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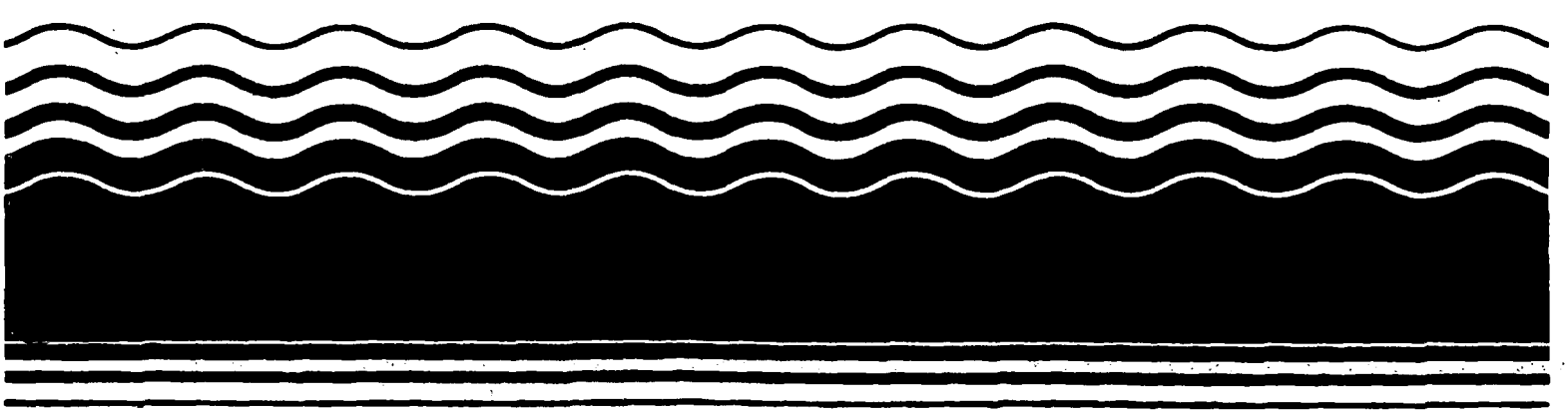
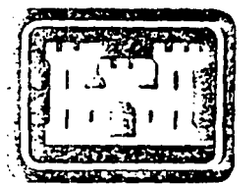
March 1999

EPA Superfund
Record of Decision:

Cornhusker Army
Ammunition Plant OU 2
Hall County, NE
9/30/1998





US Army Corps
of Engineers
Omaha District

Delivery Order No. DA01
Total Environmental
Program Support
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DAAA15-91-D-0014

CORNHUSKER ARMY AMMUNITION PLANT

Record of Decision
Operable Unit Two

FINAL DOCUMENT
April 1998

THIS DOCUMENT IS INTENDED TO COMPLY WITH THE NATIONAL ENVIRONMENTAL POLICY ACT OF 1969

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LIST OF ACRONYMS

ABA - Abandoned Burn Area
ABHA - Administration and Base Housing Areas
ADI - Allowable Daily Intake
AOC - area of concern
bgs - below ground surface
CERCLA - Comprehensive Environmental Response, Compensation, and Liability Act
CHAAP - Cornhusker Army Ammunition Plant
CHPPM – Center for Health Promotion and Preventative Medicine
COPC - Chemical of Potential Concern
CRS - Cornhusker Rail Services
DDD - 1,1-dichloro-2,2-bis(p-chlorophenyl)ethane
DDE - 2,2-bis(p-chlorophenyl)-1,1-dichloroethene
DDT - 1,1,1-trichloro-2,2-bis(chlorophenyl)ethane
EA - Excessing Assessment
ERA - Ecological Risk Assessment
FFA - Federal Facility Agreement
FS - Feasibility Study
ICF KE - ICF Kaiser Engineers
GOCO - government owned contractor operated
HHRA - Human Health Risk Assessment
MCL - Maximum Concentration Level
NCP - National Contingency Plan
NDEQ - Nebraska Department of Environmental Quality
NMAG - North Magazine Area
OU - Operable Unit
RBC - Risk-Based Concentration
RDX - cyclonite
RI - Remedial Investigation
ROD - Record of Decision
SARA - Superfund Amendments and Reauthorization Act
SCD - Site Characterization Document
SI - Site Investigation
SMAG - South Magazine Area
STP - Sewage Treatment Plant
TIC - Tentatively Identified Compound
246-TNT - 2,4,6-trinitrotoluene
TRV - Toxicity Reference Value
USAEC - United States Army Environmental Center
USATHAMA - United States Army Toxic and Hazardous Material Agency
USEPA - United States Environmental Protection Agency
UXO - unexploded ordnance

1.0 DECLARATION OF THE RECORD OF DECISION

1.1 SITE NAME AND LOCATION

Cornhusker Army Ammunition Plant Operable Unit Two (OU2), Grand Island, Nebraska.

1.2 STATEMENT OF BASIS AND PURPOSE

This Record of Decision (ROD) document presents the selected remedial action for the six areas of concern (AOCs) located at the Cornhusker Army Ammunition Plant (CHAAP) in Grand Island, Nebraska designated as OU2. The remedial action is chosen in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA), as amended by the Superfund Amendments and Reauthorization Act (SARA) of 1986, and with the National Oil and Hazardous Substances Pollution Contingency Plan (NCP). The information supporting the decisions on the selected remedy is contained in the administrative record. **Section 2.2.3** lists the documents contained in the administrative record.

The U.S. Environmental Protection Agency (USEPA) and the Nebraska Department of Environmental Quality (NDEQ) concur with the selected remedy.

1.3 DESCRIPTION OF THE SELECTED REMEDY: NO REPONSE ACTION

The remedial investigation of OU2 is part of a comprehensive environmental investigation and remediation currently being performed at CHAAP under the CERCLA program. CHAAP is divided into three operable units that include 17 sites representing potential sources of contamination.

Operable Unit Two has been designated for no further remedial action because there is no indication of adverse effects from contact with environmental media at this operable unit. In addition, there is no migration of hazardous contaminants from OU2 at concentrations that would harm human health based on the results of the human health risk assessment. It should be noted that cleanup criteria were not driven by ecological risk because the areas that comprise OU2 have poor quality habitat due to past and present uses and/or abundance of manmade structures making extensive use by terrestrial receptors unlikely.

1.4 DECLARATION STATEMENT

No further remedial actions are necessary to ensure protection of human health and the environment at AOCs designated as OU2. A five-year review of the site will be necessary to ensure that that the decision of no further action/no response action is protective of human health and the environment.

William R. Pulscher

28 Sep 98
Date

WILLIAM R. PULSCHER
Colonel, GS
Chief of Staff

Mark R. Steinkamp for

9/30/98
Date

Dennis Grams
Regional Administrator
U.S. Environmental Protection Agency, Region VII

2.0 DECISION SUMMARY

2.1 SITE NAME, LOCATION, AND DESCRIPTION

Cornhusker Army Ammunition Plant is located on an 11,936-acre (19 mi^2) tract approximately two miles west of Grand Island, Nebraska, in north-central Hall County.

The land around CHAAP is intensely cultivated and most of the original prairie grass and other vegetation have been replaced by row crops such as corn and alfalfa. Most of the land between CHAAP and Grand Island is used for farming, predominately for hay and/or pasture, dryland crops, and irrigated corn, alfalfa, and soybeans.

A large portion of CHAAP is inactive; however, much of the land and buildings are leased to various individuals and local concerns. Approximately 10,774 acres (17 mi^2) is leased out for general agricultural use as follows: 82% cropland; 15% wildlife habitat and protection areas; and 3% grazing. The majority of the cropland acreage is irrigated. Eighty-eight magazines and 25 other buildings are leased out as general storage space. The Nitrate Area and the on-post rail sidings are leased for industrial use by Cornhusker Rail Services, Inc. (CRS), a railcar refurbisher.

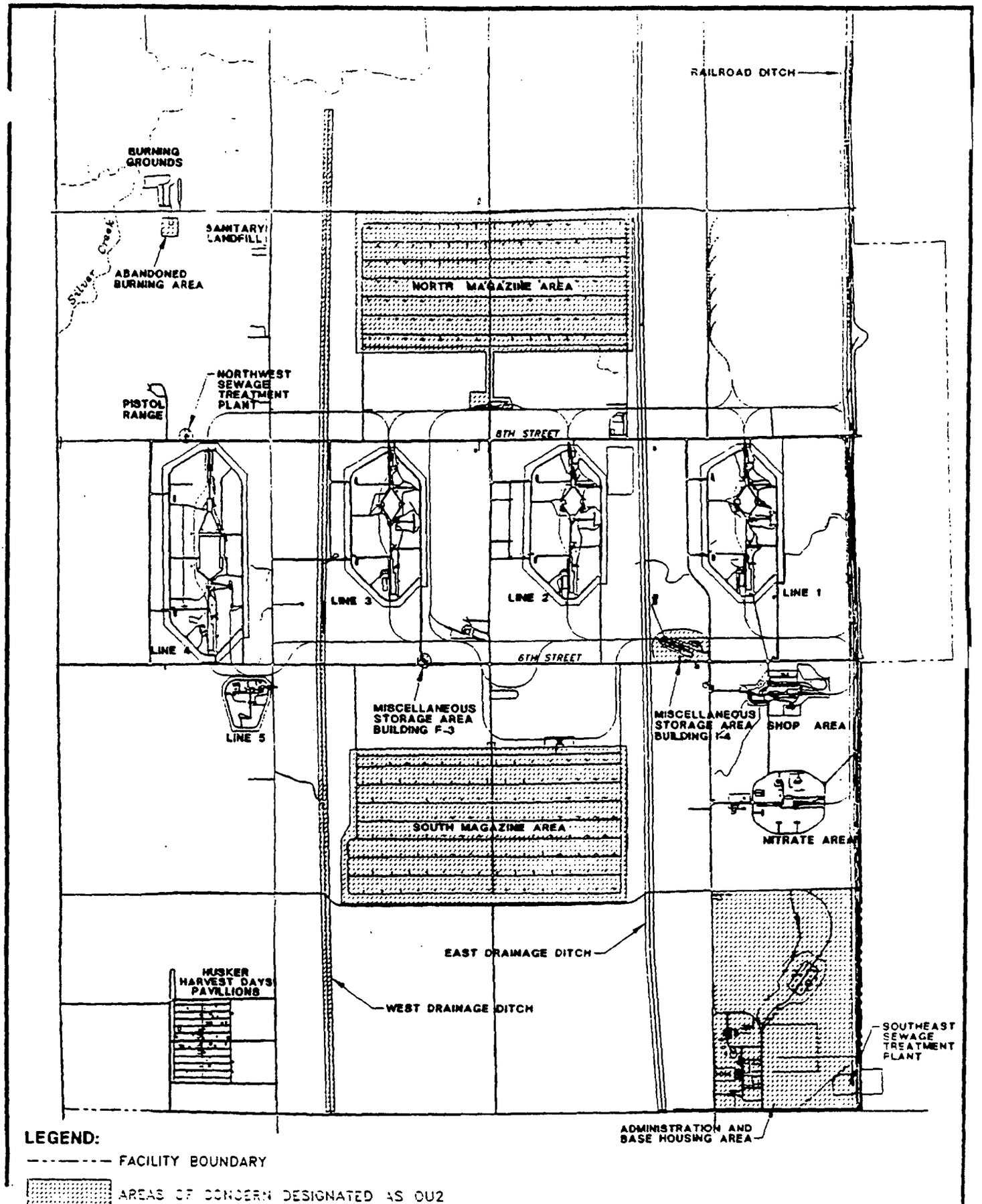
Operable Unit Two represents one component of a comprehensive environmental investigation and cleanup presently being performed at CHAAP. The CHAAP has been divided into three operable units based on land use and the extent of remedial action required to protect human health and the environment. Operable Unit One (OU1) is comprised of the explosives-contaminated groundwater plume. The Administration and Base Housing Areas (ABHA), Abandoned Burning Area (ABA), Drainage Ditches, Magazine Areas, Miscellaneous Storage Areas, and Sewage Treatment Plants (STPs) comprise Operable Unit Two (OU2). Operable Unit Three (OU3) includes the Pistol Range, Nitrate Area, Shop Area, the Sanitary Landfill and the Burning Grounds. Operable Unit Four (OU4) is comprised of the unsaturated zone of Load Lines 1-5 and the Gravel and Clay Pits. A Feasibility Study (FS) has been completed for OU3 and OU4. An interim ROD has been completed on the OU1 groundwater and saturated zone.

As indicated above, the AOCs contained in OU2 are the ABHA, ABA, Drainage Ditches, Magazine Areas, Miscellaneous Storage Areas, and STPs (**see Exhibit on page 2-2**). The ABHA is located in the southwestern corner of CHAAP and encompasses approximately one square mile. Some of the land is developed and is currently cultivated for growing various crops. The ABA is located in the northwest corner of the installation. It is approximately 100 feet x 150 feet in size and is currently part of a cultivated dry-crop field. At CHAAP, there are three main drainage ditches (i.e., Railroad Drainage Channel, the West Drainage Channel, and the East Drainage Channel). These ditches run north to south through the length of the facility. The proposed use for these drainage ditches is to receive effluent from the OU1 focused well extraction system. Two magazine areas are located at CHAAP and are designated as the North Magazine Area (NMAG) and the South Magazine Area (SMAG). The NMAG and SMAG are situated north and south of the Load Lines, respectively. The Miscellaneous Storage Areas consist of two buildings at the CHAAP facility. Pesticides and fertilizers have been stored and mixed in Building I-4 and in Building F-3, which is located just north of the SMAG Area. Two inactive STPs referred to as the Northwest STP and the Southeast STP are located at CHAAP. The Northwest STP is located just north of Load Line 4 and the Southeast STP is located east of the ABHA. Both sites are currently abandoned and covered with native vegetation but retain the man-made depressions and structures that were used while the plants were in operation.

2.2 HISTORY AND ENFORCEMENT ACTIVITIES

2.2.1 Site History

The CHAAP was constructed and fully operational in 1942. The CHAAP was a U.S. government-owned, contractor-operated (GOCO) facility, which produced artillery shells, mines, bombs, and rockets for World War II, Korean conflict, and Vietnam conflicts. The plant was operated intermittently for 30 years; the most recent operations ending in 1973.


RAILROAD DITCH
BURNING GROUNDS
SANITARY LANDFILL
Silver Creek
ABANDONED BURNING AREA
NORTH MAGAZINE AREA
NORTHWEST SEWAGE TREATMENT PLANT
PISTOL RANGE
8TH STREET
LINE 1
LINE 2
LINE 3
LINE 4
LINE 5
6TH STREET
MISCELLANEOUS STORAGE AREA BUILDING F-3
MISCELLANEOUS STORAGE AREA BUILDING T-4
SHOP AREA
NITRATE AREA
SOUTH MAGAZINE AREA
EAST DRAINAGE DITCH
HUSKER HARVEST DAYS PAVILLIONS
WEST DRAINAGE DITCH
SOUTHEAST SEWAGE TREATMENT PLANT
ADMINISTRATION AND BASE HOUSING AREA
LEGEND:
FACILITY BOUNDARY
AREAS OF CONCERN DESIGNATED AS OU2
ACAD FILE: RS-STE18

The plant was operated from 1942 through 1945 by Quaker Oats Ordnance Corporation, a subsidiary of the Quaker Oats Company that produced bombs, shells, boosters, and supplementary charges. The plant was on standby status for munitions production from 1945 through 1950. During the standby period, many of the buildings were also used for grain storage.

The plant was reactivated in 1950 to produce artillery shells and rockets to support the Korean conflict. These operations were directed by Mason & Hanger-Silas Mason Company (Mason & Hanger) until 1957 when the plant was again placed on standby status (**USATHAMA, 1980**). In 1963, a total of 809 acres from three parcels of land situated in the northeast, northwest, and southeast corners of the facility were sold to the State of Nebraska for use as wildlife management areas.

The plant was reactivated from 1965 through 1973 for the production of bombs, projectiles, and microgravel mini-mines used in the Vietnam conflict. Mason & Hanger was retained as the operator during this period of operation (**USATHAMA, 1980**). In 1973, operations ceased, the plant was again placed on standby and has not been reactivated to date. Thirty acres of the sandpit area were given to the State of Nebraska in 1977 for use by the State Game Commission. Activities at CHAAP currently are limited to maintenance operations, leasing of property for agriculture, leasing of buildings for storage and industrial operations (i.e., CRS) and wildlife management.

2.2.2 Histories of Areas of Concern Designated as OU2

Administration and Base Housing Areas: Past site activities at the ABHA have not been well documented. Records indicate that other than administration and housing facilities, there was a hospital, cafeteria, and trap shooting facility. Adjacent to the administration area is a small fenced area used by the U.S. Air Force as a satellite tracking station.

Abandoned Burn Area: Available documentation on the ABA suggests that this area was only used for a short time and that only small-scale disposal or burning operations may have been conducted. Unexploded ordnance (UXO) screening of the area found minimal evidence of past burning activities. The area covering the ABA is currently leased for cultivation.

Drainage Ditches: The Railroad Drainage Channel was constructed in 1942, during initial construction of the CHAAP facility. The West and East Drainage Channels were completed in 1973. A review of engineering drawings indicates that the Railroad Drainage Channel was designed to receive runoff from the Nitrate Area, Shop Area, and Load Line 1. The West Channel received runoff from Load Line 5, a portion of Load Line 4, the Sanitary Landfill, and the eastern half of the Burning Grounds. The East Channel received runoff from Load Lines 2 and 3, and the Magazine Areas. The proposed use for the Drainage Ditches is to receive treated effluent from the OU1 groundwater extraction system.

Magazine Areas: The Magazine Areas served as the primary storage facilities for raw materials and finished ordnance during the three production periods at CHAAP. Raw materials were received at SMAG Building M-11 on rail cars and then transferred to individual magazines prior to use at the LAP facilities. Finished ordnance was transported on rail cars from the LAP facilities to NMAG Building M-4 and then transferred to individual magazines. After munitions production ceased in 1973, all of the magazines were steam cleaned to remove any explosives residue. Many of the magazines are currently leased to farmers for use as storage areas.

Miscellaneous Storage Areas: The Miscellaneous Storage Areas consist of Building I-4 and Building F-3. Building F-3 was used to store pesticide spray containers. A drainage ditch is located approximately 20 ft north and east of the building. Building I-4 is part of a group of buildings known as the Inert Storage Area.

Sewage Treatment Plants: The Northwest STP was constructed in 1944 to serve Load Lines 4 and 5 during periods of production. Use of the Northwest STP ended in 1973 when production ceased. The Southwest STP was constructed in 1942 as part of the original facility. It served the Administration Area, Staff Housing Area, and Fire and Guard Headquarters from 1942 to 1974. This system was replaced in 1974 by a circular, bentonite-lined, stabilization lagoon located adjacent to the former leaching lagoon. The new lagoon was never used.

2.2.3 Enforcement Activities

A Federal Facility Agreement (FFA) was signed between the U.S. Army, USEPA and the NDEQ (effective September 4, 1990) to set terms for the RI/FS effort. The FFA provided the terms, listed documents to be generated, and established target dates for delivery of reports. This ROD is being conducted in accordance with the terms outlined in the FFA.

Prior to the FFA, numerous environmental studies had been conducted at CHAAP and in the surrounding area to assess and delineate contamination. As part of the U.S. Army's Installation Restoration Program, USATHAMA conducted an Installation Assessment of CHAAP in 1980. Following the Installation Assessment, USATHAMA conducted a Production Records Review to determine past disposal activities and sites, and to quantify the materials disposed of at each location.

From 1989 through 1991, USATHAMA conducted an Excessing Assessment (EA) to determine the existence of or potential for environmental contamination and to assess human health and environmental risks associated with excessing the installation. From 1982 through 1986, various investigations were performed on the facility to determine the contamination present at the various AOCs. The information gathered in these studies was summarized in a Site Characterization Document (SCD) in 1993 by USATHAMA. Following this, a Public Health Evaluation was performed by Life Systems, Inc. to determine the effects of the contamination on the exposed and potentially exposed human population and to evaluate the potential public health impacts associated with the proposed remedial alternatives for the site.

In accordance with the FFA, an Interim ROD was approved for OU1 groundwater in 1994. In 1996, a Remedial Investigation (RI) was completed for all of CHAAP. An addendum to the RI was prepared for OU2. Based on the decision that the future land use of AOCs in OU2 would be industrial, the addendum presented evidence that that for AOCs designated as OU2 (1) do not contain contamination or (2) contain contaminants, but at concentrations that are below calculated risk-based cleanup levels for soil and Maximum Contaminant Levels (MCLs) for groundwater. Based on the evaluation of the OU2 RI Addendum, a Proposed Plan for no further action/no response action was prepared to solicit comments from stakeholders and the public. No comments were received from stakeholders or the public on the Proposed Plan for no further action/no response action for areas of concern designated as OU2. It should be noted that if the land use or exposure assumptions change for the OU2 AOCs, the Army will reevaluate the decision to take no action. Furthermore, five-year reviews will be conducted to ensure that the decision of no further action/no response action is protective of human health and the environment.

The following documents provide details of the site investigations and assessments of cleanup action for Operable Unit Two.

- USAEC, 1996. Cornhusker Army Ammunition Plant Remedial Investigation/Feasibility Study Operable Unit Two Remedial Investigation Addendum, Final Document. Prepared by USAEC.
- USAEC, 1996. Cornhusker Army Ammunition Plant Remedial Investigation, Final Document. Prepared by USAEC.
- USATHAMA, 1986. Installation Restoration Program, Cornhusker Army Ammunition Plant, Site Characterization Document, Report AMXTH-IR-86086. Prepared by U.S. Army Toxic and Hazardous Materials Agency, Aberdeen Proving Ground, Maryland.
- USATHAMA, 1980a. Installation Assessment of Cornhusker Army Ammunition Plant, Report 155. March 1980.

2.3 HIGHLIGHTS OF COMMUNITY PARTICIPATION

The Proposed Plan for Operable Unit Two was released to the public in March 1997 at the information repositories listed below:

CHAAP
102 North 60th Street
Grand Island, NE 68802

Grand Island Public Library
211 North Washington Street
Grand Island, NE 68802
(308)381-5333

The notice of availability of these documents was published on March 3, 1997 in the *Grand Island Independent.* A public comment period was held from March 3, 1997 through April 2, 1997. A public meeting was held at the community room of Grand Island City Hall on March 11, 1997 to inform the public about the preferred remedial alternative for OU2 and to seek public comments. At this meeting, representatives from the U.S. Army, USEPA, and NDEQ were present to answer questions about the site and remedial alternatives under consideration. No comments were received by the Army, NDEQ, or USEPA on the No Further Action/No Response Action Proposed Plan for OU2 at CHAAP.

2.4 SUMMARY OF SITE RISKS

2.4.1 Human Health Risks

A human health risk assessment (HHRA) was performed as part of the 1996 RI (refer to Section 6.0 of the 1996 RI) for CHAAP. However, a streamlined approach was used to determine site risks. In cooperation with the Center for Health Promotion and Preventative Medicine (CHPPM), the EPA, and the NDEQ, the decision was made to perform the HHRA for the three worst contaminated sites at CHAAP (i.e., Pistol Range, Load Line 1, and the Burning Grounds). The results indicate that the risks from carcinogenic chemicals of potential concern (COPCs), associated with exposure to soils were within the target risk range for health protectiveness at Superfund sites of $1x10^{-4}$ to $1x10^{-6}$. For noncarcinogenic COPCs, hazard indices (HIs) associated with exposures to surface soil were not above one (with one exception for hypothetical future child residents at the Burning Grounds). Hazard indices associated with exposures to subsurface soil were all below one. For groundwater, only the explosives plume was associated with an unacceptable risk. The explosives plume is addressed in the OU1 interim ROD.

For the other areas at CHAAP (e.g., OU2), COPCs were identified. Because the HHRA could not directly be applied to OU2, the Army calculated risk-based cleanup levels for those site -specific COPCs based on future land use (i.e., industrial). For groundwater, COPCs were compared to MCLs. Comparison of site characterization data to those risk-based cleanup criteria was used to determine whether or not a remedial alternatives analysis was required. The HHRA is discussed below in greater detail.

The first component of the HHRA was the identification of COPCs[1] for each AOC. COPCs were selected based on an evaluation of data, a comparison of site and background concentrations for inorganic chemicals, and a concentration toxicity screening evaluation for noncarcinogenic chemicals. COPCs are presented in **Tables 1, 2 and 3** for surface soil, subsurface soil, and groundwater, respectively.

[1] COPCs in surface and subsurface soil were selected on an AOC-specific basis (thus COPCs were determined specifically for OU2), whereas groundwater COPCs were selected based on facility-wide contamination. It should be noted that because groundwater COPCs were not identified on an AOC-specific basis (they were identified on a facility-wide basis), groundwater COPCs were not necessarily associated with OU2.

TABLE 1: CHEMICALS OF POTENTIAL CONCERN IN SURFACE SOIL (0-2 ft bgs) FOR HUMAN RECEPTORS AT OU2[1]				
Abandoned Burning Area	Magazine Areas	Sewage Treatment Plants	Miscellaneous Storage Areas	Major Drainage Ditches
Cadmium	2,4,6-TNT Silver	RDX Benzo(a)anthracene Benzo(a)pyrene Benzo(b)fluoranthene Benzo(k)fluoranthene Chrysene Dibenz(a,h)anthracene Indeno(1,2,3-c,d)pyrene Arsenic Cadmium Chromium Copper Lead Mercury Silver	Benzo(a)pyrene Benzo(b)fluoranthene Benzo(k)fluoranthene alpha-Chlordane gamma-Chlordane DDD DDE DDT Lead Mercury	DDT Aluminum Cadmium Chromium Copper Iron Lead Mercury Silver Vanadium

[1] - No COPCs were selected in surface soil at the Administration and Base Housing Areas

TABLE 2: CHEMICALS OF POTENTIAL CONCERN IN SUBSURFACE SOIL (>2 ft bgs) FOR HUMAN RECEPTORS AT OU2[1]			
Abandoned Burning Area	Magazine Areas	Sewage Treatment Plants	Miscellaneous Storage Areas
Aluminum Barium Chromium Copper Iron Manganese Vanadium	Chromium	Aluminum Barium Chromium Copper Iron Manganese Silver Vanadium	2,4-D

[1] - No COPCs were selected in subsurface soil at the Administration and Base Housing Areas or Major Drainage Ditches

TABLE 3: CHEMICALS OF POTENTIAL CONCERN IN GROUNDWATER AT CHAAP
3,5-Dinitroaniline
2-Amino-4,6-dinitrotoluene
4-Amino-2,6-dinitrotoluene
2,4-Dinitrotoluene
2,6-Dinitrotoluene
RDX
1,3,5-Trinitrobenzene
2,4,6-Trinitrotoluene
Acrylonitrile
Benzene
Benzo(a)anthracene
Chrysene
1,2-Dichloroethane
bis(2-Ethylhexyl)phthalate
Indeno(1,2,3-c,d)pyrene
Methylene chloride
1,1,2-Trichloroethane
Trichloroethylene
1,2,3-Trichloropropane
1,1,2-Trifluoro-1,2-dichloroethane
Antimony
Beryllium

Excess lifetime cancer risks were calculated in the Risk Characterization. These risks are probabilities that are generally expressed in scientific notation (e.g., $1x10^{-6}$). An excess lifetime cancer risk of $1x10^{-6}$ indicates that an individual has a one in one million chance of developing cancer over a 70-year lifetime as a result of site-related exposure to a carcinogen over a 70-year lifetime under the specific exposure conditions assumed in the HHRA. Site risks are generally compared to the target risk range for health protectiveness at Superfund sites of $1x10^{-4}$ to $1x10^{-6}$.

The potential for adverse noncarcinogenic effects to occur due to exposures to contaminants is expressed as the hazard index (HI). The HI provides a useful reference point for gauging the potential for noncarcinogenic effects to occur, and HIs above 1.0 indicate the potential for adverse effects, whereas HIs below 1.0 indicate that noncarcinogenic adverse effects would not likely occur.

Quantitative risk calculations were performed for the three worst contaminated AOCs at CHAAP (i.e., Load Line 1, Burning Grounds, and the Pistol Range). Excess lifetime cancer risks associated with exposures to chemicals in surface soil at Load Line 1, the Burning Grounds, and the Pistol Range ranged from lower than to the mid-point of the $1x10^{-6}$ to $1x10^{-4}$ target risk range for both current trespassers and potential future agricultural residents; HIs associated with exposures to surface soil were not above one (with one exception for hypothetical future child residents at the Burning Grounds). Because concentrations at OU2 were generally lower than concentrations at these three AOCs, risks associated with surface soil exposures at OU2 would similarly be lower than those calculated for the three AOCs quantitatively evaluated in the HHRA.

Risks associated with exposures to subsurface soil were determined only for Load Line 1 and the Pistol Range. Excess lifetime cancer risks associated with exposures to chemicals in subsurface soil at these AOCs were lower than or equal to $1x10^{-6}$ for excavation workers; HIs associated with exposures to subsurface soil were lower than one, indicating adverse noncarcinogenic effects would not likely occur. Because concentrations at OU2 were generally lower than concentrations at these two AOCs, risks associated with subsurface soil exposures at OU2 would similarly be lower than those calculated for the AOCs quantitatively evaluated in the HHRA.

The results of the HHRA indicated that for groundwater, only the explosives plume (addressed in the OU1 interim ROD) was associated with an excess lifetime cancer risk above the $1x10^{-4}$ risk level for future agricultural residents drinking and dermally absorbing COPCs in groundwater. Noncarcinogenic adverse effects associated with explosives in groundwater could be possible for future agricultural residents if groundwater ingestion and dermal exposure to explosives were to occur under the conditions assumed in the HHRA.

With consent from the CHPPM, NDEQ, and USEPA, the Army calculated risk-based cleanup goals for COPCs in soil based on exposure to industrial workers, since the site is likely to remain in its industrial status in the future. Concentrations of COPCs that were selected in the HHRA for OU2 were compared to calculated risk-based industrial cleanup levels for soil to determine whether remediation of soil would be necessary. For groundwater, the Army compared concentrations of COPCs with Federal Maximum Contaminant Levels (MCLs), Nebraska Groundwater Standards, or calculated risk-based industrial drinking water cleanup levels if MCLs or State standards were not available. Soil and groundwater cleanup levels are discussed and presented in **Section 2.5**.

2.4.2 Ecological Risks

An ecological risk assessment (ERA) was performed as part of the 1996 RI. The purpose of this ERA was to identify those chemicals present in soil, surface water, and sediment at CHAAP that had the potential to harm ecological receptors (i.e., plants and animals). However, only surface soil chemicals were evaluated in OU2 because surface water and sediment are not present. The receptor species and/or groups that were selected for quantitative evaluation in OU2 include: terrestrial plants, earthworms, deer mouse, deer, and American robin.

Results of the ERA indicate that concentrations in many of the OU2 surface soil areas were above Toxicity Reference Values (TRVs) (i.e., guidelines that represent levels that are protective of terrestrial plants, earthworms, deer mouse, and American robin). Therefore, there is potential for adverse effects to individual plants and earthworms. However, risks associated with exposures to chemicals in surface soil at OU2 should be considered an overestimation because the areas that specifically comprise OU2 are generally considered to have poor quality habitat due to past and present uses (i.e., industrial operations) and/or abundance of manmade structures. As a result of the poor quality habitat, extensive use of these areas by terrestrial receptors is not expected. This is especially true for the Magazine Areas and Miscellaneous Storage Areas.

In addition, terrestrial receptors would more likely occur in areas adjacent to sites evaluated at OU2, such as cropland or shelterbelt areas, where the habitat quality is better, food is more plentiful, and chemical

contamination may be minimal or nonexistent. Given the habitat limitations of the areas in OU2, the actual risks to populations of terrestrial receptors are considered to be less than those calculated. As a result, the concentrations of COPCs are not risk drivers. Therefore, cleanup levels for OU2 based upon protection of ecological receptors were not calculated.

2.5 CLEANUP LEVELS

Cleanup levels for soil were calculated for the COPCs identified in the HHRA (see **Section 2.4**). Soil cleanup levels were calculated to be protective of workers in an industrial use scenario (see **Appendix A**). Federal MCLs, Nebraska Groundwater Standards, and calculated industrial drinking water cleanup levels were used as cleanup goals for groundwater. Where an MCL was not available, a cleanup level from one of the other sources was used. The basis for no further action/no response action for groundwater associated with OU2 is that concentrations of COPCs in samples collected from OU2 AOC monitoring wells were below Federal MCLs, Nebraska Groundwater Standards, and calculated risk-based industrial cleanup levels. **Tables 4** and **5** present the cleanup levels for COPCs detected in OU2 soil and CHAAP groundwater, respectively.

TABLE 4: CLEANUP LEVELS FOR SOIL COPCs (µg/g) AT CHAAP

Chemical	USEPA Region III Residential RBCs (µg/g)	Calculated Industrial Risk-Based Levels (µg/g)*
Aluminum	78,000	1,000,000
Arsenic	0.43	3.82
Barium	5,500	143,080
Benzo(a)anthracene	0.88	78.4
Benzo(a)pyrene	0.088	7.8
Benzo(b)fluoranthene	0.88	7.8
Benzo(k)fluoranthene	8.8	784
Cadmium	39	2,044
alpha-Chlordane	0.49	4.4
gamma-Chlordane	0.49	4.4
Chromium	390	10,220
Chrysene	88	784
Copper	3,100	75,628
2,4-D	780	--
DDD	2.7	17
DDE	1.9	17
DDT	1.9	17
Dibenz(a,h)anthracene	0.088	7.8
Indeno(1,2,3-c,d)pyrene	0.88	7.8
Iron	23,000	613,200
Lead	--	1,620
Manganese	1,800	49,056
Mercury	23	613
Silver	390	10,220
RDX	5.8	520
2,4,6-TNT	21	191
Vanadium	550	14,308

-- = Standard not developed for this chemical because the USEPA Region III Residential RBC was not exceeded.
* - For carcinogens, concentrations are associated with a risk of $1x10^{-6}$; for noncarcinogens, concentrations are associated with a hazard index of 1.0.

TABLE 5: CLEANUP LEVELS FOR GROUNDWATER COPCs (µg/L) AT CHAAP

Chemical	Federal Maximum Contaminant Levels (µg/L)	Calculated Industrial Risk-Based Levels (µg/L)	Nebraska Groundwater Standards (µg/L)
2-Amino-4,6-Dinitrotoluene	--	6.1	--
4-Amino-2,6-Dinitrotoluene	--	6.1	--
Antimony	6	--	--
Acrylonitrile	--	0.53	--
Benz[a]anthracene	0.1	--	--

TABLE 5: CLEANUP LEVELS FOR GROUNDWATER COPCs (µg/L) AT CHAAP			
Chemical	Federal Maximum Contaminant Levels (µg/L)	Calculated Industrial Risk-Based Levels (µg/L)	Nebraska Groundwater Standards (µg/L)
Benzene	5	--	5
Beryllium	4	--	--
Chrysene	0.2	--	--
2,4-Dinitrotoluene	--	0.42	--
2,6-Dinitrotoluene	--	0.42	--
1,2-Dichloroethane	5	--	5
Bis(2-Ethylhexyl) phthalate	6	--	--
HMX	--	5,110	--
Indeno (1,2,3-c,d)pyrene	0.4	--	--
Methylene chloride (dichloromethane)	5	38	--
Nitrobenzene	--	51	--
2-Nitrotoluene	--	1,022	--
3-Nitrotoluene	--	1,022	--
4-Nitrotoluene	--	1,022	--
RDX	--	2.6	--
1,3,5-Trinitrobenzene	--	5.1	--
2,4,6-Trinitrotoluene	--	9.5	--
1,1,2-Trichloroethane	5	--	--
Trichloroethene	5	--	5
1,2,3-Trichloropropane	--	0.041	--
Tetryl	--	1,022	--
1,3-Dinitrobenzene	--	10	--

-- = Standard not developed for this chemical.

2.6 SUMMARY AND FINDINGS OF SITE INVESTIGATION AT OU2

Based on the RI results, OU2 has been determined to require no further remedial action. Provided below is the sampling program and nature and extent of COPCs detected at each of the six AOCs designated as OU2.

The Administration and Base Housing Areas (ABHA): The sampling program at the ABHA included surface soil sampling for the 1991 EA, surface soil sampling for the 1993 SCD, and surface soil and groundwater sampling for the 1996 RI. No COPCs were selected in this area during the 1996 RI.

The Abandoned Burning Area (ABA): The sampling program at the ABA included a geophysical survey for the 1991 EA, and surface soil, subsurface soil, and groundwater sampling for the 1996 RI. No COPCs were detected above calculated risk-based industrial cleanup levels and MCLs (for groundwater) during the 1996 RI field effort.

Drainage Ditches: The sampling program at the Drainage Ditches included surface soil sampling for the 1993 SCD and 1996 RI. No further remedial action is recommended at this site because all COPCs detected in the sampling effort for the 1996 RI were below USEPA Region III Residential RBCs [chemical concentrations corresponding to fixed levels of risk, (i.e., a hazard quotient of one or a lifetime cancer risk of $1x10^{-6}$, whichever occurs at a lower concentration)] with the exception of iron. A soil sample collected from the west drainage channel contained iron at a concentration far below the calculated risk-based industrial cleanup level.

Magazine Areas: The sampling program at the Magazine Areas (NMAG and SMAG) included surface soil sampling for the 1991 EA, annual surface soil sampling for the 1993 SCD, and surface soil sampling and subsurface soil sampling (NMAG only) for the 1996 RI. Explosives compound 246-TNT (29 µg/g) was detected in a sample collected during the 1993 SCD effort from the Building M-4 loading area at the North Magazine Area. The concentration slightly exceeds the USEPA Region III Residential RBC of 21 µg/g but

is below the calculated risk-based cleanup level of 191 µg/g. The area was resampled in 1995 and 246-TNT was not detected. At the South Magazine Area, no COPCs were detected above the USEPA Region III Residential RBCs. Therefore, no further remedial action is recommended at this location.

Miscellaneous Storage Areas: The sampling program at the Miscellaneous Storage Areas included limited surface soil sampling for the 1991 EA, surface soil sampling and subsurface soil sampling for the 1993 SCD, and interior building wipe sampling and groundwater sampling for the 1996 RI. No COPCs exceeded calculated risk-based industrial cleanup levels in surface soil samples and no COPCs, pesticides, or herbicides were detected in groundwater samples from downgradient wells in any of the sampling events.

Sewage Treatment Plants (STPs): The sampling program at the STPs included: surface and subsurface soil sampling for the 1993 SCD; and surface soil, subsurface soil, and groundwater sampling for the 1996 RI. Arsenic was detected in surface soil samples during the 1996 sampling effort for the RI above the calculated risk-based industrial cleanup level that is associated with a $1x0^{-6}$ risk (3.82 µg/g). However, the maximum concentration of arsenic (11.7 µg/g) detected was below the upper range of regional background (12 µg/g) and the risk-based cleanup level that is associated with a $1x10^{-5}$ risk (38.2 µg/g). Furthermore, no other COPCs exceeded the calculated risk-based industrial cleanup level. No COPCs were detected in groundwater samples above their respective MCLs.

2.7 CONCLUSIONS

The Sewage Treatment Plants were the only areas of concern where a COPC (arsenic in soil) exceeded the calculated risk-based industrial cleanup level that is associated with a risk of $1x10^{-6}$. It should be noted that the concentrations of arsenic detected were below the upper range of regional background and the risk-based cleanup level that is associated with a $1x10^{-5}$ risk (38.2 µg/g). Based on the minimal levels of contamination present in soil and the lack of contamination in groundwater, the Army proposed No Further Action/No Response Action as the preferred alternative for AOCs designated as OU2.

2.8 DESCRIPTION OF THE "NO FURTHER ACTION/NO RESPONSE ACTION"

The preferred alternative to protect human health, welfare, and the environment at the OU2 AOCs is not a remedial action. No significant risks are associated with exposures to contamination at OU2. Therefore, the no further action/no response action is adequate to protect human health and the environment and meets the requirements for both short-term and long-term effectiveness and permanence set forth in the NCP. The no further action/no response action does not lessen the toxicity, movement, or amounts of contamination. However, the concentrations of contaminants found in the surface soil are not sufficiently toxic, mobile, or concentrated to warrant a remedial action. A five-year review will be conducted to ensure that the decision of no further action/no response action is protective of human health and the environment.

2.9 EXPLANATION OF SIGNIFICANT CHANGES

The Proposed Plan presents the selected remedy as the preferred alternative. No significant changes have been made.

3.0 RESPONSIVENESS SUMMARY

The final component of the ROD is the Responsiveness Summary. The purpose of the Responsiveness Summary is to provide a summary of the public's comments, concerns, and questions about the AOCs at OU2 and the Army's responses to these concerns. The public comment period extended from March 3, 1997 to April 2, 1997. During the public comment period, no written comments, concerns, and questions were received by CHAAP, USEPA, and NDEQ.

CHAAP held a public meeting on March 11, 1997 to formerly present the Proposed Plan and to answer questions and receive comments. The transcript of this meeting is part of the administrative record for the site. No comments were received by the Army, NDEQ, or the USEPA on the Proposed Plan for OU2 at CHAAP.

3.1 OVERVIEW

At the time of the public comment period, the Army had endorsed a preferred alternative of no further action/no response action at OU2. The USEPA and the NDEQ support the Army's plan.

3.2 SUMMARY OF COMMENTS RECEIVED DURING THE PUBLIC COMMENT PERIOD AND AGENCY RESPONSES

No comments were received by the Army, NDEQ, or the USEPA on the Proposed Plan for OU2 at CHAAP.

4.0 REFERENCES

U.S. Army Environmental Center (USAEC). November, 1996. Cornhusker Army Ammunition Plant Remedial Investigation/Feasibility Study Operable Unit Two Remedial Investigation Addendum, Final Document.

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APPENDIX A : METHODOLOGY FOR CALCULATING COPC CLEANUP LEVELS

Risk-based cleanup levels were calculated for COPCs selected for evaluation in the CHAAP HHRA. As noted earlier, COPCs were selected based on a concentration-toxicity screening for non-carcinogenic chemicals and a comparison to background concentrations for inorganic chemicals. In accordance with USEPA Region VII and NDEQ, cleanup levels were based on exposures by industrial workers at the site.

The following sections present the equations that were used to calculate risk-based cleanup levels for surface and subsurface soil and for groundwater. Equations for calculating risk-based cleanup levels are presented separately for chemicals exhibiting carcinogenic and non-carcinogenic effects.

Surface and Subsurface Soil Cleanup Levels

The equation used to calculate worker cleanup levels for chemicals exhibiting carcinogenic effects is as follows:

$$C_s = \frac{TR * BW * AT_c * DAYS}{IR * EF * ED * CF} * \frac{1}{CSF_o}$$

where:

C_s	=	chemical concentration in soil (mg/kg),
TR	=	target excess individual lifetime cancer risk ($1x10^{-6}$),
BW	=	body weight (70 kg),
AT_c	=	averaging time for carcinogenic effects (70 years),
DAYS	=	conversion factor (365 days/year),
IR	=	soil ingestion rate (50 mg/day),
EF	=	exposure frequency (250 days/year),
ED	=	exposure duration (25 years),
CF	=	conversion factor ($kg/10^6$ mg), and
SF_o	=	oral cancer slope factor ($[mg/kg-day]^{-1}$).

The equation used to calculate worker cleanup levels for chemicals exhibiting non-carcinogenic effects is:

$$C_s = \frac{THQ * BW * AT_{nc} * DAYS}{IR * EF * ED * CF} * RfD_o$$

where:

C_s	=	chemical concentration in soil (mg/kg),
THQ	=	target hazard quotient (1),
BW	=	body weight (70 kg),
AT_{nc}	=	averaging time for carcinogenic effects (25 years),
DAYS	=	conversion factor (365 days/year),
IR	=	soil ingestion rate (50 mg/day),
EF	=	exposure frequency (250 days/year),
ED	=	exposure duration (25 years),
CF	=	conversion factor ($kg/10^6$ mg), and
RfD_o	=	oral reference dose (mg/kg-day).

The target risk and hazard quotient were assumed to be a level of $1x10^{-6}$ for carcinogens and a level of 1.0 for non-carcinogens. The toxicity criteria (i.e., cancer slope factors and non-cancer reference doses) were obtained from IRIS or HEAST. Exposure parameters for workers that were obtained from USEPA (**USEPA, 1991**) included the body weight, averaging time, soil ingestion rate, exposure frequency, and exposure duration.

Groundwater Cleanup Levels

If COPCs did not have an applicable MCL, risk-based groundwater cleanup levels were calculated. The equation used to calculate worker groundwater cleanup levels for chemicals exhibiting carcinogenic effects is as follows:

$$C_{gw} = \frac{TR * BW * AT_c * DAYS * CF}{IR * EF * ED} * \frac{1}{CSF_o}$$

where:

C_{gw} = chemical concentration in groundwater (µg/L),
TR = target excess individual lifetime cancer risk ($1x10^{-6}$),
BW = body weight (70 kg),
AT_c = averaging time for carcinogenic effects (70 years),
DAYS = conversion factor (365 days/year),
CF = conversion factor (10^3 µg/mg),
IR = groundwater ingestion rate (1 L/day),
EF = exposure frequency (250 days/year),
ED = exposure duration (25 years), and
SF_o = oral cancer slope factor ($[mg/kg-day]^{-1}$).

The equation used to calculate worker groundwater cleanup levels for chemicals exhibiting non-carcinogenic effects is:

$$C_{gw} = \frac{THQ * BW * AT_{nc} * DAYS * CF}{IR * EF * ED} * RfD_o$$

where:

C_{gw} = chemical concentration in groundwater (µg/L),
THQ = target hazard quotient (1),
BW = body weight (70 kg),
AT_{nc} = averaging time for carcinogenic effects (25 years),
DAYS = conversion factor (365 days/year),
CF = conversion factor (10^3 µg/mg),
IR = groundwater ingestion rate (1 L/day),
EF = exposure frequency (250 days/year),
ED = exposure duration (25 years), and
RfD_o = oral reference dose (mg/kg-day).

The target risk and hazard quotient were assumed to be a level of $1x10^{-6}$ for carcinogens and a level of 1.0 for non-carcinogens. The toxicity criteria (i.e., cancer slope factors and non-cancer reference doses) were obtained from IRIS or HEAST. Exposure parameters for workers that were obtained from USEPA (**USEPA, 1991**) included the body weight, averaging time, water ingestion rate, exposure frequency, and exposure duration.