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Anderson Development (Amendment), MI

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16. Abstract (Limit: 200 words)

The Anderson Development site is an active chemical manufacturing facility in Adrian, Lenawee County, Michigan. The site occupies approximately 12.5 acres within a 40-acre industrial park, which is surrounded by residential areas. Site features include several onsite buildings used for manufacturing, storage, laboratories, and offices, as well as a 0.5-acre former process wastewater pretreatment lagoon containing lagoon sludge and an underlying clay layer. From 1970 to 1979, the Anderson Development Corporation (ADC) produced specialty chemicals onsite including 4,4-methylene bis (2-chlororaniline) (MBOCA), a hardening agent for the production of polyurethane plastics. Untreated process wastewater was discharged directly to surface water until 1973, when the State discovered aniline in a side drain from the facility. Later in 1973, ADC began separating process wastewater from its cooling water, with subsequent discharge of wastewater to a publicly owned treatment works (POTW). At the POTW, MBOCA was settled out with other solids and applied to the land, which has led to contamination at the POTW drying beds. In 1979, the State ordered the POTW not to accept the waste stream because of the decreased efficiency of the POTW resulting from MBOCA contamination. In 1979, after MBOCA was found in

(See Attached Page)

17. Document Analysis a. Descriptors
Record of Decision - Anderson Development, MI
First Remedial Action (Amendment) - Final
Contaminated Media: soil, sludge
Key Contaminants: VOCs (toluene, MBOCA and its degradation products), metals

b. Identifiers/Open-Ended Terms

c. COSATI Field/Group

Availability Statement	19. Security Class (This Report) None	21. No. of Pages 44
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(Formerly NTIS-35)
Department of Commerce

EPA/ROD/R05-91/177
Anderson Development, MI
F' 'st Remedial Action (Amendment) - Final

Abstract (Continued)

onsite sediment, production of the chemical ceased. In 1980 and 1981, the site owner and the State cleaned up all contaminated site areas, except for the onsite lagoon and the adjacent soil, with MBOCA levels greater than 1 mg/kg by decontaminating the plant, sweeping streets, shampooing/vacuuming residential carpet, and removing some contaminated surface soil offsite. A 1990 ROD addressed site contamination of surface soil, lagoon sludge, and underlying lagoon clay. This ROD amends the 1990 ROD, which provided for treatment of the contaminated media using in-situ vitrification, and documents the selection of low temperature thermal desorption (LTTD) as the preferred treatment technology, based on cost and other concerns. The primary contaminants of concern affecting the soil and lagoon sludge are VOCs including toluene and MBOCA and its degradation products; and metals.

The selected amended remedial action for this site includes excavating and staging 3,000 to 4,000 tons of contaminated soil, clay, and lagoon sludge with MBOCA concentrations above the 1.6 mg/kg clean-up action level in an LTTD device; performing treatability studies to evaluate effectiveness of the LTTD technology, then, if effective, treating the contaminated soil, clay, and sludge onsite using LTTD; placing the treated soil, sludge, and clay into the excavated lagoon, covering the lagoon with clean soil, and regrading the area; or if the results of the treatability study indicate that LTTD is unacceptable, using in-situ vitrification as the alternate remediation technology; collecting off-gases and treating the gases using an air pollution control train, which includes a scrubber system, air filters, and carbon adsorption beds; treating aqueous streams from the air pollution control train using ıid phase activated carbon beds; thermally regenerating or disposing of spent carbon fines from the particulate removal equipment offsite; and monitoring ground water and air. The estimated cost of the LTTD treatment options for this amended remedial action is $1,100,000.

PERFORMANCE STANDARDS OR GOALS: The "action" or clean-up level for MBOCA, the primary contaminant of concern, is 1,684 ug/kg, calculated based on EPA guidance documentation, and corresponds to the excess lifetime cancer risk level of 10^{-6}. Other volatile, semi-volatile and inorganic contaminant cleanup standards are consistent with State standards.

RECORD OF DECISION AMENDMENT

ANDERSON DEVELOPMENT COMPANY SITE
ADRIAN, MICHIGAN
LENAWEE COUNTY

PURPOSE

This decision document amends the September 1990 Record of Decision (ROD) for the Anderson Development Company Site, in Adrian, Michigan. This decision document presents the selected remedial action for the Anderson Development Company Site in Adrian, Michigan, and was developed in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA), as amended by the Superfund Amendments and Reauthorization Act of 1986 (SARA), and, to the extent practicable, the Nation Contingency Plan (NCP).

BASIS

The decision to amend the Record of Decision is based on the Administrative Record for the Anderson Development Company Site. The attached index identifies the items which comprise the Administrative Record upon which the selection of the remedial action is based.

ASSESSMENT OF THE SITE

Actual or threatened releases of hazardous substances from this site, if not addressed by implementing the remedial action selected in this Record of Decision Amendment, may present an imminent and substantial endangerment to public health, welfare, or the environment.

DESCRIPTION OF THE AMENDMENT

The selected remedial action for the Anderson Development Company Site addresses the principal threat through remediation of contaminated pretreatment lagoon sludge, surface soils around the lagoon found to have levels of contamination above health based levels, and some of the naturally occurring clay which underlies the lagoon found to have concentrations of contaminants above the clean-up action level. The major components of the selected remedial action include:

* Excavation of contaminated soils, sludge and clay with MBOCA concentrations above the clean-up action level;

* Staging of contaminated soils, sludge and clay and processing of these matrices in a low temperature thermal desorption device;

* Air monitoring during the remedial action; and

* Groundwater monitoring following the remedial action for a period of 2 years to assess and confirm the efficacy of low temperature thermal desorption.

DECLARATION

The selected remedy is protective of human health and the environment, complies with Federal and State requirements that are legally applicable or relevant and appropriate to the remedial action, and is cost-effective. The remedy utilizes permanent solutions and alternative treatment technologies to the maximum extent practicable and satisfies the statutory preference for remedies that employ treatment that reduces toxicity, mobility, or volume as a principal element. Because the contaminants will be removed in the process and disposed of off-site, a five year review is not necessary.

The State of Michigan concurs on the selected remedy.

9/30/91
DATE

FOR Valdas V. Adamkus
Regional Administrator

STATE OF MICHIGAN

JOHN ENGLER, Governor

DEPARTMENT OF NATURAL RESOURCES

STEVENS T. MASON BUILDING
P.O. BOX 30028
LANSING, MI 48909

ROLAND HARMES, Director

September 27, 1991

Mr. Valdas Adamkus, Regional Administrator
U.S. Environmental Protection Agency
Region 5, 5RA-14
230 South Dearborn Street
Chicago, Illinois 60604

Dear Mr. Adamkus:

The Michigan Department of Natural Resources (MDNR), on behalf of the State of Michigan, has reviewed the proposed Record of Decision (ROD) Amendment for the Anderson Development Company (ADC) Superfund site, (Lenawee County), which we received on September 4, 1991. The remedy in the proposed ROD Amendment consists of low temperature thermal treatment (LT3) of contaminated soils in and around the pretreatment lagoon at ADC. The full-scale implementation of this remedy is contingent upon the successful testing of this technology at the site. Should this technology not prove successful during testing, the site would be remediated by in-situ (in-place) vitrification, which was the remedy selected in the original ROD which was signed on September 28, 1990.

The selected remedial action for this site is expected to provide a permanent remedy for the site which is protective of the public health, safety, welfare, environment, and natural resources. The remedy is expected to meet the criteria for a Type B cleanup under the rules implementing the Michigan Environmental Response Act (1982 P.A. 307, as amended). The backup remedy of in-situ vitrification, if implemented, can also meet the Type B cleanup criteria. We concur with the selection of LT3 as the final remedy for this site, with in-situ vitrification as the backup remedy. This concurrence is contingent upon the successful evaluation of LT3 through the proof of process testing and the design process.

I look forward to our continued cooperation in the evaluation and full-scale implementation of the final remedy for this site.

Sincerely,

Acting

Delbert Rector
Deputy Director
517-373-7917

cc: Mr. Jonas Dikinis, EPA
Ms. Mary Tyson, EPA
Mr. Michael Valentino, EPA
Mr. Alan Howard, MDNR
Mr. William Bradford, MDNR
Mr. Scott Cornelius/Mr. Brady Boyce, MDNR

AMENDMENT TO RECORD OF DECISION

SUMMARY OF REMEDIAL ALTERNATIVE SELECTION
ANDERSON DEVELOPMENT COMPANY SITE
ADRIAN, MICHIGAN

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	RESPONSIVENESS SUMMARY	ATTACHED

I. INTRODUCTION

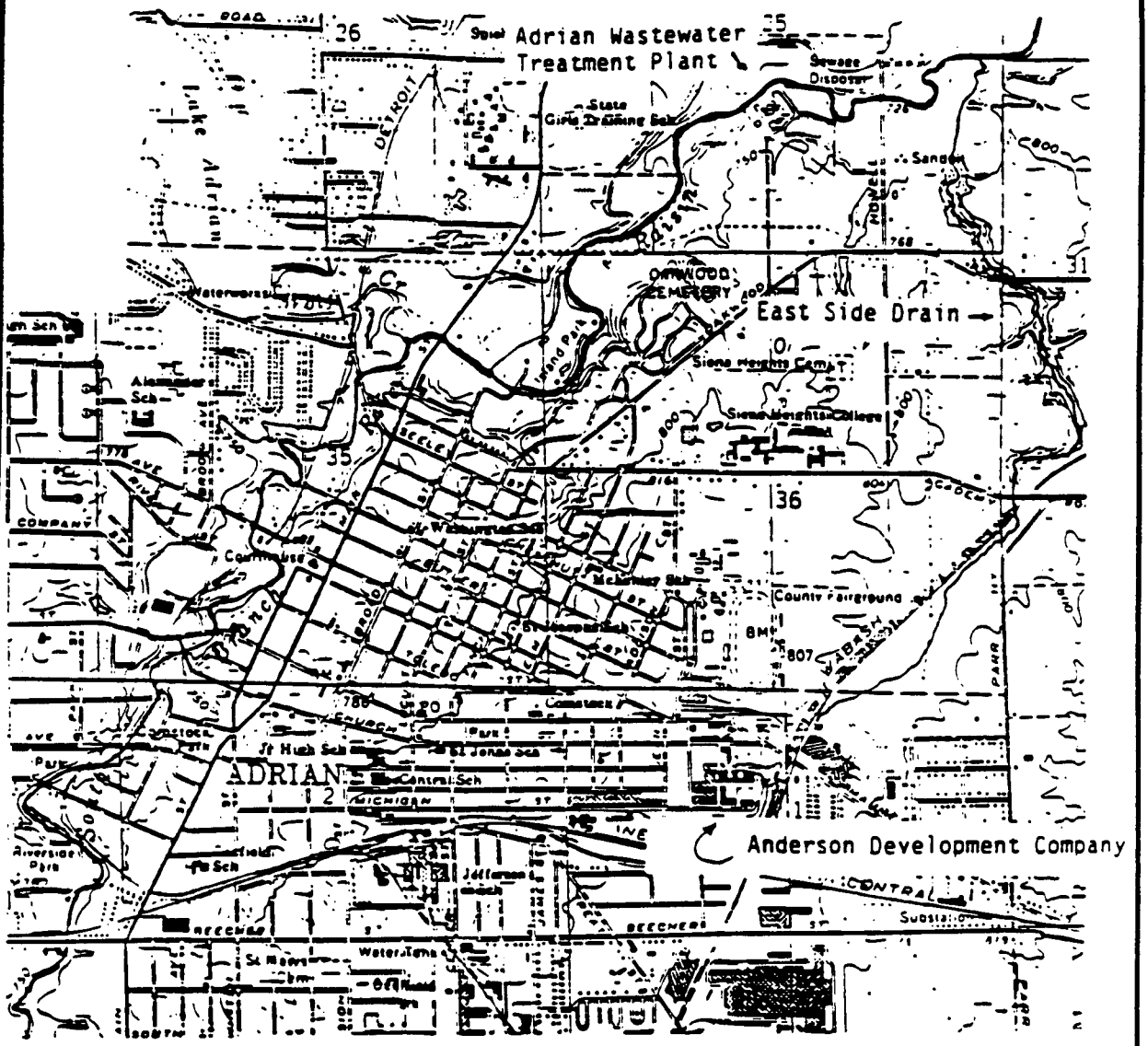
The Anderson Development Company (ADC) Site is located in an industrialized area in the southeast side of the city of Adrian, in Madison Township, Lenawee County, Michigan. (See **Figure 3-1**). The ADC facility is located at 1415 E. Michigan Street. The ADC facility occupies roughly 12.5 acres of a 40 acre industrial park, and includes several buildings which are used for manufacturing and storage, offices and laboratory space. Within this 12.5 acre area is a former process wastewater pretreatment lagoon which contains anywhere from two feet to five feet of standing water, depending on the time of year and amounts of precipitation. The approximate area of this lagoon is one-half acre.

The Record of Decision (ROD) for the site which was signed on September 28, 1990 addressed contaminated Site matrices in and around the former pretreatment lagoon area. This document amends the ROD and provides for implementation of concurrent treatability studies for the purposes of determining the applicability of low temperature thermal desorption and ISV to Site contaminants and matrices. Low temperature desorption is selected as the remedial alternative; yet it is contingent upon the successful completion of the above mentioned treatability study. In the event that low temperature desorption is determined to be unacceptable, the Site will be remediated by implementing ISV technology at the Site.

The lead agency for the remedial action at this site is the United States Environmental Protection Agency (U.S. EPA). The State of Michigan Department of Natural Resources (MDNR) is the support agency. This ROD amendment will become part of the Administrative Record File.

The remedy selected in the ROD was a final remedial action. It consisted of <u>in situ</u> vitrification (ISV) of surface soils, lagoon sludge and clay which contain 4,4'-Methylene bis(2-chloroaniline), i.e., MBOCA or Curene 442, above the Site specific, health-based action level of approximately 1.6 mg/kg of MBOCA, on a dry weight basis. The selected remedy was a source control remedial action which would have resulted in removing all MBOCA above the clean-up level. Because the findings of the Remedial Investigation did not indicate groundwater contamination, and because of the immobility of MBOCA in soils and immiscibility of MBOCA in water, only short-term post remedial action groundwater monitoring was required. Additionally, there was no need to perform a five year review because contaminants above health-based standards would not remain on-Site.

The present amendment to the ROD also requires treatment of all contaminated Site media above the 1.6 mg/kg MBOCA (dry weight basis) clean-up goal, without a need for groundwater restoration measures. Based on sampling conducted at the Site, approximately 3000 to 4000 tons of soil, sludge and clay will need to be remediated. This amendment, however, recommends that the Site be



References:
USGS 7.5 Minute Series, Adrian Quadrangle
Adrian, Michigan, 1979.

FIGURE 3-1 SITE LOCATION MAP

remediated via application of low temperature thermal desorption of contaminated matrices, followed by placement of treated soils, sludge and clay into the excavated former lagoon, covering of the lagoon with clean native soils and grading to allow for proper surficial drainage.

The selection of low temperature thermal desorption is contingent upon the successful demonstration of a full-scale treatability study to be performed in October 1991. If U.S. EPA determines that low temperature desorption can safely and effectively remove MBOCA from the contaminated matrices, achieve all Michigan Environmental Response Act (Act 307) soil clean-up criteria and meet all other clean-up and performance standards, and not generate products of incomplete combustion at levels which would pose human health or environmental risks, then Site remediation will be pursued by employing this technology. In the event that low temperature desorption fails to meet the clean-up and performance standards specified in the Scope of Work (SOW) attached to the Consent Decree for conduct of remedial design and remedial action (RD/RA), then the Site is to be remediated via ISV. An engineering-scale ISV treatability study will be performed concurrently with the low temperature desorption treatability study. The results of the ISV engineering-scale test are expected to be available in late 1991 or early 1992.

II. SITE CHARACTERISTICS

Based on the information gathered from borings and wells completed during the Remedial Investigation (RI) field activities, the hydrogeology immediately surrounding the ADC plant was described in the RI. In the pretreatment lagoon area, there is an upper brown till unit, 30 to 40 feet thick, with small but variable amounts of silt, sand and gravel. This unit does not contain perched aquifers, but contains small "pockets" of groundwater where the permeability is believed to be greater than that of the remainder of this "confining layer." Below this confining layer is a saturated and confined aquifer composed primarily of poorly sorted grey and black sand, silt and gravel. The thickness of this unit was not determined. The aquifer and confining layer are hydraulically connected, although the low permeability of the clay layer would significantly retard the vertical travel of contaminants at the Site.

Based on water level measurements, well logs, construction details and survey data collected during the RI, it is estimated that in the sandy, confined aquifer, groundwater flows approximately to the northwest. However, in the clay-rich confining layer, the flow pattern could not be predicted because of the heterogeneity of the unit. The clay-rich confining layer is not used for any water supply purposes. The residential wells closest to the ADC Site are those located in the Sunnyside Subdivision, and are believed to be upgradient with respect to the Site. These wells tap into the

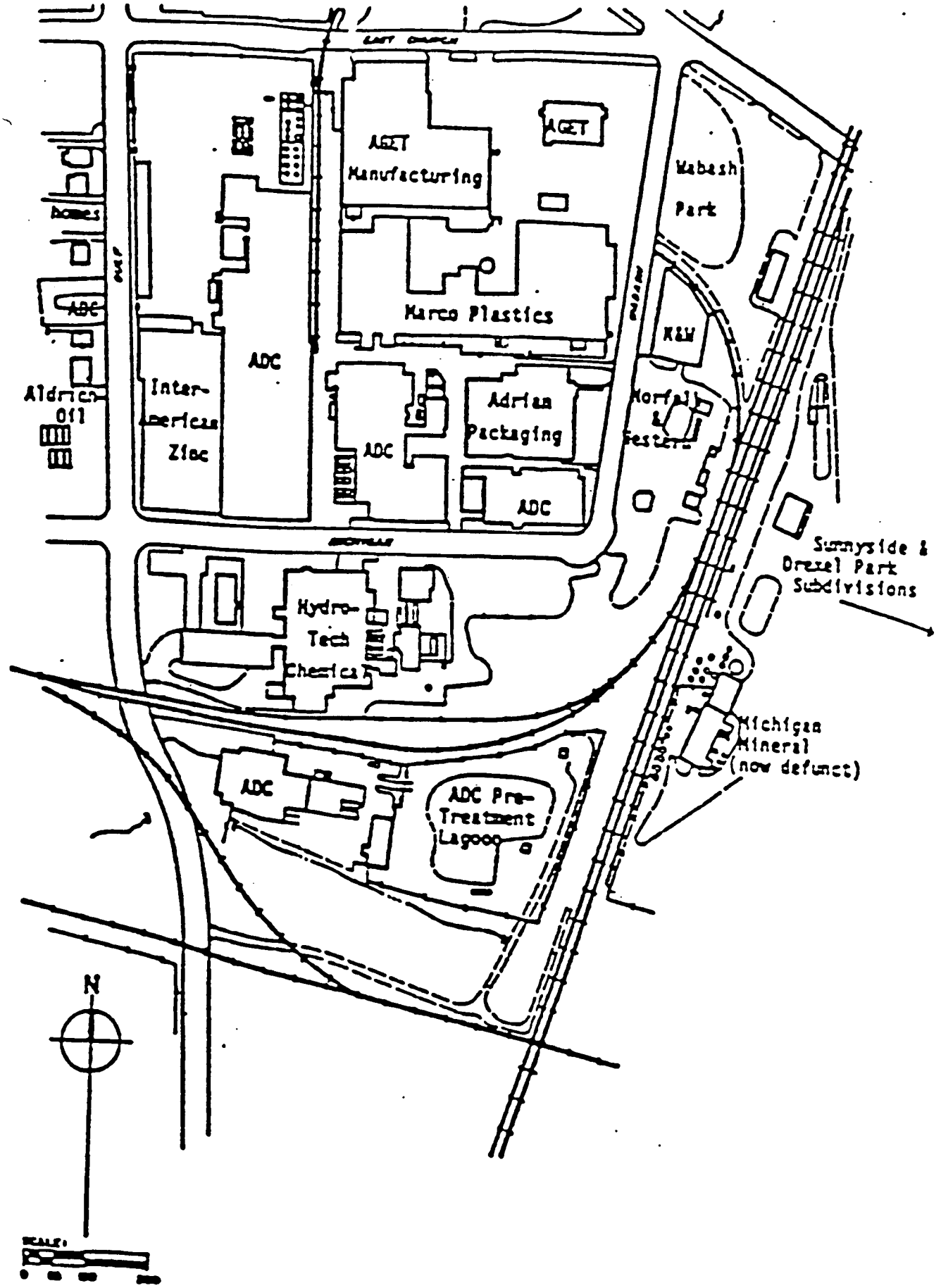
confined and deeper aquifer. Also, the residences in the Sunnyside Subdivision are provided with a central water supply. The only known operating domestic water supply well in the Sunnyside Subdivision is at the Sunnyside Cafe, located on East Maumee Street, and hydraulically upgradient to the Site.

The "area of contamination" for which a response action is necessary is limited to the former pretreatment lagoon area, and the remedial action selected in this Record of Decision represents a complete Site clean-up. During negotiations for conduct of the Remedial Investigation and Feasibility Study, the "Site" was limited to the extent of the ADC property, and was not intended to include areas of contamination away from the facility (e.g., the Adrian Wastewater Treatment Plant). Contaminated media (above the health-based clean-up action level) include lagoon sludge, some of the naturally occurring clay which underlies the lagoon, and a small volume of surface soils located adjacent and to the north of the lagoon. For a map of the area and map of the lagoon area, refer to **Figures 2 and 3-2**, respectively.

Situated in an industrialized setting, the ADC facility is within 1000 feet of Aldrich Oil, AGET Manufacturing, Marco Plastics, Adrian Packaging, Inter-American Zinc and Hydro-Tech Chemicals. The former pretreatment lagoon is located approximately 400 feet south of the ADC main office building and is within 200 feet of the property boundary of Hydro-Tech Chemicals.

Approximately 330 homes are located within a one kilometer (5/8 mile) radius of the ADC plant, including two residential subdivisions: Drexel Park and Sunnyside. Boundaries for the Site include Church Street to the north, Gulf Street to the west, Wabash Street to the east, and railroad tracks to the south and east. The closest residences to the Site are approximately 1/4 mile away.

Adrian is located in glacially-derived topography, a moraine comprised of unconsolidated and heterogeneous clay, silt, sand and gravel. The underlying bedrock formation is the Coldwater Shale, located approximately 100 to 250 feet below the land surface. Most surface soil around the ADC Site is hard clay till, brown to grey in color, with variable amounts of sand and gravel. Surface runoff from the Site is conveyed by City storm sewers to the East Side Drain, which is an ephemeral tributary to the South Branch of the River Raisin. Adrian (population 21,276) water supplies are drawn from Lake Adrian, a reservoir located on Wolf Creek which merges with the River Raisin at approximately two miles upstream of the mouth of the East Side Drain. No wetlands or floodplains have been identified near the Site. The ADC facility is within 6000 feet of the River Raisin at its closest point. The lagoon is fenced, and access is provided via a gate and unpaved road to the west of the lagoon.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Marco Plastics
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Drexel Park
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Figure 2

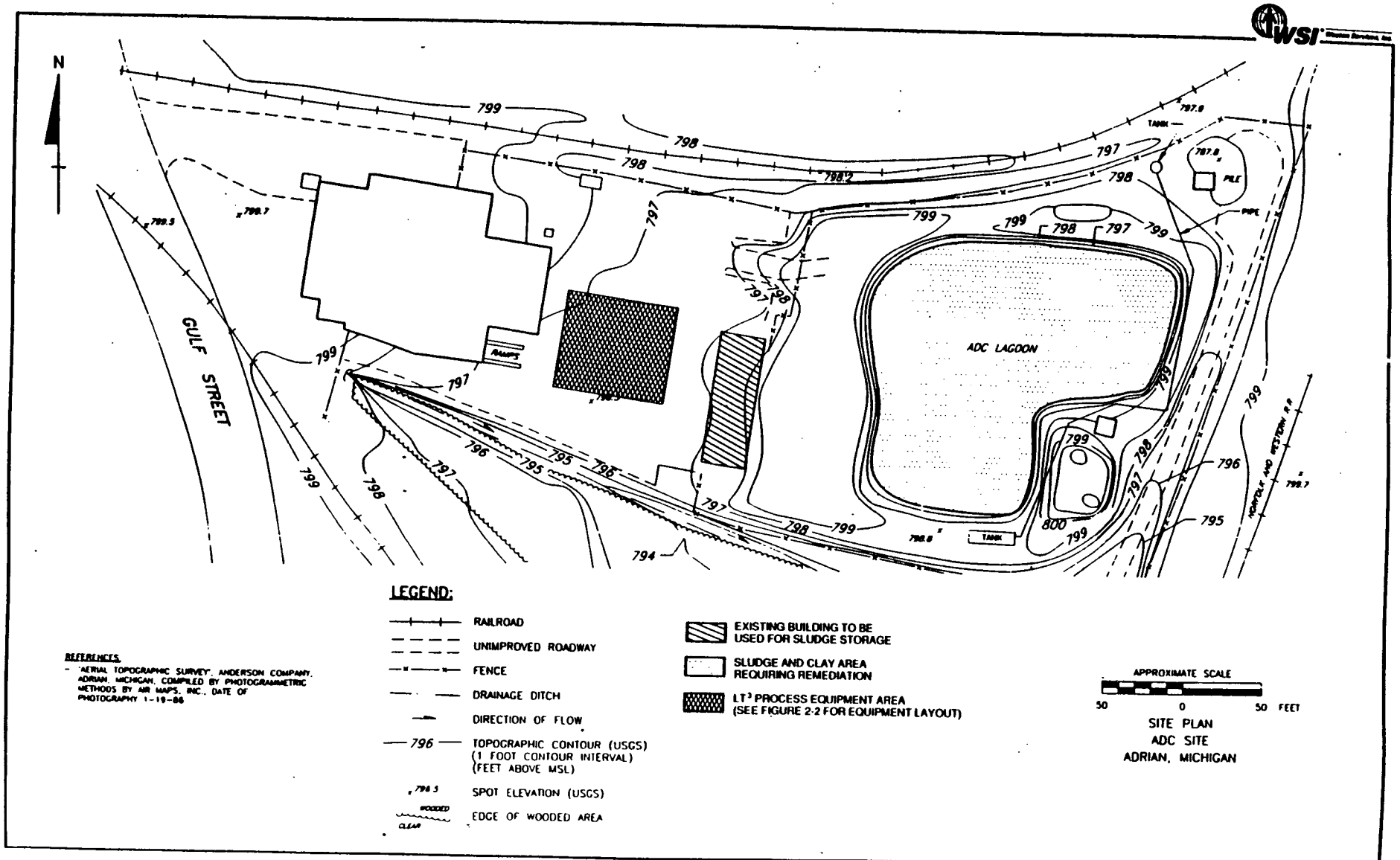

FIGURE SITE PLAN

Under CERCLA § 117 and Section 300.435(c)(2)(ii) of the National Contingency Plan, the lead agency is required to propose an amendment to the Record of Decision (ROD) if the differences in the remedial action alter the basic features of the ROD and allow the public the opportunity to comment on the proposed changes. A public meeting for the original ROD was held on July 12, 1990 with approximately 50 residents in attendance. The amendment to the ROD was made available to the public on August 28, 1991. The public meeting was held on September 12, 1991, at City Council Chambers in Adrian, Michigan.

III. SITE HISTORY

Anderson Development Company (ADC) is a corporation principally involved in the manufacture and sale of specialty organic chemicals. It is located on the southeast side of the City of Adrian in Lenawee County, Michigan. The Site covers approximately 12.5 acres, including a pretreatment lagoon, within a 40 acre industrial park. ADC is surrounded by light industrial and residential areas.

ADC is a specialty organic chemical manufacturing facility. ADC began production of MBOCA, i.e., 4,4'-Methylene bis(2-chloroaniline), in 1970 under the trade name Curene 442. MBOCA is used as a hardening agent in the manufacture of polyurethane plastics. Throughout the 1970's, ADC produced as much as 1.3 million pounds of MBOCA annually. During this period, ADC accounted for 25% to 40% of the MBOCA production in the United States. MBOCA has a number of synonyms, depending on its producer: Curalon M (Uniroyal); Cyanaset (American Cyanamid); MOCA (DuPont), etc. MBOCA is biodegradable and belongs to a class of compounds known as aromatic amines. Its molecular formula is $CH_2(C_6H_3ClNH_2)_2$. MBOCA is a known animal carcinogen and the National Institute for Occupational Safety and Health (NIOSH) recommends that it be regulated as a human carcinogen. Two known biological degradation products (metabolites) are N-acetyl -MBOCA, (AC) and N,N'-diacetyl -MBOCA, (DAC). Based on studies of similar degradation products of benzidine and other aromatic amines, these degradation products are considered even more toxic than MBOCA. MBOCA is generally considered to be a crystalline solid which does not readily dissolve in water. It has a high affinity for organic and inorganic particulate matter. MBOCA has a very low vapor pressure of 10^{-5} mm Hg @ 24 degrees Celcius. Pure MBOCA has a melting point of approximately 110 degrees Celcius (about 230 degrees Fahrenheit).

The process waste discharges of the MBOCA production process caused MBOCA contamination of the nearby East Side Drain, the Adrian Wastewater Treatment Plant (WWTP) and River Raisin . Originally, ADC discharged its process wastewater and cooling water, untreated, into the East Side Drain. This occurred through 1973 when the MDNR discovered the discharge of aniline into the East Side Drain. In

late 1973, ADC separated the process wastewater from its cooling water, thus allowing for pretreatment of the wastewater to the satisfaction of the MDNR prior to discharge to the municipal water treatment system. MBOCA discharges to the WWTP continued, resulting in decreased efficiency of the WWTP. At the WWTP, MBOCA settled out with other solids and formed a sludge material which was applied to the land leading to MBOCA contamination at the WWTP drying beds. Eventually, MDNR advised the City of Adrian not to accept ADC discharges contaminated with MBOCA. MBOCA was found in surface sediments on and around the ADC plant in 1979, and MBOCA production was stopped. MBOCA discharges to the environment occurred via surface water and airborne routes. The airborne mechanism of contamination may have resulted from sublimation of MBOCA during the manufacturing process or generation of MBOCA particles as fugitive emissions which were subsequently discharged to the environment through the plant's ventilation system. No MBOCA was detected in the subsurface soil at a depth of greater than 1.5 feet and no groundwater contamination was detected. Treated process wastewater and storm water run-off discharges from the ADC plant resulted in the contamination of the East Side Drain bottom sediments.

The Michigan Department of Natural Resources (MDNR), Michigan State Toxic Substance Control Commission (TSCC), ADC and local governmental agencies, through comprehensive cleaning and monitoring efforts, cleaned the contaminated areas (those above an MBOCA level of 1 ppm) in 1980 and 1981. Clean-up actions included in-plant decontamination, residential carpet shampooing/vacuuming, street sweeping, removal of some surface soils from roads and parking lots, and paving/tilling/covering of unpaved areas near the plant. Contaminated soils were placed in the Wayne County Municipal Landfill. This response action was funded by the State, who later recovered their costs from ADC.

The Site was placed on the National Priorities List (NPL) in 1983. In June 1984, a Remedial Action Master Plan (RAMP) was developed by U.S. EPA using available data. It was recommended in the RAMP that further investigations were necessary and some kind of remedial action needed to be implemented. On April 30, 1986, Anderson Development Company entered into an Administrative Order by Consent ("AOC" or "the Order") with U.S. EPA for the conduct of a Remedial Investigation and Feasibility Study (RI/FS). C.C. Johnson and Malhotra, P.C. was contracted by ADC to conduct all work related to the RI/FS.

On May 23, 1986, the U.S. EPA Region V Regional Administrator signed a CERCLA 106 Administrative Order by Consent stipulating the undertaking of a Remedial Investigation and Feasibility Study (RI/FS) for the purposes of determining the nature and extent of the threat to the public health or welfare or the environment due to the release or threatened release of hazardous substances or contaminants from the Site and to evaluate appropriate remedial

action alternatives to prevent or mitigate the migration or release of hazardous substances or contaminants from the Site.

The signed Order underwent a 30 day public comment period shortly thereafter. No comments were received during public comment and the Order became effective on July 2, 1986.

On July 2, 1990, the U.S. EPA published, and placed in the repository for public viewing, a Proposed Plan for remedial action. A formal public hearing was held on July 12, 1990 to answer questions in regard to the Proposed Plan and to accept verbal public comment on the Proposed Plan. U.S. EPA accepted written comment on the Proposed Plan through August 8, 1990.

IV. REMEDIAL INVESTIGATION RESULTS

The Remedial Investigation was completed in four phases. The first three phases only addressed environmental contamination of MBOCA, AC and DAC. Phase I field sampling began in October 1987 and was completed in November 1987. The results of this sampling phase were presented in two technical memoranda submitted in April 1988. Additional sampling for Phase II of the RI was conducted in September 1988, with results presented in a November 1988 technical memorandum. Further waste characterization of the pretreatment lagoon was conducted in November 1988. Phase III results were presented in the Revised RI Report submitted by ADC in January 1989. The final phase (Phase IV) was conducted in April 1989 for the purpose of characterizing lagoon sludge, lagoon clay and lagoon area groundwater for most U.S EPA Target Compound List (TCL) compounds, as well as assessing the vertical extent of MBOCA, AC and DAC contamination in the clay beneath the lagoon. Phase IV sampling results were presented in the Revised RI Report submitted in July 1989 and resubmitted with further revisions in September 1989 (Final RI Report).

Samples of soil, sediment, surface water and groundwater were collected as part of the RI. Surface soil, near-surface soil and sediment are the primary environmental media which have indicated detectable MBOCA, AC or DAC contamination. RI data indicate current on-site MBOCA levels up to 2,800 mg/kg (pretreatment lagoon sludge) and off-site MBOCA levels up to 350 ug/kg (surface soils within 2000 feet of ADC Site). Various volatile and semi-volatile organic compounds including toluene and 4-methylphenol were found in the lagoon sludge. Both the number and concentrations of detectable organics were lower in the lagoon clay.

Results of the RI indicated that groundwater and surface water on-site as well as off-site are not contaminated with MBOCA, AC, or DAC. Low levels of several volatile and semi-volatile organic compounds were detected in the confining layer. The RI concluded

that the groundwater and surface water are not contaminated at levels of concern and do not need remediation.

While various organic compounds were detected in this limited water bearing layer of clay, some of these, such as acetone and methylene chloride, have been attributable, at least in part, to laboratory contamination. Furthermore, levels of both detectable volatile and semi-volatile organics were found to be much lower in the confined aquifer than in the confining layer groundwater. When the sandy aquifer was reached during drilling, artesian conditions were found as water levels rose to the piezometric surface of the aquifer. These conditions would tend to mitigate downward contaminant migration into the underlying aquifer.

An assessment of the health risks associated with MBOCA contamination on-site and off-site was carried out and presented in the Endangerment Assessment (EA). Various exposure scenarios, through which different populations could potentially be exposed to MBOCA, were evaluated. Risks associated with oral ingestion and dermal exposure to MBOCA contaminated soil/sediment were considered for each of the scenarios.

MBOCA action/clean-up levels for 1 X 10E-04 to 1 X 10E-07 risk levels were determined for different exposure scenarios and compared with the maximum observed MBOCA levels. Consistent with the NCP, a 1 X 10E-06 "point of departure" was considered for clean-up purposes. This comparison indicated that except for the ADC lagoon area, no surface or subsurfaces soil/sediment remediation is warranted.

An "action level" or clean-up level of 1684 ug/kg (rounded down to 1.6 ppm) of MBOCA for soils (10E-06 risk level) was calculated based on the residential exposure scenario considered in the Endangerment Assessment.

The exposure routes and calculated target levels were determined in accordance with U.S. EPA guidance documents, Superfund Public Health Evaluation Manual (SPHEM) and Superfund Exposure Assessment Manual (SEAM). A 10E-06 carcinogenic risk level of approximately 1.3 ppm was calculated based on the standardized exposure assumptions as defined in Rule 299.5711 of Act 307. Within this rule is an algorithm which establishes an acceptable risk for exposure via direct contact with contaminated soils. Although the Act 307 clean-up goal is slightly more stringent than that which was determined according to U.S. EPA guidance, because the State does not see any practical or significant difference between these two values, the higher value was acceptable to MDNR. This action level of 1.6 ppm necessitates remedial action for some surface soils, lagoon sludge and clay beneath the sludge in the ADC pretreatment lagoon area. The total volume of clay to be treated can only be approximated at this time because of the fact that during Phase IV, samples of the clay could only be taken from as

deep as five (5) feet. Further sampling and analyses will be conducted during design for the purposes of delineating the extent of vertical contamination, thus allowing for more accurate cost analyses.

Feasibility Study (FS) activities began in December 1988. A draft FS was submitted by ADC on October 3, 1989. The draft FS included remedial action objectives to address contamination of the lagoon sludge, clay beneath the lagoon and some surface soils around the lagoon. The Final FS was submitted to U.S. EPA and MDNR on March 2, 1990. The FS and Proposed Plan were made available for public comment on July 2, 1990.

From the data gathered during the RI, the following conclusions were drawn in the FS:

* MBOCA concentrations in the environment surrounding the ADC plant have decreased significantly since 1980. This reduction is attributable to the cessation of MBOCA production, the initial remedial action undertaken at the plant and surrounding area, and to a lesser extent, to the biodegradation of MBOCA in the environment.

* No MBOCA, AC or DAC was detected in off-site groundwater, and only one surface water sample contained MBOCA at a detectable concentration (1 ug/l).

* Concentrations of MBOCA, AC and DAC in the surface and subsurface soils and sediment around the ADC plant area varied from non-detectable levels to a maximum of 350 ug/kg. MBOCA concentrations in soils around the former lagoon area were found to be as high as 98,000 ug/kg.

* Sludge in the former pretreatment lagoon contained MBOCA levels as high as 2,800,000 ug/kg, manganese levels as high as 101,000,000 ug/kg (10% by weight), toluene as high as 140,000 ug/kg and numerous other organic constituents in concentrations as high as 200,000 ug/kg.

* Subsurface clay beneath the lagoon contained MBOCA at concentrations up to 660,000 ug/kg, AC concentrations up to 3900 ug/kg, and DAC concentrations up to 35,000 ug/kg. Various inorganics and volatile and semi-volatile organics were also detected in the clay layer, but at levels lower than those found in the lagoon sludge.

* The confining layer does not contain detectable levels of MBOCA, but AC was found once at 21 ug/l. One Target Compound List (TCL) organic (M-Chloroaniline) was detected at 1000 ug/l, as well as several tentatively identified compounds (TIC's). However, this confining

layer does not represent an adequate, continuous aquifer and is considered unusable by both U.S. EPA and MDNR.

V. REASONS FOR ISSUING THE ROD AMENDMENT

Following issuance of the ROD in September 1990, Anderson presented U.S. EPA with the results of a bench-scale low temperature thermal desorption test. The results of this test were reviewed by U.S. EPA Region V, MDNR, and U.S. EPA's Risk Reduction and Engineering Laboratory (RREL) in Cincinnati, Ohio. In December 1990, a letter was sent to Anderson which identified certain technical deficiencies in this bench-scale test. U.S EPA did indicate that the technology did offer some promise with respect to Site remediation.

Based on a preliminary review of the low temperature thermal desorption process and the types of contaminants present at the ADC Site, Region V and MDNR, in conjunction with RREL's Superfund Innovative Technology Evaluation (SITE) Program and Superfund Technology Assessment and Research Team (START) Program, determined that further evaluation, including additional testing at full-scale, would be needed to completely evaluate the process. It is anticipated that low temperature thermal desorption will be effective in achieving the Site-specific clean-up standards for the ADC Site. The technology is expected, with a high degree of confidence, to meet all air pollutant discharge limitations, as well. Based on preliminary cost estimates prepared by Weston Services, Inc. low temperature thermal desorption is expected to have a capital cost approximately one-half that of ISV. In addition, the community perception of low temperature thermal desorption is favorable, as noted in the attached Responsiveness Summary.

VI. DESCRIPTION OF THE NEW ALTERNATIVE

This ROD amendment selects low temperature thermal desorption as the preferred response action at the Anderson Site. Low temperature thermal desorption is a process by which contaminated soils are excavated, placed in feed hoppers and either directly or indirectly heated in a thermal processing chamber in order to drive off volatile and semi-volatile organic compounds. Several methods of heating contaminated site media can be employed and vary according to a given vendor's specific design.

One process may entail heating air via a gas fired burner and passing it over the contaminated matrix as it is agitated on a conveyor belt which transports the matrix through the thermal processing unit. Such a system may involve cocurrent or countercurrent flow of hot air and contaminated soils. The temperature of the matrix (and the concomitant efficiency of

volatilization and mass transfer of contaminants from the soil matrix to the vapor phase) can be regulated by adjusting the air flow rate over the matrix, the temperature of the hot air stream and the rate of belt movement (i.e., the residence time). Another design may entail indirect heating of the soil matrix within a jacketed (i.e., thermally insulated) trough and by carrying it via a series of rotating hollow screws within the thermal processor. Hot oil passing through these screws serves as the heat transfer medium. Process variables which determine the efficiency of the operation, such as residence time and matrix temperature, can be adjusted by means of varying the rotational speed of the hollow screws and by varying the temperature of the heat transfer fluid within the screws.

After the contaminants are driven from the soil matrix, these off-gases are treated in an air pollution control train which is designed to effectively treat the organics which are vaporized as well as the particulate contribution from the process itself. Methods of off-gas treatment may include the use of cyclonic separators in a series and parallel alignment (multiple cyclones) or a fabric filter system (i.e., baghouse) for removal of particulates. Organic vapors can be removed in a medium to high energy Venturi scrubber or condenser in series or "piggyback" alignment with vapor phase activated carbon columns. Aqueous streams from the scrubber or condenser are treated in liquid phase carbon units.

Spent carbon and fines from the particulate removal equipment will be sent off-site for thermal regeneration or disposed of at a licensed off-site landfill, respectively. After all contaminated matrices have been treated to meet the clean-up and performance standards in the SOW, the treated soils will be placed back into the excavated lagoon and covered with clean native soils. Groundwater monitoring will take place on a semi-annual basis for a period of two years thereafter.

During the full-scale test demonstration, all internal and external process streams will be analyzed for a wide range of parameters. In addition, stack emissions will be monitored by employing U.S. EPA Method 5 (for particulates) and Method 25 (for volatile organics) during all phases of the test demonstration to ensure compliance with Federal and State regulations.

MBOCA vaporizes at approximately 250 °F, and should therefore be driven off of the contaminated matrices within the treatment chamber. Of paramount importance in the effectiveness of this technology is the ability to provide for sufficient surface area of the contaminated individual soil "clumps" such that all the MBOCA can be volatilized. The biggest concern here is with the clay which underlies the lagoon. Because of the stiffness of the clay, there is a materials handling concern which must be adequately addressed during design and during the full-scale test. The clay

will have to be shredded to a size which will be conducive to proper heat transfer across the individual clump, as well as allowing for effective mass transfer of the solid MBOCA bound within the soil matrix across the soil matrix, to the surface of the individual clump and ultimately into the off-gas stream as a vapor.

After the MBOCA is driven off, it may be found at several locations within the process. The cyclones and baghouse should be maintained at temperatures greater than 300 °F, and therefore, MBOCA should pass through these devices in the vapor phase. However, with the reduction in off-gas temperature to be realized in either the scrubber or condenser, this is where the greatest recondensation of MBOCA should occur. The aqueous streams generated in these devices will be treated in liquid phase activated carbon beds, followed by off-site regeneration of the carbon. MBOCA and other organics remaining in the off-gas will be treated in vapor phase carbon beds prior to off-gas release to atmosphere via the discharge stack.

Most organic compounds are amenable to adsorption on activated carbon. Because the off-gas will be introduced to the the carbon columns at approximately 90 °F, and because of the relatively high molecular weight of MBOCA and its affinity for organics in soils (as evidenced by the large retardation effect calculated during the RI), MBOCA remaining in the off-gas should be readily removed in the vapor phase carbon.

The system, therefore, should provide an effective means of removing and treating MBOCA and should result in complete restoration of the Site to levels which do not pose any unacceptable threat to human health or the environment.

VII. SUMMARY OF THE COMPARATIVE ANALYSIS OF ALTERNATIVES

A. The Nine Evaluation Criteria

This ROD Amendment examines two alternatives, ISV and low temperature thermal desorption. These two alternatives are evaluated in this ROD Amendment according to technical feasibility, environmental protection, public health protection and institutional issues.

The two alternatives were evaluated according to the following nine criteria which are used by the U.S. EPA to provide the rationale for the selection of the final remedial action at a site:

THRESHOLD CRITERIA

1) **Overall Protection of Human Health and the Environment** addresses whether or not a remedy provides adequate protection and describes how risks posed through each pathway are eliminated,

reduced or controlled through treatment, engineering controls, or institutional controls.

2) **Compliance with State and Federal Regulations (ARAR's)** addresses whether or not a remedy will meet all the applicable or relevant and appropriate requirements of other Federal and State environmental statutes and/or provides grounds for invoking a waiver.

PRIMARY BALANCING CRITERIA

3) **Reduction of Toxicity, Mobility, or Volume** is the anticipated performance of the treatment technologies a remedy may employ.

4) **Short-Term Effectiveness** addresses the period of time needed to achieve protection, and any adverse impacts on human health and the environment that may be posed during the construction and implementation period until cleanup goals are achieved.

5) **Long-Term Effectiveness and Permanence** refers to the ability of a remedy to maintain reliable protection of human health and the environment over time once cleanup goals have been met.

6) **Implementability** is the technical and administrative feasibility of a remedy, including the availability of materials and services needed to implement a particular option.

7) **Cost** includes estimated capital and operation and maintenance costs, and net present worth costs.

MODIFYING CRITERIA

8) **State Acceptance** indicates whether, based on its review of the RI/FS and the Proposed Plan, the State concurs in, opposes, or has no comment on the preferred alternative at the present time.

9) **Community Acceptance** will be assessed in the Record of Decision following a review of the public comments received on the RI/FS report and the Proposed Plan.

B. Comparative Analyses of Alternatives

The two alternatives were evaluated using the nine criteria. The regulatory basis for these criteria comes from the National Contingency Plan and Section 121 of CERCLA (Cleanup Standards). Section 121(b)(1) states that, "Remedial actions in which treatment which permanently and significantly reduces the volume, toxicity or mobility of the hazardous substances, pollutants, and contaminants is a principal element, are to be preferred over remedial actions not involving such treatment. The off-site transport and disposal of hazardous substances or contaminant materials without such

treatment should be the least favored alternative remedial action where practicable treatment technologies are available." Section 121 of CERCLA also requires that the selected remedy be protective of human health and the environment, cost effective, and use permanent solutions and alternative treatment technologies or resource recovery technologies to the maximum extent practicable.

The two alternatives are compared to the nine criteria in the following section:

1) Overall Protection of Human Health and the Environment

By treating all Site media which contain MBOCA in concentrations above the clean-up standard down to the 1.6 ppm clean-up standard, and to all Type 307 clean-up criteria, the selected alternative, or the contingency alternative will be protective of human health and the environment.

2) Compliance with State and Federal Regulations (ARAR's)

The selected alternative and the contingency alternative will each comply with all ARAR's.

3) Reduction of Toxicity, Mobility, or Volume Through Treatment

Low temperature thermal desorption will effectively reduce the toxicity of contaminated soils, sludge and clay at the Site, via removal of semi-volatile and volatile organic compounds from the treated soil matrix. These compounds will be removed in the air pollution control equipment and will be taken off-Site for proper disposal or treatment. Because contaminants will be removed from these soil matrices prior to redepositing them in the lagoon, the mobility of the organic contaminants will also be significantly reduced. Low temperature thermal desorption will not produce any substantive reductions in contaminant volume. The contingency alternative, ISV, will pyrolize organic contaminants and immobilize inorganic contaminants, thereby resulting in significant reductions in contaminant toxicity and mobility. Additionally, as the water is driven off from the soil matrices, significant volume reductions will be realized (note: evaporation of water and loss of void spaces in the soil column are the contributing elements to the marked subsidence evidenced during ISV processing).

4) Short-Term Effectiveness

Since each alternative would involve the excavation of contaminated materials, there will be the potential for short-term exposure to construction workers in the work zone. Risks to workers could be minimized by the utilization of environmental monitoring equipment and personal protective equipment. Proper dust suppression techniques could be used to minimize the amount of fugitive emissions generated. Proper maintenance of the air pollution

control equipment would mitigate any potential risks to nearby populations. Ambient air monitoring stations set up around the perimeter of the work zone would serve as a warning system to suspend operations in the event of airborne releases of contaminants. Because the prevelent contaminant, MBOCA, is of low volatility, the probability of inhalation by workers is decreased.

5) Long-Term Effectiveness and Permanence

Each alternative would achieve long-term protectiveness of human health and the environment because no MBOCA which would present unacceptable human health risks would remain on-Site. Low temperature thermal desorption would be effective in permanently removing Site volatile and semi-volatile organic compounds, and ISV would offer extremely high destruction and removal efficiencies for volatile and semi-volatile organics.

6) Implementability

There should be no difficulties in implementing the selected alternative. The low temperature thermal desorption equipment is a fabricated unit, which has been used by Anderson's remediation firm at other Superfund Sites. The contractor therefore has familiarity with the equipment and is prepared to address operation and maintainance problems which may arise in the field. The contingency alternative has not been commercially applied at full-scale, although Geosafe is expected to implement ISV at one or more Sites before it would be implemented at the ADC Site. Some difficulties may exist in obtaining an adequate connection to a power source and ADC may incur additional one-time costs to provide for this hook-up. Alternatively, a portable, diesel-powered source of electricity can be brought to the Site, although this may be more costly than arranging for a proper hook-up.

7) Cost

The construction costs associated with ISV in the Feasibility Study were estimated to be $2.3 million. Weston Services, Inc. has provided Anderson with preliminary cost estimates for thermal desorption in the amount of approximately $1.1 million.

8) State Acceptance

The State of Michigan concurs with the selected remedy and the contingency remedy.

9) Community Acceptance

The community has favorably responded to the selected remedy, although there still exists some opposition to the contingency remedy.

VIII. STATUTORY DETERMINATIONS

1. Protection of Human Health and the Environment

The selected remedy is protective of human health and the environment by treating all contaminated lagoon area media found to be above the clean-up level via either low temperature thermal desorption or in situ vitrification.

Any short term risks associated with the excavation and handling of contaminated materials (e.g., dust generation) will be minimized by the use of good construction practices such as dust suppression measures and covering of contaminated and treated stockpiles. Ambient air monitoring, as well as off-gas treatment system emissions monitoring, will be conducted to assess possible exposure during the low temperature thermal desorption full-scale on-site treatability study and the remedial action.

2. Attainment of ARAR's

The selected remedy will attain all Federal and State applicable or relevant and appropriate requirements and all clean-up and performance standards identified in the SOW.

Federal ARAR's

The major Federal and State of Michigan ARAR's and TBC's are presented here. A more complete listing and presentation in matrix format can be found in the Feasibility Study Report, and a more detailed discussion is presented in the September 1990 ROD.

General groundwater monitoring and corrective action requirements for waste management units are included in 40 CFR Part 264 Subpart F, promulgated under the Resource Conservation and Recovery Act of 1976 (RCRA). Although RCRA is not applicable to this Site because no disposal of hazardous waste took place due to the fact that the MBOCA is not considered a RCRA listed waste, these requirements are relevant and appropriate for the Site. This subpart requires a system of wells to detect hazardous constituents in groundwater downgradient of the waste unit. The detection of waste unit constituents downgradient could trigger the need for corrective action. Corrective action is required for all releases of hazardous constituents from any solid waste management unit pursuant to 40 CFR Part 264 Subpart F. There have, however, been no detected releases of contaminants in the groundwater. Each alternative includes a groundwater monitoring program which would meet the subsequent criteria of 40 CFR Part 264 Subpart F monitoring requirements.

40 CFR Part 263 lists transporter regulations which are relevant and appropriate to these alternatives. If spent activated carbon, fines from the baghouse or any other generated materials from the

low temperature thermal desorption process must be discarded off-Site, it will be done in compliance with 40 CFR Part 262 and 263 ARAR's.

The Clean Air Act sets maximum contaminant concentrations for airborne releases. Each alternative provides for stack sampling and air monitoring to evaluate air releases and assure compliance with this ARAR.

The Hazardous and Solid Waste Amendments (HSWA) to RCRA include provisions restricting land disposal of RCRA hazardous wastes. The purpose of the HSWA is to minimize the potential of future risk to human health and the environment by requiring treatment of hazardous wastes prior to land disposal. The land disposal restrictions (LDR's) under HSWA are not applicable for those alternatives involving land disposal of contaminated soil, sludge and clay or residual baghouse fines because the wastes are not RCRA listed wastes or RCRA characteristic wastes.

It was determined that the MBOCA found at the Site is not a RCRA listed U waste because it does not meet the requirements of 40 CFR Part 261.33 (i.e., it is not a discarded commercial product, off-specification specie, container residue or spill residue). LDR provisions are not considered relevant and appropriate. The Agency is undertaking a rulemaking that will specifically apply to soil and debris. Since that rulemaking is not yet complete, U.S. EPA does not consider LDR's to be relevant and appropriate at this Site to soil and debris that does not contain RCRA restricted wastes. It may be noted, however, that the selected remedy meets MBOCA treatment standards under the LDR's. A treatment standard for MBOCA is included in the Third Thirds treatment standards, at Federal Register Vol. 55, No. 106. The revised concentration-based standard is 35 mg/kg. Low temperature thermal desorption and ISV would achieve clean-up goals more than one order of magnitude more stringent than the RCRA treatment standard for MBOCA.

The Clean Air Act establishes National Ambient Air Quality Standards (NAAQS) for primary air pollutants and is an ARAR for air emissions from the Site during excavation, processing of contaminated Site media within the thermal desorption treatment chamber, and during processing of soils via ISV.

The Department of Transportation (DOT) Hazardous Materials Transportation Act, 40 U.S.C. 1801 regulates off-site transportation of hazardous waste and is relevant and appropriate for the off-site transport of MBOCA-laden materials.

The Occupational Safety and Health Administration (OSHA) establishes rules and regulations at 29 CFR 1926 for remedial workers during construction activities.

Federal "To Be Considered" Requirements ("TBC's")

Low temperature thermal desorption may involve sending materials excavated from the site to an off-site landfill. The U.S. EPA off-site policy is a TBC and will be followed to ensure that wastes are sent to a CERCLA off-site compliant RCRA permitted landfill.

The U.S. EPA Office of Groundwater has published Groundwater Classification Guidelines (GWCG's) which enable classification of all groundwater as Class I, II, or III, based on its use, value, and vulnerability. The confined sand and gravel aquifer beneath the Site would be classified as a Class II aquifer (current or potential source of drinking water). A Class II aquifer should be protected from contamination which might render the aquifer unusable or unacceptable as a source of drinking water. Therefore, contamination or degradation of the groundwater is unacceptable and should not be allowed to occur. The GWCG's are TBC for this Site.

The U.S. EPA Environmental Criteria and Assessment Office has prepared the Integrated Risk Information System (IRIS) to provide health based and regulatory information on specific chemicals. IRIS provides chemical specific information which is utilized by U.S. EPA in risk calculations and development of health based clean-up goals and is TBC. The risk tables presented in the FS utilize IRIS values where appropriate. As presented in the selected and contingency alternatives, the elimination of the direct contact threat by complete excavation of the contaminated area would comply with the health based clean-up goals developed utilizing the IRIS database. The groundwater monitoring component of the alternatives comply with the TBC health based clean-up goals developed utilizing the IRIS database.

The U.S. EPA Office of Emergency and Remedial Response, Office of Solid Waste and Emergency Response has prepared the Superfund Public Health Evaluation Manual to provide methods and guidance in preparing health-based risk assessments. The Tables presented in the FS utilize the SPHEM where appropriate. As presented in the selected and contingency alternatives, the elimination of the direct contact threat by complete excavation of the contaminated soils, sludge and clay would comply with the TBC health based clean-up goals developed utilizing the SPHEM. The groundwater monitoring component of these alternatives comply with the health based clean-up goals developed utilizing the SPHEM.

State of Michigan ARAR's

The substantive provisions of Parts 6 and 7 of the rules promulgated under Act 307 of the State of Michigan are considered an ARAR for the remedial action to be undertaken at the Site. These rules provide, inter alia, that remedial actions be protective of human health, safety and welfare, and the environment and natural resources [Rule 299.5705 (1)]. The rules specify that

this standard is achieved by a degree of clean-up which conforms to one or more of three clean-up types (Rule 299.5705 (2) et seq.). Type A criteria are based on reduction of hazardous substance levels to background or below detectable levels (Rule 299.5707). Type B criteria are based on reduction of hazardous substance levels to an acceptable risk level (e.g., an excess lifetime cancer risk of 1 X 10^{-6} for carcinogens) using standardized exposure assumptions (Rule 299.5709). Type C criteria involve a site-specific assessment of risk and remedy evaluation to select remedies which do not pose an unacceptable risk (e.g., an excess lifetime cancer risk of 1 X 10^{-6} for carcinogens). Remedy evaluation under Type C criteria must include evaluation of alternatives which meet Type B criteria. This evaluation must be made against a variety of factors listed in Rule 299.5717.

Under Rule 299.5711, ¶2 of Act 307, an alternate concentration can be selected for soils based upon the Toxicity Characteristic Leaching Procedure (TCLP), as set forth in 40 Code of Federal Regulations Part 261. Since concentrations of arsenic and barium exceed Type B concentrations in the clay and sludge at the Anderson Site, TCLP on pretreated sludge and clay will establish the alternate clean-up standards for these metals and other inorganics which presently exceed Type B criteria. Low temperature thermal desorption will not remove inorganics from soil matrices. Because of the impermeability of the confining layer, the mobility of metals is not expected to be significant.

Each of the two alternatives discussed in this ROD amendment would meet the requirements of a Type B clean-up under the Act 307 Rules.

Act 348 of 1965 and Administrative Rules defines requirements for air emissions during remedial actions and is an ARAR. Each alternative complies with this ARAR by providing an air monitoring program and a stack emissions monitoring program, as well.

Michigan Hazardous Waste Management Act, Public Act 64 of 1979, as amended, sets regulations for generators and transporters of hazardous waste and owners and operators of hazardous waste treatment, storage and disposal facilities. The selected remedy would comply with this alternative.

Rule 613 is the RCRA equivalent to 40 CFR Part 264 as previously described under Federal ARAR's.

Michigan Soil Erosion and Sediment Control Act, Public Act 347 of 1972 sets regulations prescribing the requirements for soil erosion and sedimentation control measures and procedures, and is an ARAR for each alternative.

Michigan Occupational Health and Safety Laws, Michigan Act 154 of 1974 regulates working conditions for the health and safety of workers and is an ARAR for each alternative.

State of Michigan TBC's

SARA Section 121(e) states that no permit shall be required for the portion of any remedial action conducted entirely on-site. It is the intent of the U.S. EPA to meet the substantive requirements of any permit related ARAR's or TBC's.

Based upon the above analysis, the selected and contingency alternatives would meet Federal and State ARAR's and TBC's.

3. Cost-Effectiveness

The selected remedy provides cost-effectiveness in that it offers protectiveness to human health and the environment, attains ARAR's, and when compared against the alternatives in the Feasibility Study which meet the threshold criteria, low temperature thermal desorption can be implemented at a lower capital cost than ISV, on-site thermal incineration and off-site thermal incineration. In the event that the "back-up" or contingency alternative is selected, the cost of ISV has been shown to be less than or equal to the costs associated with partial excavation of the lagoon followed by off-site incineration of the principal threat and placement of the remaining contaminated materials into an on-site RCRA landfill. The selected remedy is also less expensive than the on-site incineration of all contaminated materials above the clean-up level. Therefore, when compared to the alternatives presented in the FS which meet Type B clean-up requirements, the selected remedy is cost-effective.

4. Utilization of Permanent Solutions and Alternative Treatment Technologies or Resource Recovery Technologies to the Maximum Extent Practicable

The selected remedy provides the best balance with respect to the nine evaluation criteria as set forth in the National Contingency Plan. Treatment technologies are utilized to the maximum extent practicable by either thermally treating the contaminated Site media in order to drive off (i.e., volatilize) the contaminants of concern followed by treatment of off-gases and aqueous streams and off-site removal of contaminants or by vitrifying the entire mass of contaminated materials, thereby leaving a glass-like, impermeable monolithic structure which serves to encapsulate all inorganic contaminants and any organic contaminants which may not have been destroyed and removed during the vitrification process. The selected alternative will achieve the health based clean-up standard of 1.6 ppm of MBOCA. This alternative is further balanced with respect to the nine criteria because a permanent solution which utilizes an innovative treatment technology (either low temperature thermal desorption or ISV) is being selected. The groundwater monitoring component of the selected remedial action will assure that concentrations of contaminants do not increase after implementation of the source control remedial action.

5. Preference for Treatment as a Principal Element

The selected remedy eliminates the principal threat at the Site, direct contact with and/or ingestion of contaminated sludge, soil and clay by the use of treatment, via low temperature thermal desorption or in situ vitrification, of the contaminated media, and is in accord with the SARA preference for remedies using treatment as a principal element.

RESPONSIVENESS SUMMARY
ANDERSON DEVELOPMENT COMPANY SITE

This Responsiveness Summary has been prepared to meet the requirements of Sections 113(k)(2)(B)(iv) and 117(b) of the Comprehensive Environmental Response, Compensation and Liability Act of 1980, as amended by the Superfund Amendments and Reauthorization Act of 1986 (CERCLA), which requires the United States Environmental Protection Agency (U.S. EPA) to respond "... to each of the significant comments, criticisms, and new data submitted in written or oral presentations" on a Proposed Plan for remedial action. This Responsiveness Summary addresses concerns expressed by the public in the written and oral comments received by U.S. EPA regarding the proposed revised remedy for the Anderson Development Company ("ADC" or "Anderson") Site.

Public Comment Period

The United States Environmental Protection Agency (USEPA) recently held a public comment period from August 28 through September 26, 1991, for interested parties to comment on the revised clean-up plan for remediating contamination problems at the Anderson Development Company Site (ADC Site) in Adrian, Michigan. The required public hearing on September 12, 1991, focused on the results of a bench-scale treatability study for low temperature thermal desorption as a means of remediating contaminated Site soil, lagoon sludge and clay, and review of thermal desorption processes. The public comment period was held in accordance with Section 117 of the Comprehensive Environmental Response, Compensation and Liability Act of 1980 (CERCLA) as amended.

The purpose of this Responsiveness Summary is to document USEPA's responses to comments received during the public comment period. These comments were considered prior to selection of the final remedy for the Anderson Development Company Superfund Site, which is detailed in amendment to the Record of Decision (ROD).

Community Involvement

U.S. EPA is responsible for conducting the community relations program for this Site. A community relations program was established for the site in 1986. It established a process for a two-way flow of project information between local officials, concerned citizens, the media, and U.S. EPA. Two information repositories were established in the Adrian , Michigan local area: at the Adrian City Hall, and at the Adrian Public Library. Several different press releases and fact sheets were issued to inform the community of field activities and the findings of the RI and FS.

Community relations activities are summarized in the September 1990 ROD and the Community Relations Plan. All press releases, fact sheets, and other documents prepared for this Site are available for review in the site administrative record, if additional information is desired.

In July 1990, a public meeting was held in Adrian to discuss U.S. EPA's proposed remedial alternative, in situ vitrification (ISV) for remediation of the ADC Site. At that time, there was much public opposition to ISV. Major concerns raised by the community centered around financial impacts to Anderson Development Company, uncertainties regarding the effectiveness of ISV, and concerns regarding the safety of ISV.

From the comments received during the recent public comment period for the ROD amendment, there is strong community support for U.S. EPA's proposed amendment to the 1990 ROD. The community is in favor of low temperature thermal desorption. Some members of the community continue to express opposition to in situ vitrification as the contingency remedial alternative.

Public Meeting

The required public hearing on the revised proposed clean-up plan for the ADC Site was held from 7:00 p.m. to 8:15 p.m. on September 12 1991, in the City Council Chambers, Adrian City Hall in Adrian, Michigan. Approximately 35 persons attended, including several local, county or federal officials or their representatives, representatives of Anderson, and members of the local radio stations. Representatives of USEPA and MDNR presented information concerning low temperature thermal desorption treatment technology and studies planned to be conducted at the Anderson Site, and responded to questions from individuals attending the meeting. An oral public comment period was held. A transcript of that public meeting, including the oral public comment period, was prepared by a court reporter in attendance. Copies of the transcript are available at the Site information repositories.

Public Comments

Written Comments Received and Responses

The following written public comments relate to the following issues: 1. Community acceptance of low temperature thermal desorption; 2. Community support of U.S. EPA's decision to amend the Record of Decision; 3. Continued community opposition to ISV; and 4. Economic attractiveness of low temperature thermal desorption versus ISV.

GORDON C. PHILBROCK: "... We strongly support this plan and urge EPA to proceed as soon as possible. We are confident that this is a safe and efficient method, at a reasonable cost, to treat the soils at the site. However, we are still strongly apposed to the use of In-situ Vitrification, even as a "back-up method". There are too many unknown and hazards involved in this method."

DAVID R. SILER: "It remains my opinion that the EPA should abandon the ISV approach to the Anderson Development Company Superfund site remediation. The LTTD Approach recommended by Anderson is by far the most logical and sure solution to the site problem. Please revise the EPA position to permit the LTTD soil treatment."

EMORY M. SCHMIDT: "I am writing this letter to support the EPA proposal to amend the record of decision for the Anderson Development Company Superfund site.

... I understand that "low temperature thermal desorption" is proven safe and effective, and believe this technique is consistent with the best interests of the community and the environment, and is economically reasonable."

Response: U.S. EPA acknowledges the commentors' support. The safety and efficacy of low temperature thermal desorption will be carefully evaluated during a full-scale on-Site test demonstration. Based on data reviewed to date, U.S. EPA and MDNR are confident that this technology will be effective in treating contaminated Site soils, sludge and clay. Anderson and its contractor, Weston Services, Inc., presented cost estimates which indicate this technology can be implemented at a lower cost than ISV. Low temperature thermal desorption technology is marketed by several vendors nationally. This technology has been utilized at other Superfund sites which were contaminated with various volatile and semi-volatile organic compounds. Contaminated media at the Anderson Site contain a variety of volatile and semi-volatile organic compounds in addition to 4,4'-Methylene bis(2-chloroaniline), i.e., MBOCA. However, after review of the process, its' air pollution control equipment and results of bench-scale studies, the Agencies believe the technology will meet all clean-up and performance standards.

Regarding the commentor's statement that there are unknowns and hazards with respect to ISV, U.S. EPA believes that ISV still offers potential for Superfund site remediation. ISV has been tested approximately ninety (90) times on a wide variety of waste types at various scales. At least seven large scale tests have been performed. Also, in the event low temperature thermal desorption is determined by U.S. EPA, in consultation with MDNR, to be unacceptable for clean-up at the ADC Site, it is anticipated that ISV will be performed on a commercial scale for Superfund site remediation before remedial operations at the Anderson Site are initiated.

According to the criteria used by U.S. EPA to identify remedial technologies for Superfund sites, ISV is not an "experimental" technology. The experimental stage of the process has been completed and ISV is now considered an "innovative" technology available for use at Superfund sites.

Congress has directed U.S. EPA to meet certain statutory mandates for remedy selection at Superfund sites. These mandates include the preferences for treatment as a principal element of the remedy, and the utilization of permanent solutions and alternative treatment technologies to the maximum extent practicable. ISV is an alternative treatment technology which provides for a permanent solution. While ISV is an emerging technology, it has undergone extensive review by U.S. EPA, and data has been submitted which demonstrates its potential to successfully treat contaminants present at Anderson. However, an engineering-scale treatability study will be completed on actual contaminated media from the Anderson Site concurrent with the on-Site thermal desorption test demonstration. The engineering-scale test will determine the effectiveness of ISV in treating MBOCA and other Site contaminants, as well as determining the parameters that provide for day-to-day operation which meets the stringent performance and safety standards of U.S. EPA and the State of Michigan.

Regarding the use of innovative technologies, the preamble to the NCP states, "... U.S. EPA supports such diversification and expects that it will generally be appropriate to investigate remedial alternatives that use innovative technologies when such technology offers the potential for comparable or superior treatment performance or implementability, fewer or lesser adverse impacts than other available approaches, or lower costs for similar levels of performance than demonstrated technologies."

WILLIAM J. ROSS: "... Approximately one and one-half years ago I had the opportunity to participate in the public hearing held in Lenawee Country, regarding the cleanup process being recommended by the EPA for Anderson Development Company. My comments were not made from a technical point of view, but dealt with economic feasibility and one of concern about the quality of life for students and residents of Lenawee County.

Prior to the testimony and hearings, I drafted a letter dated July 19, 1990 to the EPA outlining my concern about what was being suggested by the EPA. Following the hearing I was dismayed at the position that the EPA had taken regarding this cleanup issue for the Anderson development Company. Needless to say, I was pleasantly surprised when the EPA, after considerable input, research and testing, reversed their decision and followed the course being recommended by Anderson Development Company and supported by myself and other residents of the Lenawee area. It appears to me, as I am sure it does to you since your agency has

reversed its decision, that the process now being recommended by EPA is satisfactory to all parties concerned. It will, in fact, provide the necessary and required cleanup and can be done at a cost that can be handled by Anderson Development without materially reducing its ability to continue as a viable economic entity in the Lenawee County area. For this we are extremely grateful.

... The closing sentence of my July 19 letter said, "I sincerely request that the Environmental Protection Agency reconsider its proposed solution and work with Anderson officials to find a mutually acceptable solution." It appears to me that the EPA and Anderson have done just that and this problem is being resolved to everyone's satisfaction."

Response: U.S. EPA and MDNR have worked diligently with Anderson Development Company over the past year while evaluating both chemical oxidation and low temperature thermal desorption technologies and their advantages and disadvantages with respect to remediation of the ADC Site. While the Agencies determined that chemical oxidation would not be a technically feasible means of addressing Site contamination, we are confident that low temperature thermal desorption will be successful during the on-Site test demonstration. If this technology meets all clean-up and performance standards to the satisfaction of the Agencies, it will be implemented for full-scale Site remediation.

DAVID B. MUNSON: "... We [Lenawee County Chamber of Commerce] would like to thank EPA and the Michigan Department of Natural Resources for listening to us and for sincerely considering the public comments that you received. It speaks well for both agencies that the community's voice was heard and that it had and impact on your decision."

Response: U.S. EPA acknoweledges the comment. The community's concerns raised last year were carefully considered by U.S. EPA and MDNR. We are confident that, through working closely with Anderson, we have arrived at a solution which would effectively address Site contamination and be protective of human health and the environment, would meet all Federal and State requirements, result in less financial impacts to Anderson than would implementation of ISV, and which would be acceptable to the community of Adrian.

An anonymous written comment addressed the spill of the chemical ortho-chloroaniline, toluene and zinc at the Anderson facility.

Response:

The thermal desorption process is expected to effectively remove volatile and semi-volatile organic compounds from soil matrices.

The questions raised by the author relating to other contaminants and processes at the Anderson facility will be reviewed by U.S. EPA as it evaluates these questions and will take appropriate follow-up action, if warranted.

Oral Comments Received and Responses

The following oral public comments relate to the following issues: 1. Community acceptance of low temperature thermal desorption; 2. Community support of U.S. EPA's decision to amend the Record of Decision; 3. Continued community opposition to ISV; and 4. Concerns relating to damage to natural gas pipelines as a result of implementing ISV at the ADC Site.

AL SMITH: "... The City did have some concerns about the previous method that was being considered and the effect that it might have on some of our utility lines. However, we have no problems with the recommended system at this time, and we would support its use in this project.

I also have a letter from Senator Jim Barryman that he asked me to read and put into the record tonight, 'I am writing to express my support for the planned clean-up project on property owned by Anderson Development Company...'."

RICHARD CANNON: "... I still oppose ISV, based on the merits that it's not proven, in my opinion."

"... the Region 5 EPA should be [commended] in their ability to work with business..."

STEVE FREEBORN: "... I, also, still oppose the back-up position [ISV] because it still seems to me it's an untested, unproven method, but I do support LTTD and, as a citizen in this County, very much look forward to the remediation of this site. I would like to thank the EPA for listening to the public."

JACK GEORGAL: "... I support the thermal desorption treatment..."

Response: U.S. EPA acknowledges the support of the community. Regarding the statements that ISV is unproven, refer to the above response. Discussion with Anderson Development Company last year indicated that it would be feasible to "tap into" high-powered transmission lines in close proximity to the Site. If this was not possible, another option would be to bring portable transformers to the Site during full-scale application of ISV, although this would result in increased costs to Anderson.

LARRY PARKINSON: "... I'm still concerned, as other people here, that your back-up position is ISV. My concerns are: Number one,

from what I've read of its recent failure, I think it was fortunate it was not a catastrophe. Two, no one from the EPA, on the ISV position, has addressed, to anyone's satisfaction, the danger of the natural gas pipe lines in that area should you decide to revert to your back-up position.

And I totally oppose your back-up position. I don't think it is a good method for this remediation because of the danger to the natural gas pipe lines."

Response: Temperatures of 100 degrees C (212 degrees F) have been measured as far as five to seven feet from the full-scale ISV treatment zone. The ISV melt, as a rule of thumb, should thus not be located closer than 15 feet to underground utility lines and structures which could be damaged by temperatures above 100 degrees C. Examination of Site diagrams provided in the Remedial Investigation Report does not indicate any above ground structures within 15 feet of the ISV treatment zone. Location of underground utilities are not noted, but there are not indications of structures which would likely have underground utilities running to them within 15 feet of the ISV treatment zone. The closest pipeline on the Site, based on maps provided U.S. EPA by the local gas company, is on the north side of the pre-treatment lagoon, more than 150 feet away from the proposed processing area. Therefore, underground natural gas pipelines are of sufficient distance from the Site that dangers to these lines (e.g., such as rupture) are non-existent. The effects of high thermal gradients within close proximity to the melt would have been negated well before distances of 150 feet from the melt. Soil temperatures near the gas pipelines would remain at ambient temperature, and subsidence effects would also not be seen at such distances, especially considering the relatively small areal size of the melt.

Exact locations of underground utilities (e.g., gas pipelines, sewers and water lines) will need to be determined during the design phase.

No surrounding homes or businesses are located within the likely distance which might be affected by soil settling that will result from ISV treatment. This matter will need to be further examined during the design phase.

U.S. EPA is aware of the failure of the Geosafe equipment at its test facility in Hanford, Washington earlier this year, which resulted in compromise of the off-gas collection hood. While the test involved non-hazardous materials, the Agency is aware of the ramifications if a similar incident had taken place during clean-up operations at a Superfund Site.

Geosafe is carefully evaluating the situation, and following conclusion of its' intensive investigation, the company will prepare a final report. Areas of concern with respect to the

incident which resulted in an expulsion of molten glass from the melt zone include movement of gases and vapors upward through the melt zone as a function of melt shape and properties of the melt, affect on melt dynamics of buried drums within the melt zone, melt dynamics as a function of soil moisture content and intensity of the electrical field, etc. Geosafe will look closely at these and other factors in its attempt to identify the conditions which lead to the contact of molten glass onto the collection hood, and subsequent ignition of the hood.

As a result of the accident, Geosafe has indefinitely suspended all commercial full-scale ISV operations. As the company further investigates the reasons for the release of the molten glass from the melt zone, design of a new off-gas hood is underway. The hood which has been constructed of fiberglass (for ease of movement during full-scale operations) will be constructed of a material which would be more resistant to extreme temperatures. Geosafe estimates that completion of the hood design will occur sometime in late 1992. Until such time as the causal relationship between the melt conditions and glass expulsion are fully known, Geosafe will not be commercially viable. Geosafe will continue to perform treatability testing as it is currently doing for the ADC Site. The results of the engineering-scale ISV test for the ADC Site should be available in early 1992.

U.S. EPA will continue to evaluate the potential for Site remediation via ISV on a site-by-site basis. Factors such as scheduling of remedial design and remedial action tasks, contaminants of concern and site-specific hydrogelogical conditions, comparitive costs of alternative clean-up options, and evaluation of clean-up alternatives with respect to the evaluation criteria specified in the National Contingency Plan will be considered by the Agency. Some Superfund Sites, by virtue of the types of contaminants found, may not have any other suitable treatment process other than ISV. For such Sites, it may be practicable to postpone remediation activities until such time as Geosafe is commercially active.

At the Anderson Development Company Site, however, U.S. EPA has identified a process which has a high degree of probability in terms of meeting clean-up and performance standards. Therefore, the Agency will proceed forward with the low temperature thermal desorption test demonstration.

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UPDATE #3
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FICHE/FRAME	PAGES	DATE	TITLE	AUTHOR	RECIPIENT	DOCUMENT TYPE	DOCNUMBER
	2	90/09/27	Letter re: Review of Record of Decision (ROD) and In Situ Vitrification at Anderson Development Company	Delbert Rector, MDNR	V. Adamkus, USEPA	Correspondence	
	16	90/10/29	Review Comments to "Work Plan to Conduct a Bench Scale Treatability Study for Anderson Development Company Lagoon" (with cover letter)	Michael A. Valentino, USEPA	J. Huerta, ADC	Correspondence	
	21	90/12/04	Letter re: Review of Low Temperature Thermal Aeration Treatability Study Report(attachment tables and attachment of letter from Brady Boyce to Michael Valentino)	Michael A. Valentino, USEPA	P.Rupert & J. Huerta, ADC	Correspondence	
	4	90/12/07	Letter re: Summarization of understanding of the features of the ultimatum offered to Anderson	J.P. Rupert, Anderson Development Company	M. Valentino, USEPA	Correspondence	
	4	91/04/19	Letter re: Approval of February 14, 1991 Proposal and Activities Schedule	Michael A. Valentino, USEPA	J.P.Rupert&J. Huerta, ADC	Correspondence	
	14	91/07/15	Technical comments on the draft Remedial Action Plan for LTTA and comments regarding the Health and Safety Plan	Brady W. Boyce, MDNR	M. Valentino, USEPA	Correspondence	
	12	91/07/19	Reponse to the EPA Comments on Low Temperature Thermal Aeration Bench-Scale Treatability Study Report	Canonie Environmental	M. Valentino, USEPA	Correspondence	
	3	91/07/19	Letter re: Anderson	James Huerta, Anderson	B. Boyce, MDNR	Correspondence	

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FICHE/FRAME	PAGES	DATE	TITLE	AUTHOR	RECIPIENT	DOCUMENT TYPE	DOCNUMBER
			Development Superfund Lagoon Water Disposal	Development Co.			
	59	91/07/19	USEPA and MDNR Review Comments to May 1991 Draft Project Work Plans for Low Temperature Thermal Aeration (LTTA) (attachment)	Michael A. Valentino, USEPA	J. Huerta, ADC	Correspondence	
	2	91/08/07	Letter re: Implementation of ISV testing	Arvid A. Sather, Michael Best and Friedrich, Counsel for Anderson Development Co.	Ms. Otaka	Correspondence	
	1	91/08/08	Letter re: Proposal for the remediation of the Adrian, Michigan site	Tim Forden, Weston Services, Inc.	J. Huerta, ADC	Correspondence	
	2	91/08/11	Letter re: Review Comments on "Pre-Remediation Lagoon Sludge and Clay Sampling Plan" and "Pre-Remediation Groundwater and Soil Sampling Plan"	Michael A. Valentino, USEPA	J. Huerta, ADC	Correspondence	
	2	89/11/00	Fact Sheet Entitled: Innovative Technology In-Situ Vitrification	USEPA		Fact Sheet	
	6	90/09/00	Fact Sheet Entitled: "Questions and Answers about EPA's Final Clean-up Plan"	USEPA		Fact Sheet	
	8	91/05/00	Fact Sheet Entitled: "Engineering Bulletin: Thermal Desorption Treatment"	USEPA		Fact Sheet	
	4	90/08/09	Memo re: Technical Review of Test Data and	Mark Meckes, USEPA	M. Valentino, USEPA	Memorandum	

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FICHE/FRAME	PAGES	DATE	TITLE	AUTHOR	RECIPIENT	DOCUMENT TYPE	DOCNUMBER
			Treatability Test Proposals presented by Anderson Development Co. (ADC)				
	3	91/02/14	Memo re: Comments on the February 13, 1991 meeting between Representative of Region V Anderson Development Co., Canonie Environmental and RREL	Mark C. Meckes, USEPA	M. Valentino, USEPA	Memorandum	
	4	91/07/09	Memo re: Comments on the Canonie Air Sampling Procedures	Maureen Kilpatrick	R. Foster, PRC	Memorandum	
	6	91/07/09	Memo re: Technical Review of "Project Work Plans, Remedial Action Plan, Health and Safety Plan", for Anderson Development Company Site, prepared by Canonie Environmental	Mark C. Meckes, USEPA	M. Valentino, USEPA	Memorandum	
	6	91/07/09	Memo re: Comments on Canonie Draft Remedial Action (Work) Plan	Rob Foster, PRC Environmental Management	M.Meckes&P.dePercin, USEPA	Memorandum	
	13	91/08/22	Memo re: Amendment to the 1990 Record of Decision for the Anderson Development Company Superfund Site, Adrian, MI	Michael A. Valentino, USEPA	Site File, AR	Memorandum	
	4	90/11/22	Geosafe Corporation Comments on Claims by Larry Penberthy, President of PEI, Inc. Against In Situ Vitrification Technology	Geosafe Corporation		Other	
	20	91/07/19	Acknowledgement of Registration (with FAX cover sheet)	James Huerta, Anderson Development Co.	M. Valentino, USEPA	Other	

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FICHE/FRAME	PAGES	DATE	TITLE	AUTHOR	RECIPIENT	DOCUMENT TYPE	DOCNUMBER
	7	88/08/00	Report Entitled: Low Temperature Thermal Treatment (LTT) of Volatile Organic Compounds from Soil: A Technology Demonstrated	Roger K. Nielson and Michael G. Cosmos, Weston Services, Inc.		Reports/Studies	
	42	89/02/00	Report Entitled: Support for the In Situ Vitrification Treatability Study at the Idaho National Engineering Laboratory: FY 1988 Summary	K.H. Oma, M.A.H. Reimus and C.L. Timmerman, Battelle		Reports/Studies	
	41	90/05/00	Report Entitled: Initial Tests on In Situ Vitrification Using Electrode Feeding Techniques	R.K. Farnsworth, K.H. Oma and C.E. Bigelow, Battelle		Reports/Studies	
	35	90/07/27	Report Entitled: Anderson Development Company RI/FS Chemical Oxidation Testing (cover letter attached)	James Huerta, Anderson Development Company	M. Valentino, USEPA	Reports/Studies	
	31	90/08/00	Report Entitled: Position Paper on Low Temperature Volatilization Systems (LTVS)	U.S. Army Corps of Engineers		Reports/Studies	
	54	90/09/00	Report Entitled: Treatability Study Report and Remedial Contracting Services Proposal	Canonie Environmental	USEPA	Reports/Studies	
	29	91/01/00	Report Entitled: Cost Comparisons for Low Temperature Volatilization Systems (LTVS) at Four Superfund Sites	U.S. Army Corps of Engineers		Reports/Studies	
	17	91/04/08	Partial report for sample received on	James Huerta, Anderson Development	M. Valentino, USEPA	Reports/Studies	

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FICHE/FRAME	PAGES	DATE	TITLE	AUTHOR	RECIPIENT	DOCUMENT TYPE	DOCNUMBER
			January 24, 1991 (with FAX cover sheet)	Co.			
	11	91/07/11	LT3 Process Description	Weston Services Inc.		Reports/Studies	

TESX-005-C05020 582-12-0007

GUIDANCE DOCUMENTS INDEX - UPDATE #2
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TITLE	AUTHOR	DATE
Innovative Technology In-Situ Vitrification (2 pgs)	USEPA OSWER #9200.5-251FS	89/11/00
Research Results and Recommendations for Environmental and Occupational Levels (251 pgs)	Toxic Substance Control Commission	82/07/00
Guidance for conducting remedial investigations and feasibility studies under CERCLA (390 pgs)	OERR/OSWER #9355.3-01	88/10/01
A compendium of Superfund field operations (300 pgs)	OERR/OWPE OSWER #9355.0-14	87/12/01
Data quality objectives for remedial response activities: development process (150 pgs)	OERR/OWPE OSWER #9355.0-7B	87/03/01
Data quality objectives for remedial response activities/ Scenario: RI/FS activities at a site w/ contaminated soils and groundwater (120 pgs)	OERR/OWPE OSWER #9355.0-7B	87/03/01
Land disposal restrictions (22 pgs)	OERR/OWPE	87/08/11

N.B.: THESE GUIDANCE DOCUMENTS WERE RELIED UPON BY EPA DURING RI/FS.

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TITLE	AUTHOR	DATE
Guidelines for groundwater classification under the EPA groundwater protection strategy (600 pgs)	Office of Groundwater Protection	86/12/01
CERCLA compliance with other environmental statutes (19 pgs)	OSWER #9234.0-2	85/10/02
CERCLA compliance with other laws manual. (245 pgs)	OERR OSWER #9234.1-01	88/08/08
Inegrated risk information (IRIS) a computer-based health risk information system available through E-Mail brochure on access is included (--pgs)	OHEA	00/00/00
Superfund Exposure Assessment Manual (160 pgs)	OERR OSWER #9285.5-1	88/04/01
Superfund Public Health Evaluation Manual (500 pgs)	OERR/OSWER OSWER #9285.5-1	88/10/01
Toxicology Handbook (126 pgs)	OWPE/OSWER #9850.2	85/08/01
Endangerment Assessment	OSWER #9850.0-1	85/11/22

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TI.	AUTHOR	DATE
Guidance (Secondary Reference) ** Cost Analysis (11 pgs)		
Community Relations in Superfund: A Handbook (Interim Version) (189 pgs)	OERR/OSWER #9230.0-03B	88/06/01
Endangerment Assessment Guidance	OSWER #9850.0-1	85/11/22