US Army Corps
of Engineers®
Buffalo District

RECORD OF DECISION

FOR THE LINDE SITE

TONAWANDA, NEW YORK

MARCH 2000

I.

DECLARATION FOR THE RECORD OF DECISION

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DECLARATION FOR THE RECORD OF DECISION

SITE NAME AND LOCATION

Linde Site
Town of Tonawanda, New York

STATEMENT OF BASIS AND PURPOSE

This Record of Decision (ROD) presents the selected remedial action for the Linde Site in the Town of Tonawanda, New York. This remedial action was chosen in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act, 42 United States code 9601 et seq., as amended (CERCLA), and the National Oil and Hazardous Substances Pollution Contingency Plan (NCP) as directed by Congress in the Energy and Water Appropriation Act for Fiscal Year 1999, PL 105-245. The information supporting the United States Army Corps of Engineers (USACE) decision as the lead agency on the selected remedy is contained in the Administrative Record file located at the USACE Public Information Center, 1776 Niagara Street, Buffalo, NY 14207 and the Tonawanda Public Library, 333 Main Street, Tonawanda, NY 14150. Comments on the proposed plan provided by the New York State Department of Environmental Conservation (NYSDEC) during the public comment period were evaluated and considered in selecting the final remedy. USACE also considered comments from the U.S. Environmental Protection Agency. NYSDEC has expressed reservations especially regarding the cleanup level for uranium and the USACE application of 10 CFR Part 40, Appendix A, Criterion 6(6) which was used for the derivation of the uranium cleanup level. For this reason NYSDEC has reserved its support for the proposed plan pending review of the final status survey data once remediation is complete.

ASSESSMENT OF THE SITE

Actual or threatened releases of hazardous substances from this site, if not addressed by implementing the response action selected in this ROD, may present an endangerment to public health, welfare, or the environment in the future.

DESCRIPTION OF THE SELECTED REMEDY

Background on Remedy Selection

During the early to mid-1940’s, portions of the property formerly owned by Linde Air Products Corp., a subsidiary of Union Carbide Industrial Gas (Linde), now owned by Praxair, Inc., in the Town of Tonawanda, New York were used for the separation of uranium ores. The separation processing activities, conducted under a Manhattan Engineer District (MED) contract, resulted in elevated radionuclide levels in portions of the Linde property. Subsequent disposal and relocation of the processing wastes from the Linde property resulted in elevated levels of radionuclides at three nearby properties in the Town of Tonawanda: the Ashland 1 property; the Seaway property; and the Ashland 2 property. Together, these three (3) properties, with Linde, have been referred to as the Tonawanda Site.

Under its authority to conduct the Formerly Utilized Sites Remedial Action Program (FUSRAP), the U.S. Department of Energy (DOE) conducted a Remedial Investigation (RI), Baseline Risk Assessment (BRA), and Feasibility Study (FS) of the Tonawanda Site. In November 1993, DOE issued a Proposed Plan (PP) for public comment for the Tonawanda Site, describing the preferred remedial action alternative for disposal of remedial waste and cleanup plans for each of the Tonawanda Site properties. The 1993 PP recommended that remedial wastes from the Tonawanda Site properties be disposed in an engineered on-site disposal facility to be located at Ashland 1, Ashland 2, or Seaway.

Numerous concerns and comments were raised by the community and their representatives regarding the preferred alternative identified in DOE's 1993 PP and the proposed onsite disposal of remedial action waste. In 1994, DOE suspended the decision-making process on the 1993 PP and re-evaluated the alternatives that were proposed.

On October 13, 1997, the Energy and Water Development Appropriations Act, PL 105-62, was signed into law, transferring responsibility for the administration and execution of FUSRAP from DOE to USACE.

In April 1998, USACE issued a ROD for cleanup of Ashland 1, Ashland 2, and Area D of the Seaway Site properties. Remediation of those properties, was initiated by USACE in June 1998.

On March 26, 1999, after reviewing the history of the Linde Site and conducting an evaluation of Linde Site information not available in 1993 and potential remedial alternatives, USACE issued a revised PP for cleanup of the Linde Site. This ROD documents selection of a remedy which is significantly but not fundamentally different from the remedy proposed in the PP. The changes will not affect the degree of cleanup provided in the selected remedy and those portions of the site not included in this remedial action will be the subject of public comment in a later CERCLA action.

Remedies for Seaway Areas A, B and C are being addressed in a separate remedial action.

This remedial action does not address any contamination which may be present at the site due to activities at the site after the period of MED contract work.

Selected Remedy

The remedy selected for the Linde Site includes the residual radioactive material removal and building and slab removal actions of Alternative 2 as described in the PP issued on March 26, 1999 but does not include Building 14 nor the soils underneath Building 14. USACE has determined that the cleanup standards found in 40 CFR Part 192, the standards for cleanup of the uranium mill sites designated under the Uranium Mill Tailings Radiation Control Act (UMTRCA) and the Nuclear Regulatory Commission (NRC) standards for decommissioning of licensed uranium and thorium mills, found in 10 CFR Part 40, Appendix A, Criterion 6(6) are relevant and appropriate for cleanup of MED-related contamination at the Linde Site. The major elements of this remedy will involve excavation of the soils with contaminants of concern (COCs) (radium, thorium and uranium) above the soil cleanup levels and placement of clean materials to meet the other criteria of 40 CFR 192, and cleanup of contaminated surfaces in buildings with COCs above the surface cleaning levels.

Compliance with these standards will require USACE to: (1) Remove MED-related soil so that the concentrations of radium do not exceed background by more than 5 picocuries per gram (pCi/g) in the top 15 centimeters (cm) of soil or 15 pCi/g in any 15 cm layer below the top layer, averaged over an area of 100 square meters (m^2); (2) Remediate occupied or habitable buildings so that an annual average radon decay product concentration (including background) does not exceed 0.02 Working Level (WL) and the level of gamma radiation does not exceed the background level by more that 20 microroentgens per hour; (3) control the releases of radon into the atmosphere resulting from the management of uranium byproduct materials do not exceed an average release rate of 20 pCi/meter^2 second (m^2s); (4) removal of MED-related soils with residual radionuclide concentrations averaged over a 100 square meter area that exceeds unity for the sum of the ratios of these radionuclide concentrations to the associated concentration limits, above background, of 554 pCi/g for total uranium (U_{total}), 5 pCi/g for Radium-226 (Ra-226) and 14 pCi/g for Thorium-230 (Th-230) for surface cleanups and 3,021 pCi/g of U_{total}, 15 pCi/g of Ra-226 and 44 pCi/g of Th-230 for subsurface cleanups; (5) In addition, consistent with the proposed plan released for public comment in March 1999 prior to promulgation of the amendment to 10 CFR Part 40, Appendix A, Criterion 6(6) in June 1999, USACE will remediate the Linde Site to insure that no concentration of total uranium exceeding 600 pCi/g above background will remain in the site soils; and (6) removal of MED-related residual radioactive materials from surfaces necessary to meet the benchmark dose for surfaces of 8.8 mrem/y based on the specific location of the surfaces and exposure scenarios. Appropriate as low as reasonably achievable (ALARA) principles will be included in the detailed site remediation plan.

USACE had determined that, pursuant to 40 CFR 300.430(e)(2)(i)(A)(2), a site specific total uranium cleanup guideline was required to address isolated areas of elevated uranium contamination at the site because uranium is not specifically addressed in 40 CFR Part 192 or any other applicable or relevant and appropriate requirement (ARAR) available at the time the PP was released in March 1999. USACE had proposed to remove contaminated soils exceeding 600 pCi/g and committed to ensuring that the remaining soils will not exceed an average of 60 pCi/g of total uranium, as measured over a volume of soil 2,000 m^2 by 3 m thick. Subsequent to the public comment period, a new ARAR (amendment to 10 CFR Part 40, Appendix A, Criterion 6(6), as described above) was promulgated and became effective on June 11, 1999, making the use of the site specific uranium guideline unnecessary. USACE assessed the 10 CFR 40, Appendix A, Criterion 6(6) standards and the Linde radiological assessment (USACE 2000) and concluded that the criteria associated with this ARAR for the Linde Site soils would be to limit the residual radionuclide concentrations remaining in soils within a 100 square meter area to concentrations that results in unity or less for the sum of the ratios of these radionuclide concentrations to the associated concentration limits, above background, of 554 pCi/g for U_{total}, 5 pCi/g for Ra-226 and 14 pCi/g for Th-230 for surface cleanups and 3,021 pCi/g of U_{total}, 15 pCi/g of Ra-226 and 44 pCi/g of Th-230 for the subsurface. Remediation of the site in accordance with this ROD will result in a more stringent cleanup of U_{total} at the Linde Site than was originally proposed in the Proposed Plan and provides assurance that no concentration of total uranium exceeding 600 pCi/g above background will remain in soils at the Linde Site.

Verification of compliance with soil cleanup standards and criteria will be demonstrated using surveys developed in accordance with the Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM) and as may be required by the ARARs. Methodology to determine radon and gamma radiation levels will be developed in accordance with the ARARs and documented in the work plan for site remediation. The cleanup of contaminated building and structure surfaces will be conducted in accordance with the 10 CFR Part 40, Appendix A, Criterion 6(6) using building/structure-specific decontamination protocols to be detailed in the work plan for site remediation.

The selected remedy will involve the demolition of buildings necessary to remediate the site. These buildings include Buildings 57, 67, 73, 73B, 75 and 76 and will also include the building slabs and foundations. The slabs that are remaining after the demolition of Buildings 30 and 38 and the tank saddles north of Building 30 will also be removed. A wall in Building 31 will be removed to access sub-slab and sub-footing soils exceeding criteria. Soils and surfaces containing MED-related contamination will be remediated in order to meet the ARARs. The final remediation of Building 14 and soils under Building 14 has been excluded from this ROD, to be addressed separately in the future. The selected remedy will also include remediation of the adjacent Niagara Mohawk and CSX Corporation (formerly Conrail) properties, where radioactive contamination has already been identified or may be identified as the remediation work is implemented and will be limited to following releases that originated from the Linde Site resulting from MED-related operations. The plan also includes the removal of contaminated sediments from drainlines and sumps, the removal of contaminated soil from a blast wall structure located east of Building 58, and remediation of a subsurface vault structure located just west of Building 73. This ROD also does not address the groundwater at the Linde Site. A ROD will be issued in the future that evaluates the Site groundwater and selects any required remedial action. The selected remedy addresses the principal threat at the site by eliminating radioactive contamination in soils and on building structures that may pose a threat to the health of persons at the site. This remedy will not result in MED-related hazardous substances remaining at the site above the health-based levels after completion of the scope identified above. The Corps will perform all required 5-year reviews.

The estimated cost of the selected remedy is $27,700,000.

STATUTORY DETERMINATIONS

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 hazardous substances which are the subject of this response action, and is cost-effective.

None of the remedial alternatives identified for the Linde Site provide onsite treatment for the materials to be removed. The selected remedy includes offsite disposal, involving containment at the final disposal location and any treatment, which may be required to meet the standards of the offsite facility. This alternative thus would achieve reduction in mobility, although no treatment is planned which will reduce the toxicity or volume of the disposed materials. The FS evaluated currently available treatment technologies for treatment during the removal and found none that would be economically and technologically feasible at this time. Thus, the selected alternative achieves the best possible result in terms of satisfying the statutory preference for remedies that employ treatment that reduces toxicity, mobility, or volume as a principal element.

MG Hans Van Winkle
Deputy Commanding General for Civil Works
20 Massachusetts Avenue, NW
Washington, DC 20314-1000

3 March 2000
Date

RECORD OF DECISION
FOR THE
LINDE SITE

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ACRONYMS AND ABBREVIATIONS

ALARA	As Low as Reasonably Achievable
ARAR	applicable or relevant and appropriate requirement
ave.	Average
BNI	Bechtel National, Inc.
BRA	Baseline Risk Assessment
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
Ci	Curie
CFR	Code of Federal Regulations
cm	centimeter
COC	contaminant of concern
Conrail	Consolidated Rail Corporation
cy	cubic yard(s)
DOE	Department of Energy
dpm	disintegrations per minute
ECIDA	Erie County Industrial Development Authority
EE/CA	Engineering Evaluation/Cost Analysis
FBDU	Ford Bacon Davis Utah, Inc.
ft	foot/feet
FS	Feasibility Study
FUSRAP	Formerly Utilized Sites Remedial Action Program
g	gram
gpm	gallons per minute
GPR	ground penetrating radar
HI	Hazard Index
HQ	Hazard Quotient
L	liter
lb	pound
m	meter
MARSSIM	Multi-Agency Radiation Survey and Site Investigation Manual
MED	Manhattan Engineer District
mg	milligram
μR/hr	microroentgens per hour
NCP	National Contingency Plan
NEPA	National Environmental Policy Act
NRC	Nuclear Regulatory Commission
NWI	National Wetlands Inventory
NYSDEC	New York State Department of Environmental Conservation
O&M	Operations and Maintenance
ORNL	Oak Ridge National Laboratory
pCi	picocuries
PP	Proposed Plan
QA/QC	Quality Assurance/Quality Control
Ra	radium
RCRA	Resource Conservation and Recovery Act
RI	Remedial Investigation
RME	reasonable maximum exposure
Rn	radon
ROD	Record of Decision
s	second

Acronym List (continued)

SAIC	Science Applications International Corporation
SFMP	Surplus Facilities Management Program
SHPO	State Historical Preservation Office
TEDE	Total Effective Dose Equivalent
Th	thorium
U	uranium
UMTRCA	Uranium Mill Tailings Radiation Control Act
U.S.	United States
U.S.C.	United States Code
USACE	United States Army Corps of Engineers
USEPA	United States Environmental Protection Agency
USFWS	United States Fish and Wildlife Service
WL	Working Level
yr	year(s)

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II.

DECISION SUMMARY

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1. SITE NAME, LOCATION, AND DESCRIPTION

Linde Site
Town of Tonawanda, New York

1.1 Site Overview

During the early to mid-1940's, portions of the property formerly owned by Linde Air Products Corp., a subsidiary of Union Carbide Industrial Gas (Linde), now owned by Praxair, Inc., in the Town of Tonawanda, New York, were used for the separation of uranium ores. These processing activities, conducted under a MED contract, resulted in radioactive contamination of portions of the property and buildings. Subsequent disposal and relocation of processing wastes from the Linde property resulted in radioactive contamination of three nearby properties in the Town of Tonawanda: the Ashland 1 property, the Seaway property, and the Ashland 2 property. Together these three properties, with Linde, have been referred to as the Tonawanda Site (Figures 1-1 and 1-2). This ROD addresses the Linde Site.

USACE is the lead agency for purposes of selecting and implementing the remedial action pursuant to authority established in CERCLA and Public Law 105-245. The Linde Site is not listed on the United States Environmental Protection Agency's (USEPA) National Priority List. For purposes of FUSRAP, the Linde Site remedial actions will address only hazardous substances that were released during the period of MED contract work and related to activities in support of MED and not any earlier or later releases of hazardous substances that may have occurred, except to the extent they may be commingled with the MED-related hazardous substances.

1.2 Site and Vicinity Land Use

1.2.1 Site Description

The Linde Site is now owned by Praxair and comprises about 135 acres located at East Park Drive and Woodward Avenue in the Town of Tonawanda. The site is bounded on the north and south by other industry and small businesses, on the east by the CSX Corporation (CSX) [formerly Consolidated Rail Corporation (Conrail)] railroad tracks and Niagara Mohawk property and easements, and on the west, by a park owned by Praxair which is open to the public. The regional and vicinity locations of the Linde Site are shown in Figures 1-1 and 1-2, respectively.

The property contains office buildings, fabrication facilities, warehouse storage areas, material laydown areas, and parking lots (Figure 1-3). Access to the property is controlled by Praxair. Approximately 1,400 employees work at the Praxair facilities.

The property is underlain by a series of utility tunnels that interconnect some of the main buildings and by an extensive network of storm and sanitary sewers. (Section 1.3.1 describes stormwater drainage at Linde.)

The Linde property is generally flat. In assessing stormwater runoff, the RI report (BNI 1993) estimates that approximately half of the Linde plant area is covered with impervious surfaces such as roofs, paved areas and sidewalks; and the other half is covered with a packed gravel surface that allows infiltration of precipitation. Several railroad spurs extend onto the property from the CSX property east of the site. A

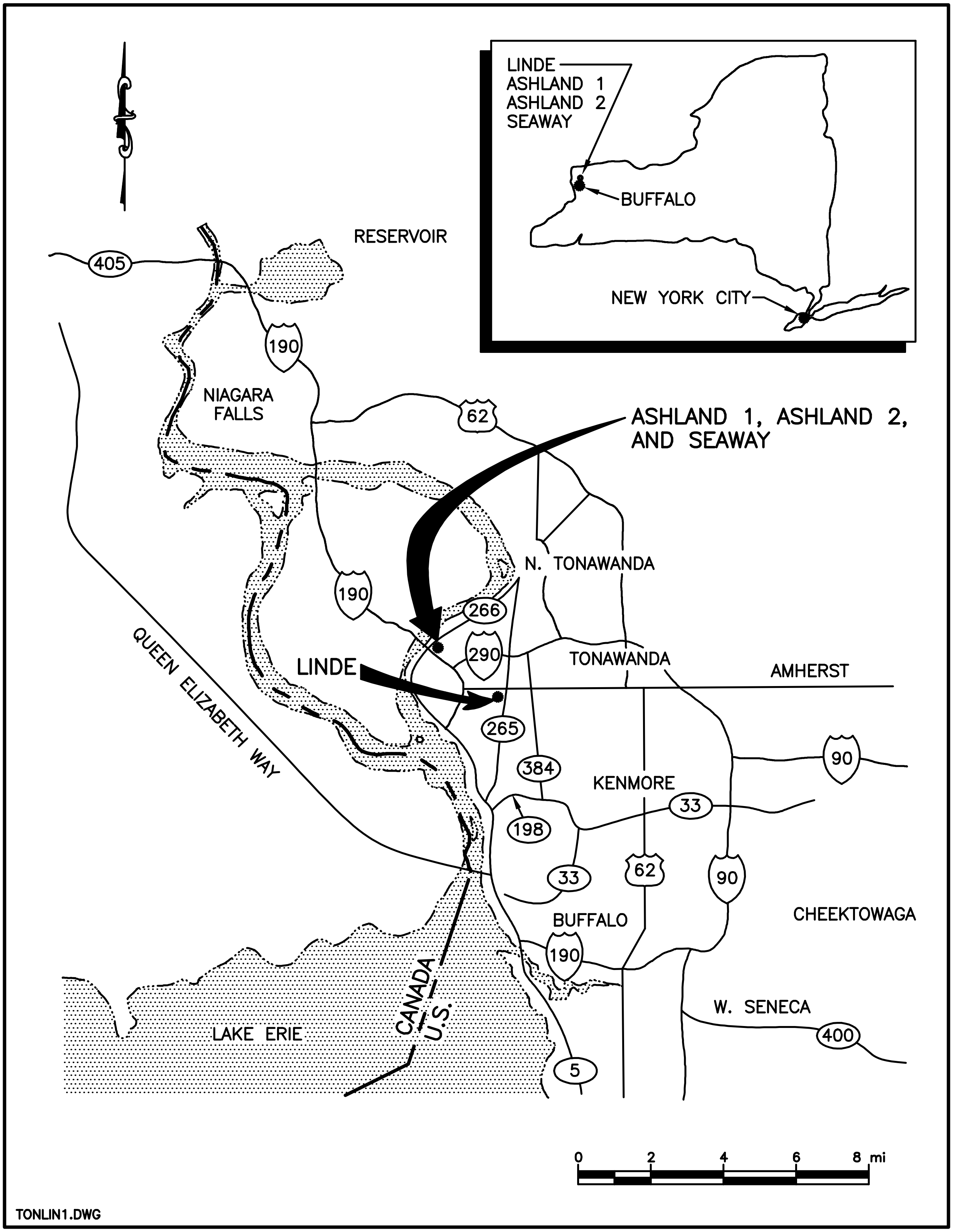

FIGURE 1–1
REGIONAL LOCATION OF THE TOWN OF TONAWANDA, NEW YORK AND THE ASHLAND 1, ASHLAND 2, SEAWAY AND LINDE SITES

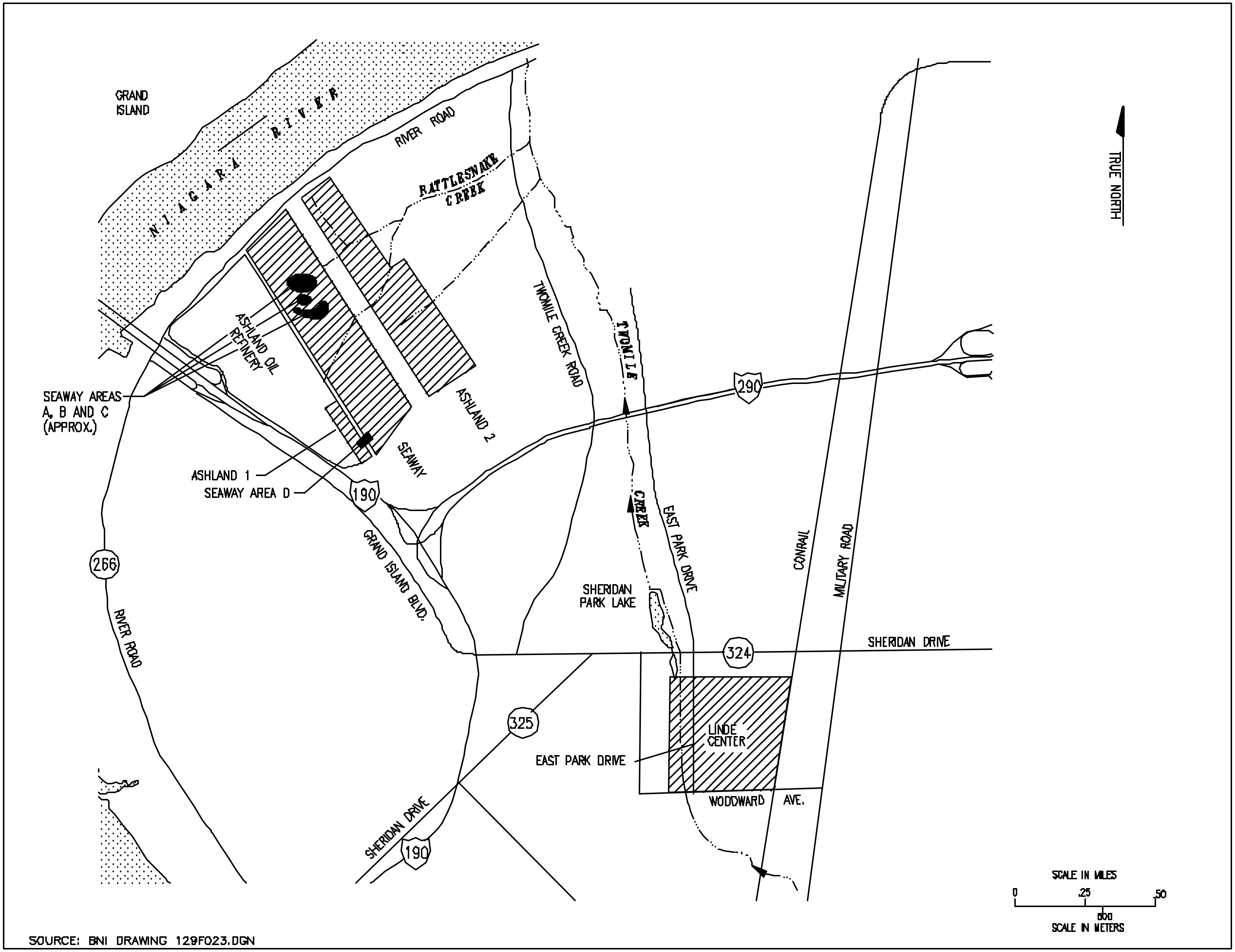

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FIGURE 1–2
VICINITY LOCATIONS OF ASHLAND 1, ASHLAND 2, SEAWAY AND LINDE SITES

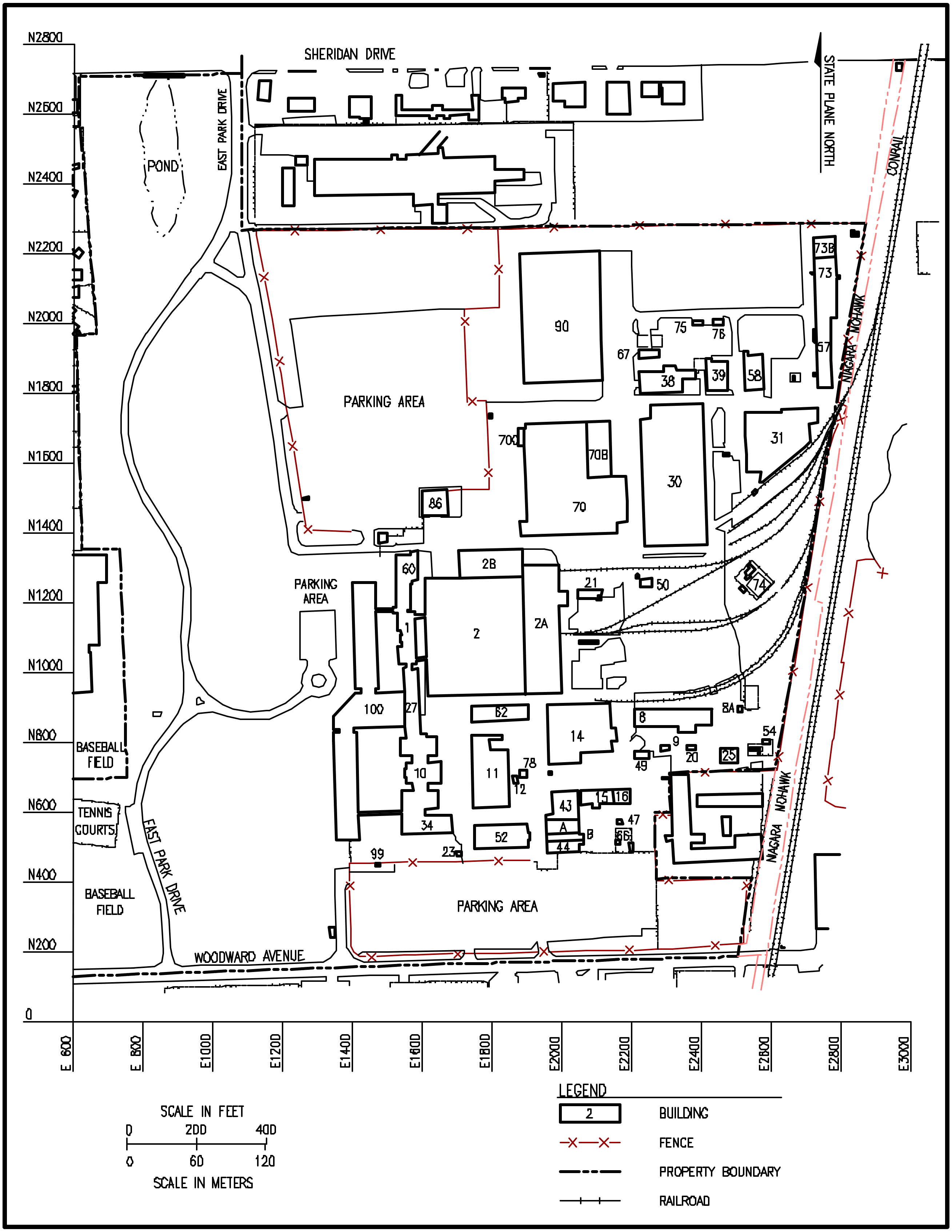

FIGURE 1–3
LINDE SITE LOCATIONS

soil and timber blast wall is located east of Building 58. A subsurface storage vault, shown on a 1946 drawing of the Linde property, is believed to be located about 15 feet west of Building 73, based on a ground penetrating radar (GPR) investigation during the RI. Radioactive waste may be contained in this structure. Details of radioactive materials detected at Linde during the RI and subsequent investigations are described in Section 5 of this ROD.

1.2.2 Vicinity Description

Land uses in proximity to the Linde property include the CSX property, commercial and residential areas, and Kenmore Sisters of Mercy Hospital to the east, small businesses, light industries, and residential areas to the north, business and industrial areas to the south, and a low density residential area and Holmes Elementary School to the west. Sheridan Park, owned by the Town of Tonawanda's Parks and Recreation Department, is located one-fourth mile to the northwest of the Linde property. Two Mile Creek flows through this property. Recreational uses include an 18-hole public golf course, picnicking, and playgrounds. Sensitive uses within one mile of the Linde property include five schools, two community buildings, and a senior citizens' center. The Linde property is fenced and has a buffer zone of grass and trees around the main buildings (DOE 1993b).

1.2.3 Zoning and Future Land Uses

The Linde Site is currently used for commercial and industrial purposes, and industrial facilities have been present at the site for more than 60 years. As described above, the site is surrounded by industries and small business on three sides and by a park, which is owned by Praxair, on the side.

The Town of Tonawanda has adopted a zoning ordinance that regulates land uses. Zoning districts were established to permit varying degrees of land uses. There are three residential zoning districts, two commercial districts, and an industrial district. The Town of Tonawanda also has two other districts: performance standards and waterfront.

Most of the Linde property is owned by Praxair. A small parcel (4.7 acres), located within the Linde property, is owned by the Erie County Industrial Development Agency (ECIDA). The ECIDA purchased the property as an incentive for Linde to expand. The ECIDA is exempt from paying property taxes on the parcel and the parcel is used by Linde as a logistics center (DOE 1993b).

The Linde property is located in a Performance Standards Zoning District. The purpose of the Performance Standards District is to encourage and allow the most appropriate use of the land available now as well as approaching future commercial and industrial uses unhampered by restrictive categorizing, thus extending the desirability of flexible zoning, subject to change with changing conditions. Restrictions in this district permit an institution for human care or treatment or a dwelling unit only if the development abuts a residential zoning district. Other restricted uses include junkyards, waste transfer or disposal, land mining and stockyards. Any proposed uses must follow the acquisition of a Performance Standards use permit. Performance Standards uses are not permitted that exceed New York State regulations or other standards listed in the zoning codes book, such as standards for noise, odor emission, dust emission, and vibrations, as measured at the individual property line.

Zoning in the Linde property vicinity includes a business district to the north, a low-density residential area to the west, and the Performance Standard District to the south and east.

Current zoning for the site as a Performance Standard area is to encourage and allow the most appropriate use of the land available now as well as approaching future commercial and industrial uses unhampered by restrictive categorizing. Because the west boundary of the site abuts a residential zone, construction of an institution for human health care or treatment or a dwelling unit are not strictly prohibited under the Performance Standard zoning category. However, given the past and current use of the Linde Site for industrial and commercial uses t for more than 60 years, including the ownership of part of the property by ECIDA to promote industrial use, USACE has concluded that the reasonably anticipated future land use of the property will be for industrial/commercial purposes (USACE 1999b) (USACE 2000).

1.3 Physical and Environmental Site Characteristics

1.3.1 Topography and Surface Water Drainage

The Linde Site is relatively flat and is situated on a broad lowland east of Two Mile Creek, a tributary of the Niagara River. Two Mile Creek begins south of Linde in a natural channel. Near the southern boundary of the Linde Site flow in Two Mile Creek is directed into twin subsurface 9 feet (ft) x 7 ft box conduits which traverse the Linde Site, underground. Stormwater runoff from Linde is collected in the facility's stormwater sewer system and is discharged to the two conduits. The twin conduits carry Two Mile Creek flows northerly, ultimately discharging through two large flow control gates located on the downstream face of the concrete dam that impounds Sheridan Park Lake. The control gates are pressure operated, releasing storm flow from the conduits, when necessary. Downstream of the Sheridan Park Dam, the natural channel of the Two Mile creek conveys flow in a generally northerly direction to the Niagara River, approximately 2 ¼ miles north of the Linde Site (see Figure 1-2).

1.3.2 Geology

The Linde Site is located within the Erie-Ontario Lowland Physiographic Unit of New York (BNI 1993). The Erie-Ontario Lowland has significant relief characterized by two major escarpments—the Niagara and the Onondaga. The elevation of the ground surface is approximately 600 ft above mean sea level at the Linde Site (BNI 1993).

1.3.2.1 Regional Geology

Mapping of regional bedrock geology indicates that the site area is situated on clayey glacial till. Underlying this glacial till is the Camillus Shale of the Salina Group. This Upper Silurian formation is approximately 400 ft thick in the area and consists predominantly of gray, red, and green thin-bedded shale and massive mudstone. Interbedded with the shale and mudstone are relatively thin beds of gypsum, dolomite, and limestone. The Camillus Shale dips southward at approximately 0.8%. The formation contains broad, low folds with amplitudes of a few feet and frequencies of a few hundred feet. The fold axes are generally oriented from east to west.

1.3.2.2 Site Bedrock Geology

Boring logs for eight (8) monitoring wells constructed at Linde during the RI show bedrock encountered at depths ranging from approximately 82 to 96 ft (BNI 1993).

The bedrock encountered (shales of the Salina Group) is generally described as a gray shale and mudstone with abundant thin layers and irregularly shaped masses of gypsum. In some intervals, as thick as 10 ft., gypsum constitutes as much as half of the rock. The thickest individual gypsum layer found was 1 ft. Generally, gypsum is present in only small amounts, as joint and fracture fillings.

All boreholes with significant core recovery showed moderate to extensive fracturing in the upper 6 to 15 feet of bedrock. Cores were noted to be only slightly fractured in most places below this upper zone. Joints were primarily perpendicular to the core axes and parallel to bedding planes. Joint surfaces were mostly planar to gently undulated and slightly rough. Partial to full gypsum crystal development characterized many joints and a few joints were coated with mud. Jointing was found to be common at the contact between gypsum and shale. Core descriptions by field geologists indicate that solution features are relatively common in the bedrock, especially in the gypsum.

1.3.2.3 Site Soils

Based on numerous soil borings, the RI report indicates that the natural soils at Linde appear to be covered by a fill layer ranging in thickness from 0 to 17 ft. As noted in boring logs, the fill contains substantial quantities of slag and fly ash that was apparently brought on-site from local sources for grading purposes during the construction of the Linde facility (BNI 1993).

Undisturbed soils that underlie the site are composed primarily of clay and sandy clay. These soils have low permeabilities precluding significant infiltration of precipitation.

1.3.3 Groundwater

1.3.3.1 Regional Hydrogeology

Information on regional hydrogeology available in the RI report (BNI, 1993), indicates that the unconsolidated materials contain the most productive water-bearing zones in the Niagara Region. These materials have a wide range of hydrogeologic properties, caused by variations in thickness, distribution and lithology. In areas where relatively thick sequences of coarse-grained glaciofluvial deposits are present, well yields as much as 700 gallons per minute (gpm) are reported.

The soluble limestone and dolomites of the Salina Group and the overlying Onondaga Formation are considered to be a single aquifer. Groundwater within this aquifer is controlled by secondary porosity features (i.e., fractures, joints, and bedding plane openings). These discontinuities have been enlarged by the solutioning of gypsum by groundwater. Wells completed in this aquifer can yield as much as 300 gpm, but generally yield less then 100 gpm. Groundwater obtained from this aquifer is generally potable except where groundwater has been degraded by upward movement of mineralized water from the underlying shales of the Salina Group.

The Camillus Shale (shales of the Salina Group) is the most productive bedrock aquifer in the region. Water in this formation is obtained primarily from solution cavities that have formed as the gypsum contained in the rock dissolved. Yields from individual wells of greater than 1,000 gpm from the Camillus Shale are not unusual in the Buffalo-Tonawanda area.

Groundwater in the shales of the Salina Group generally exists under artesian conditions. Records of wells drilled at and near the Linde Site indicate that water rises to a depth approximately 40 ft below the surface of the land in wells completed in the shale. Average hydraulic conductivities measured at these wells are in excess of 1×10^{-3} ft/s (3×10^{-2} centimeters/second [cm/s]). These relatively high hydraulic conductivities can be attributed almost entirely to the gypsum solution cavities.

Although the shales of the Salina Group constitute the most productive bedrock aquifer in the region (well yields as much as 1,200 gpm), the shales also contain the poorest quality water. Groundwater from these shales have high concentrations of dissolved solids, calcium, magnesium, sulfate and chloride. In the vicinity of the Linde Site, waters drawn from wells completed in the shale typically have total dissolved solids contents ranging from 2,000 to 6,000 milligrams/liter (mg/L), sulfate contents of 1,000 to1,500 mg/L, and chloride contents of 1,500 to 2,000 mg/L. These high levels of total dissolved solids and salinity (derived from the evaporates) preclude use of this water for potable consumption without extensive, costly treatment. Its use is restricted to certain industries that can tolerate the high salinity and total dissolved solids.

Underlying the Salina Group are the dolomites of the Lockport Formation. Like the Salina Group, the dolomites have secondary porosity developed in open bedding, joints, fracture zones, and solution widened discontinuities. Reported well yields for the Lockport Formation (as much as 110 gpm) are lower than the Salina Group. Because the Lockport Formation contains a gypsiferous zone, the groundwater typically contains high concentrations of sulfate rendering it to be non-potable.

1.3.3.2 Site Hydrogeology

At the Linde Site, the most productive water-bearing zone is comprised of the coarse-grained basal zone of the unconsolidated deposits and the fractured and jointed upper part of the Salina Group bedrock. This zone is collectively referred to as the contact-zone aquifer. Because bedrock does not occur at uniform depths throughout the area and the favorable water-bearing characteristics of the bedrock portion may not always correspond to the areas of coarsest-grained overburden, differences in the water-bearing properties of the contact zone aquifer may occur within short distances.

Information on the contact-zone aquifer is based on data from a total of 19 deep boreholes/wells across the Tonawanda properties (i.e., 11 at Ashland 1 & 2 and 8 at Linde). Data from the 19 deep boreholes/wells indicate that groundwater in the contact-zone aquifer is under confined conditions. At location B32W02D water rose more than 55 ft above the top of the contact zone. At the Linde Site, groundwater rose 40-50 ft above the contact zone.

Recharge to the contact-zone aquifer probably occurs at several locations. For example, carbonate rocks that constitute an aquifer to the south are exposed (or are minimally covered by unconsolidated material) 3.5 to 4.5 miles southeast of Linde. Also, coarse-grained alluvial deposits along Ellicott Creek, approximately 6 miles east of Linde, may be hydraulically connected to the contact zone aquifer.

Piezometric surface maps for the contact-zone aquifer at the Tonawanda properties indicate fairly flat hydraulic gradients throughout the Tonawanda properties (i.e., gradients ranging from 0.0004 to 0.0005 ft/ft at Ashland 1 and the southeast portion of Ashland 2).

At Linde, the piezometric surface appears to slope gently to the southwest. Projections of piezometric contours suggest that the low heads probably existed in the industrial area along Sheridan Drive from the Niagara River to Kenmore Avenue. Several high capacity industrial wells are located in this area including wells owned by Goodyear Tire and Rubber (also referenced as Dunlop Tire and Rubber in the RI), E.I. DuPont de Nemours and Company (also referenced as E.I. DuPont and Co. in the RI), and Linde Air Products Corp.; a subsidiary of Union Carbide Industrial Gas (Linde), now owned by Praxair, Inc. It is reported that well yields for the industrial wells ranged from 90 to 3,000 gpm (or 0.1 to 4.3 million gallons per day).

Estimates of average linear groundwater velocity for the contact-zone aquifer provided in the RI report are based on piezometric data along with estimates of hydraulic conductivity. The estimated groundwater flow velocity was reported to range from 5.5 feet/year (ft/yr) to 82 ft/yr.

1.3.4 Ecological and Cultural Resources

1.3.4.1 Terrestrial Biota

The Linde property supports several nearby mature eastern cottonwood, American sycamore, white ash, northern red oak, and shagbark hickory trees that were planted during landscaping activities. Urban lawns with plantings of shrubs were also established and are given periodic maintenance. Original vegetation was destroyed and natural plant succession has been disrupted during the industrial development and use of the Linde facility and surrounding area. Years of continuous industrial activity have left only marginal areas for natural plant communities. The property provides minimal urban wildlife habitats, supporting only the cosmopolitan species of birds and small mammals (DOE 1993b).

1.3.4.2 Aquatic Biota

The pond, located in the northwest corner of the Linde property, is connected to Sheridan Park Lake by a culvert underneath Sheridan Drive. Sheridan Park Lake is stocked annually by the New York State Department of Environmental Conservation (NYSDEC) with about 2,000 adult calico bass (BNI 1993). An aquatic biota survey conducted of Sheridan Lake by NYSDEC in 1980 indicated the presence of warm water fish such as goldfish and perch.

Sections of Two Mile Creek's channel below Sheridan Park Lake are cleared of sediments annually by park staff. Increased water turbidity and disturbance of benthic and possibly of fish communities by physical removal are likely to result from this activity.

1.3.4.3 Floodplains and Wetlands

No portion of the Linde property is within the 100-year flood zone of Two Mile Creek since it is contained in twin box culvert conduits along the western boundary of the property (DOE 1993b).

A review of National Wetland Inventory (NWI) maps (Tonawanda West and Buffalo Northwest quadrangles) identified no floodplains or wetlands onsite at Linde. Surface runoff from the site drains into two offsite floodplain and wetland areas to the north and west. West of Linde, a marshy strip lying along the twin conduits situated in the stream bed that runs parallel to the western boundary and empties into Two Mile Creek is mapped as a palustrine emergent floodplain and wetland with persistent narrow-leafed vegetation and temporary water regime. On the northeast corner of Linde, a palustrine forested floodplain and wetland with broad-leaved deciduous vegetation and a temporary water regime was identified on NWI maps. Also, information in the *Soil Survey of Erie County, New York* indicates areas of Linde that meet the criteria for hydric soils (DOE 1993b).

1.3.4.4 Endangered and Threatened Species

Except for occasional transient individuals, no federally-listed or proposed endangered or threatened species under jurisdiction of the United States Fish and Wildlife Service (USFWS) have been sighted in the project impact area. The most likely listed species to appear on or near the sites are the osprey, bald eagle, and peregrine falcon. No listed or suspected critical habitats occur on the Linde Site (DOE 1993a).

1.3.4.5 Archaeological, Cultural, and Historical Resources

A review of New York State records on archaeological, cultural, and historical resources indicates that none of these resources is close to the project area. Specifically, State Historical Preservation Office (SHPO) records do not indicate any known archaeological sites within a mile of the project area. In addition, SHPO records indicate that there are no cultural or historic sites near the project area listed on or eligible for the National Register of Historic Places (DOE 1993b).

2. SITE HISTORY

2.1 Site History Overview

As described in the foregoing sections, during the early to mid-1940's, Linde Center was contracted by MED to separate uranium from pitchblende uranium ore and domestic ore concentrates. These processing activities resulted in elevated levels of radionuclides in portions of the property and buildings. Subsequent disposal and relocation of processing wastes from Linde resulted in elevated levels of radionuclides at three nearby properties in the Town of Tonawanda: the Ashland 1 property, the Seaway property, and the Ashland 2 property.

The history of the Linde Site is summarized below. (Refer to Figure 1-3 for locations.)

2.2 History of the Linde Property

2.2.1 Site Ownership

Tax mapping property information of the Town of Tonawanda indicates ownership of property at the Linde Site location by Union Carbide, Linde Division, in 1936. While portions of the land at the site were previously owned by the Town of Tonawanda, Excelsior Steel Ball Company, Metropolitan Commercial Corporation, and the Pullman Trolley Land Company, the land was not used by any of these owners (FBDU 1981). It is likely that at some time in the past, the land was farmed (FBDU 1981). Commercial industrial processes were being conducted at the Linde Site by the Linde Air Products Division of Union Carbide prior to MED operations in the 1940's. Union Carbide operations continued at the Linde Site after the MED-related activities ceased. In the 1990's Praxair acquired the property and continued to perform commercial industrial processes focusing primarily on research and development.

A radiological survey report prepared for the Linde Site by Oak Ridge National Laboratory (ORNL) in 1978 reports that the "site was used for the separation of uranium dioxide from uranium ores and for the conversion of uranium dioxide to uranium tetrafluoride during the period of 1940-1948" (ORNL 1978). The 1978 ORNL report also states that the Linde Air Products Division was under contract to MED to perform uranium separations from 1940 through approximately 1948 (ORNL 1978).

As described in the RI report, five (5) Linde buildings were involved in MED activities: Building 14 (built by Union Carbide in the mid-1930's) and Buildings 30, 31, 37, and 38 (built by MED on land owned by Union Carbide) (BNI 1993). Ownership of Buildings 30, 31, 37, and 38 was transferred to Linde when the MED contract was terminated (BNI 1993). As discussed in the RI report, there were three phases to the processing conducted at Linde – Phase 1: uranium separation from the ore; Phase 2: conversion of triuranium octoxide (U_3O_8) to uranium dioxide; and Phase 3: conversion of uranium dioxide to uranium tetrafluoride. The RI report states that the contaminants of concern at the Linde Site were primarily associated with the waste streams and residues of the Phase 1 operation and that any residues from the Phase 2 and 3 operations were reprocessed, which is discussed in more detail in Section 2.2.2. All phases of operation have been reported to have occurred during the 1942 to 1946 period. A review of historical and recent documents indicates that the operations may have extended to the year 1948, particularly the Phase 2 and 3 operations (DOE 1997). Regardless of the actual duration of operations, the primary activity over most, if not all of the period during which MED-related activities occurred at the Linde Site was the separation of uranium from the ore; and the principal contaminants of concern were from the processing of wastes and residues from that operation since the residues from the other two phases were reported to have been recycled (Aerospace 1981).

2.2.2 Uranium Processing at Linde

As described in the RI report, Linde was selected for a MED contract because of the company's experience in the ceramics business, which involved processing uranium to produce salts used to color ceramic glazes. Under the MED contract, uranium ores from seven different sources were processed in Linde: four African ores (three low-grade pitchblendes and torbernite) and three domestic ores (carnotite from Colorado) (BNI 1993).

The domestic ore tailings sent to Linde resulted from commercial processing, conducted primarily in the Western United States, to remove vanadium. The vanadium removal process resulted in disruption of the uranium decay chain and the removal of radium. For this reason, uranium supplied to Linde had low concentrations of radium compared with the natural uranium (U) and Thorium-230 (Th-230) concentrations.

The African ores shipped to Linde as unprocessed mining ores contained uranium in equilibrium with all of the daughter products in its decay chain (e.g., Th-230 and radium-226 [Ra-226]). The other constituents of the ores were similar to those of the domestic ores. Laboratory and pilot plant studies were conducted at Linde from 1942 to 1943 and uranium processing began at Linde in 1943 (BNI 1993). From mid-1943 to mid-1946, a total of about 28,000 tons of ore was processed at Linde (Aerospace 1981).

A three-phase process was used to separate uranium from the uranium ores and tailings. Phase 1 (conducted in Building 30) consisted of separating U_3O_8 from the feedstock materials by a series of process steps consisting of acid digestion, precipitation, and filtration. The filtrate (liquid remaining from the processing operations) from this step was discarded as liquid waste into the injection wells, storm sewers, or sanitary sewers, and the filter cake was discarded as solid waste and was ultimately taken to Ashland 1. The U_3O_8 from Phase 1 was processed into uranium dioxide (UO_2) in Phase 2 (Building 30). In Phase 3 (Buildings 31 and 38), the uranium dioxide was converted to uranium tetrafluoride (UF_4). Residues from Phases 2 and 3 were reprocessed (Aerospace 1981).

The principal solid waste resulting from Phase 1 was a solid, gelatinous filter cake consisting of impurities remaining after filtration of the uranium carbonate solutions. Phase 1 also produced insoluble precipitates of the dissolved constituents, which were combined with the tailings. The precipitated species included large quantities of silicon dioxide, iron hydroxide, calcium hydroxide, calcium carbonate, aluminum hydroxide, lead sulfate, lead vanadate, barium sulfate, barium carbonate, magnesium hydroxide, magnesium carbonate, and iron complexes of vanadium and phosphorus (Aerospace 1981).

Between 1943 and 1946, approximately 8,000 tons of filter cake from the Phase 1 processing of domestic ores were taken from the temporary tailings pile at Linde and transported to the former Haist property, now known as Ashland 1. These residues contained approximately 0.54 percent uranium oxide [86,100 pounds (lbs) of natural uranium], which corresponds to 26.5 curies (Ci) of natural uranium. Because the residues from the African ore were relatively high in radium content compared with processed domestic ore residues, the African ore supplier required that the African ore residues be stored separately so that the radium could be extracted. Between 1943 and 1946, approximately 18,600 metric tons (20,500 tons) of residues were shipped to the former Lake Ontario Ordnance Works in Lewiston, New York, where they could be isolated and stored in a secure area (Aerospace 1981). The production progress reports also showed that approximately 140 metric tons (154 tons) of African ore residues were shipped to Middlesex, New Jersey (Aerospace 1981).

2.2.3 Disposal of Liquid Effluent from Uranium Processing and Groundwater at the Linde Site

The 1993 RI report for the Tonawanda Site (BNI 1993) indicated that approximately 55 million gallons of waste effluent containing dissolved uranium oxide was injected into the subsurface at Linde through seven (7) wells over a period of three years beginning in 1944. The RI report further indicated that precipitates were formed in the bedrock formation where injection occurred. The RI report concluded that the subsurface radioactive contamination probably occurs in the subsurface at Linde as minor percentages of uranyl sulfates and carbonates precipitated in the shale under the Linde Site where they are presumed to be immobile (BNI 1993). This ROD does not address the groundwater at the Linde Site. A ROD will be issued in the future that evaluates the Site groundwater and selects any required remedial action.

2.3 Site Investigations and Studies

Extensive investigations and studies of the Linde Site and Linde Site conditions were conducted and were relied upon in the preparation of the RI report, BRA, and FS for the Linde Site, which were issued by DOE in 1993. USACE reviewed these DOE documents, conducted additional studies of the Linde Site, and issued the results of these studies in 1999. The following briefly identifies the key investigations and studies of the Linde Site that are available in the administrative record files.

The principal MED-related radiological COCs identified in the investigations conducted at the Linde Site are total uranium, radium and thorium. Additional details of site contamination are presented in Sections 5 and 6.

2.3.1 DOE Remedial Investigation

A two-phase remedial investigation of the Tonawanda Site, including Linde, was conducted by DOE from 1988 to 1992. The remedial investigation incorporated the findings of earlier site investigations including, but not limited to, a radiological survey of the site in 1976 by ORNL (ORNL 1978) and an evaluation of 1943 to 1946 liquid effluent discharge from the Linde plant (Aerospace 1981). The 1993 DOE RI report lists these and other references relied upon by DOE in preparing the report.

The 1993 DOE RI report (BNI 1993) describes the investigations conducted at the Linde Site and the findings of investigations and studies to characterize site conditions, determine the nature and extent of contamination, and characterize the fate and transport of contamination in site media.

2.3.2 DOE Baseline Risk Assessment

Using the results of the investigations and studies reported in the RI report, DOE conducted a baseline risk assessment and reported the findings in the BRA issued by DOE in 1993 (DOE 1993a). The BRA describes the potential risks to human health and the environment posed by the presence of MED-related contamination. No significant risks from chemical contamination were identified. The BRA found that radiological contamination could pose risks to human health if exposures to contamination in some Linde Site areas is not controlled or remediated.

2.3.3 DOE Feasibility Study

Based on the findings of the RI report and BRA, DOE conducted an FS to identify and evaluate remedial alternatives for the Tonawanda Site properties, including Linde. Cleanup objectives for the site were those that DOE uses under DOE Orders, which are not applicable to USACE. Included among the alternatives evaluated was an alternative envisioning the excavation of MED-contaminated soil from the Linde Site, and the other three Tonawanda Sites (Ashland 1, Ashland 2 and Seaway) and containment of all the Tonawanda Site contaminated soils in an engineered cell on Ashland 1, Ashland 2 or Seaway. Other alternatives included complete excavation with off-site disposal and partial excavation leaving inaccessible MED-contaminated soils in place. The details of the FS are available in the FS report (DOE 1993b) issued by DOE in 1993.

2.3.4 1993 DOE Proposed Plan

In November 1993, DOE issued its PP for the Linde Site (DOE 1993c). As described in Part I of this ROD, the remedial alternative recommended in the 1993 PP recommended containment of all MED-contaminated soils from the Tonawanda Site at an engineered cell to be constructed at Ashland 1, Ashland 2, or Seaway. Due to public concern over this proposed cell, DOE suspended further actions in order to re-evaluate remedial alternatives for the Tonawanda Sites, including Linde.

2.3.5 USACE Technical Memorandum: Linde Site Radiological Assessment

In early 1999, USACE, having no specific ARAR standards that addressed residual concentrations of uranium in soils, prepared a document entitled Technical Memorandum: Linde Site Radiological Assessment (USACE 2000). The USACE assessment (USACE 2000) considered the radiological risk associated with the presence of uranium in the Linde Site soils and also the risks associated with uranium due to its chemical toxicity. As described in the assessment report (USACE 2000), a uranium cleanup level for the Linde Site soils based on limiting radiological risks was determined to be more restrictive than the cleanup level based on the chemical toxicity of uranium. USACE found that the total residual uranium concentration could range from approximately 7 to 740 pCi/g for an intended future of industrial land use, which results in potential maximum radiological risks ranging from 10^{-6} to 10^{-4}, respectively. An evaluation of the radiological assessment report (USACE 2000) concludes that the risks associated with the residual radium and thorium concentrations after remediation to the 40 CFR Part 192 standards are approximately 10^{-5} for the assessment areas. Therefore, USACE chose a uranium cleanup guideline of 600 pCi/g for total uranium, which is based on limiting potential radiological risks due to uranium in the Linde Site soils to less than 10^{-4}. USACE evaluated using 600 pCi/g for total uranium as a cleanup guideline for these isolated spots throughout the site to estimate what the residual uranium concentrations would be after removing isolated spots exceeding this guideline. USACE found that the average residual uranium source term concentrations in the various assessment units (USACE 2000) would be below 60 pCi/g.

Since that evaluation, new regulations amending 10 CFR 40, Appendix A, Criterion 6(6) were promulgated by the NRC and became effective on June 11, 1999. These regulations were evaluated and determined to be relevant and appropriate for the Linde Site since they addressed residual uranium and other radionuclides present at uranium mill sites, similar to the Linde Site. USACE then used the information contained in this radiological assessment (USACE 2000) to determine what the surface and subsurface cleanup benchmark doses would be for the average member of the critical group (commercial/industrial worker scenario) and the associated concentration limits for each of the radionuclides to be used in computing the sum of the ratios for each radionuclide of concern present to the concentration limit which is limited to unity or less. The results of the evaluation found that the surface and subsurface cleanup benchmark doses for a commercial/industrial worker scenario were 8.8 mrem/y and 4.1 mrem/y, respectively. The various radionuclide concentration limits, above background, within a 100 square meter area for the surface cleanup benchmark dose were 554 pCi/g of U_{total}, 5 pCi/g of Ra-226 and 14 pCi/g of Th-230. The various radionuclide concentration limits, above background, within a 100 square meter area for the subsurface cleanup benchmark dose were 3,021 pCi/g of U_{total}, 15 pCi/g of Ra-226 and 44 pCi/g of Th-230.

2.3.6 USACE Addendum to the Feasibility Study for the Linde Site

In March 1999, USACE issued its Addendum to the Feasibility Study for the Linde Site (USACE 1999b). The Addendum to the FS focuses on the Linde Site and summarizes findings and assessments not available at the time the 1993 DOE FS (DOE 1993b) was prepared. Key findings of the 1993 DOE documents pertaining to the Linde Site and findings of the recent USACE Linde documents are included. The status of building demolition and decontamination at Linde is updated, and updated information on radiological contamination is summarized. The alternatives considered for the Linde Site are described and evaluated, including risks and costs.

2.3.7 Proposed Plan for the Linde Site

In March 1999, USACE also issued its Proposed Plan (PP) for the Linde Site (USACE 1999c). The PP summarizes findings of Linde Site investigations and studies, identifies the cleanup criteria for Linde Site remediation, describes the remedial action alternatives identified and evaluated by USACE, describes the findings of the evaluation, and proposes a plan for remediation, referred to as Alternative No. 4, which involves the excavation and off-site disposal of contaminated soils, decontamination of buildings, and the imposition of institutional controls in Building 14 of the Linde Site, where a minor amount of contamination would be left after remediation is completed. The details of the alternatives considered for Linde Site remediation are described in Section 7 of this ROD. An explanation of the significant differences between the PP and this ROD is provided in Section 11 of this ROD.

The remedy selected for the Linde Site includes the residual radioactive material removal and building and slab removal actions of Alternative 2 as described in the March 1999 PP but does not include Building 14 nor the soils beneath Building 14.

2.3.8 Recent Removal Actions Conducted at Linde

From 1995 to the present, several removal actions have been undertaken at the Linde Site. These actions are summarized in the following section.

2.3.8.1 Demolition of Building 38

In January 1996, DOE issued an Engineering Evaluation/Cost Analysis (EE/CA) for Praxair Interim Actions (DOE 1996a). This EE/CA addressed demolition of Building 38 and the cleanup of radioactively contaminated soil that was located next to Building 90 at Linde. Demolition of Building 38 and the off-site disposal of contaminated debris from Building 38 and the contaminated soil near Building 90 has been completed consistent with the preferred alternative described in the EE/CA.

2.3.8.2 Decontamination of Buildings 14 and 31

The January 1996 DOE EE/CA (DOE 1996a) also stated DOE's intent to decontaminate Buildings 14, 31, and 30 at the Linde Site. A categorical exclusion was prepared by DOE under the National Environmental Policy Act (NEPA) to address the decontamination at Buildings 14 and 31 (DOE 1996a). Decontamination work at Buildings 14 and 31 has been completed.

A report entitled *Post Remedial Action Report for Building 14 at the Linde Site, Tonawanda, New York* (USACE 1998c), provides details of efforts initiated under DOE to decontaminate Building 14 interior surfaces and subsurface soils beneath slabs inside the building where MED-related activities occurred. These decontamination efforts were completed by USACE in 1998. The decontamination criteria for the soils and surfaces used during this effort were established by DOE. The decontamination efforts were completed by USACE as part of the transfer of the FUSRAP from DOE to USACE and Congress' mandate for USACE to honor DOE's past commitments. A few currently inaccessible areas were identified where removal to the criteria established by DOE was not possible.
The report (USACE 1998c) indicates that risks from residual materials remaining in currently inaccessible areas would be acceptable under current circumstances and building uses and controls.

A document entitled *FUSRAP Technical Memorandum: Delineation and Remedial Action Performed in Building 31* at the Praxair Site (BNI 1997a) describes the decontamination performed in Building 31. The decontamination work was performed by DOE using criteria established by DOE. An ORNL report entitled *Results of the Independent Radiological Verification Survey of Remediation at Building 31, Former Linde Uranium Refinery* (ORNL 1998) indicates the decontamination in accordance with DOE criteria was successful. The report notes that there is still radioactive contamination under part of the Building 31 slab. Removal of the Building 31 slab and the contamination beneath the slab is included in the remedy selected for implementation at the Linde Site.

2.3.8.3 Demolition of Building 30

In November 1996, DOE issued an EE/CA addressing the demolition of Building 30 at Linde and the off-site disposal of the resulting contaminated building rubble (DOE 1996b). USACE issued a responsiveness summary and Action Memorandum selecting the preferred alternative as the appropriate course of action in February of 1998. The demolition of Building 30 was completed in accordance with the Action Memorandum in September 1998.

3. HIGHLIGHTS OF COMMUNITY PARTICIPATION

Public input was encouraged to ensure that the remedy selected for the Linde Site meets the needs of the local community in addition to being an effective solution to the problem. The administrative record file contains all of the documentation used to support the preferred alternative and is available at the following locations:

U.S. Army Corps of Engineers
Public Information Center
1776 Niagara Street
Buffalo, NY 14207-3199

Tonawanda Public Library
333 Main Street
Tonawanda, NY 14150

Letters announcing the release of the Proposed Plan were mailed on March 26 to 858 members of the community on the site mailing list. Advertisements announcing the release were placed in The Buffalo News on March 28, the Niagara Gazette on March 28, the Tonawanda News on March 31, The Record Advertiser on March 31, and The Ken-Ton Bee on March 31. A news release was also issued to the same newspapers.

USACE's PP for the Linde Site was issued on March 26, 1999 (USACE 1999c), the comment period started on March 28, 1999, and USACE granted extensions to the comment period through June 11, 1999.

Public meetings were held on April 27 and June 3, 1999 to provide information about the remedial alternatives and the opportunity to submit comments on the PP. Responses to public comments are presented in the Responsiveness Summary, which is provided as an appendix in this document. The Responsiveness Summary, combined with the FS and revised PP, will constitute the final FS and PP for the Linde Site.

Discussions regarding the significant changes between the PP and this ROD are presented in Section 11. As indicated in Section 11, a new public comment period is not required for the changes. The work excluded from this remedial action will be addressed in separate CERCLA documentation that will be presented to the public for comment at a later time. Also, the additional ARAR will not substantially affect the protectiveness of the remedy or subsequent uses of the site.

4. SCOPE OF REMEDIAL ACTION

The remedial action involves cleanup of MED-related radiological contaminated media and MED-related radiological contaminated structural surface areas in accordance with ARARs selected for the site.

4.1 Cleanup Criteria and Standards

The cleanup criteria and standards to be used in remediation of the Linde Site are described in the following sections.

4.1.1 ARARs

Agencies responsible for remedial actions under CERCLA must ensure that selected remedies meet ARARs. The following sections define ARARs and describe the ARAR adopted by USACE for cleanup of the Linde Site.

4.1.1.1 ARARs - Definitions

Applicable requirements are those cleanup standards, standards of control, and other substantive environmental protection requirements, criteria, or limitations promulgated under federal environmental or state environmental or facility siting laws that specifically address a hazardous substance, pollutant, contaminant, remedial action, location or other circumstance at a CERCLA site. An applicable requirement directly and fully addresses an element of the remedial action.

Relevant and appropriate requirements are those cleanup standards, standards of control, and other substantive environmental protection requirements, criteria or limitations promulgated under federal environmental or state environmental or facility siting laws that while not "applicable" to a hazardous substance, pollutant, contaminant, remedial action, location or other circumstance at a CERCLA site, address problems or situations sufficiently similar to those encountered at the CERCLA site that their use is suited to the particular site.

Only those state standards that are promulgated, are identified by the state in a timely manner, and are more stringent than federal requirements may be applicable or relevant and appropriate. USACE has determined that the following are the cleanup ARARs for the remedial activities at the Linde Site.

4.2 ARARs for the Linde Site

The standards found in 40 CFR Part 192 are not considered applicable because the regulation is only applicable to specific sites designated under UMTRCA. However, USACE has determined that 40 CFR Part 192 is relevant and appropriate to the cleanup of the Linde Site. This determination was made based on the similarity of the ore processing activities to extract uranium and resulting radionuclides found in the waste after processing at uranium mill sites where the regulation is applicable.

Subpart B of 40 CFR Part 192 addresses cleanup of land and buildings contaminated with residual radioactive material from inactive uranium processing sites, and sets standards for residual concentrations of Ra-226 in soil. It requires that radium concentrations shall not exceed background by more than 5 pCi/g in the top 15 cm of soil or 15 pCi/g in any 15 cm layer below the top layer, averaged over an area of 100 m^2.

Subpart B also provides standards for any occupied or habitable building associated with the soils beneath or surrounding the building, not the equipment or surfaces within the building. These standards require that the remedial action shall be and reasonable effort shall be made to:

- achieve an annual average (or equivalent) radon decay product concentration (including background) not to exceed 0.02 Working Level (WL). In any case, the radon decay product concentration (including background) shall not exceed 0.03 WL, and
- the level of gamma radiation shall not exceed the background level by more than 20 microroentgens per hour.

These 40 CFR Part 192, Subpart B requirements are considered relevant and appropriate to the cleanup of the Linde Site and buildings.

New regulations amending 10 CFR 40, Appendix a, Criterion 6(6) were promulgated and became effective on June 11, 1999. These regulations were evaluated and determined to not be applicable to the Linde Site. However, they were found to be relevant and appropriate for the Linde Site since they addressed residual uranium and other radionuclides present at uranium mill sites, similar to the Linde Site. 10 CFR 40, Appendix A, Criterion 6(6) requires that residual radioactive materials remaining after remediation will not result in a total effective dose equivalent (TEDE), considering all radionuclides present (e.g., radium, thorium, and uranium) to the average member of the critical group exceeding a benchmark dose established based on cleanup to the radium standards of 5 pCi/g in the top 15 centimeters and 15 pCi/g in subsequent 15 centimeter layers below the top layer and must be as low as reasonably achievable (ALARA). This benchmark dose is then used to establish allowable soil and surface concentration levels for the various radionuclides present other than radium.

Using the information contained in the radiological assessment (USACE 2000), USACE computed the benchmark doses for the cleanup of surfaces and subsurfaces. The results of the evaluation found that the surface and subsurface cleanup benchmark doses for a commercial/industrial worker scenario were 8.8 mrem/y and 4.1 mrem/y, respectively. The various radionuclide concentration limits, above background, within a 100 square meter area for the surface cleanup benchmark dose were 554 pCi/g of U_{total}, 5 pCi/g of Ra-226 and 14 pCi/g of Th-230. The various radionuclide concentration limits, above background, within a 100 square meter area for the subsurface cleanup benchmark dose were 3,021 pCi/g of U_{total}, 15 pCi/g of Ra-226 and 44 pCi/g of Th-230. These criteria would apply to the soils being remediated at Linde. The surface criteria will be developed for specific buildings or surfaces based on likely exposure scenarios and meeting the surface cleanup benchmark dose of 8.8 mrem/y. These specific surface criteria as well as appropriate ALARA principles will be included in their respective remediation work plans.

4.3 Summary of Remedial Action Objectives and Cleanup Standards and Guidelines for MED-Contaminated Media at the Linde Site

The general remedial action objectives for cleanup of the Linde Site are the CERCLA threshold criteria:

- the remedy must be protective of public health and the environment; and
- the remedy must attain ARARs.

In meeting these general remedial action objectives, USACE has determined that the standards of 40 CFR Part 192 and 10 CFR 40, Appendix A, Criterion 6(6) are relevant and appropriate for Linde Site cleanup. The cleanup criteria at the Linde Site will be the following: (1) the removal of soils exceeding the 40 CFR 192 standards for radium, which includes consideration of thorium, when averaged over 100 square meters; (2) removal of soils with residual radionuclide concentrations within a 100 square meter area that results in exceeding unity for the sum of the ratios of these radionuclide concentrations to the associated concentration limits, above background, of 554 pCi/g for U_{total}, 5 pCi/g for Ra-226 and 14 pCi/g for Th-230 for surface cleanups and 3,021 pCi/g of U_{total}, 15 pCi/g of Ra-226 and 44 pCi/g of Th-230 for subsurface cleanups, and (3) removal of residual radioactive materials from surfaces necessary to meet the benchmark dose for surfaces of 8.8 mrem/y based on the specific location of the surfaces and exposure scenarios. In addition to the above requirements of the ARAR, USACE will remediate the Linde site to insure that no concentration of total uranium exceeding 600 pCi/g above background will remain in the site soils. Application of the ARAR standards for MED-contaminated media at the Linde Site will be conducted as described, generally, below.

4.3.1 Soils Cleanup

Soils at the Linde Site exceeding the standards found in 40 CFR Part 192 will be excavated and disposed off-site as detailed in Section 7. In addition, in order to comply with 10 CFR Part 40, Appendix A, Criterion 6(6), soils within any 100 square meter area will be removed when necessary to reduce to less than unity the sum of the ratios of the residual radionuclide concentrations to the associated concentration limits, above background, of 554 pCi/g for U_{total}, 5 pCi/g for Ra-226 and 14 pCi/g for Th-230 for surface cleanups and 3,021 pCi/g of U_{total}, 15 pCi/g of Ra-226 and 44 pCi/g of Th-230 for subsurface cleanups to comply with 10 CFR 40, Appendix A, Criterion 6(6). In addition to the above requirements of the ARAR, USACE will remediate the Linde site to insure that no concentration of total uranium exceeding 600 pCi/g above background will remain in the site soils. In order to gain access to MED-contaminated soils located under buildings or buildings slabs, demolition of building slabs will be required. Appropriate ALARA principles will be included in the detailed site remediation plan. Soils beneath Building 14 will be addressed separately from this ROD. MED-contaminated sediments in drainlines at Linde, as detailed in the RI, will also be remediated to the standards of 40 CFR Part 192 as well as the new standards in 10 CFR Part 40, Appendix A, Criterion 6(6). Verification of compliance with soil cleanup standards and criteria will be demonstrated using surveys developed in accordance with the Multi-Agency Radiation Survey and site Investigation Manual (MARSSIM) and as may be required by the ARARs.

4.3.2 Building and Structures Cleanup

The cleanup of contaminated building and structure surface areas will be conducted in accordance with the 10 CFR Part 40, Appendix A, Criterion 6(6) using building/structure specific decontamination protocols to be detailed in the work plan for site remediation. Residual radioactive materials will be removed from surfaces necessary to meet the benchmark dose for surfaces of 8.8 mrem/y based on the specific location of the surfaces and exposure scenarios and appropriate ALARA principles. Building 14 MED-related radiological contamination will be addressed separately from this ROD.

4.3.3 Groundwater

This ROD does not address the groundwater at the Linde Site. A ROD will be issued in the future that evaluates the Site groundwater and selects any required remedial action.

5. SUMMARY OF SITE CHARACTERISTICS

5.1 Site contamination Overview

The 1993 DOE RI report (BNI 1993) describes elevated levels of radionuclides at the Linde Site resulting from the separation of uranium ores at the property during the mid-1940's under a MED contract. The MED-related contamination at Linde resulted, for the most part, from three activities associated with uranium processing: the handling of uranium ores, the temporary storage and handling of solid residues before they were shipped offsite for disposal, and the disposal of liquid waste from the uranium processing operations. The 1993 PP (DOE 1993c) identified three sources of radioactive contamination at Linde: the uranium processing buildings, surface and subsurface soils, and sediments in sumps and storm and sanitary sewers. The primary radioactive contaminants in the soils and sediments are U-238, Ra-226, Th-230, and their respective radioactive decay products (DOE 1993c).

The following sections provide additional details of the MED-related contamination as reported in the 1993 RI and FS reports. In the 1993 DOE reports, radiological contamination is defined in terms of DOE criteria. DOE's criteria are described in Section 2.6.1 of the Addendum to the Feasibility Study (USACE 1999b).

Since the RI report was prepared in 1993 Buildings 38 and 30 have been demolished and Buildings 14 and 31 have been decontaminated. The findings of pre-remediation investigations undertaken as part of these activities and an update of current contamination conditions following building demolition and decontamination at the Linde Site are included in the descriptions of current contamination at the Linde Site where appropriate.

5.2 Radioactive Contamination in Surface and Subsurface Soils

The RI (BNI 1993) indicates that U-238, Ra-226, and Th-230 are the primary MED-related radionuclides of concern in the surface and subsurface soils at Linde. The 1993 RI identified contamination in four (4) areas of the Site as follows:

Area 1 contains primarily superficial radioactive contamination located in the northwest corner of the main parking lot area at Linde. The RI report indicates the contamination does not extend deeper than 4 ft.

Area 2 contains primarily superficial contamination located along the northern boundary of Linde and the northeastern corner of the main parking area. A temporary storage pile for the consolidation of radioactively contaminated soils and windrow materials is located in this area. Contamination does not extend deeper than 1.2 m (4 ft). (This material has now been removed from the Linde Site.)

Area 3 is located along the fence line in the northeastern corner of the property. Evidence of radioactive contamination in this area extends off the property and encompasses a railroad spur formerly used to haul uranium ore into Linde. Sampling results show that the radioactive contamination is present to a depth of 4 ft in the area west of the railroad tracks and to a depth of 2.0 ft east of the tracks.

Area 4 includes the areas of Buildings 30, 31, 38, 58, and a blast wall outside Building 58. Sampling results show that the soil beneath Building 30 is radioactively contaminated to a depth of 2.4 m (8 ft).

As described in Section 2.3.9, several remedial actions have been conducted at Linde since the 1993 RI and FS reports were prepared. These remedial actions included the demolition of Buildings 38 and 30 and the decontamination of Buildings 31 and 14.

A subsurface investigation at Buildings 31 and 57 was conducted in 1996. Results of the investigation indicate the presence of radioactive contamination in soils at locations not reported in the 1993 DOE documents, including contamination under Building 57.

As described in Section 2.3.9.2, decontamination of Building 14 was completed in 1998, including removal of radioactively contaminated soils from beneath floor slabs (USACE 1998c). A small, inaccessible volume of radioactively contaminated soils were left under structural support members. As described in Section 4.3.1, Building 14 and the soils under the building will be addressed separately from the action under this ROD.

The information available in the 1993 DOE documents, along with the findings of subsequent surveys and investigations, were used by USACE to develop an updated database for MED-related radioactively contaminated soils at Linde. The updated database and the 5/15/600/60(ave.) criteria described in Section 4.3 were used to estimate the volume of MED-related radioactively contaminated soils as reported in the Addendum to the Feasibility Study for the Linde Site (USACE 1999b) and the PP (USACE 1999c).

As detailed in the *USACE Technical Memorandum: Linde Site Radiological Assessment* (USACE 2000), the 95 percent upper confidence limit (UL_{95}) values for radiological contamination in site soil used in the assessment of risks ranged from 0.88 pCi/g to 41.7 pCi/g for Ra-226, from 2.5 pCi/g to 82.4 pCi/g for Th-230, and from 30 pCi/g to 197 pCi/g for U-238. Results of analyses of individual soil samples ranged from background to in excess of 1,800 pCi/g for total uranium, from background to in excess of 200 pCi/g for Ra-226, and from background to in excess of 800 pCi/g for Th-230. Additional details of the location of and the assessment of radiological contamination in site soils is presented in Section 6.4

5.3 Chemical Contamination in Surface and Subsurface Soils

The non-radioactive MED-related contaminants in the surface and subsurface soils at Linde were determined to be metal precipitates expected to be found in MED filter cake. The 1993 RI evaluated the possible existence of Resource Conservation and Recovery Act (RCRA) hazardous waste and concluded that Linde soils would not contain hazardous waste. Additionally, the BRA concluded that chemical contaminants found on the Linde Site do not pose a health threat (DOE 1993a).

The remedial action to be conducted at Linde will not address any releases of hazardous substances that may have occurred due to operations conducted at Linde prior to or after MED operations, except to the extent that substances are commingled with the MED era radioactive contamination. Sampling will be conducted of all materials to be disposed during the remedial action to ensure proper disposal of the material (i.e., demonstrate compliance with disposal facility waste acceptance criteria). Should any hazardous materials be found that are not commingled with MED-related radiological materials, the site owner, Praxair, will be notified for them to take the appropriate actions for that material as well as any remaining similar materials at the site. Details of the sampling will be included in the work plans for the project.

5.4 Contamination in Surface Water

The RI report reported no surface water contamination from MED-related activities in surface waters onsite or directly downstream from the Linde property.

5.5 Contamination in Sediments

Results of RI sampling of sediments downstream of Linde indicated no radionuclide concentrations above background (DOE 1993b).

Radioactive contamination was detected in sediments found in sumps inside Building 30 as well as in the sanitary and storm sewers. The sediments in the Building 30 sumps were found to contain concentrations of U-238, Ra-226, and Th-230, above background levels. Samples taken in the sanitary and storm sewers at various locations indicated U-238, Ra-226, and Th-230 contamination. The contamination may have resulted from process liquid collection systems used during operations or during the construction of the concrete floor. Contamination detected in the sanitary and storm sewers resulted from the disposal of production effluents into these systems. Contaminated sediments were found in sumps and drains during the decontamination of Building 14 (USACE 1998c). The RI concludes that the exact extent of contamination in the drain system will need to be determined during the remedial action.

5.6 Contamination of Groundwater

As discussed in Section 2.2.3, USACE has decided to address the status of groundwater at the Linde Site under a separate CERCLA action as a separate operable unit.

5.7 MED-Related Radioactive Contamination in Buildings and Structures

The 1993 DOE RI report (BNI 1993) described the primary types of radioactive contamination in Linde buildings as fixed beta-gamma emitting radionuclides and dust contaminated with U-238, Th-230, and Ra-226. The RI report identified radioactive contamination exceeding DOE guidelines in parts of Building 14, 30, 31 and 38. The presence of a subsurface vault just west of Building 73 was also identified as a structure that may contain radioactive waste.

As described in Section 2.3.9, Buildings 38 and 30 have been demolished and Buildings 14 and 31 have been decontaminated.

5.8 Radiological Data Evaluation

The goal of the data evaluation was to identify a set of radiological contaminants of concern (COCs) that are likely site-related and then select those COCs that are valid to use in the quantitative risk characterization. Radiological sample analyses for the RI were performed in accordance with approved protocols. The detailed analytical results are contained in appendices to the RI report (BNI 1993). Data quality objectives and Quality Assurance/Quality Control (QA/QC) procedures are discussed in Appendix D to the RI (BNI 1993). Similar procedures were used in the evaluation of data developed subsequent to the RI.

5.8.1 Background Levels of Radioactivity in Linde Site Soils

The standards contained in the ARARs are typically stated in terms of concentrations or levels in excess of site background. The 1993 BRA (DOE 1993a) adopted background levels for radioactivity in soils for all of the Tonawanda Sites based on mean concentrations reported for soils in an undisturbed area of Ashland 2. Background levels of radionuclides in soils used by DOE and USACE, in subsequent assessments, are:

- Ra-226, 1.1 pCi/g
- Th-230, 1.4 pCi/g
- U-238, 3.1 pCi/g

Based on the relative abundance of the uranium isotopes, the background values for total uranium was calculated to be 6.1 pCi/g.

5.8.2 Summary of Radiological COCs

The final list of radiological COCs for soil includes Ra-226, Th-230, U-238 and their associated decay products (DOE 1993a). Although not considered MED-related, the Th-232 and U-235 series were included in the risk assessment conducted by DOE. No elevated levels of radionuclides were detected in surface waters or sediments downstream of the Linde Site (DOE 1993b). Th-230 and U-238 were identified as radiological COCs in sediments found on the Linde Site in sumps and sanitary and storm sewers (DOE 1993b).

5.9 Potential Chemical COCs

The chemical data evaluated are those reported in the RI report for the Tonawanda Site (BNI 1993). Chemicals in the RI database were evaluated in accordance with EPA data validation guidance in *Risk Assessment Guidance for Superfund, Volume I* (EPA 1989). Background samples for soil were used to identify naturally-occurring levels of chemicals and ambient concentrations.

As detailed in the BRA, risks resulting from nonradioactive chemical constituents were found to be within the USEPA acceptable risk range. Therefore, there are no chemical COCs for human health concerns.

6. SUMMARY OF SITE RISKS

The 1993 BRA (DOE 1993a) was prepared to evaluate the risk to human health and the environment from the radioactive and chemical constituents at the site. In accordance with EPA guidance, the primary health risks investigated were cancer and other chemical-related illnesses, as well as the ecological risks. This assessment evaluated the potential risks that could develop in the absence of cleanup and assumes that no controls (e.g., fencing, maintenance, protective clothing, etc.) are, or will be, in place. The purpose of the BRA was to determine the need for cleanup and provide a baseline against which the remedial action alternatives were compared. The complete report is in the administrative record file and a brief summary of the radiological and chemical health risks, as well as the ecological risks, is provided herein.

The BRA identified the means by which people and the environment may be exposed to constituents present at the Tonawanda Site. Mathematical models were used to predict the possible effects on human health and the environment from exposure to radionuclides and chemicals for both present and future uses at the site. Under Section 300.400(e)(2)(i)(A)(2) of the NCP, "acceptable exposure levels are generally concentration levels that represent an excess upper bound life-time cancer risk to an individual of between 10^{-4} and 10^{-6} using information on the relationship between dose and response." The 10^{-6} risk level shall be used as the point of departure for determining remediation goals for alternatives when ARARs are not available or not sufficiently protective because of the presence of multiple pathways of exposure."

The modeled risk estimates in the BRA were then compared to the NCP's risk criteria. The findings of these comparisons of USACE's updated risk characterization for the site are described below.

6.1 Radiological Health Risk

The 1993 BRA provides risk estimates for average (mean) exposure conditions under hypothetical scenarios for current and projected future land use. These estimated risks were calculated using the average radionuclide concentrations present at the properties. The results predicted that, for the current land uses, no one would be exposed to unacceptable risks. For assumed future land uses, the mean radiological risk, as was reported in the original 1993 PP, was predicted to be within the NCP's range of acceptability at Linde.

USEPA's guidance for risk characterization requires that modeling to estimate risks also include what is called a Reasonable Maximum Exposure (RME) scenario. RME calculations assume that a worker at the site for a longer period of time than the average worker (30 years for the RME worker and 22 years for the average worker), would be exposed to higher concentrations of dust than the average worker, would inhale more air than the average worker, would spend more time each day outside than the average worker, and would ingest more soil each day than the average worker. Using these higher RME exposure assumptions, the BRA reported that RME radiological risks to workers at some Linde Site areas slightly exceed the NCP's target risk range under current conditions. The BRA assumed that future use of the Linde Site will be commercial/industrial.

As briefly described in Section 1, USACE prepared a Technical Memorandum (USACE 2000) evaluating radiological risks at the Linde Site assuming no action is taken and also assessing risks after cleanup.

The USACE assessment of radiological risks at the Linde Site used updated information on the location of radiologically contaminated soils. The Linde Site currently is used for commercial and industrial purposes, and industrial facilities have been present at the site for more than 60 years. Given the past and current use of the Linde Site for industrial and commercial uses over more than 60 years, including the ownership of part of the property by ECIDA to promote industrial use and the zoning restrictions on the property, USACE has concluded that the reasonably anticipated future land use of the property will be for commercial/industrial purposes (USACE 1999b) (USACE 2000). The USACE assessment considered the most likely future land use of the Linde Site to be its current commercial/industrial use.

The results of the USACE assessment show current risks to commercial/industrial workers at the site to be higher than the NCP's target risk range for several areas of the Linde Site. Additional details of the USACE assessment are presented in Section 6.4.

6.2 Chemical Health Risk

The 1993 BRA also evaluated cancer and chemical toxicity risks. The risk of developing an incremental increase of cancer over a 70-year lifetime from chemical carcinogens at the site was evaluated for both average (mean) exposure and for RME. The evaluation showed no chemical risks at Linde exceeding the NCP's target risk range.

Potentials for chemical noncarcinogenic health effects were also evaluated in the BRA. These potential effects are expressed as chemical-specific hazard quotients (HQs). HQs were tabulated for chemicals of concern. HQs were summed for each pathway to provide a total hazard index (HI) for the pathway. The calculated HIs for all exposure pathways for all scenarios evaluated at the Tonawanda Site properties, including Linde, are much less than 1, thus indicating that no unacceptable effects would be expected.

6.3 Ecological Risk

The Ecological Risk Assessment included in the 1993 BRA follows USEPA's general procedures for ecological assessments in the Superfund program. The characterization of habitats and biota at risk are semiqualitative, and screening of contaminants and assessment of potential impacts to biota are based on measured environmental concentrations of the constituents and toxicological effects reported in the literature.

The Linde Site is located in a highly modified urban, industrial area and provides urban wildlife habitat supporting only cosmopolitan species of birds and small mammals. No critical habitats for threatened or endangered species are present on the Site. No threatened or endangered species exist on the Linde Site and ecological risks are minimal. USACE has concluded that no significant impact has occurred to ecological resources from previous releases of hazardous substances at the Linde Site.

6.4 USACE Radiological Assessment of the Linde Site

An assessment of the Linde Site was conducted by USACE to estimate potential exposures and associated risks from radionuclides at the Linde Site (USACE 2000). As described in Section 4.1.1, the assessment was initially conducted in early 1999 to develop a site-specific cleanup guideline for uranium since there was no uranium ARAR available at that time. Since then, new regulations amending 10 CFR 40, Appendix A, Criterion 6(6) were promulgated and became effective on June 11, 1999. These regulations were evaluated and determined to be relevant and appropriate for the Linde Site since they addressed residual uranium and other radionuclides present at uranium mill sites, similar to the Linde Site.

The Linde Site assessment assumed that the most likely future land use at Linde will be continued commercial/industrial. The basis for concluding that the most likely use of the site in the future is commercial/industrial is presented in Section 1.2.3 of this ROD. The assessment also assumed that construction or utility workers will be involved in on-site activities in the remediated area for limited periods of time. Radiation doses and associated risks were evaluated using radiological contamination data from the site and the RESRAD Code (Yu et al. 1993).

The assessment included an evaluation to determine current risks, assuming no radiological materials have been removed from the Building 14 area and future risks at the Linde Site, as discussed in Section 2.3.5.

For purposes of the assessment, the Linde Site was divided into twelve (12) assessment units. The location of the assessment units and sample locations for the radiological data used in the assessment are shown in Figure 6-1.

Figure 6-2 shows the locations of samples exceeding the site cleanup criteria. As shown in Figure 6-2, criteria are only exceeded in assessment units 7 through 11. As shown in the assessment report, the no action alternative presents risks outside of the acceptable CERCLA risk range of 10^{-4} to 10^{-6}. The risks associated with the residual uranium after cleanup to the standards of the ARARs are acceptable (USACE 2000).

7. DESCRIPTION OF REMEDIAL ALTERNATIVES

7.1 Remedial Action Alternatives Evaluated in the 1993 FS and PP and Updated Description of Linde Alternatives

Detailed descriptions of the remedial alternatives considered for the Tonawanda site in 1993, including the Linde Site, can be found in the FS (DOE 1993b), which is available in the administrative record. A total of 6 alternatives were considered in the FS. The following section describes the 1993 alternatives and updates the descriptions of alternatives considered by USACE in the 1999 PP for the Linde Site.

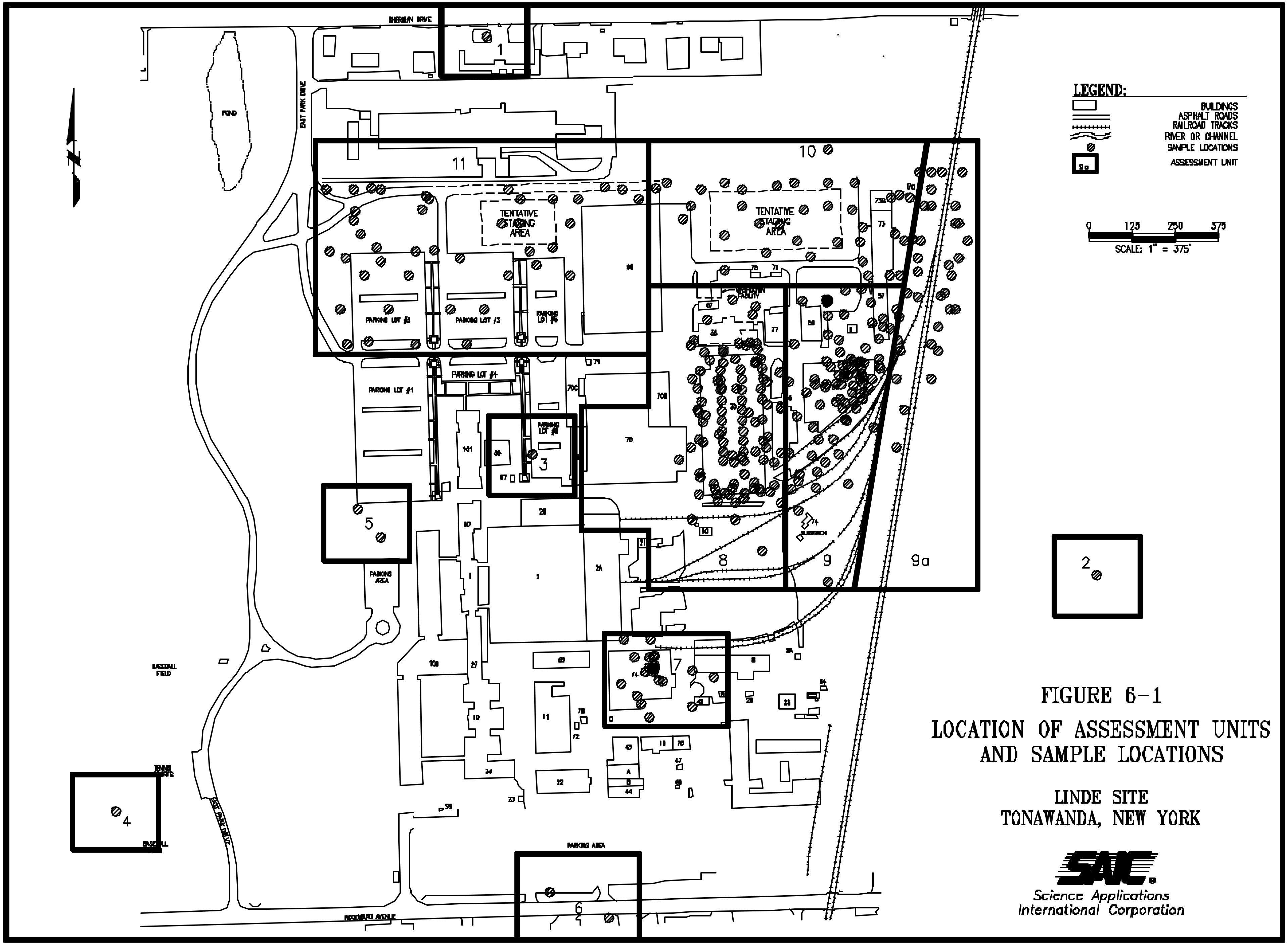

FIGURE 6-1
LOCATION OF ASSESSMENT UNITS AND SAMPLE LOCATIONS

LINDE SITE
TONAWANDA, NEW YORK

LINDE6-1 DWG

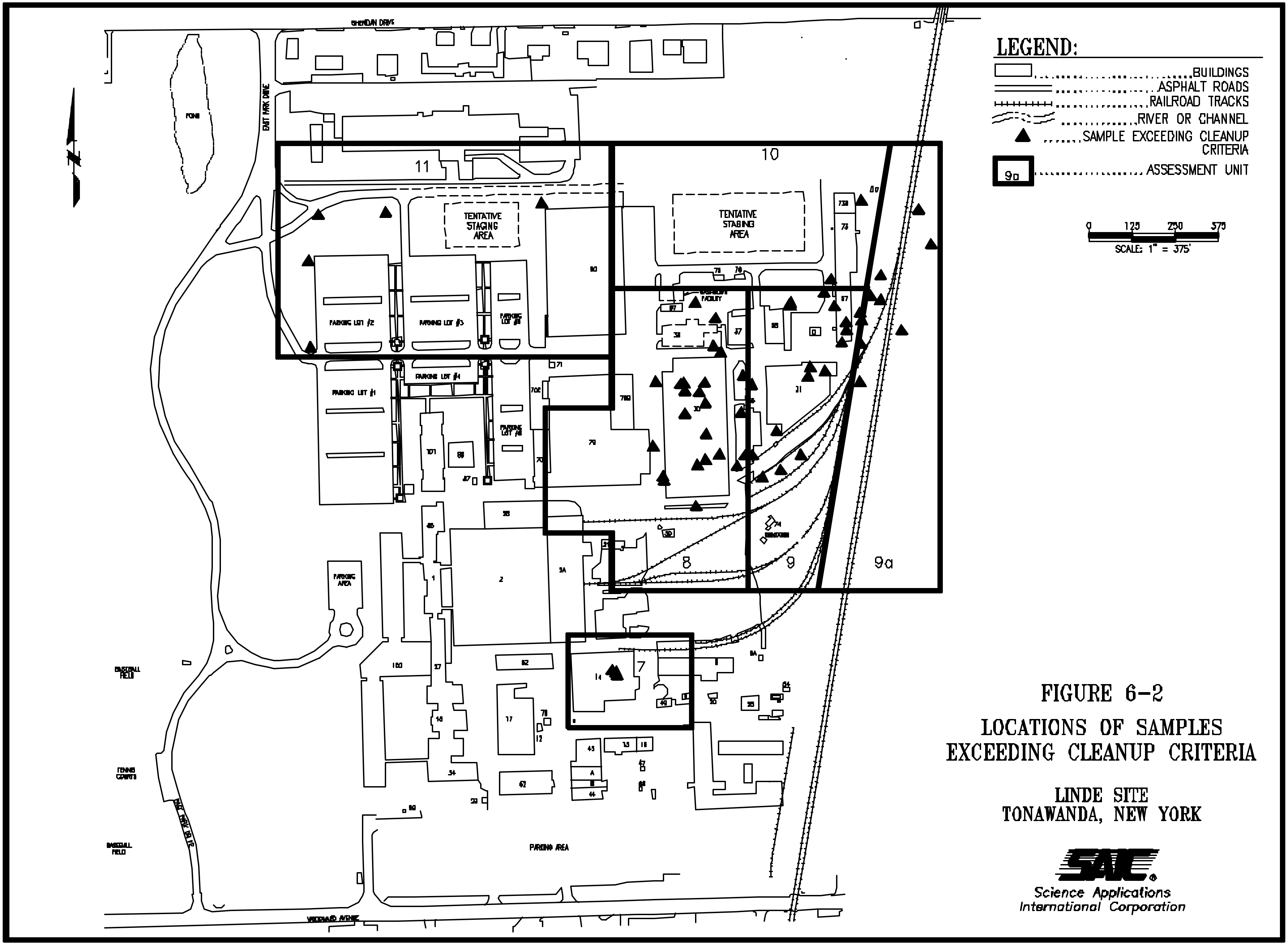

FIGURE 6-2

LOCATIONS OF SAMPLES EXCEEDING CLEANUP CRITERIA

LINDE SITE
TONAWANDA, NEW YORK

LINDE62A DWG

7.1.1 Linde Site Alternatives

Alternative 1: No Action. The no-action alternative is required under CERCLA regulations to provide a baseline for comparison with other alternatives. Under this alternative, no action is taken to implement remedial activities. Periodic monitoring of the Site as appropriate would be continued. This alternative was evaluated in the 1993 FS and is the baseline for comparison with other alternatives for the Linde Site.

Alternative 2: Complete Excavation and Decontamination with Offsite Disposal. This alternative was evaluated in the 1993 FS. Complete excavation of MED-contaminated soils containing radionuclides above guidelines and offsite disposal and decontamination of the surfaces of structures exceeding guidelines would remove the source of elevated levels of radionuclides from the Linde Site. Section 4 addresses the cleanup standards and guidelines selected by USACE for Linde.

Alternative 3: Complete Excavation with Onsite Disposal. This alternative is similar to Alternative 2 regarding excavation of soils, however, all excavated soils would be placed in an on-site engineered disposal cell to be located on Ashland 1, Ashland 2 or Seaway. Institutional controls would be imposed to control access to the onsite engineered disposal cell and the cell would be designed to minimize future exposures or releases to the environment. After consideration of comments received from the public and State on the 1993 PP, USACE eliminated this alternative from further consideration.

Alternative 4: Partial Excavation with Offsite Disposal. In the 1993 FS, this alternative included the excavation of accessible contaminated soils, institutional controls and containment for “access-restricted” soils, demolition of Buildings 14, 31 and 38, decontamination of Building 30 and offsite disposal. Soils covered by buildings or structures were determined to be access-restricted. Under this alternative, the soils were to be left in place until the buildings or structures were abandoned and demolished.

Given the demolition of Buildings 38 and 30 and the decontamination of Building 14, including removal of all but a limited volume of contaminated soil beneath Building 14 that is considered inaccessible due to structural considerations, only a limited quantity of contaminated soil is currently considered inaccessible at the Linde Site. Accordingly, **Alternative 4** was redefined as **Excavation, Decontamination and Institutional Controls**. Under this alternative, surfaces and soil with contamination exceeding cleanup guidelines would either be decontaminated or removed from the site at all locations except the limited quantity that may exist at Building 14. Institutional Controls would be placed on the use of Building 14 to preclude future exposure to MED-related radionuclides that could exceed acceptable risk levels. The controls could include measures such as deed restrictions, prohibiting intrusion into building areas or subsurface areas without imposing restrictive conditions, restricting use of areas, employee training, posting warnings and similar measures.

Alternative 5: Partial Excavation With On-Site Disposal. Alternative 5 was the same as Alternative 4 in the 1993 FS and PP, except contaminated soils removed from Linde would be disposed in an on-site engineered disposal cell to be located at Ashland 1, Ashland 2, or Seaway. After consideration of comments received from the public and State on the 1993 PP, USACE eliminated this alternative from further consideration.

Alternative 6: Containment with Institutional Controls. Containment for the Linde Site would involve capping of areas exceeding guidelines for radiological contamination. After consideration of comments received from the public and State on the 1993 PP, USACE eliminated this alternative from further consideration.

7.1.2 Summary of Current Alternatives

As described above, the remedial alternatives considered by USACE in the 1999 PP for the Linde Site are:

- Alternative 1 - No Action.
- Alternative 2 - Complete Excavation and Decontamination with Off-Site Disposal.
- Alternative 4 - Excavation, Decontamination and Institutional Controls

However, since USACE has decided to exclude from the scope of this ROD the remedial actions associated with Building 14 and the groundwater system, Alternatives 2 and 4 are essentially the same with respect to the remedial actions to be taken for the soils and various contaminated surfaces. Therefore, there are only two alternatives for the scope addressed by this ROD: (1) No Action and (2) Complete Excavation and Decontamination with Off-Site Disposal. These two alternatives are analyzed in Section 8.

8. SUMMARY OF COMPARATIVE ANALYSIS OF ALTERNATIVES

The two alternatives that are appropriate for the scope of actions to be covered by this ROD are (1) No Action and (2) Complete Excavation and Decontamination with Off-Site Disposal as discussed in Section 7.1.2. These two alternatives were evaluated using the CERCLA criteria to determine the more favorable actions for the cleanup of the Linde Site. These criteria are described below. The criteria were established to ensure that the remedy is protective of human health and the environment, meets regulatory requirements, is cost effective, and utilizes permanent solutions and treatment to the maximum extent practicable. The results of the detailed evaluation of the two alternatives addressing the Linde Site soils and various contaminated surfaces, excluding Building 14 and groundwater system, are summarized in the following sections. The evaluation criteria are described in Section 8.1, followed by a summary of the comparative analysis in Section 8.2.

8.1 Evaluation Criteria

The following two criteria are threshold criteria and must be met.

- *Overall Protection of Human Health and the Environment* - addresses whether an alternative provides adequate protection and describes how risks are eliminated, reduced, or controlled through treatment, engineering controls, or institutional controls.

- *Compliance with Federal and State Environmental Regulations* - addresses if a remedy would meet all of the federal and state ARARs.

The following criteria are considered balancing criteria and are used to weigh major tradeoffs among alternatives being evaluated.

- *Long-Term Effectiveness and Permanence* - addresses the remaining risk and the ability of an alternative to protect human health and the environment over time, once cleanup goals have been met.

- *Short-Term Effectiveness and Environmental Impacts* - addresses the impacts to the community and site workers during cleanup including the amount of time it takes to complete the action.

- *Reduction in Toxicity, Mobility, or Volume Through Treatment* - addresses the anticipated performance of treatment that permanently and significantly reduces toxicity, mobility, or volume of waste.

- *Implementability* - addresses the technical and administrative feasibility of an alternative, including the availability of materials and services required for cleanup.

- *Cost* - compares the differences in cost, including capital, operation, and maintenance costs.

The following are considered modifying criteria and are generally taken into account after public comment is received on the PP.

- *State Acceptance* - evaluates whether the State agrees with, opposes, or has no comment on the preferred alternative.

- *Community Acceptance* - addresses the issues and concerns the public may have regarding each of the alternatives as expressed in comments.

8.2 Alternative Comparison

The purpose of the following analysis is to weigh the advantages and disadvantages of the alternatives, when compared with each other, based on the evaluation criteria. This information was used to select a preferred alternative.

The alternatives considered in the evaluation, Alternatives 1 and 2 would involve the following:

- **Alternative 1, No Action.** This alternative would involve no remediation of the Linde Site. Periodic monitoring would be required.

- **Alternative 2, Complete Excavation and Decontamination with Offsite Disposal.** This alternative would involve the demolition of buildings necessary to remediate the site. These buildings include Buildings 57, 67, 73, 73B, 75, and 76 and would also include the building slabs and foundations. The slabs that are now remaining after the demolition of Buildings 30 and 38 and the tank saddles north of Building 30 would also be removed. A wall in Building 31 would be removed to access sub-slab and sub-footing soil exceeding criteria. Contaminated sediments in drainlines and contaminated soils in the blast wall structure east of Building 58 would be removed. The subsurface vault west of Building 73 would be investigated and removed if found to be contaminated. MED-related soils would be removed in order to comply with the cleanup criteria. Surface cleanup criteria will be developed for specific buildings or surfaces based on likely exposure scenarios and meeting the surface cleanup benchmark dose of 8.8 mrem/y. These specific surface criteria will be included in their respective work plans.

The results of the evaluation are summarized in the following sections.

Overall Protection of Human Health and the Environment. Alternative 2, providing complete excavation of soils containing radionuclides and decontamination of surfaces to comply with the cleanup criteria, provides the greatest degree of protection to human health and the environment, because the materials containing radionuclides above the criteria are removed from the site and are permanently isolated in a disposal facility. A degree of risk to workers is involved with implementing this alternative, because the associated work involves intrusive activities for handling and moving materials containing radionuclides above guidelines. These risks can be minimized by using safety procedures and equipment. Alternative 1 provides no increased protection over the current site conditions and would not be protective of human health if current restrictions on exposure to areas containing contamination were to be discontinued.

Compliance with ARARs. Alternative 2 meets the ARARs because all soil containing MED-related radionuclides that does not meet the cleanup criteria would be excavated and permanently isolated in an off-site disposal cell or facility and all surface contamination would be remediated or eliminated by demolition and isolated in an off-site disposal cell or facility. Appropriate ALARA principles and practices to be used in the field for removal of soils and surfaces exceeding the criteria are included in the detailed remediation work plan, which is developed prior to any remediation efforts being initiated. One ALARA practice used by USACE is the actual over-excavation of materials as materials exceeding criteria are removed thus resulting in residual concentrations being much lower than the criteria. The remaining levels of residual radioactive materials after remediation to the cleanup standards will also result in compliance with the ARAR standards regarding radon and indoor gamma radiation levels above background. The estimated indoor radon concentrations were found to be below the standard of 0.2 WLs (USACE 2000). The maximum gamma radiation level inside building structures covered by the scope of this ROD was measured to be 15 μr/hr including background (ORNL 1978) before any soil remediation, which is already below the 20 μr/hr standard. Any soil remediation should reduce this maximum gamma radiation level even further. Alternative 1, however, is noncompliant with the ARARs because all of the waste on the Linde Site containing radionuclides above the cleanup criteria, remains on-site with no additional protection provided.

Long-term Effectiveness and Permanence. A primary measure of the long-term effectiveness of an alternative is the magnitude of residual risk to human health after remediation. The adequacy and reliability of engineering and/or institutional controls used to manage residual materials that remain onsite must also be considered.

Alternative 2 provides the highest degree of long-term effectiveness and permanence because all soils containing radionuclides above the cleanup criteria are excavated and removed from the site and all surface contamination would be remediated or eliminated by demolition and isolated in an off-site disposal cell or facility.

For Alternative 2, the risk calculated for an industrial/commercial worker at the Site, is within acceptable levels.

Alternative 1, no action, has low long-term effectiveness because the post-implementation remedial risks equal those now at the site.

Short-term Effectiveness and Environmental Impacts. Short-term effectiveness is measured with respect to protection of community and workers as well as short-term environmental impacts during remedial actions and time until remedial action objectives are achieved. An increase in the complexity of an alternative typically results in a decrease in short-term effectiveness because of increased handling and processing and, alternatives involving offsite disposal of wastes would result in a decrease in short-term effectiveness because of the increased time required and transportation-related risks.

Alternative 1, no action, is the most effective in protecting the community and workers and controlling impacts during implementation since no actions that could create impacts are undertaken. Alternative 1 requires the shortest time to implement. The short-term effectiveness of Alternative 2 ranks lower in terms of this criterion because it is more complex and will require a longer time to implement.

Reduction in Toxicity, Mobility, or Volume through Treatment. Neither of the alternatives provides treatment on site for the materials to be removed. Alternative 2, which provides for offsite disposal, will include containment at the final disposal location and any treatment which is required to meet the standards of the offsite facility. This alternative thus will achieve reduction in mobility, although no treatment is planned which will reduce the toxicity or volume of the disposed materials. The no action alternative, would provide no removal of materials. The 1993 Feasibility Study (DOE 1993b) evaluated currently available treatment technologies for treatment in the course of removal and found none are economically and technologically feasible at this time.

Implementability. In regard to implementability, the alternatives were evaluated with respect to the following:

- ability to construct and operate the technology,
- reliability of the technology,
- ease of undertaking additional remedial actions,
- ability to monitor effectiveness,
- ability to obtain approvals and coordinate with regulatory agencies,
- availability of offsite disposal services and capacity, and
- availability of necessary equipment and specialists.

The degree of difficulty in implementing an alternative increases with the complexity of the remediation activity. The design, engineering, and administrative requirements of Alternative 1, no action, are essentially negligible. Alternative 2 is more complex than Alternative 1 but is technically and administratively feasible. Materials and services for Alternative 2 are readily available.

Cost. The estimated costs for the Linde Site alternatives in 1999 dollars are:

- Alternative 1, No Action: $900,000
- Alternative 2, Complete Excavation and Decontamination and Off-Site Disposal: $27,700,000

Public Acceptance. At the public meeting conducted on June 3, 1999, support for the selected remedy was voiced by the public. The details of comments at the two public meetings conducted for the project, written comments and USACE's responses to comments, are included in Appendix A of this ROD.

State Acceptance. Correspondence from NYSDEC concerning this ROD received in 1999 is included in Appendix B, along with USACE responses and considerations of issues raised in these letters. Correspondence from NYSDEC received in February 2000 is included as Attachment 3 with a USACE response letter included as Attachment 4. Additionally, USEPA has provided comments on the preferred alternative (see Attachment 1). Attachment 2 is a response letter to USEPA.

9. THE SELECTED REMEDY

USACE has selected a remedy that includes the soils, buildings, and slabs removal actions described in the PP as Alternative 2 excluding Building 14 and soils beneath Building 14. The final remedy for Building 14 and any soils remaining under Building 14 that may exceed the removal criteria and groundwater will be addressed separately from this ROD. The selected remedy is believed to provide the best balance among the considered alternatives with respect to the evaluation criteria, will protect human health and the environment, will comply with ARARs, and is considered cost effective. This remedy requires the removal of MED-related residual radioactive materials so that the standards of the ARARs are met. That will involve the removal of residual radioactive materials so that; (1) the concentrations of radium in remaining soil do not exceed background by more than 5 pCi/g in the top 15 cm of soil or 15 pCi/g in any 15 cm layer below the top layer as averaged over $100m^2$; (2) the residual radionuclide concentrations remaining in soils within a 100 square meter area that results in unity or less for the sum of the ratios of these radionuclide concentrations to the associated concentration limits, above background, of 554 pCi/g for U_{total}, 5 pCi/g for Ra-226 and 14 pCi/g for Th-230 for surface cleanups and 3,021 pCi/g of U_{total}, 15 pCi/g of Ra-226 and 44 pCi/g of Th-230 for subsurface cleanups; and (3) the remaining residual radioactive materials on structure surfaces meet the benchmark dose for surfaces of 8.8 mrem/y based on the specific location of the surfaces and exposure scenarios. In addition, in order to meet the commitments made to the community at the public meetings, USACE will remediate the Linde site to insure that no concentration of total uranium exceeding 600 pCi/g above background will remain in the site soils.

The selected remedy will involve the demolition of buildings necessary to remediate the site. These buildings include Buildings 57, 67, 73, 73B, 75 and 76 and will also include the building slabs and foundations. The slabs that are remaining after the demolition of Buildings 30 and 38 and the tank saddles north of Building 30 will also be removed. A wall in Building 31 will be removed to access sub-slab and sub-footing soils exceeding criteria. The selected remedy will also include remediation of the adjacent Niagara Mohawk and CSX Corporation (formerly Conrail) properties, where radioactive contamination has already been identified or may be identified as the remediation work is implemented and will be limited to following releases that originated from the Linde Site resulting from MED-related operations. The plan also includes the removal of contaminated sediments from drainlines and sumps, the removal of contaminated soil from a blast wall structure located east of Building 58, and remediation of a subsurface vault structure located just west of Building 73.

It also provides the best balance among the considered alternatives with respect to the evaluation criteria. In addition, implementation of this remedy can be accomplished in compliance with all applicable laws relating to the protection of the public health and the environment. This remedy will not result in MED-related hazardous substances remaining at the site above the health-based levels after completion of the scope identified above. The Corps will perform all required 5-year reviews.

10. STATUTORY DETERMINATIONS

The selected remedy satisfies the statutory requirements of Section 121 of CERCLA as follows:

- the remedy must be protective of human health and the environment;
- the remedy must attain ARARs or define criteria for invoking a waiver;
- the remedy must be cost effective; and

- the remedy must use permanent solutions and alternative treatment technologies to the maximum extent practicable.

The manner in which the selected remedy satisfies each of these requirements is discussed in the following sections.

10.1 Protection of Human Health and Environment

Upon completion, the selected remedy for the Linde Site will be fully protective of human health and the environment and meet cleanup criteria based on ARARs. During remedial activities, engineering controls during construction will be put in place as required and environmental monitoring and surveillance activities will be maintained to ensure protectiveness, so that no member of the public will receive radiation doses above guidelines from exposure to residual radioactive contaminants.

There are no short-term threats associated with the selected remedy that cannot be readily controlled and mitigated. In addition, no adverse cross-media impacts are expected from the remedy.

10.2 Attainment of ARARs

USACE has determined that standards of 40 CFR Part 192 and the standards of 10 CFR Part 40, Appendix A, Criterion 6(6)are relevant and appropriate for Linde Site cleanup. USACE assessed the 10 CFR 40, Appendix A, Criterion 6(6) standards and the Linde radiological assessment (USACE 2000) and concluded that the criteria associated with this ARAR for the Linde Site would be to (1) limit the residual radionuclide concentrations remaining in soils averaged within a 100 square meter area to concentrations that results in unity or less for the sum of the ratios of these radionuclide concentrations to the associated concentration limits, above background, of 554 pCi/g for U_{total}, 5 pCi/g for Ra-226 and 14 pCi/g for Th-230 for surface cleanups and 3,021 pCi/g of U_{total}, 15 pCi/g of Ra-226 and 44 pCi/g of Th-230 for subsurface cleanups, and (2) limit remaining residual radioactive materials on structure surfaces to levels necessary to meet the benchmark dose for surfaces of 8.8 mrem/y based on the specific location of the surfaces and exposure scenarios.

This remedy requires the removal of MED-related residual radioactive materials so that the standards of the ARARs are met. That will involve the removal of residual radioactive materials so that; (1) the concentrations of radium in remaining soil do not exceed background by more than 5 pCi/g in the top 15 cm of soil or 15 pCi/g in any 15 cm layer below the top layer as averaged over $100m^2$, and (2) the residual radionuclide concentrations remaining in soils averaged within a 100 square meter area that results in unity or less for the sum of the ratios of these radionuclide concentrations to the associated concentration limits, above background, of 554 pCi/g for U_{total}, 5 pCi/g for Ra-226 and 14 pCi/g for Th-230 for surface cleanups and 3,021 pCi/g of U_{total}, 15 pCi/g of Ra-226 and 44 pCi/g of Th-230 for subsurface cleanups, and (5) the remaining residual radioactive materials on structure surfaces meet the benchmark dose for surfaces of 8.8 mrem/y based on the specific location of the surfaces and exposure scenarios. In addition to meeting this ARAR, USACE will remediate the Linde site to insure that no concentration of total uranium exceeding 600 pCi/g above background will remain in the site soils.

Verification of compliance with soil cleanup standards and criteria will be demonstrated using surveys developed in accordance with the Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM) and as may be required by the ARARs. Methodology to determine radon and gamma radiation levels will be developed in accordance with the ARARs and documented in the work plan for site remediation. The cleanup of contaminated building and structure surface areas will be conducted in accordance with the 10 CFR Part 40, Appendix A, Criterion 6(6), using building/structure-specific decontamination protocols to be detailed in the work plan for site remediation.

10.3 Cost Effectiveness

Cost is evaluated by comparing the costs between alternatives that meet the threshold criteria of protectiveness and compliance with ARARs, and then determining the alternative that provides the best balance of the five balancing criteria, including cost.

The selected remedy is effective because risks are reduced to acceptable levels. Increased short-term risks to workers, the public, and the environment may occur during implementation of the remedy, but these risks will be minimized by appropriate mitigative measures. Total cost in 1999 dollars for the selected remedy is estimated at $27,700,000. In consideration of these factors, the selected remedy provides the best overall effectiveness of all alternatives evaluated relative to its cost.

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

The selected remedy for the Linde Site provides a permanent solution to contamination that currently exists on this property.

None of the practicable alternatives identified for the Linde Site provides onsite treatment for the materials to be removed. Alternatives 2 and 4 provide for offsite disposal, which may include some treatment as possibly required of the disposal facilities. These alternatives, thus, would achieve reduction in mobility (through containment), although no treatment which will reduce the toxicity or volume of the disposed materials may be required. The FS evaluated available treatment technologies for treatment in the course of removal and found none were economically and technologically feasible. Thus, the selected alternative achieves the best possible result in terms of satisfying the statutory preference for remedies that employ treatment that reduces toxicity, mobility, or volume as a principal element.

11. EXPLANATION OF SIGNIFICANT CHANGES

The PP provided for involvement with the community through a document review process and a public comment period. Public meetings were advertised and held on April 22, 1999 and June 3, 1999. The public comment period was extended and comments that were received during the 71-day public comment period are addressed in Appendix A of this ROD.

After a review of the comments on the proposed plan, USACE determined that it was appropriate to make several changes to the preferred alternative before selecting a remedy. The changes involved the total uranium cleanup guideline and deferring a final decision on Building 14 and groundwater remediation. Each of these changes, which constitute a significant (pre-ROD) change from the preferred alternative presented in the PP, has been incorporated into this ROD and the selected remedy and are discussed below. The identification of 10 CFR Part 40, Appendix A, Criterion 6(6) as an ARAR for the Linde Site is also a pre-ROD change. None of these changes result in reducing the protectiveness of the remedy described in the Proposed Plan.

Based on the following evaluations, there were not significant changes justifying a new public comment period. The changes either had no significant effect on the remedy or they could have been reasonably anticipated. The new 10 CFR 40, Appendix A, Criterion 6(6) only provides a method of calculating the cleanup levels for a portion of the site contamination but will result in a cleanup level that is not significantly different from that included in the PP and will not change the expected land use assumed and discussed in the PP. In addition, the exclusion of the groundwater and Building 14 from this ROD will result in them being addressed in later CERCLA documentation that will be presented to the public for comment. As discussed in the following paragraphs, the NRC benchmark dose will result in a soil cleanup level for all radioactive contaminants that is as protective as that applicable to radium, which was included in the PP.

Total Uranium Cleanup Guideline

The comments received from the public indicated a concern for the application of the total uranium guideline for soils as it was originally expressed in the proposed plan. In order to address those concerns, USACE has further described and defined the guideline. Subsequent to the public input, new regulations amending 10 CFR 40, Appendix A, Criterion 6(6) were promulgated and became effective on June 11, 1999. These regulations were evaluated and determined to be relevant and appropriate for the Linde Site since they addressed residual uranium and other radionuclides present at uranium mill sites, similar to the Linde Site. USACE assessed the 10 CFR 40, Appendix A, Criterion 6(6) standards and the Linde radiological assessment (USACE 2000) and concluded that the criteria associated with this ARAR for the Linde Site soils would be to limit the residual radionuclide concentrations remaining in soils averaged within a 100 square meter area to concentrations that results in unity or less for the sum of the ratios of these radionuclide concentrations to the associated concentration limits, above background, of 554 pCi/g for U_{total}, 5 pCi/g for Ra-226 and 14 pCi/g for Th-230 for surface cleanups and 3,021 pCi/g of U_{total}, 15 pCi/g of Ra-226 and 44 pCi/g of Th-230 for subsurface. Compliance with this regulation will result in a more stringent cleanup of U_{total} at the Linde Site than was originally proposed in the Proposed Plan. In addition, in order to meet the commitments made to the community at the public meetings, USACE will remediate the Linde site to insure that no concentration of total uranium exceeding 600 pCi/g above background will remain in the site soils.

10 CFR 40, Appendix A, Criterion 6(6)

New regulations amending 10 CFR 40, Appendix A, Criterion 6(6) were promulgated and became effective on June 11, 1999. This new amendment addresses areas contaminated with other radionuclides in addition to radium, which is addressed by the 5 pCi/g and 15 pCi/g radium standards included in the first paragraph of Criterion 6(6) as well as 40 CFR 192, Subpart B. 10 CFR 40, Appendix A, Criterion 6(6) requires that radioactive contamination, considering all radionuclides including radium, remaining after remediation, will not result in a total effective dose equivalent (TEDE) to the average member of the critical group exceeding the benchmark dose after cleanup to the 40 CFR Part 192 standards of soils contaminated with radium only. The criterion also states if more than one residual radionuclide is present in the same 100-square-meter area, the sum of the ratios for each radionuclide of concentration present to the concentration limit will not exceed “1” (unity).

USACE evaluated the new standard, the draft NRC guidance included in the Federal Register (Vol. 64, N0. 69, dated April 12, 1999, pp. 17690–17695), and the Linde Radiological Assessment (USACE 2000). Based on the current understanding by USACE of the new standard and associated guidance, USACE was able to use the data and information contained in the Linde Radiological Assessment (USACE 2000) to establish the benchmark doses and associated radionuclide concentration limits for surface cleanups as well as subsurface cleanups. The results in the Linde Radiological Assessment were based on RESRAD runs modeling the conditions at the Linde Site. The document also included what the allowable concentrations would be for various radionuclides to meet dose objectives both with and without cover materials for the most likely scenario at the site, the industrial/commercial scenario. These results are contained in Table 3-3 of the Linde Radiological Assessment. Using those results, USACE was able to derive the benchmark dose for surface cleanup by dividing the 10 mrem/y (no cover) by the 5.7 pCi/g of Ra-226 associated with that dose and then multiplying the result by 5 pCi/g of Ra-226, which results in a benchmark dose of 8.8 mrem/y for surface cleanups. Table 3-3 data was then used to derive the allowable concentrations for the radionuclides, total uranium and Th-230. The same methodology was used in deriving the same information for subsurface cleanups. The data used were the results in Table 3-3 based on a cover depth of 6 inches. The resulting benchmark dose for subsurface cleanups was calculated to be 4.1 mrem/y. The following tabulates the results of the assessment and what the radionuclide limits are for surface and subsurface cleanups:

	Allowable Residual Concentration Limit for Indicated Benchmark Dose (pCi/g)	
Radionuclide	**Surface: 8.8 mrem/yr**	**Subsurface: 4.1 mrem/yr**
Ra-226	5.0	15
Th-230	14	44
U-total	554	3,021

During remediation, the actual radionuclide concentrations within a 100 square meter area will be divided by its corresponding concentration limit from the table above. These ratios are then added and must be equal to or less than "1" (unity). If the sum of these ratios exceeds unity, additional soil removal is necessary.

The allowable residual radionuclide concentrations on structure surfaces would be computed for specific structures and the associated exposure scenarios and would be based on meeting the benchmark dose of 8.8 mrem/y for surface cleanups.

Building 14

The two action alternatives presented in the PP for remediating the Linde Site (Alternatives 2 and 4) differed only in the way Building 14 (and soils remaining under the building slabs and footings that contain contaminants exceeding the cleanup guidelines) would be addressed during the remediation process. The preferred alternative presented in the PP, Alternative 4, proposed that the building would remain on the site and that institutional controls would be implemented to protect workers in the building, and future site users from inadvertent exposures to residual contaminants remaining within and under the building. Alternative 2 included the demolition and disposal of the building and residual contaminated soils currently remaining under the building.

Comments received during the public comment period, including the public meetings, indicated that the community is concerned about leaving residual contamination on the site, even if institutional controls would prevent exposure to the contaminants.

USACE has decided that additional assessment of the possible remedies for Building 14 (and residual soils under the building) is warranted. Therefore, the building and soils under the building are being excluded from this ROD and will be addressed separately in accordance with CERCLA, allowing for the initiation of remedial actions to proceed on the remainder of the site.

Groundwater

The original RI, FS and PP for the Linde (Tonawanda) site(s), proposed that no action was warranted to address on-site groundwater. USACE further investigated existing available information relating to the groundwater at the Linde Site and presented findings in a document entitled "Synopsis of Historical Information on Linde Effluent Injection Wells" (USACE 1999a). The result of that assessment was also a conclusion that no remediation of the groundwater is warranted. This conclusion was re-stated in the 1999 Linde PP (USACE 1999c).

Comments received during the comment period expressed concerns about the sufficiency of the samples relied upon in coming to the conclusion that no remediation of the groundwater is warranted. A ROD will be issued in the future that evaluates the Site groundwater and selects any required remedial action .

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ATTACHMENT 1

USEPA LETTER OF JANUARY 12, 2000

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UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 2
290 BROADWAY
NEW YORK, NY 10007-1866

JAN 1 2 2000

Lt. Col. Mark D. Feierstein
Department of Army
Buffalo District, Corps of Engineers
1776 Niagara Street
Buffalo, NY 14207-3199

Dear Colonel Feierstein:

The purpose of this letter is to thank you for arranging the December 21, 1999, meeting concerning the proposed remedial action for the Linde Site and to confirm the understanding which we reached at that meeting. We understand that the proposed remedial action for the Linde facility, a facility in the Formerly Utilized Sites Remedial Action Program (FUSRAP), is one which the Buffalo District of the United States Army Corps of Engineers (USACE) is seeking to implement pursuant to a soon-to-be issued Record of Decision (ROD). Clearly, the USACE, the New York State Department of Environmental Conservation (DEC), and the U.S. Environmental Protection Agency (EPA) agree that the proposed remedial action at the Linde Site, in order to be consistent with the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), needs to be protective of human health and the environment, and it is with this common objective that I believe we have reached an understanding and resolution regarding your proposed remedial action.

Nature and Resolution of ROD-Related Issues

CERCLA and its implementing regulations, the National Contingency Plan (NCP), set forth the process for the selection of CERCLA remedies. At sites where there is contamination with radionuclides and a risk which requires some action to be taken, CERCLA requires an evaluation of those risks and a determination as to what are the appropriate clean-up standards. For such a remedy to be appropriately protective, the applicable or relevant and appropriate requirements (ARARs) and the risk posed by the site must be considered. While I believe USACE, DEC, and EPA would agree on these preceding statements, it is the application of the steps in this process which was the crux of our disagreement prior to the meeting. EPA believes that in order for a remedy at the Linde Site to be consistent with CERCLA, certain ARARs must be considered[1], and any remedy must result in a clean-up that is within an acceptable risk range under CERCLA. You calculated clean-up levels for total uranium of 554 picocuries per gram (pCi/g) for surface contamination and 3,021 pCi/g for subsurface contamination. These calculated uranium clean-up numbers do not include groundwater considerations and reflect a use of benchmarking against a subsurface radium clean-up level that EPA does not find pertinent to this site. Hence, based on EPA's calculations, we believe the risks associated with your calculation of clean-up levels for total uranium at the Linde Site exceed the established CERCLA risk range of 10^{-4} - 10^{-6}. To describe this in some further detail, EPA disagrees with the interpretation of the appropriateness of the use of 15 pCi/g as a subsurface radium clean-up limit, especially in light of the fact that your subsequent benchmarking of the dose from this radium concentration is used to derive the equivalent subsurface uranium concentration of 3,021 pCi/g as a limit. We do not recognize that the 15 pCi/g radium level is an ARAR, and, therefore, do not accept that the technique of benchmarking is applicable in this circumstance. We note that USACE has not considered groundwater in its calculations of what it considers to be the appropriate soil clean-up levels, nor has it yet obtained any groundwater well data for the purpose of evaluating the impact of soil contamination on groundwater. (EPA and USACE agree that a subsequent groundwater operable unit is needed.)

However, after our discussions on these concerns, USACE has stated that it anticipates that after remediation of the Linde Site, the maximum limits for average radionuclide concentrations will be 2.0 pCi/g for radium-226, 3.5 pCi/g for thorium-230, and 60.8 pCi/g for total uranium. These levels are within the concentration levels that are consistent with clean-up levels at other CERCLA radiation sites. Therefore, if you achieve these levels at the Linde Site, levels which we would agree are protective, we can support the Linde Site remedial action.

Summary of Mutual Understanding

At the December 21 meeting, EPA agreed that if USACE performs the remedial action and it results in a clean-up that will achieve levels of radium at 5 pCi/g, of thorium at 5 pCi/g, and of uranium at 60 pCi/g [2], EPA will be satisfied that the remedial action is consistent with CERCLA

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[1] For example, with regard to the soils excavation and disposal, an ARAR analysis must be performed for the National Emission Standards for Hazardous Air Pollutants (40 C.F.R. 61) related to radioactive materials, or rad-NESHAPs, and the off-site policy for waste disposal as contained in the National Contingency Plan; and for groundwater, an ARAR analysis must be performed for the Safe Drinking Water Act (40 C.F.R. 141 and 142) and the Uranium Mill Tailings Radiation Control Act (40 C.F.R. 192) Maximum Contaminant Levels (MCLs).

[2] These levels must be achieved by calculating the limits using the limit as the sum of the fractions of each radionuclide and with confirmation being provided through the use of the Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM), using a 95% confidence level.

and protective of human health and the environment, subject to the results of the groundwater study which USACE has agreed it will perform in the future.

A clean-up which meets the levels set forth immediately above is protective: With respect to groundwater, because of the limited number of groundwater monitoring wells and related data, our position on protectiveness is contingent on USACE's performance of necessary groundwater studies in a future groundwater operable unit and, if necessary, the performance of remedial action to protect groundwater to meet ARARs. USACE has acknowledged that the proposed ROD, when finalized, will reflect this fact, and that groundwater will be the subject of a subsequent ROD.

USACE has indicated that during the Linde Site clean-up operations to date and in future cleanup actions, it has met, and will meet, the substantive equivalent of the radiation portion of the National Emission Standards for Hazardous Air Pollutants (NESHAPs). You agree to share all existing data in this regard and plans for future site perimeter air monitoring. When we receive these materials we can discuss any remaining concern vis a vis whether this perimeter monitoring is sufficient to meet the substantive requirements of the rad-NESHAP rule, as set forth at 40 C.F.R. §61.

It is our understanding that at the national level the USACE has acknowledged that when waste disposal will take place at a site different from that of the remedial action, the USACE will follow the substantive requirements for "off-site" disposal as contained in the National Contingency Plan (NCP). We offer to work with the Buffalo District of the USACE in its efforts to meet the substantive requirements of the "off-site" policy when disposing of wastes generated during the Linde remedial action.

We have agreed to pursue a Memorandum of Understanding between USACE and EPA to assist our respective Agencies in communicating at the Linde Site and for remedial actions for future FUSRAP clean-ups in the Buffalo District area.

Other Commitments

During our meeting you also made the commitment to provide the data you have accumulated during USACE's previous clean-up actions at the Linde Site. This commitment is most welcome, and we look forward to receiving this information.

Attached is a list of other data we have requested as it relates to the Linde Site FUSRAP clean-up. We would appreciate receiving these data or a status update on when they will be available for release by the end of January 2000.

Conclusion

I believe our meeting was a positive step toward a productive and constructive working relationship. We will be pleased to work with you to develop a Memorandum of Understanding so we can work as effectively as possible on the Linde Site remedial action as well as the remediation process at the other sites you will be addressing under the FUSRAP program.

During the December 21 meeting, a commitment was made to address the agenda items which were not covered that day at a future meeting in New York City or Albany. We propose that a meeting be scheduled in late January or early February in New York City for this purpose. I look forward to our further discussions and receiving reports of progress on the Linde site.

Sincerely,

Kathleen C. Callahan

Kathleen C. Callahan, Director
Division of Environmental Planning and Protection

cc: S. Hammond, NYSDEC

Attachment (list of data requested)

ATTACHMENT 2

USACE LETTER OF FEBRUARY 17, 2000

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DEPARTMENT OF THE ARMY
BUFFALO DISTRICT, CORPS OF ENGINEERS
1776 NIAGARA STREET
BUFFALO, NEW YORK 14207-3199

REPLY TO
ATTENTION OF

February 17, 2000

Project Management

SUBJECT: Linde FUSRAP Site, Tonawanda, New York

Ms. Kathleen C. Callahan
Director Division of Environmental Planning and Protection
U.S. Environmental Protection Agency - Region 2
290 Broadway
New York, New York 10007-1866

Dear Ms. Callahan:

This is in response to your January 12, 2000 letter concerning the Linde FUSRAP Site, Tonawanda, New York.

Enclosed is a copy of the requested information identified in an attachment to your letter:

Specifically:

a. Uranium cleanup levels - as requested, we are providing the parameters and values used in deriving surface and subsurface soil thorium and uranium concentration levels identified in the RESRAD modeling.

b. NESHAP - As you are aware, we have no formal NESHAP reports but we are providing calculations and data packages as requested.

c. Linde Building 30 -

(1) Project Completion Report identifying the transportation and disposal of the material,

(2) Radioactivity Isotopic Analytical Data Report,

(3) Chemical/Radiological Sampling and Analysis Plan,

(4) The waste classification decision document flow chart shown at a June 3, 1999 Jackson Wyoming meeting by Ms. Julie Petersen is not available,

(5) June 12, 1996 Bechtel letter, subject: Soil Pile Segregation for the Linde Praxair Site,

(6) USACE legal analysis - there is no legal analysis concerning the regulatory status of Building 30 waste.

If you have any questions or require any additional information, please contact Mr. Ray Pilon at (716) 879-4146.

Sincerely:

George B. Brooks
Deputy for Programs & Project Management

ATTACHMENT 3

NYSDEC LETTER OF FEBRUARY 18, 2000

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New York State Department of Environmental Conservation
Executive Office, Room 608
50 Wolf Road, Albany, New York 12233-1010
Phone: (518) 457-3446 • **FAX:** (518) 457-7744
Website: www.dec.state.ny.us

John P. Cahill
Commissioner

February 18, 2000

Lieutenant Colonel Mark D. Feierstein
Department of the Army
Buffalo District Corps of Engineers
1776 Niagara Street
Buffalo, New York 14207-3199

Re: Linde FUSRAP Site

Dear Colonel Feierstein:

This will provide the Department of Environmental Conservation's position to the US Army Corps of Engineers (Corps) concerning its February 2000 draft Record of Decision (ROD) regarding the remediation of the Linde Site in Tonawanda, New York. These comments are based upon a review of the draft ROD, supporting information and the discussions from several meetings. The Corps is tasked with remediating the site under the federal government's Formerly Utilized Sites Remedial Action Program (FUSRAP) pursuant to the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA). The Department met with you and others on February 15, 2000, at the offices of Praxair, the successor to Linde and current occupant of the site. At the meeting, the Department agreed to send the Corps a letter providing its position on the draft ROD and the Corps' proposed plans for the remediation of the Linde Site.

You stated at the meeting that the Buffalo District of the Corps would not undertake the remediation of the Linde Site without the State's support that it should go forward. It remains the State's position that every FUSRAP site in New York State should be remediated by the responsible federal agency. However, the State has concerns with the draft ROD that the Corps has provided for our review. In an effort to move forward, the Department does not intend to repeat our comments issued in our letters of August 23, 1999 and November 8, 1999. We trust that these letters have been placed in the formal record for the final ROD.

Initially, as we discussed on February 15, 2000, we suggest you provide additional public comment on the draft ROD. Additionally, the Department understands, based on our meeting on February 15, 2000, that the Corps has committed to performing 5 year reviews and the draft ROD reflects this commitment.

If the Corps' decision is to proceed with remediation of the Linde Site as proposed in the ROD, the State will review the final status survey data from the site with respect to the review criteria attached hereto. If the final status survey data are consistent with these criteria, then we would agree that the remediation of the radioactive material is protective and we would be able to support the Linde site remedial action. However, in the event that these criteria are not satisfied, then the remediation of the radioactive materials may not be adequate for unrestricted use of the site, and the State (DEC and NYS Department of Health) would have to evaluate the appropriate steps to be taken in the event the remedy is not protective of the public health and the environment.

Thank you for the opportunity to contribute to this process.

Sincerely,

Frank V. Bifera
General Counsel

Enclosure

cc: D. Conroy
K. Callahan
R. Tramontano
P. Lehner
D. Munro
S. Hammond
G. Mikol

Criteria for Final Status Survey Data from Linde FUSRAP Site

NYSDEC will use the following criteria in reviewing the final status survey results and any data DEC staff collect:

1. Except where stated otherwise in these criteria, the Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM) written by the US Department of Defense, the US Department of Energy, the US Department of Environmental Protection, and the US Nuclear Regulatory Commission will be followed.

2. Average concentrations of the radioactive contaminants will be calculated over an area of 100 square meters or less and a depth of 15 centimeters or less [10 CFR 40, Appendix A, criterion 6(6) and 40 CFR 192.12]

3. The Working Derived Concentration Guideline Limits ($DCGL_W$) will be 60 pCi/g for total uranium, 5 pCi/g for radium-226, and 5 pCi/g for thorium-230 [identified as protective levels in January 12, 2000 letter from EPA to Corps; see also 40 CFR 192 and EPA Directive No. 9200.4-25].

4. The sum of ratios, as defined in 10 CFR 20, Appendix B, Note 4, and 6 NYCRR Part 380-11.7, Note 4, will be applied.

5. In Class 2 areas, the elevated measurement comparison DCGL ($DCGL_{EMC}$) will be performed in accordance with MARSSIM. In Class 1 areas, the $DCGL_{EMC}$ for uranium and thorium shall not exceed 0.05 percent by weight [10 CFR 40.3 and 40.13(a) and 10 NYCRR 16.2(a)(12) and Table 1, Appendix 16-A, item(g)].

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ATTACHMENT 4

USACE LETTER OF FEBRUARY 24, 2000

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DEPARTMENT OF THE ARMY
BUFFALO DISTRICT, CORPS OF ENGINEERS
1776 NIAGARA STREET
BUFFALO, NEW YORK 14207-3199

REPLY TO
ATTENTION OF

FEB 24 2000

Project Management

Mr. Frank V. Bifera
General Counsel
New York State Department of Environmental Conservation
Executive Office - Room 608
50 Wolf Road
Albany, New York 12233-1010

Dear Mr. Bifera:

This is to acknowledge your February 18, 2000 letter regarding the Linde FUSRAP Site.

Based on your letter, I have recommended the Record of Decision be signed by the Deputy Commanding General for Civil Works as quickly as possible so we may initiate remedial action of contaminated soils pursuant to the Comprehensive Environmental Response, Compensation and Liabilities Act (CERCLA). The remedial action will, of course, be performed to the standards that are fully protective to human health and the environment as presented in the Record of Decision.

Both our agencies and the local community share mutual interest in providing a fully protective remedial action plan at the Linde FUSRAP site. We will work cooperatively together to ensure a successful completion of this project.

Thank you for your personal attention to this matter.

Any questions pertaining to this matter may be directed to Mr. Raymond Pilon by calling (716) 879-4146 or by writing to the above address.

Sincerely,

Mark D. Feierstein
Lieutenant Colonel, U.S. Army
Commanding

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