U.S. ENVIRONMENTAL PROTECTION AGENCY
SUPERFUND PROGRAM
PROPOSED PLAN
FORMER NEBRASKA ORDNANCE PLANT SUPERFUND SITE
OPERABLE UNIT 5

MEAD, NEBRASKA **JULY 2011**

THE EPA ANNOUNCES PROPOSED PLAN

This Proposed Plan identifies the preferred alternative(s) for addressing the contaminated soil, the final closure of the Agricultural Research and Development Center (ARDC) Landfill area and the contaminated groundwater at the Former Nebraska Ordnance Plant Superfund site (Site) Operable Unit 5 and provides the rationale for this preference. In addition, this Proposed Plan includes summaries of other alternatives evaluated for use at Operable Unit 5.This Proposed Plan is issued by the U.S. Environmental Protection Agency, the lead agency for the Site, and the Nebraska Department of Environmental Quality, the support agency. The EPA, in consultation with the NDEQ, will select a final remedy for Operable Unit 5 after reviewing and considering all information submitted during the 30-day public comment period. The EPA, in consultation with the NDEQ, may modify the preferred alternative(s) or select another response action presented in this Proposed Plan based on new information or public comments. Therefore, the public is encouraged to review and comment on all the alternatives presented in this Proposed Plan.

The EPA is issuing this Proposed Plan as part of its public participation under section 300.430(f)(2) of the National Oil and Hazardous Substances Pollution Contingency Plan. This plan summarizes information that can be found in greater detail in the Final Report, April 8, 2011, Remedial Investigation/ Feasibility Study; the Baseline Human Health Risk Assessment; and the Screening Level Ecological Risk Assessment, August 2010. The EPA and the NDEQ encourage the public to review these documents to gain a more comprehensive understanding of Superfund activities that have been conducted at Operable Unit 5.

Dates to remember: **MARK YOUR CALENDAR**

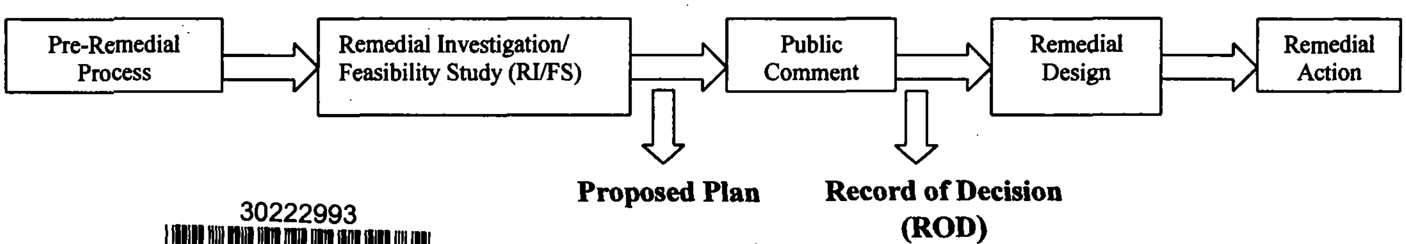
PUBLIC COMMENT PERIOD: The EPA will accept written comments on this Proposed Plan during the public comment period of July 1, 2011, through August 1, 2011.

PUBLIC MEETING: The EPA will hold a public meeting to explain this Proposed Plan and all of the alternatives presented in the Feasibility Study. Oral and written comments will also be accepted at the meeting. The meeting will be held on July 13, 2011, from 7:00 to 9:00 p.m.at the Research and Education Building ARDC at the southeast corner of County Road 11 and NE Highway 63.

For more information, see the Administrative Record at the following locations:

Mead Public Library	U.S. EPA Region 7
316 South Vine Street	Records Center
Mead, NE 68041	901 North 5th Street
(402) 624-6605	Kansas City, KS 66101

The Superfund Remedial Process



SITE HISTORY

The Site is located in Saunders County, Nebraska, approximately one-half mile south of Mead, 30 miles west of Omaha and 35 miles northeast of Lincoln. The University of Nebraska ARDC occupies a portion of the Site. The Site was situated on approximately 27 square miles. The ARDC consists of approximately 9,660 acres (over 15 square miles). The ARDC is a major research and education facility of the University of Nebraska Institute of Agricultural and Natural Resources. It serves as the primary site for field-based research involving 90 faculty and 150 graduate students in nine Institute of Agricultural and Natural Resources' departments.

The Site operated during World War II and the Korean Conflict. It consisted of four bomb Load Line areas, an Ammonium Nitrate Plant, an Atlas Missile Area and a Bomb Booster Assembly Area. Other ancillary areas included a Fuse Testing Area, a Sewage Treatment Plant, Demolition Ground, vehicle maintenance areas and equipment maintenance shops. All of the structures associated with these areas have been removed or converted into peace-time reuse.

The University of Nebraska acquired the property in several transactions from 1962 to 1971. The ARDC has been used for crop and energy research.

The University of Nebraska used portions of the Site for disposal of various wastes including laboratory wastes, paint wastes and research animal wastes. The wastes were deposited in trenches primarily located in four disposal areas at Load Line 1, Load Line 2, the ARDC Landfill and the Sewage Treatment Plant. The majority of the disposal activities conducted by the University of Nebraska occurred during the late 1970s and continued into the 1980s. The state of Nebraska issued the University of Nebraska a Solid Waste Disposal Area License in 1981. The ARDC Landfill accepted wastes until 1993.

The results of several environmental investigations indicated that trichloroethene (TCE) and Royal Demolition Explosive (RDX) are the main contaminants of concerns in the groundwater from operations associated with the Site.

The main contaminant of concern in the groundwater associated with disposal of wastes by the University of Nebraska is 1,4-dioxane.

In recognition of the various contaminants, media affected and potentially responsible parties, the Site was divided into several operable units. Operable Units 1, 2 and 3 are being addressed by the U.S. Army Corps of Engineers; Operable Unit 5 is being addressed by the University of Nebraska.

The investigations by both entities indicated that the contaminants of concern from all sources have intermingled at certain areas of the Site. The intermingling of the contaminants may have an effect on the remedial alternatives and must be considered during the selection of the remedial action(s).

The Site was placed on the National Priorities List in August 1990. In September 1991, the USACE, the EPA and the NDEQ entered into an Interagency Agreement to investigate and control environmental contamination at the Site. The USACE has conducted environmental investigations and implemented remedies to address aspects of the contamination at the Site.

The EPA and the University of Nebraska negotiated an Administrative Order on Consent which went into effect in February 2005 for the completion of a non-time-critical removal action and a Remedial Investigation/ Feasibility Study at the ARDC Landfill, which is part of Operable Unit 5.

The University of Nebraska implemented the removal action between September 2007 and May 2008. The EPA finalized the Removal Action Completion Report in February 2009. The University of Nebraska completed the Remedial Investigation/Feasibility Study in several phases between October 2005 and January 2011. The EPA finalized the Remedial Investigation/Feasibility Study Report in April 2011. The United States, on behalf of the USACE and the EPA, negotiated a Consent Decree with the University of Nebraska which was entered in September 2005. Through this Consent Decree, the University of Nebraska agreed to pay for response costs, provide for site access and implement Institutional Controls at the ARDC.

One of the areas of concern—Load Line 1—where the University of Nebraska's contamination has impacted the groundwater is immediately upgradient of an area of extremely elevated TCE contamination where the USACE is investigating the potential for operating a groundwater extraction system. Two other potentially responsible parties—former government contractors—are performing a Focused Extraction Pilot Test to determine the effectiveness of an in-well treatment system to remove the TCE at the area of elevated TCE contamination.

OPERABLE UNIT 5 CHARACTERISTICS

The ARDC is a major research and education facility of the University of Nebraska Institute of Agricultural and Natural Resources. The ARDC has 5,000 acres in row crops. Over 5,000 domestic farm animals used for research and teaching are located at the ARDC.

The soils in the ARDC are well drained and consist of gray or black silty loam or silty clay loam.

The Platte River is located approximately five miles east-northeast of the ARDC. Overland drainage from the Site flows into tributaries of Johnson Creek and Silver Creek and eventually into the Platte River. Numerous overland flow pathways exist on and near the ARDC.

The geologic strata characterizing the ARDC consist of bedrock shales and sandstones overlain by unconsolidated deposits of sands and gravels and surficial loess. The unconsolidated deposits range in thickness from 45 to 150 feet. The Peoria Loess, which is composed of clayey silt to silty clay, mantles the Site and ranges in thickness from 2 to 25 feet. The underlying Pleistocene sands and gravels are glaciofluvial and fluvial deposits and consist of two distinctive stratigraphic layers—the upper Todd Valley Fine Sand Unit and the lower Todd Valley Sand and Gravel Unit. The upper, fine sand unit ranges in thickness from 30 to 90 feet and consists of very fine- to coarse-grained sand that coarsens to a gravely sand at the base. The lower sand and gravel unit consists primarily of fine gravel but ranges from medium to coarse gravel with variable amounts of fine to very coarse sand. It becomes coarser at depths and ranges from 0 to 55 feet thick. The bedrock consists of sandstone and shale. Depths to bedrock range from 20 feet below ground surface in the Burial Site A to 150 feet below ground surface at Load Line 1.

The Todd Valley Pleistocene sand and gravel deposits constitute an important regional groundwater reservoir, i.e., the Todd Valley aquifer. The upper, unconfined aquifer beneath the ARDC consists of the Todd Valley Sand and Gravel Unit and a portion of the overlying Todd Valley Fine Sand Unit; the depth in the groundwater is approximately 40 feet below ground surface in the area of investigation.

The underlying Dakota aquifer (Omadi Sandstone in the study area) is also utilized as a water source and is likely hydraulically connected to the Todd Valley aquifer in the eastern and southern portion of the ARDC but is generally confined and isolated by the Omadi Shale aquitard in the northwestern portion.

SCOPE AND ROLE OF THE ACTION

The scope and role of the proposed remedial actions are specific to Operable Unit 5. The effects of the disposal of various wastes by the University of Nebraska have been determined to extend to the groundwater and, to a certain extent, have comingled with other contaminants of concern that are being addressed by the USACE and other potentially responsible parties as part of Operable Unit 2 (groundwater). The effects or interference of contaminants of concern from Operable Unit 2 must be considered when determining the remedial alternatives for Operable Unit 5.

The EPA has therefore determined that the contaminants of concern and their associated health risks of all known or potential contaminants of the entire Site must be included and considered in selecting the preferred remedial alternative(s). This is supported by the National Contingency Plan which discusses in the Preamble the consideration of cumulative risks of multiple contaminants that are known or suspected carcinogens.

Health Risks

Step 1: Contaminants of Concern

The media of concern has been determined to be the contaminated soils below 20 feet in depth at Load Line 1 removal area, the contaminated soils in and adjacent to the ARDC Landfill, and the contaminated groundwater at Load Line 1 and the ARDC Landfill areas.

The primary contaminants of concern have been categorized into two groups—soil contaminants of concern and groundwater contaminants of concern. The primary soil contaminant of concern is 1,4-dioxane at Load Line 1 disposal area. The 1,4-dioxane and other soil contaminants are in the ARDC Landfill areas and will be addressed as part of the landfill closure. The primary groundwater contaminants of concern are 1,4-dioxane; TCE; and RDX.

STEP 1: CONTAMINANTS OF CONCERN

TCE: The Safe Drinking Water Act standard or "Maximum Contaminant Level" for TCE is 5 micrograms per liter. Long-term exposure to this compound has been associated with health effects to the liver and may have an increased risk of developing cancer.

1,4-dioxane: A Maximum Contaminant Level has not been established, but a Preliminary Remediation Goal for 1,4-dioxane is 6.1 micrograms per liter. It has been classified as a Group B2 probable human carcinogen of low carcinogenic hazard and may lead to adverse health effects.

Other contaminants to be considered:

RDX: A Maximum Contaminant Level has not been established, but a Lifetime Health Advisory for RDX is 2 micrograms per liter.

Step 2: Exposure

The exposure assessment uses the site description and constituent characterization to identify potentially exposed human receptor populations, identify potential exposure pathways and calculate estimated daily intakes of the chemicals of potential concern.

Behavioral and physiological factors influencing exposure frequency and levels are presented in a series of exposure scenarios as a basis for quantifying constituent intake levels by receptor populations for each identified exposure pathway.

Site-specific information such as climate, geology, soils, groundwater, surface water, population demographics, land use, water use, agricultural practices, etc., will be incorporated to predict the constituent levels to which receptors would be exposed. Once these exposure levels are determined, they will be compared with the appropriate health-effects criteria to characterize human health risks.

Steps 3 and 4: Assess and Characterize Risk

Risk characterization integrates the results of the exposure and toxicity assessments to derive quantitative and qualitative estimates of the potential cancer risk and noncancer hazards that may occur due to exposure to site-related contaminants.

The EPA's risk assessment team has reviewed and discussed the latest information provided by the University of Nebraska's risk assessor. The University of Nebraska's risk assessor, in consideration of the comments set forth in the EPA's letter dated on March 25, 2010, submitted a revised Baseline Human Health Risk Assessment dated in August 2010. This document was approved after subsequent review by the EPA's risk assessment team in December 2010. The following is a brief discussion of the potential concerns based on their location, the media of concern and the contaminants of concern:

- Load Line 1 disposal area had the upper 20 feet of contaminated soil removed during the non-time-critical removal action. The remainder of the contaminated soil below 20 feet in depth is very small and is unlikely to add significant contamination to the groundwater. There is no threat of dermal exposure to the remaining contaminated soil, the area continues to be operated by the ARDC and any public access is controlled.

- The 1,4-dioxane and the TCE in the groundwater below and downgradient of the Load Line 1 removal area present an unacceptable cancer risk to human receptors due to the TCE and the potential for adverse health risks due to the 1,4-dioxane. The investigations indicate that the RDX is intermingled with the other contaminants in the groundwater that are above the Lifetime Health Advisory for the contaminant.

- The 1,4-dioxane and the TCE in the groundwater below and downgradient of the ARDC Landfill and Burial Area D present an unacceptable cancer risk to human receptors due to the TCE and the potential for adverse health risks due to the 1,4-dioxane.

- Surface soils at the ARDC Landfill that have been capped present no significant threat at this time but could present some threat of exposure to trespassers in the areas that are not capped. The remedial investigations have verified that the ARDC Landfill has not been properly capped to meet either federal or state requirements. The capping of the entire ARDC Landfill area with approved soil materials in compliance with federal or state requirements will reduce the potential risk of contact with any of the ARDC Landfill materials, reduce the infiltration of water to those materials and thus reduce the potential impact to the groundwater from any contaminants in the ARDC Landfill.

The 1,4-dioxane was in the scintillation fluids that were part of the wastes that were disposed of at the burial locations. The 1,4-dioxane is considered to be an emerging contaminant of concern and continues to be found at a large number of sites nationwide where solvents have been released. The 1,4-dioxane is used as a stabilizer in a number of solvents. Investigations of sites nationwide have found that it does not degrade in the subsurface, is readily miscible in water and often moves along an aquifer ahead of the product that it had been used to stabilize. Treatment technologies available to reduce and destroy the 1,4-dioxane are still being developed. The ex situ (removal from the subsurface media for treatment at the surface) remediation technologies have been developed, and the in situ (treatment in the subsurface media) remediation technologies continue to be developed.

There are no receptors immediately downgradient of the contaminant plume at Load Line 1 and the ARDC Landfill. Detailed studies of the subsurface sediments in the unconfined aquifer downgradient of Load Line 1 indicate there are localized subsurface channels which tend to have higher levels of the contaminants of concern. The subsurface channels have the potential to move the small mass of the 1,4-dioxane downgradient at an increased rate of migration toward the southern boundary of the Site's area. The Phase II Supplemental Remedial Investigations completed in November and December 2010 were successful in defining the extent of the 1,4-dioxane at Load Line 1. The downgradient migration of the 1,4-dioxane appears to be trending to the south/southeast in the direction of the USACE well FEW-11.

The 1,4-dioxane has been classified as a Group B2 probable human carcinogen of low carcinogenic hazard and may lead to adverse health effects. The contamination has comingled with the TCE and the RDX in the drinking water aquifer underlying the Site. The Preliminary Remediation Goal for the 1,4-dioxane is 6.1 micrograms per liter, the maximum contaminant level for the TCE is 5.0 micrograms per liter and the Lifetime Health Advisory for the RDX is 2 micrograms per liter.

The EPA's risk assessment team has determined that the risk level of the 1,4-dioxane in the drinking water aquifer provides the justification for the consideration of and preference for treatment. The cumulative risk level when the TCE and the RDX are considered provides additional justification for the preference for treatment.

Ecological Risks

A Draft Screening Level Ecological Risk Assessment was submitted to the EPA's risk assessment team on November 23, 2009.

The draft document assessed three areas of the Site that potentially could have ecological effects from the University of Nebraska's disposal of wastes and determined that the ecological effects appeared to be minimal. However, the lack of site-specific data for ecological receptors was a reason for the greatest amount of uncertainty for the assessment.

The review by the EPA's risk assessment team provided both general and specific comments. A revised Draft Screening Level Ecological Risk Assessment was submitted in August 2010. The EPA's risk assessment team approved the revised document in October 2010.

Based upon the results of the current baseline risk assessment, it is the EPA's current judgment that the preferred alternatives identified in this Proposed Plan are necessary, at a minimum, to protect public health or welfare or the environment from actual or threatened releases of hazardous substances into the environment.

REMEDIAL ACTION OBJECTIVES

Section 121(b) of the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA, informally referred to as the Superfund law) requires the selection of remedial actions to attain a degree of cleanup that ensures protection of human health and the environment, is cost effective and uses permanent solutions and alternative treatment technologies or resource recovery technologies to the maximum extent practicable.

To satisfy CERCLA requirements, the following remedial action objectives were developed for soils at Operable Unit 5:

- For protection of human health – prevent exposure to soils with contaminant concentrations which result in an excess cancer risk greater than $1x10^{-6}$ or a Hazard Quotient greater than 1.0, whichever is less.

- For protection of the environment – reduce the soil contaminant levels to prevent migration of the 1,4-dioxane and other contaminants from soils to groundwater.

The following remedial action objectives were developed for groundwater at Operable Unit 5:

- For protection of human health – prevent exposure to groundwater with contaminant levels greater than the maximum contaminant levels[1] and for those contaminants without established maximum contaminant levels, prevent exposure to groundwater with contaminant concentrations greater than the Preliminary Remediation Goal or the Lifetime Health Advisory. The intermingling of the 1,4-dioxane with the TCE and the RDX results in a case with multiple contaminants and allows for the 10^{-6} risk level to be used as a point of departure for determining remediation goals.

- For protection of the environment – minimize further degradation of the local drinking water aquifer by the contaminants.

To address the remedial action objectives in the selection of the proposed remedial alternatives, which are designed to restore the groundwater aquifer to drinking water levels and to prevent additional contamination from reaching the groundwater aquifer, the chemical-specific, location-specific and action-specific applicable or relevant and appropriate requirements were used as listed in Tables 6.1, 6.2 and 6.3 of the Remedial Investigation/Feasibility Study.

SUMMARY OF REMEDIAL ALTERNATIVES

The Final Remedial Investigation/Feasibility Study Report, dated April 8, 2011, delineated areas of contaminated soils and groundwater at Operable Unit 5 for developing remedial alternatives.

Section 6.6 of the Final Remedial Investigation/Feasibility Study Report is captioned: Identification and Screening of Remedial Alternatives. Section 6.7 of the Final Remedial Investigation/Feasibility Study is captioned: Detailed Evaluation of Remedial Alternatives. These sections did not reference specific alternatives by any designation, such as by a specific alternative number, etc., as is recommended in the EPA's guidance.

Therefore, the EPA has developed a remedial alternative numbering system in order to discuss those alternatives. Tables 6.4 and 6.5 of the Final Remedial Investigation/Feasibility Study Report are a Summary of

[1] Maximum Contaminant Levels are the maximum permissible levels of contaminants in water which are delivered to a user of a public water system. Maximum Contaminant Levels are promulgated by the EPA pursuant to the Safe Drinking Water Act.

Cost Estimates of alternatives by media. There are additional breakdowns of tasks and costs for each alternative in Appendix K in a table format.

Alternative 1 for the Soil Media specified in Table 6.4 has been named No Action/Soil instead of Institutional Controls. A No Action/Soil Alternative is required in order to compare other alternatives for that specific media. The Institutional Controls are currently in place, and will remain in place, and thus are assumed to add no additional cost to the alternatives.

Alternative 3 No Action/Groundwater has been added to the alternatives listed in Table 6.5. A No Action/Groundwater Alternative is discussed in sections 6.6.2.1 and 6.7.2 of the Feasibility Study. A No Action/Groundwater Alternative is required in order to compare other alternatives for that specific media. The Institutional Controls are currently in place, and will remain in place, and thus are assumed to add no additional cost to the alternatives.

The **EPA Preferred Alternative for the soil at Load Line 1 removal area is Alternative 1 No Action/Soil** as briefly described below. The EPA agrees that the small amount of contamination left in the soil below 20 feet in depth from the surface is minimal and will be, at most, a small contributor of contamination to the groundwater.

The **EPA Preferred Alternative for the Landfill Closure is Alternative 9 Landfill Cap Installation and Groundwater Monitoring** as briefly described below. The removal action at the Burial Site D area was completed in 2008. The landfill cover required for closure can now be completed in accordance with state requirements.

The **EPA Preferred Alternative for the groundwater at Load Line 1 and the ARDC Landfill areas will be Alternative 5 In Situ Biological Oxidation at Load Line 1 and Alternative 4 Long-term Monitoring of Groundwater at Both Load Line 1 and the ARDC Landfill** as briefly described below. The existing Institutional Controls at the ARDC would remain in place.

REMEDIAL ALTERNATIVES

Alternative 1 – No Action/Soil

This alternative at the Load Line 1 removal area would not involve any remedial actions with the exception of existing Institutional Controls at the ARDC. The small amount, if any, of contaminated soil below 20 feet in depth is not anticipated to release contamination to the groundwater. The Site area would remain in its present condition. This alternative is required by the National Contingency Plan and CERCLA and is a baseline alternative against which effectiveness of other alternatives can be compared.

Alternative 2 – Removal of Soil for Treatment or Disposal/Load Line 1 Removal Area

This alternative would remove any 1,4-dioxane-contaminated soil below the depth of 20 feet that was not removed during the prior removal action to an estimated depth of 40 feet. The existing Institutional Controls at the ARDC would remain in place. This alternative would remove any remaining 1,4-dioxane-contaminated soil which could be a source of groundwater contamination.

Alternative 3 – No Action/Groundwater

This alternative would not involve any remedial actions at either Load Line 1 or the ARDC Landfill areas of the contaminated groundwater with the exception of the existing Institutional Controls at the ARDC. It is anticipated that the contaminants at Load Line 1 area would migrate but dissipate and disperse, and the concentrations would be gradually reduced. Any contamination that may eventually reach the USACE well FEW 11 would be treated at the AOP Plant. The Site area would remain in its present condition. This alternative is required by the National Contingency Plan and CERCLA and is a baseline alternative against which effectiveness of other alternatives can be compared.

Alternative 4 – Long-term Monitoring of Groundwater

This alternative is the Long-term Monitoring Quarterly as listed in Table 6.5 and Table K-5. This alternative would involve monitoring groundwater wells using both existing and new monitoring wells at Load Line 1 and the ARDC Landfill for an estimated period of seven years with a goal to demonstrate stable or decreasing plume concentrations and no further migration of the 1,4-dioxane. It is anticipated that the contaminant would migrate but dissipate and disperse, and thus the concentration would be gradually reduced. The existing Institutional Controls at the ARDC would remain in place.

Alternative 5 In Situ Biological Oxidation

This alternative is the ISCO-Aerobic aquifer and Fenton's (Bio Option) as listed in Table 6.5 and Table K-6 of the Feasibility Study. This alternative would focus on the area of the plume above 50 parts per billion of 1,4-dioxane. A Pilot Study would be implemented to determine the aquifer conditions and spacing of injection points. Figure 6.5 of the Feasibility Study displays the proposed location of the injection area. Long-term monitoring would be implemented to ensure the continual biodegradation of the contaminant and that it is occurring in the portion of the plume not remediated. The existing Institutional Controls at the ARDC would remain in place.

Alternative 6 In Situ Chemical Oxidation by Ozone Sparging

This alternative is the Ozone Sparging (Chemical Option) as listed in Table 6.5 and Table K-7 of the Feasibility Study. This alternative would focus on the area of the plume above 50 parts per billion of 1,4-dioxane. A Pilot Study would be implemented to determine the effectiveness of the method followed by a full-scale operation. Figure 6.6 of the Feasibility Study displays the proposed location of the area. Long-term monitoring would be implemented to ensure the effectiveness of the method in addressing the portion of the plume contaminated with 1,4-dioxane. The existing Institutional Controls at the ARDC would remain in place.

Alternative 7 Ex Situ Granular Activated Carbon

This alternative is the Pump and Treat-GAC as listed in Table 6.5 and Table K-8 of the Feasibility Study. This alternative would focus on the area of the plume above 50 parts per billion of 1,4-dioxane. A Pilot Study would be implemented to determine the effectiveness of the method followed by a full-scale operation. Figure 6.7 of the Feasibility Study displays the proposed location of the alternative. The Feasibility Study states that this method is not as effective or efficient as other methods, and the treated water would have to be disposed through a permitted surface water discharge permit or transported to a permitted waste water treatment plant. Long-term monitoring of the portions of the plume not remediated is not included in the description (Sections 6.6 and 6.7) or in Table K-8 of the cost summary of the Feasibility Study. The existing Institutional Controls at the ARDC would remain in place.

Alternative 8 Ex Situ UV Oxidation

This alternative is the Pump and Treat-UV as listed in Table 6.5 and Table K-9 of the Feasibility Study. This alternative would focus on the area of the plume above 50 parts per billion of 1,4-dioxane. A Pilot Study would be implemented to determine the effectiveness of the method followed by a full-scale operation. Figure 6.7 of the Feasibility Study displays the proposed location of the alternative. The Feasibility Study states that this method is one of the successful methods in the literature for treating 1,4-dioxane. The treated water would have to be disposed through a permitted surface water discharge permit or transported to a permitted waste water treatment plant. Long-term monitoring of the portion of the plume not remediated is not included in the description (Sections 6.6 and 6.7) or in Table K-8 of the cost summary of the Feasibility Study. The existing Institutional Controls at the ARDC would remain in place.

Alternative 9 Landfill Cap Installation and Groundwater Monitoring

This alternative is listed in Table 6.4 under the ARDC Landfill Closure and in Table K-11 of the Feasibility Study. This alternative would supplement and extend the existing cover, maintain the cover and monitor groundwater for 30 years under the state of Nebraska's regulations, which are more stringent than the EPA's requirement. The existing Institutional Controls at the ARDC would remain in place.

Alternative 10 Removal and Off-site Disposal of Landfill Wastes

This alternative is listed in Table 6.4 under the ARDC Landfill Closure and in Table K-12 of the Feasibility Study. This alternative would remove landfill wastes and transport the wastes to an approved off-site location(s). Post removal would include covering the area with topsoil and seeding and post closure groundwater monitoring. The existing Institutional Controls at the ARDC would remain in place.

Common Elements

The common element of all alternatives, including the EPA proposed preferred alternatives, is the implementation of Institutional Controls. The Institutional Controls are important to insure that exposures to soil and groundwater are controlled. The Final Remedial Investigation/Feasibility Study Report refers to Institutional Controls that are already in place because of the ownership of the ARDC by the University of Nebraska. Additional controls may need to be put into place in areas surrounding the ARDC Landfill as well as downgradient of the landfill since the University of Nebraska does not own that property. For all alternatives, CERCLA requires that the EPA reviews the remedy every five years after the construction of the remedial action to ensure that the remedy continues to be protective of human health and the environment. This five-year review would be a sitewide review. The intent of the review is to evaluate the remedial action to ensure that human health and the environment are being protected by the remedy being implemented. Depending on the results of the evaluation, additional remedial actions could be required.

EVALUATION CRITERIA FOR SUPERFUND REMEDIAL ALTERNATIVES
Overall Protection of Human Health and the Environment determines whether an alternative eliminates, reduces or controls threats to human health and the environment through Institutional Controls, engineering controls or treatment.
Compliance with Applicable or Relevant and Appropriate Requirements evaluates whether the alternative meets federal and state environmental statutes, regulations and other requirements that pertain to the Site or whether a waiver of such requirement is justified.
Long-term Effectiveness and Permanence considers the ability of an alternative to maintain protection of human health and the environment over time.
Reduction of Toxicity, Mobility or Volume of Contaminants Through Treatment evaluates an alternative's use of treatment to reduce the harmful effects of contaminants, their ability to move in the environment and the amount of contamination present.
Short-term Effectiveness considers the length of time needed to implement an alternative and the risks the alternative poses to workers, residents and the environment during implementation.

Implementability considers the technical and administrative feasibility of implementing the alternative, including factors such as the relative availability of needed services and materials.
Cost includes estimated capital and annual operations and maintenance costs as well as present net worth cost. Present net worth cost is the total cost of an alternative over time in terms of today's dollar value. Cost estimates are expected to be accurate within a range of +50 to -30 percent.
State/Support Agency Acceptance considers whether the state agrees with the EPA's analyses and recommendations as described in the Remedial Investigation/Feasibility Study and Proposed Plan.
Community Acceptance considers whether the local community agrees with the EPA's analyses and preferred alternative. Comments received on the Proposed Plan are an important indicator of community acceptance.

EVALUATION OF ALTERNATIVES

In this section, the remedial alternatives are evaluated in detail to provide enough relevant information about each alternative so that an appropriate remediation measure can be selected. Under CERCLA and the National Contingency Plan, nine criteria (as shown in the table above) are used to evaluate remedial alternatives. The first two criteria—the threshold criteria—are requirements that an alternative must meet to be selected as the preferred alternative. The next five criteria— balancing criteria—are used to weigh major trade-offs among the alternatives. The last two criteria— modifying criteria—will be fully evaluated only after public comment is received on this Proposed Plan.

Overall Protection of Human Health and the Environment

Alternative 1 No Action/Soil – This alternative would be protective because the amount of contaminated soil is extremely small and any remaining contamination may have already been transported to the groundwater. Any contaminated soil is at a depth over 20 feet below ground surface. The existing Institutional Controls at the ARDC would remain in place.

Alternative 2 Removal of Soil for Treatment or Disposal/Load Line 1 Removal Area – This alternative would be protective by removing any remaining contamination from the soil below 20 feet in depth and would not contribute to any additional groundwater contamination. The existing Institutional Controls at the ARDC would remain in place.

Alternative 3 No Action/Groundwater – This alternative would be less protective than other groundwater alternatives for any potential users of the contaminated groundwater. Without groundwater monitoring or some kind of treatment option implemented, the migration of the contaminant in the aquifer would not be measured or known. There would be no documentation that the 1,4-dioxane would be captured and treated by the USACE's focused extraction system. The existing Institutional Controls at the ARDC would remain in place.

Alternative 4 Long-term Monitoring of Groundwater – This alternative would be more protective than Alternative 3 but less protective than other groundwater alternatives that would use both treatment and monitoring. The EPA has investigated and monitored numerous sites across the nation and has not been aware of any data supporting the degradation of the 1,4-dioxane in groundwater. The information available on the 1,4-dioxane indicates that it is readily moved by a groundwater aquifer and that any decrease in concentration will be due to dilution instead of degradation. The existing Institutional Controls at the ARDC would remain in place.

Alternatives 5 and 6 In Situ Biological Oxidation and In Situ Chemical Oxidation by Ozone Sparging – The implementation of either alternative has the potential for being protective of any potential users of the contaminated groundwater at Load Line 1. The information to be obtained during the Remedial Design would be used to determine the potential for either method to be used and the specific parameters for each method. The treatment of part of the plume (greater than 50 micrograms per liter of 1,4-dioxane) in addition to long-term monitoring of groundwater would be protective by reducing the mass of the contaminants and allowing for the flexibility of adjustments to the remedial action with time if needed. The existing Institutional Controls at the ARDC would remain in place.

Alternative 7 Ex Situ Granular Activated Carbon – The alternative of using Granular Activated Carbon on extracted groundwater has been determined to be not as effective or efficient for treating the 1,4-dioxane as other methods and thus would not be as protective as other alternatives. The lack of long-term monitoring of the plume not remediated would not allow for the determination of the method to be protective. The existing Institutional Controls at the ARDC would remain in place.

Alternative 8 Ex Situ UV Oxidation – The alternative of using UV Oxidation on extracted groundwater from part of the plume (greater than 50 micrograms per liter of 1,4-dioxane) has the potential for being protective of any potential users of the contaminated water at Load Line 1 but has been determined to be not as protective as other alternatives. The information to be obtained during the Remedial Design would be used to determine the potential for this method to be used. The lack of long-term monitoring of the plume not remediated would not allow for the determination of the method to be protective. The existing Institutional Controls at the ARDC would remain in place.

Alternative 9 Installation of Landfill Cover for Closure – This alternative is designed to be protective by installing an engineered cap over the entire ARDC Landfill areas and closing it in compliance with the state of Nebraska's requirements. This would be protective against any direct exposure at the surface and would provide a protective cover to prevent infiltration of surface water/precipitation through the ARDC Landfill materials and transport of contaminants to the groundwater. The existing Institutional Controls at the ARDC would remain in place.

Alternate 10 Removal and Off-site Disposal of Landfill Wastes – This alternative would be protective of any direct exposure of the landfill materials by removing them off-site rather than closing the landfill with an engineered cap. The existing Institutional Controls at the ARDC would remain in place.

The preferred alternatives as proposed by the EPA are Alternatives 1 and 9 for soil and Alternatives 5 and 4 for groundwater. Alternatives 1 and 9 for soil are considered protective; Alternatives 5 and 4 for groundwater are considered protective.

Compliance with Applicable or Relevant and Appropriate Requirements[4]

Section 121(d) of CERCLA requires that remedial actions comply with applicable or relevant and appropriate requirements. Applicable or relevant and appropriate requirements include the requirements of federal environmental laws and promulgated state environmental laws that are more stringent than the equivalent federal law.

[4] There are three types of applicable or relevant and appropriate requirements: (1) Chemical-specific applicable or relevant and appropriate requirements are health- or risk-based values or methodologies that establish the acceptable amount or concentration of a hazardous substance that may be found in or discharged to the ambient environment, (2) Location-specific applicable or relevant and appropriate requirements are restrictions placed on the concentration of a hazardous substance or activity solely because they occur in a specific location, and (3) Action-specific applicable or relevant and appropriate requirements are technology- or activity-based requirements pertaining to the treatment or management of hazardous substances.

Applicable requirements include federal or state cleanup standards; standards of control and other substantive requirements; criteria or limitations that specifically address a hazardous substance, pollutant, contaminant, remedial action, location or other circumstances at Operable Unit 5.

Relevant and appropriate requirements include federal and state cleanup standards; standards of control; and other substantive environmental protection requirements, criteria or limitations that while not applicable address problems or situations sufficiently similar to those at Operable Unit 5.

As stated in the Site History and Scope and Role of the Action set forth in this Proposed Plan, the contaminants associated with the Site's operations during World War II and the Korean Conflict and the later disposal of wastes by the University of Nebraska have mixed the risks and cleanup levels of all contaminants, including the effects of the comingled contaminants on the treatment technology, must be considered for the remedial action.

Alternative 1 No Action/Soil – The chemical-specific applicable or relevant and appropriate requirements attained during the removal action would directly apply to this alternative. The removal action completed by the University of Nebraska greatly reduced the potential for any additional 1,4-dioxane that may be present in the materials below 20 feet in depth to be transported to the groundwater.

Alternative 2 Removal of Soil for Treatment or Disposal/Load Line Removal Area – The chemical-specific applicable or relevant and appropriate requirements attained during the completed removal action would apply and prevent any additional 1,4-dioxane, if present, to be transported to the groundwater.

Alternative 3 No Action/Groundwater – No applicable or relevant and appropriate requirements would directly apply to this alternative. The alternative assumes that all of the 1,4-dioxane in the groundwater will be diluted or captured and treated by the USACE well FEW-11 and the AOP Plant prior to reaching any receptor, i.e., drinking water well. Since there would be no monitoring system in place, there would be no data to support any conclusions.

Alternative 4 Long-term Monitoring of Groundwater – The chemical-specific applicable or relevant and appropriate requirements for the drinking water aquifer would apply as discussed in Step 1 of the Health Risks above.

Alternatives 5 and 6 In Situ Biological Oxidation and In Situ Chemical Oxidation by Ozone Sparging – The chemical-specific applicable or relevant and appropriate requirements for the drinking water aquifer would apply as discussed in Step 1 of the Health Risks above. Monitoring of the treated area and the nontreated area at Load Line 1 would provide data to determine compliance with the chemical-specific applicable or relevant and appropriate requirements.

Alternatives 7 and 8 Ex Situ Granular Activated Carbon and Ex Situ UV Oxidation – The chemical-specific applicable or relevant and appropriate requirements for the drinking water aquifer would apply as discussed in Step 1 of the Health Risks above for the treated areas but would not apply for the nontreated part of the plume because there is no long-term monitoring planned.

Alternative 9 Landfill Cap Installation and Groundwater Monitoring – The action-specific and location-specific applicable or relevant and appropriate requirements would apply specifically to the state's landfill closure requirements. The chemical-specific applicable or relevant and appropriate requirements would apply by installing an impermeable cap according to the state's landfill closure requirements and monitoring to prevent additional contamination of the drinking water aquifer.

Alternative 10 Removal and Off-site Disposal of Landfill Wastes – The removal of wastes would help to meet the chemical-specific applicable or relevant and appropriate requirements for the groundwater since there would be no wastes to contribute to the contamination of the aquifer.

The preferred alternatives as proposed by the EPA are Alternatives 1 and 9 for soil and Alternatives 5 and 4 for groundwater. The chemical-specific applicable or relevant and appropriate requirements would apply for all preferred alternatives that are proposed utilizing the clean up goals as discussed in Step 1 of the Health Risks above. Alternative 9 would also provide for action-specific and location-specific applicable or relevant and appropriate requirements.

Long-term Effectiveness and Permanence

Alternatives 1 and 2 for soil provide for long-term effectiveness and permanence because there is no potential for exposure to contaminated soils at the surface, and the existing Institutional Controls at the ARDC would remain in place. Alternative 2 would add a slightly higher degree of long-term effectiveness and permanence with the removal of any remaining contaminated soil below the depth of 20 feet from the surface.

Alternative 3 does not necessarily provide for long-term effectiveness and permanence because there are no remedial actions or a groundwater monitoring program to be implemented. There would be no data available to assess the effectiveness of the USACE's focused extraction system if the contaminant plume reached the USACE well FEW-11.

Alternative 4 has a potential for long-term effectiveness and permanence if the monitoring provides information that the plume stabilizes and the concentrations decrease. This alternative, in addition to one of the treatment alternatives, would provide for additional long-term effectiveness and permanence.

Assuming that the Pilot Study provides adequate information to design and implement a full-scale system, Alternatives 5 and 6 for in situ treatment of groundwater in addition to Alternative 4 would provide for long-term effectiveness and permanence. Both alternatives would provide for the flexibility that if the long-term monitoring indicates additional treatment is necessary, it could be easily expanded and implemented.

Alternatives 7 and 8 have the potential for long-term effectiveness and permanence, but the technology is not as effective or efficient as other methods of treatment. Neither alternative provides for any monitoring of the nontreated part of the plume. Both methods require either a permitted surface water discharge or transportation to a permitted waste water treatment plant.

Alternative 7, landfill closure, provides for a certain degree of long-term effectiveness and permanence by installing an engineered cap over the entire landfill and monitoring to comply with the state of Nebraska's requirements. This alternative would prevent any direct exposure and prevent the infiltration of water that could transport contaminants to the groundwater.

Alternative 8, landfill closure, provides for long-term effectiveness and permanence by removing the landfill material and monitoring the groundwater.

The preferred alternatives as proposed by the EPA are Alternatives 1 and 9 for soil and Alternatives 5 and 4 for groundwater. Implementation of these alternatives would provide for long-term effectiveness and permanence.

Reduction of Toxicity, Mobility or Volume of Contaminants through Treatment

Alternative 1 – This alternative for soil would not provide for any additional reduction of toxicity, mobility or volume of contaminants through treatment other than what has already been completed during the removal action.

Alternative 2 – If any remaining contamination is present, this alternative for soil would provide some limited reduction of toxicity, mobility or volume of contaminants the remaining contamination below 20 feet.

Alternatives 3 and 4 – These alternatives for groundwater do not provide for any removal or treatment of the groundwater.

Alternatives 5 and 6 – These alternatives provide for the reduction of toxicity, mobility or volume of contaminants through treatment.

Alternatives 7 and 8 – These alternatives provide for the reduction of toxicity, mobility or volume of contaminants through treatment.

Alternative 9 – This alternative does not provide for the reduction of toxicity, mobility or volume of contaminants through treatment but does provide for the reduction of water infiltration through the landfill material and thus reduces the toxicity, mobility or volume of contaminants available to the groundwater.

Alternative 10 – This alternative does not provide for the reduction of toxicity, mobility or volume of contaminants through treatment but does provide for the reduction of toxicity, mobility or volume of contaminants to the groundwater by the removal of the landfill materials.

The preferred alternatives as proposed by the EPA are Alternatives 1 and 9 for soil and Alternatives 5 and 4 for groundwater. Alternative 1 does not provide for any additional reduction of toxicity, mobility or volume of contaminants through treatment other than what has been completed during the removal action. Alternative 9 reduces the toxicity, mobility or volume of contaminants available to the groundwater by reducing the water infiltration through the landfill materials. Alternative 5 does provide for the reduction of toxicity, mobility or volume of contaminants through treatment. Alternative 4 does not provide for the reduction of toxicity, mobility or volume of contaminants through treatment but when implemented with Alternative 5 does provide information to determine if the treatment as described in Alternative 5 needs to be expanded.

Short-term Effectiveness

Alternative 1 – This alternative would provide no additional short-term effectiveness other than what has been completed by the removal action.

Alternative 2 – This alternative would provide additional short-term effectiveness with the removal of any contamination below 20 feet in depth.

Alternative 3 – This alternative would provide no short-term effectiveness.

Alternative 4 – This alternative would provide no short-term effectiveness. This alternative, in addition to one of the treatment alternatives, would provide for additional short-term effectiveness by monitoring the effectiveness.

Alternatives 5 and 6 – These alternatives for in situ treatment of groundwater would have some short-term effectiveness since the implementation of any treatment technology would reduce the overall time to attain the clean up levels.

Alternatives 7 and 8 – These alternatives for ex situ treatment of groundwater would have the potential of short-term effectiveness since the implementation of any treatment technology would reduce the overall time to attain the clean up levels.

Alternatives 9 and 10 – These alternatives have short-term effectiveness because of the potential for trespassers to be in areas of potentially contaminated soil at the surface.

The preferred alternatives as proposed by the EPA are Alternatives 1 and 9 for soil and Alternatives 5 and 4 for groundwater. Alternative 1 provides no additional short-term effectiveness other than what has been completed by the removal action. Alternative 9 and Alternatives 5 and 4 together do provide for some short-term effectiveness.

Implementability

There are no technical or administrative problems with the implementation of Alternatives 1, 2, 3, 4, 5, 6, 8 and 9.

Alternative 7 – The ex situ treatment of 1,4-dioxane with activated carbon is not as effective or efficient as other methods of treatment.

Alternative 10 – The removal and off-site disposal of landfill wastes would be very difficult. The type and quantity of wastes are not known and would have to be characterized, possibly stabilized or treated, prior to transportation and then transported to the appropriate waste disposal facility.

The preferred alternatives are Alternatives 1 and 9 for soil and Alternatives 5 and 4 for groundwater. There are no unusual technical or administrative problems with the implementation of the alternatives.

Cost

A summary of estimated costs is included in Tables 6.4 and 6.5 of the Remedial Investigation/Feasibility Study Report. More detailed cost summaries are included in the tables in Appendix K

Note: The Institutional Controls will remain in place and therefore were not included in any of the cost estimates.

The preferred alternatives are as follows:

Alternative 1: $0

Alternatives 5 and 4: $2,548,194

Alternative 9: $2,798,640

The cost estimates in Appendix K include a 15 percent contingency.

State/Support Agency Acceptance

The state of Nebraska is currently reviewing the information regarding the preferred alternatives.

Community Acceptance

Community acceptance of the preferred alternatives will be evaluated after the public comment period ends and will be described in the Record of Decision.

SUMMARY OF THE PREFERRED ALTERNATIVES

The preferred alternatives were selected after a thorough review of the Remedial Investigation/Feasibility Study Report in consideration of the remedial action objectives and the evaluation criteria.

Alternative 1 No Action/Soil: This alternative addresses the Load Line 1 removal area at which a small amount of contaminated soil might remain at a depth of 20 feet below the ground surface. The small amount of contaminated soil, if it exists, is not anticipated to release contamination to the groundwater. The areas would remain in their present condition. The existing Institutional Controls at the ARDC would remain in place.

Alternative 9 Landfill Cap Installation and Groundwater Monitoring: This alternative would supplement and extend the existing cover, maintain the cover and monitor groundwater for 30 years under the state of Nebraska's regulations. The closure requirements of the state are more stringent than the EPA's requirements and thus would be implemented. The cap would divert and reduce the amount of water available to infiltrate the landfill materials and reduce the potential for any additional contamination of the groundwater. The existing Institutional Controls at the ARDC would remain in place.

Alternative 5 In Situ Biological Oxidation at Load Line 1 and Alternative 4 Long- term Monitoring of Groundwater at both Load Line 1 and the ARDC Landfill: The combination of the two alternatives would treat and reduce the contamination of the groundwater aquifer at Load Line 1 and provide for long-term monitoring of the groundwater at both Load Line 1 and at the ARDC. The Pilot Study and full-scale implementation of a system of biological oxidation would be completed in the area of the groundwater plume above 50 parts per billion of 1,4-dioxane at Load Line 1 as shown in Figure 6.5 of the Feasibility Study. The long-term groundwater monitoring system would then determine the success of the treatment system by monitoring the remaining plume of 1,4-dioxane to determine if it would meet the Preliminary Remediation Goal of 6.1 parts per billion. The review of the monitoring data would continue. A periodic assessment would determine if the plume is stabilized below the Preliminary Remediation Goal and if any additional remediation actions, such as an expansion of the biological oxidation system, need to be considered. The existing Institutional Controls at the ARDC would remain in place.

The preferred alternatives can change in response to public comment or new information.

Based on the information available at this time, the EPA believes the preferred alternatives would be protective of human health and the environment, would comply with applicable or relevant and appropriate requirements, would be cost effective and would utilize permanent solutions and alternative treatment technologies to the maximum extent practicable.

COMMUNITY PARTICIPATION

The EPA and the NDEQ will provide information regarding the cleanup of Operable Unit 5 at the Site through public meetings, the Administrative Record file for the Site and announcements published in the newspaper.

The EPA and the NDEQ encourage the public to gain a more comprehensive understanding of the Site and the Superfund activities that have been conducted at the Site.

The dates for the public comment period; the date, location and time of the public meeting; and the locations of the Administrative Record file are provided on the front page of this Proposed Plan.

GLOSSARY OF TERMS

Specialized terms used in this Proposed Plan are defined below:

Administrative Record : The body of documents that "forms the basis" for selection of a particular response at a site. An Administrative Record is available at or near the site to permit interested individuals to review the documents and to allow meaningful public participation in the remedy selection process.

Aquifer: An underground layer of rock, sand or gravel capable of storing water within cracks and pore spaces or between grains. When water contained within an aquifer is of sufficient quantity and quality, it can be used for drinking or other purposes. The water contained in the aquifer is called groundwater.

Applicable or Relevant and Appropriate Requirements: The federal and state environmental laws that a selected remedy will meet.

Capital Costs: Expenses associated with the initial construction of a project.

Chemical Oxidation Treatment: The use of chemicals called "oxidants" to destroy pollution in soil and groundwater. Oxidants help change harmful chemicals into harmless ones.

Comprehensive Environmental, Response, Compensation and Liability Act: The law enacted by Congress in 1980 to evaluate and clean up abandoned, hazardous waste sites. The EPA was charged with the mission to implement and enforce CERCLA.

Contaminant Plume: A column of contamination with measurable horizontal and vertical dimensions that are suspended in and move with groundwater.

Groundwater: Underground water that fills pores in soils or openings in rocks to the point of saturation. Groundwater is often used as a source of drinking water via municipal or domestic wells.

Maximum Contaminant Levels: The maximum permissible level of a contaminant in water that is delivered to any user of a public water system.

Monitoring: Continued collection of information about the environment that helps gauge the effectiveness of a clean up action.

National Oil and Hazardous Substances Pollution Contingency Plan: The federal regulations that guide the Superfund program.

Operable Unit: Term for each of a number of separate activities undertaken as part of a Superfund site cleanup.

Operation and Maintenance: Activities conducted at a site after the construction phase to ensure that the cleanup continues to be effective.

Plume: A body of contaminated groundwater flowing from a specific source.

Present Worth Analysis: A method of evaluation of expenditures that occurs over different time periods. By discounting all costs to a common base year, the costs for different remedial actions can be compared on the basis of a single figure for each alternative.

Record of Decision: The decision document in which the EPA selects the remedy for a Superfund site.

Superfund: The nickname given by the press for CERCLA because the program was well funded in the beginning.

Toxicity: A measure of degree to which a substance is harmful to human and animal life.

Volatile Organic Compounds: Carbon compounds, such as solvents, which readily volatilize at room temperature and atmospheric pressure. Most are not readily dissolved in water, but their solubility is above health-based standards for potable use. Some volatile organic compounds can cause cancer.

FIGURES AND TABLES

PROPOSED PLAN

FORMER NEBRASKA ORDNANCE

PLANT SUPERFUND SITE

OPERABLE UNIT 5

MEAD, NEBRASKA

Note: All figures and tables from the Final Remedial Investigation/Feasibility Study Report; Former Nebraska Ordnance Plant Site, Operable Unit 5; University of Nebraska Agricultural Research and Development Center; Mead, Nebraska; Final Report; April 8, 2011

Table 6.4

Rating of Alternative Remedial Technologies for Load Line 1 Soil and ARDC Landfill

Feasibility Study

University of Nebraska Agricultural Research and Development Center

REMEDIAL ALTERNATIVE	SCORE	CRITERIA			ESTIMATED COST
		Effectiveness	Implementation	Cost	
Load Line 1 Soil					
Institutional Controls	14	4	5	5	$0
Removal of Soil for Treatment or Disposal	8	5	2	1	$591,000
ARDC Landfill Closure					
Landfill Cap Installation and Groundwater Monitoring	14	4	5	5	$2,799,000
Removal and Offsite Disposal of Landfill Wastes	9	5	3	1	$4,012,000

Notes:

Rating of Effectiveness, Implementability and Cost based on individual alternative relative to other remedial options considered.

Rating Grade

5 = high effectiveness, easy implementability, low cost

3 = moderate or average

1 = lower effectiveness, difficult implementability, high cost

Table 6.5:
Rating of Alternative Remedial Technologies for Groundwater
Feasibility Study
University of Nebraska Agricultural Research and Development Center

REMEDIAL ALTERNATIVE	SCORE	CRITERIA[1] Effectiveness	Implementation	Cost	Cost Estimates[2] Pilot Study	Total Implementation Cost[3]	Implementation Cost By Chemical[4] 1,4-Dioxane	TCE	RDX
Long-Term Monitoring - Quarterly	11	1	5	5	$189,972	$902,719	$243,734	$622,876	$36,109
InSitu Treatments									
ISCO- Aerobic Aquifer and Fenton's (Bio Option)	6	2	1	3	$346,243	$1,645,475	$444,278	$1,135,378	$65,819
Ozone Sparging (Chemical Option)	9	3	2	4	$308,218	$1,543,765	$416,817	$1,065,198	$61,751
ExSitu Treatments									
Pump and Treat - GAC	8	2	4	2	$336,028	$1,678,453	$453,182	$1,158,133	$67,138
Pump and Treat - UV	7	3	3	1	$372,428	$2,464,443	$665,400	$1,700,466	$98,578

Notes:
Cost Estimates are in 2011 dollars.
Rating of Effectiveness, Implementability and Cost based on individual alternative relative to other remedial options considered.
Rating Grade
5 = high effectiveness, easy implementability, low cost
3 = moderate or average
1 = lower effectiveness, difficult implementability, high cost

[1] Criteria ratings based on compairson of Remdial Alternatives presented
[2] All cost estimates in presented in 2011 dollars
[3] Total Implementation Cost includes cost for Pilot Study
[4] Implementation Cost Breakdown by Chemical based on Percentage of Chemical in groundwater from Table K-1

Table K-5
Cost Estimate Summary
for Long Term Monitoring

Task		Total Cost
QUARTERLY MONITORING, REPORTING AND CLOSURE COSTS		
Quarterly Monitoring (4 quarters; year 1)		
Labor (Field, Reporting, Prj Mgmt)		$49,312
Sampling Equipment and Supplies, Travel, Shipping		$4,500
Purge Water Disposal (16-drums)		$6,400
Analytical - GW (20 wells)		$16,000
GW Quarterly Reports		$20,000
	Subtotal	**$96,212**
Pilot Study[1] (1-year only)		
Well Installation and Development (6)		$93,760
1 Year of Quarterly Groundwater Monitoring		$96,212
	Subtotal	**$189,972**
Six Additional Years of Quarterly Groundwater Monitoring[2] (escalated at 5% annually)		**$687,147**
Site Closure		
Closure Report		$5,000
Agency Consultation		$3,600
	Subtotal	**$8,600**
Groundwater Monitoring Well Abandonment		
Well Destruction		$12,000
Disposal Cost		$5,000
	Subtotal	**$17,000**
Quarterly Monitoring	**Total Cost**	**$902,719**

TOTAL ESTIMATED COST (No Contingency) **$902,719**

Notes:
[1]Pilot Study assumes first year of Long Term Monitoring
[2]Estimated number of years calculated from Table K-4.
Rounded up to 6-yrs to reach 1,4 Dioxane at 6.1 ppb plus one-year confirmation monitoring

Table K-6
Cost Estimate Summary
ISCO - Aerobic Aquifer and Fenton's Reagent Injection

TASK		Estimated Cost
Preconstruction		
Design Plans, Bid Documents		$8,750
Work Plan		$13,400
Permitting (Boring)		$12,500
	Subtotal	**$34,650**
Pilot Study (3-month only)		
Well Installation and Development (3)		$46,880
Groundwater Sampling and Bacteria Analysis		$11,150
Fenton's Reagent Injection		$264,160
Reporting		$24,053
	Subtotal	**$346,243**
Construction - Bacteria and Fentons Injection		
Fenton's Reagent Injection (3X)		$660,700
Bacteria Injection (1X)		$94,900
	Subtotal	**$755,600**
Construction - Groundwater Well Installation		
Well Installation and Development (3)		$46,880
	Subtotal	**$46,880**
System Operation and Maintenance		
Labor & Utilities		$0
Maintenance Equipment		$0
	Subtotal	**$0**
Closure Activities and Reporting		
Quarterly GW Monitoring (2-years)		$197,235
Project Management and Reporting		$25,240
Closure Activities and Agency Consultation		$13,000
Well Abandonment		$12,000
	Subtotal	**$247,475**

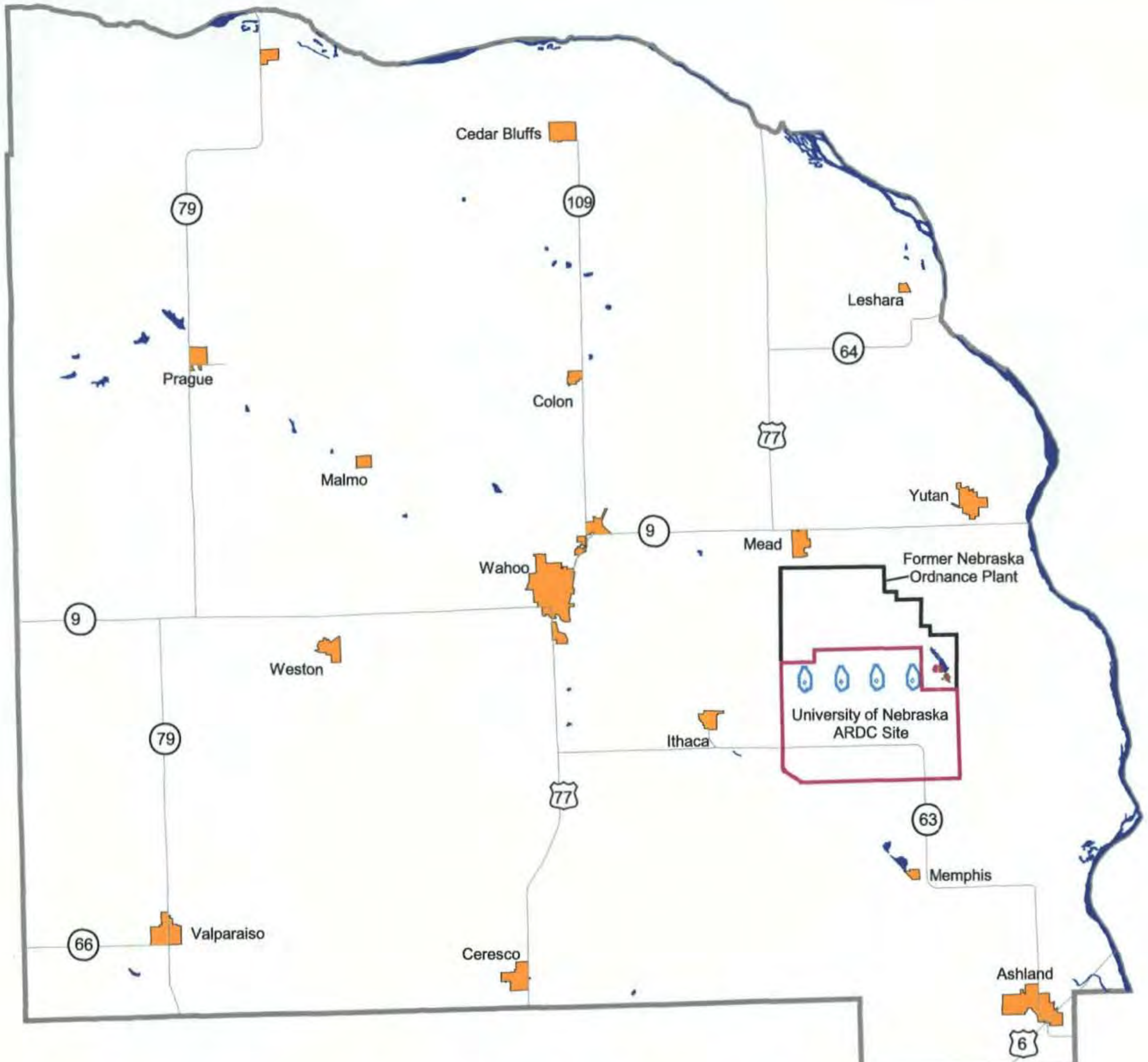
Estimated Cost: Fenton's Reagent Injection	**$1,430,848**
Total Estimated Cost with Contingency at 15%	**$1,645,475**

Notes:
1. Pilot Study assumes 50 injection locations followed by 2 rounds of groundwater monitoring to determine effectiveness of treatment. Pilot Study will last 3 months.
2. Assuming a minimum of 100 injection locations for the first round of Fenton's. The first round includes the number of injections from the pilot study. Number of locations reduced in half for each proceeding injection round.
3. Injection of Fenton's and the bacteria will be performed using a direct push rig.
4. Groundwater monitoring will span 1 year after the first injection followed by 1 year of monitoring for closure.

Table K-11: Cost Estimate Summary for
ARDC Landfill Capping and Long-term Monitoring

Description	Quantity	Unit Price	Units	Total Price
Preconstruction				
Engineering				$40,600
			Subtotal	**$40,600**
Construction				
Mobilization	1	$8,000	LS	$8,000
Stripping and Grubbing	10,000	$2.00	SY	$20,000
Earthwork	10,000	$15.00	CY	$150,000
Revegetation	10,000	$2.50	SY	$25,000
			Subtotal	**$203,000**
Maintenance				
Long-term Maintenance	30	$3,000.00	YR	$90,000
			Subtotal	**$90,000**
Reporting				
Long-term Monitoring	30	$70,000.00	YR	$2,100,000
			Subtotal	**$2,100,000**
Estimated Cost: ARDC Landfill Capping and Long-term Monitoring				**$2,433,600**
Total Estimated Cost with Contingency at 15%				**$2,798,640**

P:\4663\4663050010\TECHNICAL\GIS\Nebraska_Ord\Projects\RI_Report_Supplemental_rev.apr



Saunders County Inset

Nebraska

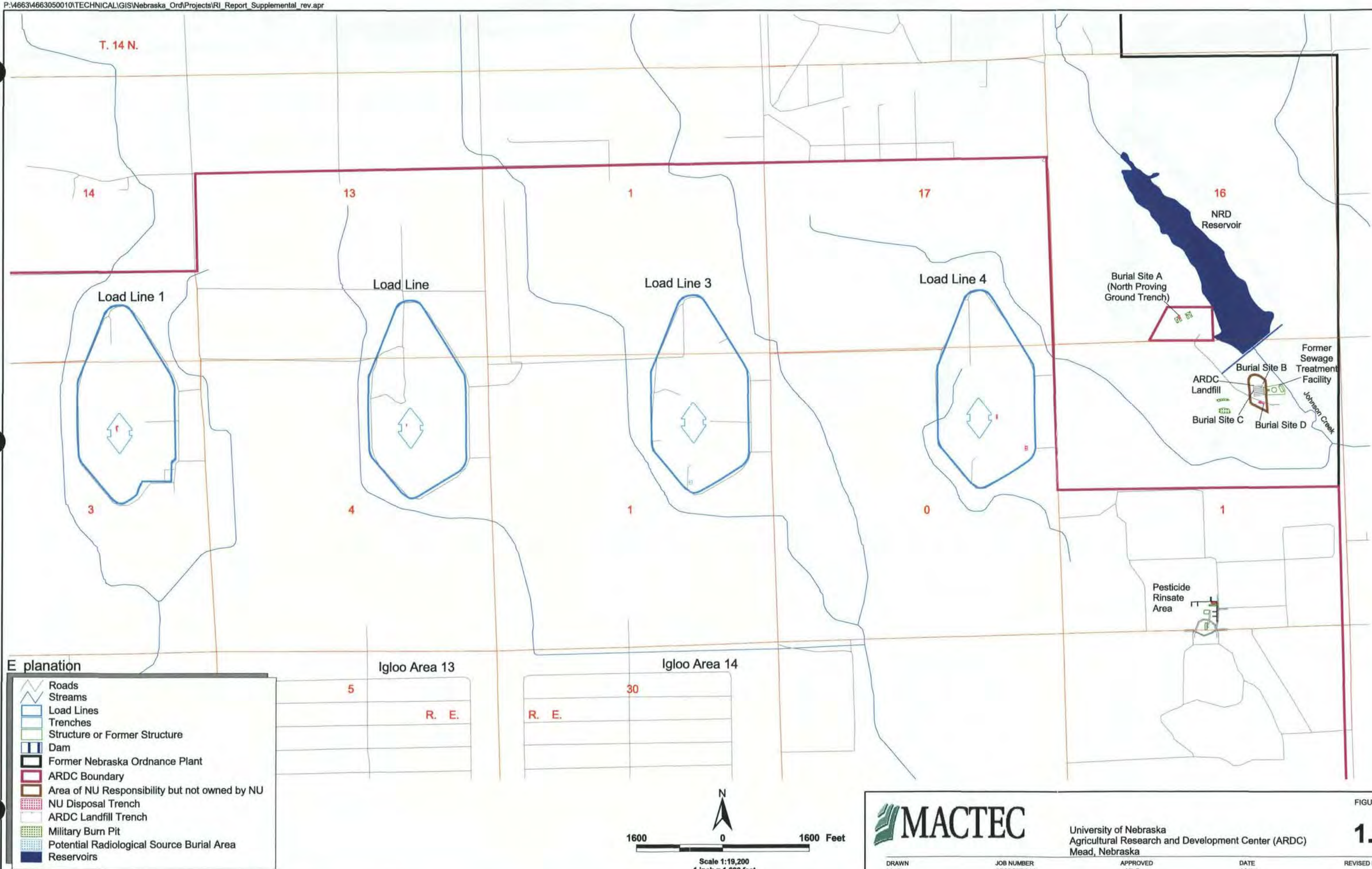
MACTEC

University of Nebraska
Agricultural Research and Development Center (ARDC)
Mead, Nebraska

FIGURE 1.1

DRAWN	JOB NUMBER	APPROVED	DATE	REVISED DATE
MJC	4663050010	KLC	11/07	

P:\4663\4663050010\TECHNICAL\GIS\Nebraska_Ord\Projects\RI_Report_Supplemental_rev.apr



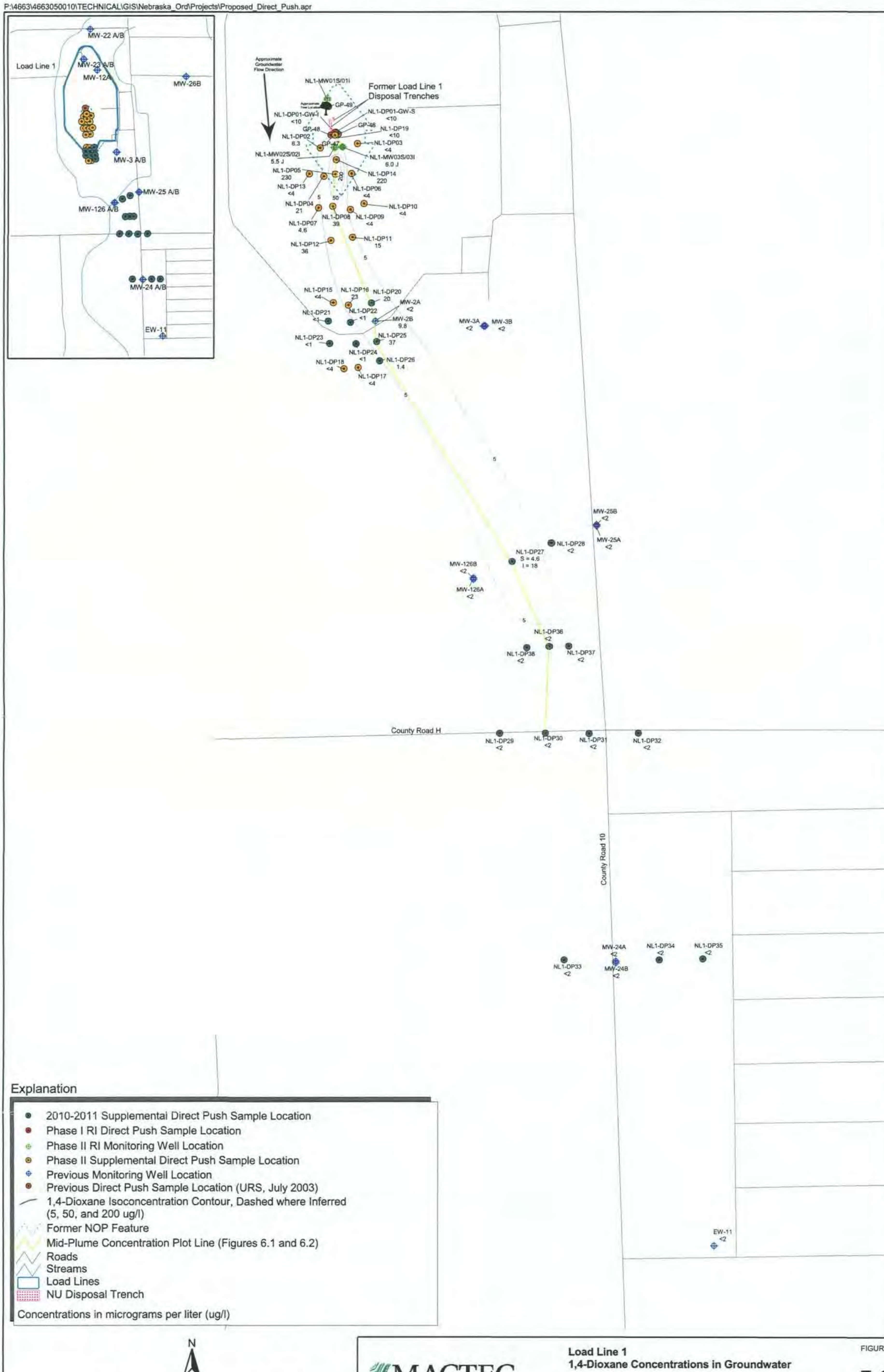
MACTEC

University of Nebraska
Agricultural Research and Development Center (ARDC)
Mead, Nebraska

FIGURE
1.2

DRAWN	JOB NUMBER	APPROVED	DATE	REVISED DATE
MJC	4663050010	KLC	11/07	

P:\4663\4663050010\TECHNICAL\GIS\Nebraska_Ord\Projects\Proposed_Direct_Push.apr



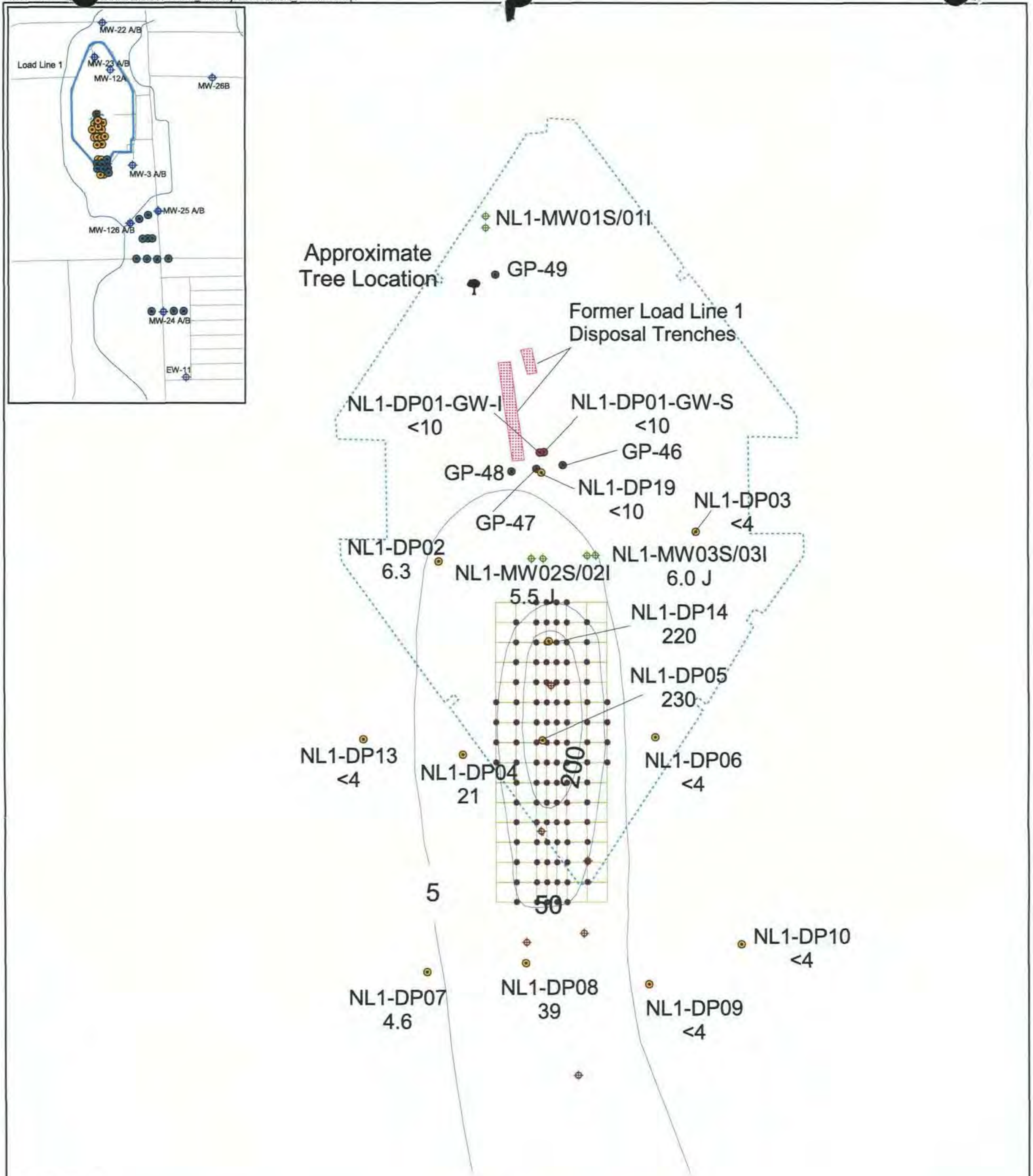
MACTEC

Load Line 1
1,4-Dioxane Concentrations in Groundwater

University of Nebraska
Agricultural Research and Development Center (ARDC)
Mead, Nebraska

FIGURE **5.3**

DRAWN	JOB NUMBER	APPROVED	DATE	REVISED DATE
MJC	4663050010	KLC	10/10	03/11



Explanation

- Proposed Monitoring Well Location
- Proposed ISCO Injection Location
- 2010-2011 Supplemental Direct Push Sample Location
- Phase I RI Direct Push Sample Location
- Phase II RI Monitoring Well Location
- Phase II Supplemental Direct Push Sample Location
- Previous Monitoring Well Location
- Previous Direct Push Sample Location (URS, July 2003)
- 1,4-Dioxane Isoconcentration Contour, Dashed where Inferred (5, 50, and 200 ug/l)
- Isco Injection Grid
- Former NOP Feature
- Roads
- Streams
- Load Lines
- NU Disposal Trench

Concentrations in micrograms per liter (ug/l)

N

100 0 100 Feet

Scale 1:1,200
1 inch = 100 feet

MACTEC

Load Line 1 In Situ Treatment
ISCO Alternative

University of Nebraska
Agricultural Research and Development Center (ARDC)
Mead, Nebraska

FIGURE **6.5**

DRAWN	JOB NUMBER	APPROVED	DATE	REVISED DATE
MJC	4663050010	KLC	10/10	03/11