contaminants.
Amount of contaminants treated or destroyed.	None.	None.	The volume of contaminated sediment that would be removed is 4,000 cubic yards.	The volume of contaminated sediment that would be treated is 4,000 cubic yards.

Table 4-1. Comparative evaluation of remedial action alternatives (continued).

	Alternative			
Criteria	**1A**	**2**	**3**	**4**
Effectiveness magnitude of residual risk.	The risks identified in the baseline risk assessment would remain unchanged.	Would reduce risk by minimizing the potential for direct contact with or ingestion of the capped sediment contaminants. Land use restrictions would minimize the risk of potential future offsite use of contaminated sediment.	Risk associated with the sediment contamination would be eliminated by removal of the media to a secure landfill. However, the material would remain contaminated.	Risk associated with the sediment contaminants in excess of cleanup levels would be eliminated by removal of the contaminated media and destruction of the contaminants through incineration.
Adequacy and reliability of controls.	Continued access and use restrictions would be required.	Sediment monitoring, maintenance of the cap, and enforcement of land use restrictions would be required throughout the life of the alternative to ensure that remediation measures continued to be effective.	Monitoring would be required to verify that removal measures were effective.	Monitoring would be required immediately following the alternative to verify removal.
Permanence of remedy.	Not applicable.	Routine replacement and repair of materials and equipment would be required during the life of this alternative. Future remedial action might ultimately be required during the life of this alternative.	No future remedial action should be required in the excavated area. However, recontamination of the areas due to contaminant migration in the creek is likely.	No future remedial action should be required in the excavated area. However, recontamination of the areas due to contaminant migration in the creek is likely.

Table 4-1. Comparative evaluation of remedial action alternatives (continued).

	Alternative			
Criteria	**1A**	**2**	**3**	**4**
Compliance with ARARs.	Sediment containing contaminants in concentrations in excess of NYS limits would remain. Would comply with all other ARARs, with the exception of requirements regarding application for remediation of the sediment.	Sediment containing contaminants in concentrations in excess of NYS limits would remain. Would comply with all other ARARs, with the exception of requirements regarding application for remediation of the sediment.	Would comply with all ARARs. Alternate concentration limits would be set based on the best available technology applied to removal of the contaminated sediment.	Would comply with all ARARs. Alternate concentration limits would be set based on the best available technology applied to removal of the contaminated sediment.
Implementability, technical feasibility.	Not applicable.	Construction activities would be routine. All proposed technologies have been proven effective. Would not restrict future remedial actions.	All proposed technologies have been proven effective. Would not restrict future remedial actions.	All proposed technologies have been proven effective. Would not restrict future remedial actions.
Administrative feasibility.	Restrictions may be difficult to implement.	Access to City, state, and private property would be required. Restrictions might be difficult to implement.	Access to City, state, and private property might be required.	Access to City, state, and private property would be required. Land use restrictions might be difficult to implement.

Table 4-1. Comparative evaluation of remedial action alternatives (continued).

	Alternative			
Criteria	**1A**	**2**	**3**	**4**
Availability of services and materials.	Readily available.	Readily available. OSHA health and safety trained workers would be required.	Readily available. OSHA health and safety trained workers would be required.	Readily available. OSHA health and safety trained workers would be required.
Estimated Costs (1993 $) Construction Costs	$19,200	$330,400	$1,090,600	$1,387,600
Present Worth of Operation and Maintenance Costs	$52,100	$57,900	$0	$0
Total Present Worth Cost (5%, 30 Years)	$71,300	$388,300	$1,090,600	$1,387,600

Notes:

Alternative 1. No action.
Alternative 2. Capping of sediment.
Alternative 3. Excavation sediment and disposal in a Subtitle D Landfill.
Alternative 4. Excavation of sediment and disposal offsite by thermal treatment/recycler.

implement emission control measures, as necessary, to prevent releases during construction/excavation activities. Alternatives 3 and 4 would also require runon and runoff controls to prevent releases due to surface water runoff or mobilization of contaminants during excavation and materials handling. Initial release of volatile organics during modified landfarming of sediment under Alternative 3 to reduce TCLP benzene concentrations, if necessary, is not anticipated to be significant, based on existing data, but would be controlled in compliance with applicable air quality regulations. All work under all the alternatives would be conducted in conformance with OSHA regulations to protect onsite workers.

Alternative 2 would require two months to complete construction of the cap, while Alternative 3 or 4 would take four to six months to complete construction and/or removal and offsite transport of the sediment. Modified landfarming if necessary, of the sediment under Alternatives 3 and 4 would be completed in 1 to 2 months. Under Alternative 2, which relies on capping to contain the contaminant sediment, RAOs would be met once use restrictions were implemented and monitoring confirmed that the contamination was being contained. Alternative 1A would be completed immediately, long-term monitoring would be used to determine if RAOs were met.

4.3 REDUCTION OF TOXICITY, MOBILITY OR VOLUME

Alternative 4 would result in complete removal of the organic contaminants and would permanently reduce the toxicity, volume, and mobility of these media containing concentrations of contaminants above the cleanup levels. Under Alternative 3, the mobility and volume of contaminated soil would be reduced by offs-site disposal. The reduction of volume by Alternatives 3 and 4 would be minor in comparison to the remaining contamination if remediation of the entire creek is not implemented. Alternative 2, capping, would reduce the contaminant mobility by limiting infiltration through contaminated sediment.

4.4 LONG-TERM EFFECTIVENESS AND PERMANENCE

All three alternatives (with the exception at 1A) would remediate the area adjacent to the site and leave minimal residual risk until near sediment buildup occurs from other contaminant sources. The same alternatives also would minimize the potential for contact with the sediment contaminants by removing these areas or covering them with a cap. Alternative 4 would permanently remove the organic contaminants in the excavated sediment by thermal treatment. Under most alternatives, use restrictions would minimize the risk associated with potential future use. Alternative 3 would permanently remove the contaminated sediment from the site in question, but would transfer the contaminants to a solid waste landfill where they would remain relatively immobilized.

Alternative 2 would require the most long-term control measures, including monitoring, maintenance of the cap, and enforcement of land use restrictions. These activities would be required throughout the life of the alternatives to ensure that remediation measures continued to be effective. Long-term monitoring would be required under all alternatives.

Future remedial action might be required under all Alternatives. For all alternatives long term effectiveness will be limited if continuing contaminant sources are not controlled. Performing significant remediation on a section of the creek, while other areas are still contaminated and can recontaminate the remediated area is not, overall, an effective alternative.

4.5 COMPLIANCE WITH ARARs

With the exception of Alternatives 1A and 2, all the alternatives would actively reduce contaminant concentrations in the sediment.

4.6 IMPLEMENTABILITY

All the alternatives except 1A would be labor intensive, but construction activities would be routine. The necessary equipment, materials, workers, and specialists required to implement all the alternatives are readily available. Excavation associated with Alternatives 3 and 4 will require dredging equipment and significant dewatering and sediment control efforts.

Alternatively, dewatering the area to be excavated by rerouting creek flow could be accomplished with coffer dams and high volume pumps. Dewatering would enhance the effectiveness of excavation but the associated cost eliminated further consideration in the screening section of this study.

Administratively, all the alternatives could be implementable. All four alternatives would require access to City, state, and private property. Land use and surface water use restrictions would be required for all alternatives. All the alternatives would require coordination with a variety of federal, state, and local authorities, including USEPA, NYSDEC, and the City of Buffalo. All four alternatives would be compatible with future remedial action at the site.

4.7 COSTS

The present worth costs range from a low of $71,300 for Alternative 1A, to a high of $1,387,600 for Alternative 4. These present-worth costs were based on a 30-year service period and an annual discount rate of five percent. A cost sensitivity analysis based on varying discount rates and remedial activities is provided in Section 4.8.

4.8 COST SENSITIVITY ANALYSIS

The cost estimates prepared for each remedial action alternative involve approximations, assumptions, estimations, interpretations, and engineering judgment. In most cases, one or two key variables have a significant impact on the total present worth of an alternative. The purpose of a sensitivity analysis is to evaluate the impact of these key parameters on the total present worth by varying them, while holding all other factors constant. Alternatives 1A and 2 are the only alternatives requiring long-term monitoring; changes in required surface water monitoring frequency could significantly affect total cost.

The transportation and disposal cost estimates for Alternative 4 are conservative; if a competitive disposal situation exists the costs may be reduced up to 50% (approximately $300,000). Three alternatives assume an area to cap or volume to excavate. Additional area or volume affects costs significantly. If pretreatment of sediment is required in Alternatives 3 and 4 to reduce TCLP benzene to non-hazardous levels, additional operational cost would be incurred up to approximately $20 per cubic yard.

If all material excavated required pretreatment this could amount to $80,000.

Capping or excavating sediment in a small stretch of the creek is unlikely to have a cost-effective, long-term effect. Remediation by additional parties of other contaminated areas and removal of contaminant sources should be accomplished before a cost effective remediation can be accomplished. Additionally, disturbance of contaminated sediments during excavation will require expensive control strategies; the likely surface water contamination associated with the alternatives further calls into question their cost-effectiveness.