RECORD OF DECISION

PESTICIDE STORAGE FACILITY

OPERABLE UNIT 002

FORT RILEY, KANSAS

SEPTEMBER 1997

PSF 7 1 001

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

ATTACHMENT

1.0 DECLARATION

SITE NAME AND LOCATION

Pesticide Storage Facility, Operable Unit 002
Federal Facility Site - Fort Riley, Kansas

STATEMENT OF BASIS AND PURPOSE

This Record of Decision document presents the selected remedial action for the Pesticide Storage Facility, Operable Unit 002, at Fort Riley, Kansas, chosen in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA), as amended by the Superfund Amendments and Reauthorization Act of 1986 (SARA), and to the extent practicable, the National Oil and Hazardous Substances Pollution Contingency Plan (NCP). This decision is based on the Administrative Record for the site.

This remedy was chosen by the Department of the Army and Fort Riley, in consultation with the United States Environmental Protection Agency, Region VII (USEPA) and the Kansas Department of Health and Environment (KDHE). The State of Kansas concurs with the selected remedy via a letter of concurrence.

DESCRIPTION OF THE SELECTED REMEDY

The selected remedy for the Pesticide Storage Facility, Operable Unit 002, at Fort Riley is No Further Action. A Removal Action in which contaminated soils were excavated, transported, and disposed off-site was completed in 1994. Based upon current and projected industrial land use at the site and the populations that may be exposed to site contamination, it has been determined that the site does not pose a significant threat to public health, welfare, and the environment.

If a significant change in land use at the PSF is proposed by Fort Riley, or if any portion of the site property is transferred or leased to a non-government entity, Fort Riley will notify Region VII of the U.S. Environmental Protection Agency (EPA) and the Kansas Department of Health and Environment (KDHE) in writing of the proposed change in land use or transfer of lease of the property or a portion of the property. If the change in land use is determined to be a major change in land use, a reevaluation of the remedy decision will be required. Depending upon the nature of the transfer or lease of the site property, EPA and/or KDHE may require Fort Riley to reconsider the no further action decision selected in this Record of Decision, which may require the implementation of additional response actions, including institutional controls, prior to the transfer or lease of site property.

DECLARATION STATEMENT

At this time, no further remedial action is necessary for Operable Unit 002, the Pesticide Storage Facility to ensure protection of human health and the environment. Section 300.430(f) (4) (ii) of the National Oil and Hazardous Substances Pollution Contingency Plan (NCP) states that if a remedial action is selected that results in hazardous substances, pollutants or contaminants remaining at a site above levels that allow for unlimited use and unrestricted exposure, the lead agency shall review such action no less often than every five years after initiation of the selected remedial action. Although the decision reached in the Record of Decision is no further action, this decision is based upon current and reasonably projected land use and exposures. However, hazardous substances, pollutants or contaminants may remain at the site above levels that would allow for unlimited use and unrestricted exposure. Therefore, the five year review will apply to this site.

LEAD AND SUPPORT AGENCY ACCEPTANCE OF THE RECORD OF DECISION, OPERABLE UNIT 002, PESTICIDE STORAGE FACILITY FT. RILEY, KANSAS

Signature Sheet for Record of Decision for Operable Unit 002, Pesticide Storage Facility, Fort Riley, Kansas, Final Action.

Helen McHugh
Colonel Kent D. Thomas
Garrison Commander, Fort Riley
United States Department of the Army

26 Sep 97
Date

for N/A Searcy
Dennis Grams, P.E.
Regional Administrator
U.S. Environmental Protection Agency - Region VII

SEP 29 1997
Date

2.0 DECISION SUMMARY

2.1 SITE NAME, LOCATION, AND DESCRIPTION

Pesticide Storage Facility, Operable Unit 002
Fort Riley, Kansas

Fort Riley (the installation) is situated along the north bank of the Kansas and Republican Rivers in Riley and Geary counties in north-central Kansas (Figure 2-1). The installation is comprised of approximately 101,000 acres. It lies within the Osage Plains section of the Central Lowlands physiographic province. The general topography around Fort Riley consists of plains incised by steep drainage features. Terrain on the installation varies among the following features: (1) narrow, alluvial bottomlands and wide, meandering floodplains and associated terraces along the Republican and Kansas Rivers; (2) steep slopes and hilly relief; and (3) flat-lying or slightly dipping uplands.

The Pesticide Storage Facility (PSF) site (the site) is situated on a terrace on the north side of the Kansas River Valley, approximately 2,000 feet north and west of the Kansas River. The PSF site covers about 2/3 of an acre around Building 348 and is located in the Main Post Area. The area of investigation is indicated on Figure 2-2. The site includes a portion of the Public Works (formerly Directorate of Engineering and Housing [DEH]) Storage Yard, which is surrounded by a fence and has secured access. The site extends south of Dickman Avenue to the south-central edge of the Main Post cantonment area and southeast across the railroad tracks. The entire site is within a zone designated as Industrial use in the Fort Riley Master Plan. (See attached Main Post area land use zone map.) Topographic elevations at the site are about 25 feet higher than the Kansas River. The ground surface east of the Building 348 fence slopes downward toward the east-southeast at a grade of approximately 10 percent. There is an abrupt slope change just east of the PSF fence line.

Surface run-off across the site generally flows east - southeast as sheet flow, following the topography of the site. After flowing around Buildings 345, 346, 347, and 348, the surface run-off is directed to a 12-inch corrugated metal pipe culvert that discharges via overland drainage into the rock-lined channel east of the yard area. The lined drainage ditch runs from Dickman Avenue to the railroad tracks southeast of the site. The sides of the drainage ditch are constructed of cemented limestone blocks. Surface run-off in this channel proceeds southward under the railroad tracks and then flows into an unnamed tributary leading to the Kansas River.

2.2 SITE HISTORY AND REMEDIAL ACTIVITIES

Fort Riley was established in 1852, as an outpost near the confluence of the Republican and Smoky Hill Rivers. Since its inception, Fort Riley has continually served as a major center of military education and readiness, at times including a population of more than 20,000 military residents and civilian employees. The Fort Riley reservation historically has functioned both as a small municipality and light industrial complex. Solid waste disposal (landfilling), wastewater treatment and discharge, facilities maintenance and construction, pesticide and herbicide usage, and electrical equipment installation, storage, and repair, are among the environmentally significant activities at Fort Riley. Fort Riley's function as a military training, equipment supply, and maintenance center historically has required management and disposal of wastes associated with these activities.

Building 348 was constructed in 1941 as a general purpose warehouse. Fort Riley records do not indicate when pesticides were first stored in Building 348. However, interviews with Fort Riley personnel reveal that Building 348 had been used for pesticide storage since at least 1973. Prior to the late 1970s, the maintenance/storage yard east of and adjacent to Building 348 was used to wash down vehicles and spray equipment used for pesticide applications. Since at least 1976, the majority of pesticide application at Fort Riley has been performed by outside contractors who were not allowed to use the PSF site. During 1988, several polychlorinated biphenyl (PCB)-containing electrical transformers were stored in containers outside the southeast corner of Building 348. Other items previously stored at the PSF site include paint, pesticides/herbicides, pressure-treated lumber, and various general improvement materials and equipment.

Pursuant to Section 105 of the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA), as amended by the Superfund Amendments and Reauthorization Act of 1986 (SARA), Fort Riley was proposed for inclusion on the National Priorities List (NPL) on July 14, 1989. There are currently five identified Operable Units (OUs) at Ft. Riley. Two sites (MPLF) at Fort Riley, the PSF site and Southwest Funston Landfill, were combined by the U.S. Environmental Protection Agency (USEPA) as one site for purposes of Hazard Ranking System (HRS) scoring. The USEPA reasoned that both contaminant sources potentially affect the same shallow aquifer and target populations. The installation was placed on the NPL as of October 1990, with a combined score of 33.79 on the HRS. (A HRS score of 28.5 is needed for inclusion on the NPL.)

The Department of the Army - Fort Riley, the USEPA Region VII, and the State of Kansas Department of Health and Environment (KDHE) negotiated a Federal Facilities Agreement (FFA) for Fort Riley, Docket No. VII-90-F-0015, also referred to as the Interagency Agreement (IAG), which became effective on June 28, 1991. The FFA specifically requires that the PSF site be addressed through the Remedial Investigation/Feasibility Study (RI/FS) process. Consistent with the National Contingency Plan (NCP) §300.415, the FFA also allows the Army to perform Removal Actions concurrent with RI/FS activities. The following documents were prepared in accordance with the FFA:

- RI Report (December 1993)
- Removal Action Engineering Evaluation/Cost Analysis Report (EE/CA) (August 1993)
- Removal Action Memorandum (December 1993)
- RI Addenda (June 1997)
- Proposed Plan (July 1997)

Site contamination at the PSF site was first revealed by Army pesticide use monitoring studies conducted prior to 1990. Fort Riley initiated planning of the RI/FS in 1990 during the development of the FFA. Field activities began in the early spring of 1992. The results of the RI and a Baseline Risk Assessment (BLRA) were presented in the RI Report.

Concurrent with the performance of the RI and BLRA activities, the opportunity to perform a non-time-critical Removal Action addressing contaminated soils was recognized. An EE/CA was performed to: (1) determine if a Removal Action was appropriate to protect human health and the environment; (2) identify, evaluate, and recommend options for a Removal Action which could be incorporated into a permanent solution to remediate the site; and (3) develop a remedy that meets the occupational safety and health requirements of site workers and allows continuing use of the site.

The public comment period for the EE/CA was held August 17, through September 16, 1993. A public meeting was held at Fort Riley on September 7, 1993. No comments were received during the public comment period. Subsequent to the finalization of the EE/CA, the Removal Action Memorandum was signed. The Action Memorandum Decision was to excavate and dispose of contaminated soil off-site. The USEPA and KDHE concurred with the Removal Action.

The initial Removal Action Goals (goals), presented below, were generated from exposure scenarios for future site workers developed in the BLRA. These goals were extremely conservative, as they were based on a carcinogenic risk level of 10^{-6} and the assumption that 100 percent of the chemical in contact with the skin would be absorbed. Additional exploratory sampling of the site revealed a greater than anticipated area of contamination based on the initial Removal Action Goals, a factor which would significantly increase the cost for remediation. With the exception of heptachlor, which was not a "risk driver", the Removal Action Goals for the pesticides were recalculated using more realistic dermal absorption factors. The Removal Action Goals for arsenic were revised based on results of a background study. These revised Goals are presented below.

Revised Absorption Factors and Removal Action Goals

CONSTITUENT	ACTION MEMORANDUM GOALS		REVISED GOALS	
	Absorption Factor	Removal Action Goal (mg/kg)	Absorption Factor	Removal Action Goal (mg/kg)
Chlordane	100%	0.17	10.9%	1.58
DDT, DDD, DDE	100%	0.66	37.8%	1.73
Dieldrin	100%	0.014	10.9%	0.127
Heptachlor	100%	0.050	100%	0.050
Arsenic	100%	0.12	NA	7.1[(1)]

References for absorption factors per Agency for Toxic Substances and Disease Registry (ATSDR), 1987 - 1993
NA - Not applicable
(1) - Removal Action Goal of background soil concentrations was established.

During performance of the Removal Action, the actual excavation limits were guided by sampling the sidewalls and bottom of the excavations to determine if the action levels had been met. A total surface area of less than 1/2 acre was excavated to a depth of between 1 and 8 feet below the land surface. A total of approximately 2,700 tons of excavated soils was taken to an approved off-site landfill for disposal. The excavations were backfilled to approximately their original elevations. Vegetation was reestablished to restore the site for unrestricted use as an equipment and material storage area. The Removal Action was completed in June 1994.

An RI Addenda (dated June 1997) documents the Removal Action, presents a residual risk assessment of the site, presents a statistical comparison of potential chemicals of concern in groundwater to background concentrations, and identifies applicable or relevant and appropriate requirements (ARARs) for the site. The residual risk assessment is based on concentrations remaining in the soil after the Removal Action.

The Proposed Plan (dated July 1997) described the preferred remedy for the PSF site to be No Further Action and provided the rationale for this preference. As a companion to the RI report, the Proposed Plan was provided to inform the public of Fort Riley's, USEPA Region VII's, and KDHE's preferred remedy based on the Administrative Record and solicit public comments pertaining to the preferred remedy. The Administrative Record is the set of supporting information used to determine the preferred alternative.

2.3 HIGHLIGHTS OF COMMUNITY PARTICIPATION

The RI/FS process was conducted in accordance with CERCLA requirements to document the comprehensive remedial activities and proposed remedial plan for the PSF site. Primary documents developed during the RI/FS process have been made available for public review as part of the Administrative Record file at the Fort Riley Directorate of Environment and Safety, Building 407. These reports were also made available to potentially affected persons and to the public in the following information repositories: Dorothy Bramlage Public Library, Manhattan Public Library, and Clay Center Carnegie Library.

Notices of availability of these documents and the notice for the public meeting to discuss the Proposed Plan were published in the Manhattan Mercury and the Junction City Daily Union newspapers on August 24, 25, and 26, 1997, and in the Fort Riley Post on August 29, 1997.

A public comment period for this remedial action was declared from August 24, 1997, through September 22, 1997, to provide a reasonable opportunity for comment and to disseminate information regarding the Proposed Plan.

An availability session was held at the Fort Riley community club, Riley's Restaurant and Event Center, Building 446, on September 4, 1997. At this meeting, representatives from the U.S. Army, KDHE, and USEPA were available to inform the public of the preferred alternative and to record public comments. No members of the public attended the availability session. All public participation requirements of CERCLA Sections §113(k) and §117 were met with the actions described above.

This decision document presents the selected remedial action for the PSF site, Operable Unit 002 at Fort Riley, Kansas, which was chosen in accordance with CERCLA, as amended by SARA and, to the extent practicable, the NCP. The decision for this site is based on the Administrative Record.

2.4 SCOPE AND ROLE OF OPERABLE UNIT

As with many Superfund sites, the issues at Fort Riley are complex. As a result, five OUs have been identified at the site:

- OU001 - Southwest Funston Landfill
- OU002 - Pesticide Storage Facility
- OU003 - Dry Cleaning Facility
- OU004 - Marshall Army Airfield Former Fire Training Area (MAAF-FFTA)
- OU005 - 354 Area Groundwater Solvent Detections Site

This Record of Decision addresses OU002, Pesticide Storage Facility (PSF).

The evaluation of contamination at the PSF site addressed the soils, groundwater, surface water, sediments, and air. The RI identified the nature and extent of contamination at the site, and included performance of the BLRA. Based on the BLRA, it was concluded that unacceptable risks may have existed to people working at the site, primarily from dermal contact of constituents in site soils.

The purpose of the Removal Action was to remove contaminated soils from the PSF site, thereby preventing current or future exposure to site workers. By removing soils causing excessive cumulative risk from the site, long-term protectiveness is provided under the future anticipated land use scenario. Therefore, no further remedial action is warranted for surface and subsurface soils.

The groundwater does not pose a risk to human health or the environment. No pesticides have been detected during groundwater monitoring. Concentrations of inorganics in the groundwater were statistically similar to background concentrations, or occurred below Federal Maximum Contaminant Levels (MCLs) for drinking water. In addition, no complete exposure pathway currently exists, and the potential for use of the groundwater as a potable water supply in the future is remote. Therefore, remedial action is not warranted for groundwater.

Likewise, constituent concentrations detected in site sediments, surface waters, and air do not pose unacceptable risk to human health or the environment under current and future planned land use scenarios. Therefore, remedial action is not warranted for these media.

2.5 SUMMARY OF SITE CHARACTERISTICS

Initial RI activities began in 1990, with field activities occurring in 1992 and 1993. A non-time-critical Removal Action addressing contaminated soils was performed in 1994. This section will discuss characteristics of the site by media, including the soils, groundwater, surface water, and sediments. A comparison of the extent of contamination in the soils prior to and following the Removal Action is presented.

2.5.1 Surface and Subsurface Soils

Pre-Removal Soil Characteristics

Soils were sampled during the initial RI field activities in 1992 and 1993. Surface and shallow subsurface soil samples were collected and analyzed to assess the extent of soil contamination. The primary constituents found in soils at the site consisted of: arsenic, the pesticide DDT and related compounds DDE and DDD, chlordane, dieldrin, and heptachlor. Other inorganics (such as barium, chromium, and lead) and organics (such as polynuclear aromatic hydrocarbons [PAHs]) were also detected. Additional soil samples were collected prior to the soil Removal Action to further define the extent of contamination at the site.

Areas of pesticide-contaminated soil are identified based on sample results from both the RI field activities and the removal action sampling activities. The areas are located adjacent to and east of Building 348 (Figure 2-3). Table 2-1 summarizes the analytical data for pesticides occurring in the soils prior to excavation activities. Exceedances of the Removal Action Goals were observed for several of the pesticide constituents in both surface and subsurface soils.

In the surface soils, the Removal Action Goals were exceeded by chlordane in 12 samples, dieldrin in 5 samples, heptachlor in 1 sample, and DDT and metabolites in 4 samples. Maximum concentrations of chlordane, DDT and DDT metabolites occurred within the same order of magnitude as the Removal Action Goals. The detected maximum concentrations of dieldrin and heptachlor were an order of magnitude greater than the Removal Action Goals.

Of the subsurface soil samples, chlordane exceeded Removal Action Goals in 18 samples, dieldrin in 1 sample, heptachlor in 3 samples, and DDT in 10 samples. With the exception of DDT and heptachlor, maximum concentrations of the pesticides were within the same order of magnitude as their respective Removal Action Goals. The maximum detected DDT and heptachlor concentrations were an order of magnitude greater than the Removal Action Goal.

Inorganic constituents were routinely found in detectable concentrations in both background and PSF samples collected prior to soil excavation. Elevated levels of lead were detected in 2 samples, with a maximum of 770 mg/kg at the 2- to 2.5-foot depth interval. Arsenic concentrations occurred above background levels in two samples with a maximum of 120 mg/kg at the 3.5- to 4.5-foot depth interval.

Several PAHs were detected in a single surface soil sample and a small number of subsurface soil samples. PAHs were detected in the soils in three areas of the PSF: 1) along the fence to the east of the PSF and extending east; 2) at the bottom of the culvert leading to the east from the southeastern corner of the fence; and 3) near the southeastern corner of the PSF. The sources of PAHs are believed to be the result of runoff from paved areas and pressure-treated lumber. PAHs represented a small fraction of the cumulative risk presented by the site soils and were not considered contaminants of concern.

In the Removal Action, approximately 2,700 tons of soil were excavated and disposed of in an approved landfill off-site. Excavation of soil was completed in phases, with each phase followed by confirmatory soil sampling. The confirmatory soil sampling data were used to plan excavations for the subsequent phases. The areas and depth of excavation are presented on Figure 2-4.

Post-Removal Soil Characteristics

The site characteristics for the soil media were significantly altered by the Removal Action. The contaminated soils which contributed to the unacceptable risks to site workers were largely removed by the action, with only a few isolated locations remaining with soils exceeding Removal Action Goals. This is the case for both surface and subsurface soils. Analytical data for the pesticides in samples collected following the Removal Action are summarized in Table 2-1. Figure 2-5 shows the locations of surface and subsurface samples exceeding Removal Action Goals for residual pesticides in the soils. Following the Removal Action, chlordane, heptachlor, DDT, and DDT metabolite levels in surface soil samples did not exceed the Removal Action Goals. Dieldrin slightly exceeded the Removal Action Goal in a single surface sample. Maximum detection concentrations for all pesticides had been reduced in the surface soils.

Nine chlordane samples, one DDT sample, and two heptachlor samples exceeded the Removal Action Goals in subsurface soils. Some of the subsurface samples exhibiting exceedances were located adjacent to the building foundation, where excavation activities could potentially have endangered the building stability. The maximum detected concentrations for chlordane and heptachlor were an order of magnitude greater than the Removal Action Goal. The maximum DDT concentration was only slightly above the Removal Action Goal. With the exception of chlordane and heptachlor, detected maximum concentrations of the pesticides had been reduced by at least an order of magnitude.

Of the inorganics, lead was found to occur at elevated concentrations at two locations, with a maximum concentration of 770 mg/kg at the 2.0- to 2.5-foot soil depth. Isolated occurrences of elevated arsenic concentrations were encountered, with concentrations exceeding the Removal Action Goal (7.1 mg/kg) in 3 samples. However, 2 samples collected under the asphalt pavement exhibited concentrations of 16 mg/kg and 20 mg/kg. The third sample, collected from a location east of Building 348 at a depth of 5 feet, was a minor exceedance at 9.4 mg/kg.

PAHs were not analyzed during the Removal Action. Based on the locations of the PAH-contaminated soils prior to the Removal Action, these soils have mostly been excavated (as described above) and replaced with clean fill.

2.5.2 Groundwater

Groundwater samples were collected from monitoring wells installed at the site to evaluate the possibility of contamination leaching from the soil into the groundwater. Well locations are shown on Figure 2-2. Groundwater samples were analyzed for volatile and semi-volatile organics, pesticides/PCBs, metals, organophosphorus pesticides, herbicides, chloride, sulfate, nitrate, and bicarbonate. The groundwater sampling results indicated the presence of several inorganic constituents. However, the concentrations of these compounds detected in samples collected from the on-site monitoring wells were statistically similar to the concentrations found in samples collected from background monitoring wells with the exception of beryllium in a single on-site well. No pesticides were detected. A single detection of toluene was observed.

2.5.3 Surface Water and Sediments

The possibility of contaminant migration from surface run-off was assessed by analyzing surface-water and sediment samples from a nearby drainage feature east and southeast of the site. Constituents detected in upgradient and downgradient surface water consisted of various metals and inorganics that are naturally occurring in the area. Downgradient concentrations were consistent with the upgradient sample except that aluminum, iron, vanadium, zinc, and sulfate were slightly above background in some samples. Sediment analytical results revealed that volatile organic compounds, pesticides, PAHs, and metals existed within the drainage ditch downgradient and to the east of the PSF site.

2.6 SUMMARY OF SITE RISKS

Two risk assessments have been conducted for the PSF site at Fort Riley. The first of these was a BLRA, which was presented in the RI report. Based on the results of the RI and the BLRA, a non-time-critical Removal Action took place. The remedial action objectives for the Removal Action were human health risk-based concentrations. Following the Removal Action, a residual risk assessment (RRA) for human health was conducted using data from areas that were not excavated and from confirmation sampling during the Removal Action. Both the BLRA and RRA were performed in a manner consistent with the USEPA "Risk Assessment Guidance for Superfund" for human health and ecological risk assessments. Summaries of the BLRA and RRA are presented in Sections 2.6.1 and 2.6.2, respectively. In addition, a summary of the effectiveness of the Removal Action is presented in Section 2.6.3. Finally, a summary of the ecological risk assessment activities is presented in Section 2.6.4.

2.6.1 Baseline Risk Assessment

A summary of the results of the BLRA are presented in this section. The results of the BLRA indicated that unacceptable risks due to potential exposures to both carcinogenic and noncarcinogenic constituents existed at the PSF site. The risk estimates presented in the BLRA included potential ingestion, inhalation, and dermal contact exposures to surface soil, subsurface soil, surface water, and sediment. These risks were the basis for implementing the non-time-critical Removal Action. The chemicals of concern (COCs) that were primarily responsible for the risks calculated for the BLRA were:

- Surface Soil: arsenic, barium, benzo(a)anthracene, chlordane, chromium, DDT, DDE, DDD, dieldrin, heptachlor
- Subsurface Soil: arsenic, benzo(a)pyrene, chlordane, DDT, DDE, DDD, dieldrin
- Surface Water: arsenic
- Sediment: arsenic

Objectives and Methodology

The objective of the BLRA was to determine the effects of the existing conditions on the exposed and potentially exposed populations if no action were to be taken to remediate conditions at the site. The results of the BLRA were used to determine whether further study and/or remedial actions were necessary.

The BLRA consisted of four successive steps which are discussed in the following sections:

- Identification of Chemicals of Concern
- Exposure Assessment
- Toxicity Assessment
- Risk Characterization

Chemicals of Concern

The COCs identified in the soil, surface water, and sediments sampled at the site were selected for evaluation in the BLRA based on the following criteria, in accordance with USEPA guidance:

- Comparison of chemical concentrations with background concentrations
- Evaluation of detected concentrations and frequency of detection
- Evaluation of essential nutrients
- Comparison of concentrations with blank results from samples
- Evaluation of data qualifiers
- Evaluation of toxicity and use of a concentration-toxicity screen

The COCs identified for the BLRA are presented in Table 2-2.

Exposure Assessment

The objectives of the exposure assessment were to characterize the exposure setting, identify the potential exposure pathways, and quantify the potential exposure to expected site-related contaminants. For the purposes of this decision document, the information presented in this summary is focused on populations that may be exposed to site-related contamination and land use.

Chemical-specific intakes for the COCs were quantified by identifying a series of variables that describe the exposed population. These variables typically include contact rate (e.g., soil ingestion rate), exposure frequency, exposure duration, and body weight. The calculation procedures used in the BLRA to estimate pathway-specific intakes were the standard procedures described in USEPA guidance for conducting risk assessments.

Potentially Exposed Populations - The PSF site is situated on an escarpment on the north side of the Kansas River Valley, approximately 2,000 feet north and west of the Kansas River, on the southeast edge of the Main Post cantonment area. The area of and immediately surrounding the PSF is moderately industrial/commercial in nature. The site includes the DEH yard which is enclosed by a fence and a gate that is locked after normal work hours. The DEH yard includes areas used to perform vehicle and heavy equipment maintenance and storage areas for vehicles, equipment, and supplies. Much of the site is paved, with the remainder covered with grass.

The human populations which were potentially exposed to the COCs at the PSF site were those persons who may come into contact with the soils, sediment, or surface water at the site. Due to the industrialized nature of the PSF site and restricted access to the DEH yard (i.e., fencing and secured entry), utility workers, landscaping crews, or on-site workers were the most likely current human receptors for exposure to potential soil contamination at the PSF site. Site workers or landscapers may have also contacted contaminated surface water and sediments while

performing maintenance or landscaping activities in the lined channel located to the east of the site, outside the fenced area.

While some contamination may have existed outside the fenced DEH yard (e.g., in the area of stressed vegetation and along the lined channel that drains surface run-off from the site), the steep terrain, the intermittent nature of the stream in the lined channel, the presence of overgrown vegetation, as well as the industrial uses of the area, would have deterred visitors from exploring or playing in this area.

The closest residential area on post, Housing Area No. 5, is located approximately 0.3 miles northwest of the site. Housing Area No. 5 consists of 63 living units that house officers with the rank of captain or major. A playground and recreational area are located near the center of the housing area. Another family housing area, Housing Area No. 2, situated west of Housing Area No. 5, is located approximately 0.4 miles from the site. This area houses lieutenant colonels, colonels, and their families. A total of 46 living units are in Housing Area No. 2. Since the officers residing here are of higher rank and generally are older, relatively fewer children occupy the residences in this area.

Although the closest residential area is only 0.3 miles away, it was considered unlikely that on-post residents would come in contact with site media during recreational activities (i.e., running or jogging) due to the restricted nature of the DEH yard and the dense vegetation present in the contaminated areas outside the fence. Exposures due to inhalation of fugitive dust would not be significantly greater than that experienced by on-site workers.

Likewise, the children living in the housing areas nearby were unlikely to be exposed to contaminants detected in site media during play or exploration activities because Housing Area No. 5 provides a playground for children's recreational use. The equipment present on this playground includes swing sets, a set of rings, see-saws, a slide, a tennis court, a basketball hoop, and two activity centers. With all this equipment available for their use, it was considered unlikely that children would travel to the PSF site to play. Also, children were not observed playing near the DEH yard. However, in order to conservatively estimate exposures at the site, a children's recreational use scenario was developed in order to estimate exposures due to the (unlikely) event of play in the lined channel adjacent to the site.

The groundwater beneath the PSF site is not used as a potable water supply. Fort Riley obtains its potable water from well fields located approximately 1.8 miles upgradient from the PSF. The city of Ogden obtains its water supply from wells located approximately 3 miles downgradient from the site. On-site wells have low yields, making their use for water supply purposes impractical. Because the groundwater pathway is incomplete at the PSF, it is unlikely that chemicals detected in the groundwater beneath the site impact human populations. Therefore, risks associated with groundwater exposures are not presented.

Subpopulations of Potential Concern - Sensitive subpopulations (i.e., nurseries, nursing homes, or hospitals) present within a three-mile radius of the PSF site include Irwin Army Community Hospital. Children, the elderly, and women of child-bearing age living nearby were considered sensitive subpopulations. Women of child-bearing age and children were known to be living in Main Post Family Housing Area No. 5, located approximately 0.3 miles northwest of PSF. Children were evaluated as a sensitive subpopulation for the current sediment/surface-water recreational scenario and future residential pathways considered in the BLRA.

Current Land Use - At the time the BLRA was being conducted, the PSF and DEH yard were being used as a storage and maintenance area supporting the services necessary to maintain the buildings, grounds, and utilities systems at Fort Riley. Building 348 was being used to store herbicides, preformulated pesticides, general improvement materials, and paint. Several subsurface utility lines were located adjacent to and beneath the site. The site and surrounding area are within a zone designated for Industrial land use in the Fort Riley Master Plan.

Potential Future Land Uses - In developing future use scenarios, it was assumed that no remedial actions were to take place. Such "no-action" scenarios also provided a baseline for the comparison of remedial alternatives in the Feasibility Study. Future use scenarios assumed that future development of the site will be unrestricted. According to 1992 and 1993 interviews with Fort Riley's DEH Master Planner and personnel from Fort Riley's Real Property Section, the future use of the PSF and the surrounding land was considered unlikely to change from its use as an equipment storage area as long as Fort Riley remained an active military installation. Fort Riley was not being considered for placement on the military installation closure lists. Residential development of the site at some future date was considered unlikely because the elevation of the PSF is only approximately 10 to 15 feet above the Kansas River floodplain, and the land is not protected by a levee. The site and surrounding area are within a zone designated for Industrial land use in the Fort Riley Master Plan. Future land use is expected be industrial.

The potential exposure pathways that were quantified in the BLRA are summarized in Table 2-3.

Toxicity Assessment - A toxicity assessment is an integral part of the risk assessment in which quantitative reference values describing the COCs are evaluated. For the BLRA, this effort was conducted using the following hierarchy of sources of toxicity information, as suggested by USEPA guidance:

- USEPA Integrated Risk Information System (IRIS)
- USEPA Health Effects Assessment Summary Tables (HEAST)
- USEPA Environmental Criteria and Assessment Office (ECAO) (currently the National Center for Environmental Assessment [NCEA])
- USEPA Criteria Documents

The reference doses (RfDs) and reference concentrations (RfCs) for noncarcinogenic COCs and cancer slope factors (CSFs) for carcinogenic COCs that were used in the RRA are presented on Table 2-4 and Table 2-5, respectively. By definition, the RfD and RfC values are an estimate of

a daily exposure level for the human population that is likely to be without appreciable risk of deleterious effects during a lifetime. For carcinogenic chemicals, the CSF correlates the estimated total chronic daily intake of a chemical to a probability for incremental cancer risk.

Toxicity information for the dermal exposure route is typically not available. Therefore, in accordance with USEPA Region VII guidance, oral RfDs and cancer slope factors were used directly as dermal toxicity values.

Risk Characterization

The risk characterization integrates the results of the exposure and toxicity assessments into quantitative and qualitative expressions of risk. To characterize potential noncarcinogenic effects, comparisons are made between the estimated chemical intakes and the RfDs and/or RfCs for those chemicals. To characterize potential carcinogenic effects, estimated chemical intakes are multiplied by the chemical-specific CSFs.

Noncarcinogenic Effects Characterization - Noncarcinogenic effects were characterized by comparing the estimated chemical intakes to the appropriate RfD and/or RfC value. When the estimated chronic daily intake of a chemical exceeds the appropriate RfD, there may be a concern for potential noncancer effects from exposure to that chemical. The ratio of the chronic daily intake to the chronic RfD and/or RfC is referred to as the "hazard quotient (HQ)." The sum of the hazard quotients for each chemical in a specific pathway is termed the "hazard index (HI)." It is important to note that the HQ does not represent a statistical probability; a ratio of 0.01 does not mean that there is a one in one hundred chance of the effect occurring. Rather, an HQ quotient greater than 1 indicates that the "threshold" for that chemical has been exceeded.

Carcinogenic Risk Characterization - Risks from potential carcinogens were estimated as probabilities of excess cancers as a result of exposure to chemicals from the site. The CSF correlates estimated total chronic daily intake directly to incremental cancer risk. Chemical-specific cancer risks were estimated by multiplying the CSF by the chronic daily intake estimates; pathway-specific cancer risks were estimated by summing the chemical-specific risks for the particular pathway. The results of the risk characterization are considered as upper-bound estimates of the potential carcinogenic risk.

Summary of the Baseline Risk Assessment

As presented and discussed in this section, the results of the BLRA indicated that unacceptable risks existed at the PSF due to the site-specific constituents. The HIs and cancer risks calculated during the BLRA are summarized below. These risk estimates were the basis for the Removal Action at the PSF.

Summary of Baseline Risk Assessment (BLRA) Results

Receptors	Total Hazard Index	Total Cancer Risk
Current:		
Site Worker	9	8×10^{-4}
Landscaper	0.03	2×10^{-6}
Utility Worker	0.06	7×10^{-6}
Recreational Child	2.2	--
Future:		
Site Worker	33	4×10^{-3}
Landscaper	0.23	1×10^{-5}
Utility Worker	0.22	2×10^{-5}
Construction Worker	24	1×10^{-4}
Recreational Child	2.2	--

2.6.2 Residual Risk Assessment

The RRA provided a conservative indication of the potential risks due to exposure to site-specific chemicals remaining at the PSF site. For soil/sediment, none of the exposure pathways for which risks were assessed in the RRA exceeded a hazard index of 1. Similarly, no exposure pathway exceeded a cancer risk of 1×10^{-6}, although it should be noted that cancer risk estimates for two pathways were approximately equivalent to 1×10^{-6}. These were potential dermal exposure to surface soil by current and future site workers. However, because the potential risks at the site resulting from exposure to site-related constituents were estimated (using conservative assumptions) to be less than or equal to the most conservative point-of-departure applied to risk assessments for carcinogenic constituents, risks at the site were considered to be acceptable.

Objectives and Methodology

Following completion of the Removal Action, the RRA was conducted to address the human health risks that remained at the site. In order to focus the RRA, residual risks were only calculated for exposure pathways for which cancer risks were estimated to be equal to or greater than 1×10^{-6} (for carcinogens) or those for which hazard indices were estimated to be equal to or greater than 1 (for non-carcinogens) in the BLRA. That is, those pathways for which the numerical risk or hazard values would not be significant in the total risk or hazard index value were not re-calculated. The exposure pathways for which residual risks were evaluated are

shown on Table 2-6. The other primary differences between the BLRA and RRA were:

- Revised exposure point concentrations (due to the Removal Action)
- Revised dermal absorption factors

Chemicals of Concern

For the RRA, the chemicals remaining in the soil/sediment at the site following the Removal Action were retained as COCs. The data that were used were from the analyses performed as part of the Removal Action and, where appropriate, from the RI (i.e., data for locations not excavated during the Removal Action). Areas that were excavated to a depth of 2 feet or more during the Removal Action, and then backfilled, were considered subsurface soil. Other areas (i.e., areas not excavated or those excavated to a depth of less than 2 feet) were considered to be surface soil unless covered by pavement or concrete.

Exposure Assessment

The PSF site was inactive when the RRA was conducted. Pesticides and related materials are now stored in the new pesticide building located approximately 1,500 feet from the site. Future land use is expected to be very similar to the current and historical uses. The site and surrounding area are within a zone identified in the Fort Riley Master Plan as Industrial. The area is expected to remain classified as Industrial in the future. The portion of the Building 348 structure used for pesticide and herbicide storage will be examined and "closed" as appropriate. This action may or may not involve demolition of the structure and/or its floor slab and foundation. The demolition of Building 348 and new construction is also a future possibility.

The exposure assessment for the RRA was conducted in the same manner as the BLRA, except for the two differences noted previously. First, exposure point concentrations were recalculated using data from site conditions after the Removal Action. Second, dermal absorption factors were revised (downward from 100 percent) on the basis of information in ATSDR's Toxicity Profiles. The dermal absorption factors used in the RRA are shown below.

Dermal Absorption Factors Used in the Residual Risk Assessment (RRA)

Parameter	Revised Dermal Absorption Factor	Source
Inorganic Compounds	0.01 (1 percent)	USEPA
Volatile and Semi-Volatile Organic Compounds	1 (100 percent)	Conservative assumption
Chlordane	0.109 (10.9 percent)	ATSDR
Heptachlor	0.109 (10.0 percent)	ASTDR
DDD, DDE, and DDT	0.378 (37.8 percent)	USEPA

Toxicity Assessment

For the RRA, the toxicity assessment was conducted as described in Section 2.6.1 for the BLRA. In addition, the toxicity values used in the BLRA were verified to be current for use in the RRA.

Risk Characterization

As discussed in Section 2.6.1, the risk characterization portion of a risk assessment integrates the results of the exposure and toxicity assessments into quantitative and qualitative expressions of risk. To characterize potential noncarcinogenic risks, the estimated chemical intakes are compared to (i.e., divided by) the chemical-specific RfDs and RfCs for the COCs. To characterize potential carcinogenic risks, the estimated chemical intakes are multiplied by the chemical-specific slope factors for the COCs. The results of the risk characterization, as calculated and provided in the RRA, are presented below.

For noncarcinogens, none of the exposure pathways evaluated had an HI estimate greater than 1, the standard point-of-departure below which adverse noncarcinogenic health effects are not expected. A summary of these HI estimates, by pathway, is presented in Table 2-7.

For carcinogens, none of the exposure pathways evaluated had a risk greater than 1×10^{-6}, the most conservative point-of-departure typically used to evaluate unacceptable cancer risk. A summary of the cancer risk estimates, by pathway, is presented in Table 2-8.

2.6.3 Effectiveness of the Removal Action

The non-time-critical Removal Action at the PSF reduced the risks associated with site-related contamination to acceptable levels for current and reasonably anticipated future land use and exposures. The Removal Action was undertaken on the basis of unacceptable risks presented in the BLRA due primarily to dermal exposures to contaminated soil at the site. The results of the Post-Removal Action risk assessment (i.e., the RRA) indicated that the risks due to potential exposures at the PSF were acceptable . The results of the RRA indicated that the Removal Action was effective in reducing the site-related risks at the PSF site.

2.6.4 Ecological Risk Assessment

The ecological risk assessment (ERA) that was conducted during the RI was re-evaluated as part of the RRA. For the ERA, potential receptors present in the vicinity of the PSF and the potential pathways by which these receptors might be exposed to the COCs present in surface soil, surface water, and sediment were identified. Possible risks to environmental receptors arising from exposure to site contaminants were characterized. The objectives of the ERA were to:

- Evaluate the value or uses of nearby natural resources (e.g., land, air, water, biota)
- Identify potential environmental impacts
- Assess the significance of identified environmental impacts

The ERA comprised the following tasks:

- Ecological Receptor Identification
- Exposure Pathway Evaluation
- Selection of Relevant Exposures
- Toxicity Assessment and Identification of ARARs
- Risk Characterization

Adverse impacts to ecological receptors were not expected due to the developed nature of the site and surrounding area, and the limited amount of release to media that would support receptors. In summary, negative impacts to fauna and flora at the PSF site were not readily apparent during the site characterization phase of the RI. Although terrestrial and aquatic life in the area of the drainage ditch may potentially suffer adverse effects from constituents detected in site surface-water and sediment samples, other (larger) sources of surface water/sediment are located nearby. Ecological receptors would tend to favor these sources over the intermittent stream on site. Therefore, the environmental impact of the contamination detected in the surface water and sediment was considered to be low. In addition, the contamination present in site surface water and sediment was not expected to impact downstream media because the natural character of the drainage ditch (i.e., its intermittent flow) does not consistently discharge surface water and flush sediments to downstream points.

Similarly, potential risks to environmental receptors due to exposure to soil at the site were considered to be minimal. The area most impacted by soil contamination prior to the Removal Action (the small stressed area of vegetation noted in the RI report) was of very limited extent (approximately 20 feet by 20 feet). This area of stressed vegetation was excavated during the Removal Action. There are areas adjacent to the site that provide suitable habitats and food supplies for animal species that may pass by or frequent the site.

2.7 SUMMARY DESCRIPTION OF THE "NO FURTHER ACTION" ALTERNATIVE

The selected remedy for the Pesticide Storage Facility, Operable Unit 002, at Fort Riley is No Further Action. A Removal Action in which contaminated soils were excavated, transported, and disposed off-site was completed in 1994. Based upon current and projected land use at the site and the populations that may be exposed to site contamination, it has been determined that the site does not pose a significant threat to public health, welfare, and the environment.

Basis of "No Further Action" Alternative:

- Current and anticipated reasonable future land use is industrial. Future residential or other land uses resulting in higher exposure levels is not anticipated.
- No contamination of groundwater and no current or anticipated future use of groundwater beneath the site.

The previous release of contamination at the site will be annotated in the Master Plan Environmental Overly (MPEO) from which users of the Master Plan will be directed to the documents that detail the results of associated investigations and the remedial actions taken.

If a significant change in land use at the PSF is proposed by Fort Riley, or if any portion of the site property is transferred or leased to a non-government entity, Fort Riley will notify Region VII of the U.S. Environmental Protection Agency (EPA) and the Kansas Department of Health and Environment (KDHE) in writing of the proposed change in land use or transfer of lease of the property or a portion of the property. If the change in land use is determined to be a major change in land use, a reevaluation of the remedy decision will be required. Depending upon the nature of the transfer or lease of the site property, EPA and/or KDHE may require Fort Riley to reconsider the no further action decision selected in this Records of Decision, which may require the implementation of additional response actions, including institutional controls, prior to the transfer or lease of site property. A major land use change is a change in land use classification that is inconsistent with the exposure assumptions presented in the risk assessment and which may reasonably be expected to result in unacceptable risk.

At this time, no further remedial action is necessary for Operable Unit 002, the Pesticide Storage Facility to ensure protection of human health and the environment. Section 300.430(f) (4) (ii) of the National Oil and Hazardous Substances Pollution Contingency Plan (NCP) states that if a remedial action is selected that results in hazardous substances, pollutants or contaminants remaining at a site above levels that allow for unlimited use and unrestricted exposure, the lead agency shall review such action no less often than every five years after initiation of the selected remedial action. Although the decision reached in the Record of Decision is no further action, this decision is based upon current and reasonably projected land use and exposures. However, hazardous substances, pollutants or contaminants may remain at the site above levels that would allow for unlimited use and unrestricted exposure. Therefore, the five year review will apply to this site.

3.0 RESPONSIVENESS SUMMARY

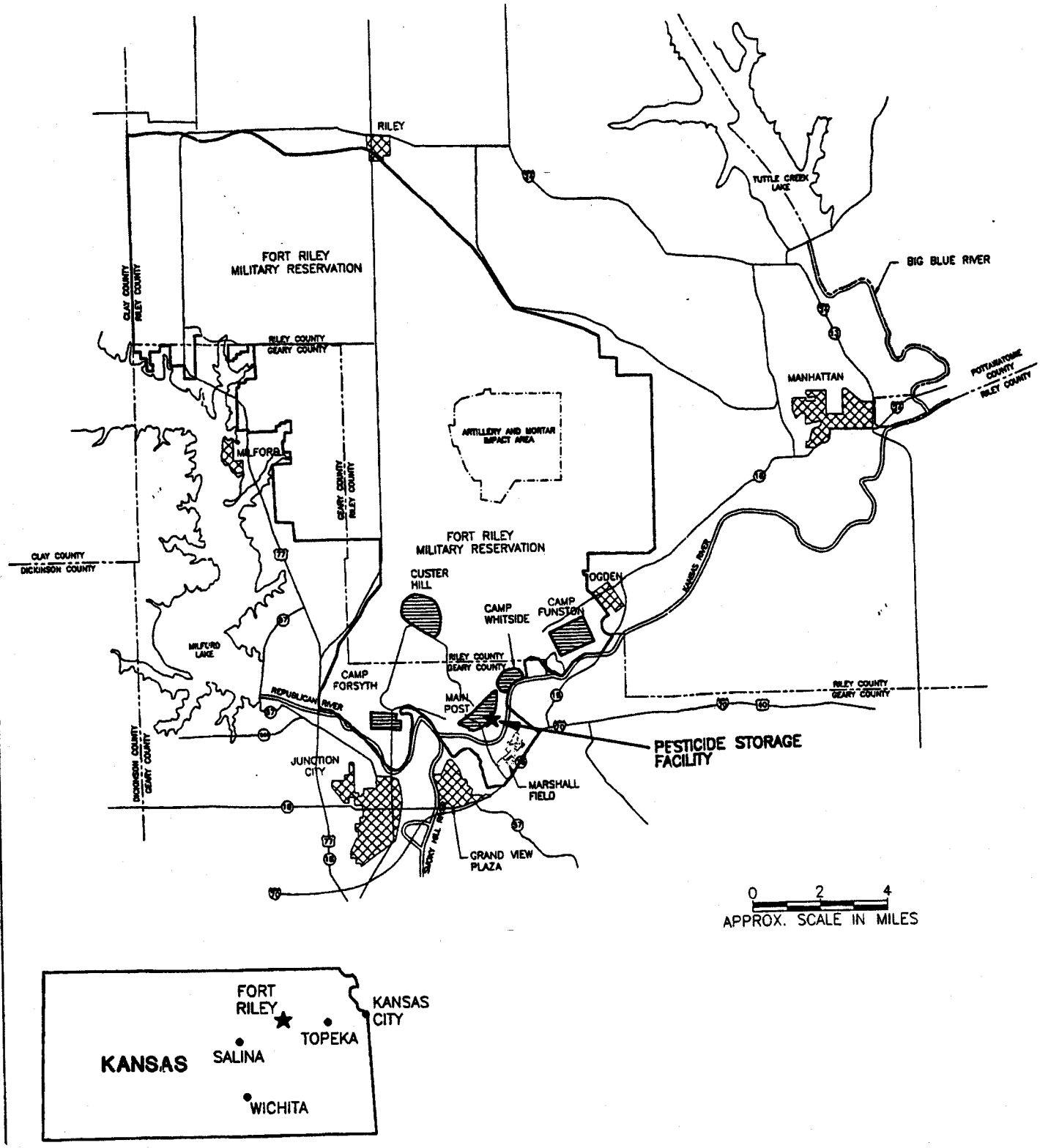
No verbal or written comments were received regarding the Pesticide Storage Facility, Ft. Riley Proposed Plan at a public Availability Session held on September 4, 1997, or during the 30-day public comment period. Therefore, a responsiveness summary is not included.

FIGURES

FIGURE 2-1

PESTICIDE STORAGE FACILITY LOCATION MAP

FORT RILEY, KANSAS

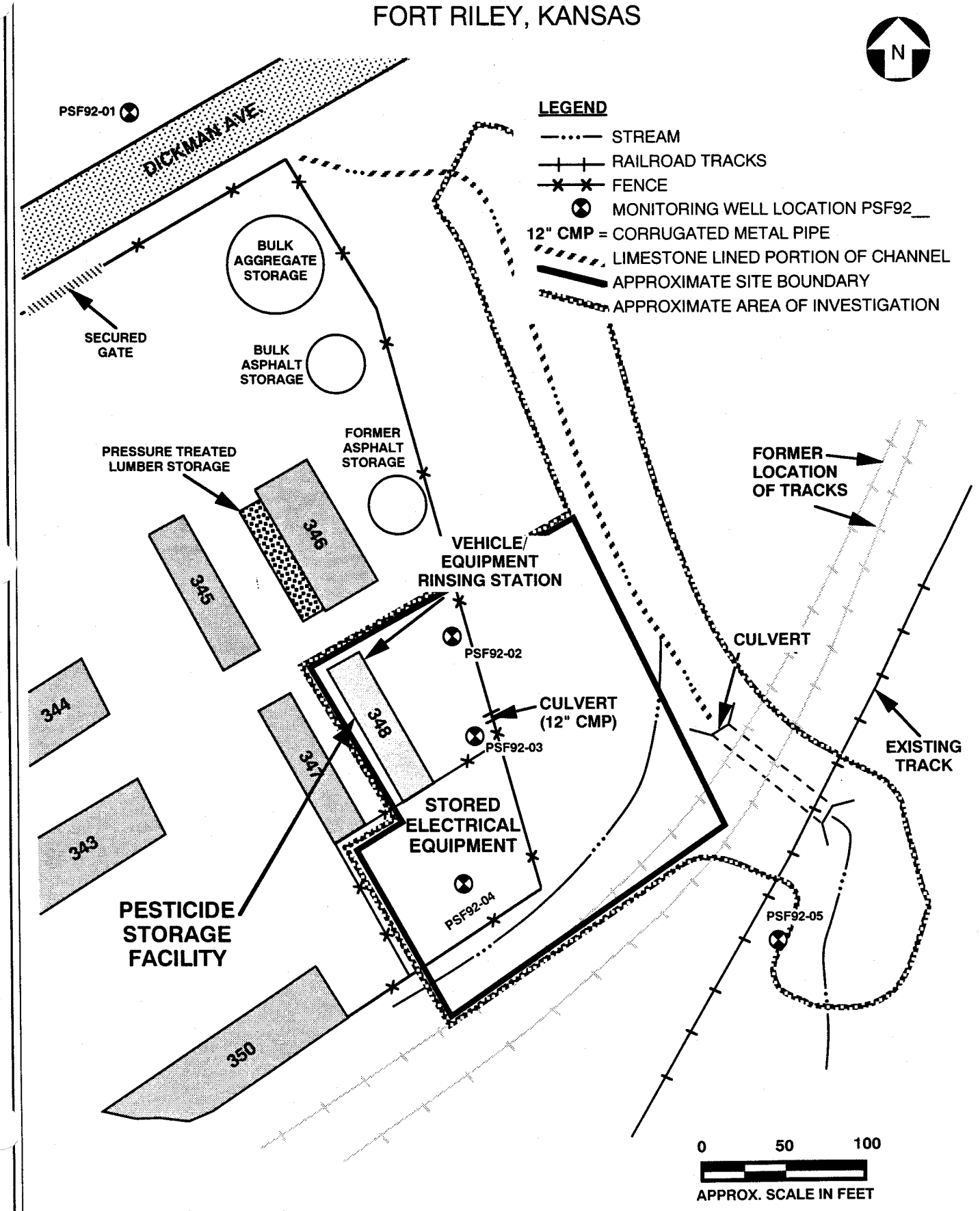


2563-0308.21

FIGURE 2-2

PESTICIDE STORAGE FACILITY – 1992

FORT RILEY, KANSAS

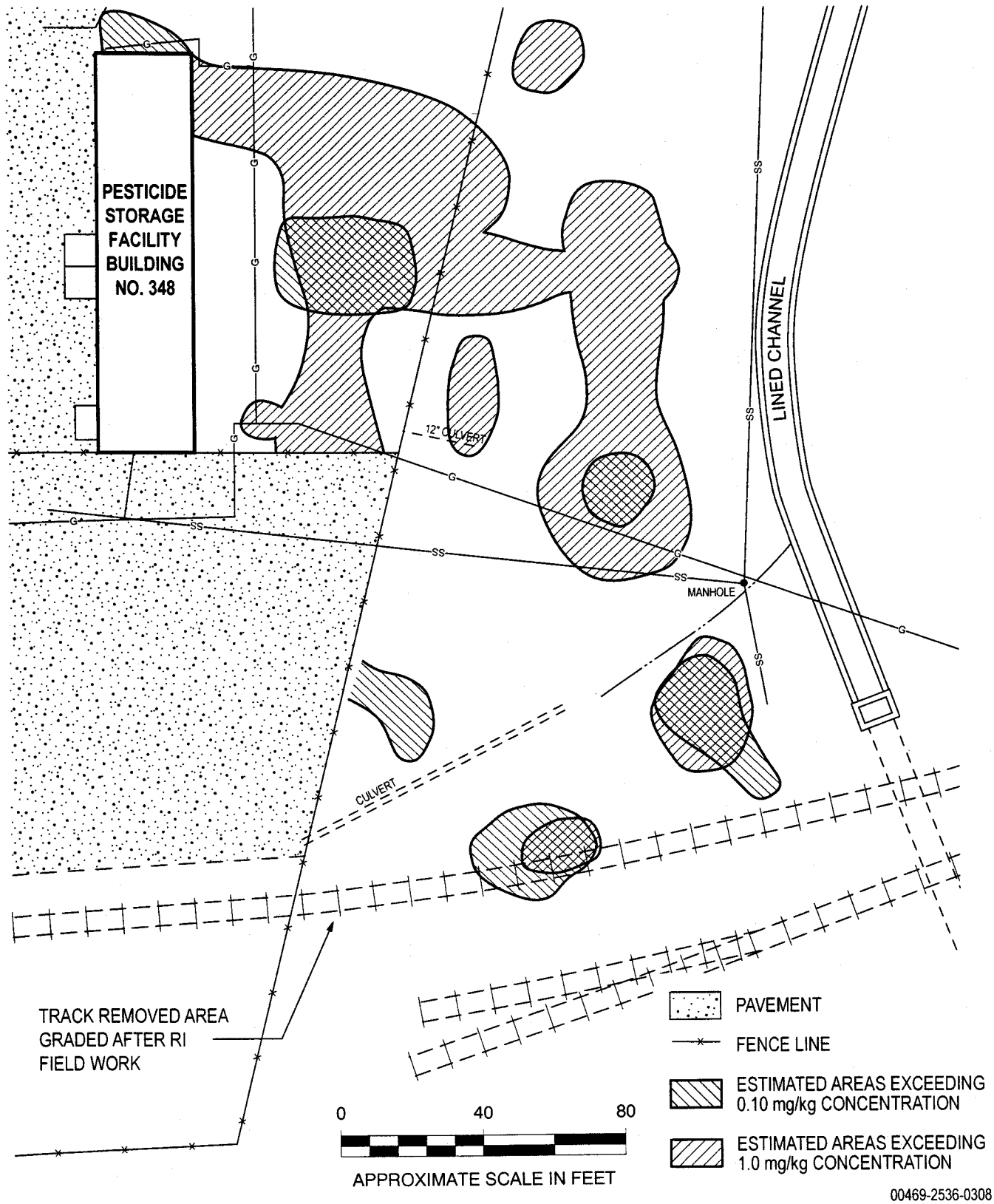


00533-2536-0308

FIGURE 2-3

PRE-REMOVAL ACTION DISTRIBUTION OF PESTICIDES IN SURFACE SOIL

PESTICIDE STORAGE FACILITY – FORT RILEY, KANSAS



00469-2536-0308

FIGURE 2-4

FINAL REMOVAL ACTION EXCAVATIONS

PESTICIDE STORAGE FACILITY

FORT RILEY, KANSAS

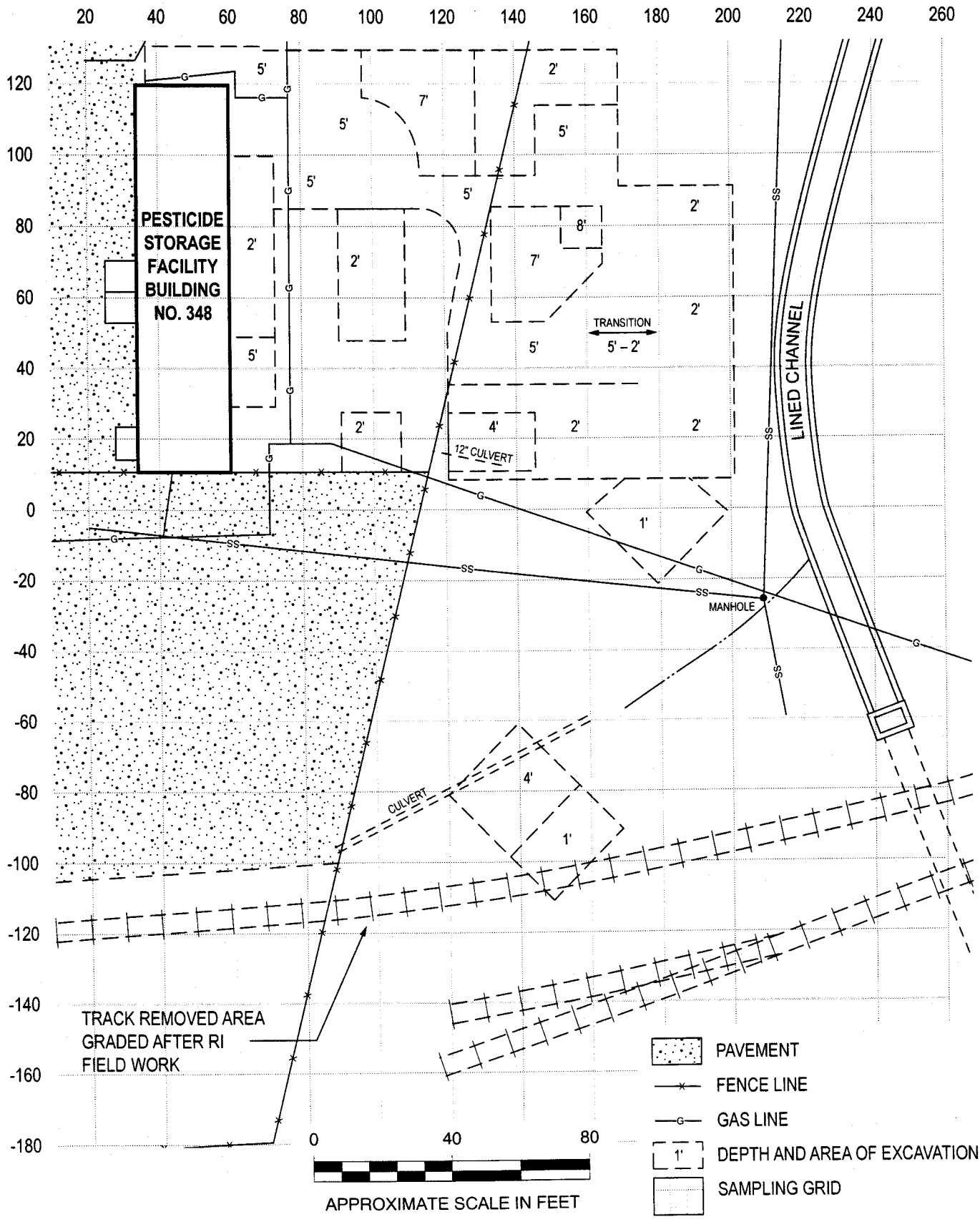
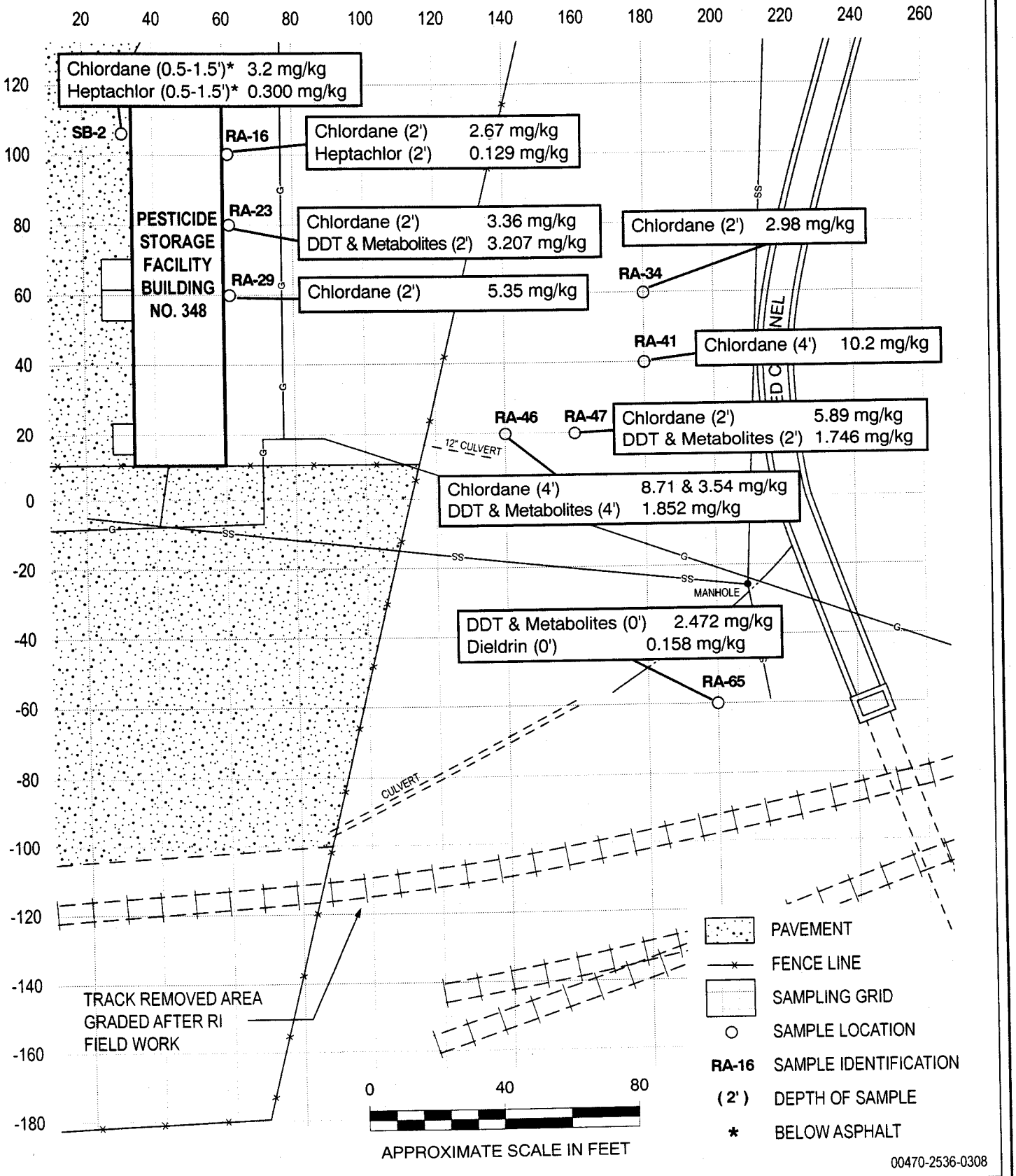


FIGURE 2-5

REMAINING SOIL SAMPLES EXCEEDING REMOVAL ACTION REMEDIAL GOALS

PESTICIDE STORAGE FACILITY – FORT RILEY, KANSAS



00470-2536-0308

TABLES

TABLE 2-1

COMPARISON OF PRE-REMOVAL AND POST-REMOVAL ACTION POSITIVE ANALYTICAL RESULTS WITH REMOVAL ACTION GOALS
Record of Decision
Pesticide Storage Facility
Fort Riley, Kansas

		SURFACE SOILS			SURFACE SOILS		
		Pre-Removal			Post-Removal		
Constituent	Removal Action Goal Surface Soils (mg/kg)	Frequency of Detection	Minimum Detected Concentration (mg/kg)	Maximum Detected Concentration (mg/kg)	Frequency of Detection	Minimum Detected Concentration (mg/kg)	Maximum Detected Concentration (mg/kg)
Chlordane	1.58	56/102	0.021	5.89	17/52	0.0207	1.12
DDD	1.73	16/38	0.022	0.925	7/18	0.0237	0.454
DDE	1.73	19/26	0.036	1.8	12/18	0.0356	0.847
DDT	1.73	74/102	0.006	2.63	35/52	0.012	1.29
Dieldrin	0.127	40/102	0.007	1.4	20/52	0.007	0.158
Heptachlor	0.05	15/102	0.001	0.129	2/52	0.004	0.0093

TABLE 2-1

COMPARISON OF PRE-REMOVAL AND POST-REMOVAL ACTION POSITIVE ANALYTICAL RESULTS WITH REMOVAL ACTION GOALS
Record of Decision
Pesticide Storage Facility
Fort Riley, Kansas

		SUBSURFACE SOILS			SUBSURFACE SOILS		
		Pre-Removal			Post-Removal		
Constituent	Removal Action Goal Surface Soils (mg/kg)	Frequency of Detection	Minimum Detected Concentration (mg/kg)	Maximum Detected Concentration (mg/kg)	Frequency of Detection	Minimum Detected Concentration (mg/kg)	Maximum Detected Concentration (mg/kg)
Chlordane	1.58	89/189	0.005	8.71	46/133	0.0051	10.2
DDD	1.73	37/155	0.001	1.34	20/106	0.0013	0.925
DDE	1.73	68/155	0.008	1.16	35/106	0.0104	0.794
DDT	1.73	94/189	0.011	33	47/133	0.011	1.95
Dieldrin	0.127	18/189	0.004	0.2	12/133	0.007	0.077
Heptachlor	0.05	18/189	0.001	0.3	9/133	0.0012	0.3

TABLE 2–2

SUMMARY OF CHEMICALS OF CONCERN FOR THE BLRA
Record of Decision
Pesticide Storage Facility
Fort Riley, Kansas

Chemical	Range of Detected Concentrations				
	Surface Soils (mg/kg)	Subsurface Soils (mg/kg)	Monitoring Well Soil Borings (mg/kg)	Surface Water (mg/L)	Sediment (mg/kg)
Aluminum	NT	NT	NT	0.6–12 B	NT
Anthracene	ND	0.25–0.76	ND	ND	ND
Arsenic	2.4–16	0.8–120	0.4–3.7	0.004–0.0044	0.8–3.8
Barium	35–130	39–160*	44–190	0.014–0.29	44–150
Benzo(a)anthracene	< 0.12–0.16	0.11–1.8	0.11–0.6	ND	0.12–0.16
Benzo[a]pyrene	ND	0.27–1.3	< 0.11– 0.68	ND	ND
Benzo(b)fluoroanthene	ND	0.38–1.4	< 0.36–1	ND	ND
Benzo(k)fluoroanthene	ND	0.46–1.2	ND	ND	ND
Beryllium	NT	NT	NT	ND	NT
Cadmium	ND	0.7–5	ND	< 0.004–0.0045	1.3–3.3
alpha–Chlordane	0.029–1.6	0.0037–1.5	0.015–0.073	ND	0.0058–0.067
gamma–Chlordane	0.03–1.6	0.004–1.6	0.0051–0.071	ND	0.0076–0.065
Chromium	6.9–156	4.5–41	4.8–20	0.01–0.024	4.2–25
Chrysene	< 0.12–0.45	0.11–1.7	0.11–0.64	ND	0.12–0.24
Copper	NT	NT	NT	0.0064–0.013	NT
4,4'–DDT	0.45–1*	0.012–33	ND	ND	0.0086–0.48
Dibenzofuran	ND	0.055–0.13	ND	ND	ND
Dieldrin	0.077–0.094	0.01–0.2*	0.0087–0.013	ND	0.02–0.056
Indeno[1,2,3–cd]pyrene	ND	0.175–0.38	< 0.36–0.48	ND	ND
Lead	32–540	4.4–770	4.7–58	< 0.002–0.0042 M	15–210
Manganese	NT	NT	NT	0.063–0.19	NT
Mercury	ND	0.1–1.3	0.1–0.3	ND	0.1–0.4
Phenanthrene	< 0.16–0.78	0.23–2.7	< 0.14–0.56	ND	0.2–0.36
Vanadium	NT	NT	NT	0.0064–0.026	NT
Chloride, inorganic	NT	NT	NT	38–65	NT
Nitrate	NT	NT	NT	NT	NT
Sulfate	NT	NT	NT	74–106	NT
Bicarbonate, as $CaCO_3$	NT	NT	NT	170–290	NT

ND – Not detected
NT – Not tested
B – Associated with blank contamination
M – Matrix interference
* Not selected as a chemical of potential concern in this medium

TABLE 2–3

EXPOSURE PATHWAY SUMMARY FOR THE RRA
Record of Decision
Pesticide Storage Facility
Fort Riley, Kansas

Medium	Land Use/Populations	Exposure Pathway
Surface Soils	Current Land Use:	
	Landscapers	Incidential Ingestion, Inhalation of Fugitive Dust, Dermal Contact
	Utility Workers	Incidential Ingestion, Inhalation of Fugitive Dust, Dermal Contact
	Site Workers	Incidential Ingestion
	Future Land Use:	
	Landscapers	Incidential Ingestion, Inhalation of Fugitive Dust, Dermal Contact
	Utility Workers	Incidential Ingestion, Inhalation of Fugitive Dust, Dermal Contact
	Residents	Incidential Ingestion, Inhalation of Fugitive Dust, Dermal Contact
	Site Workers	Incidential Ingestion
Subsurface Soils	Current Land Use:	
	Utility Workers	Incidential Ingestion, Inhalation of Fugitive Dust, Dermal Contact
	Landscapers	Incidential Ingestion, Inhalation of Fugitive Dust, Dermal Contact
	Future Land Use:	
	Utility Workers	Incidential Ingestion, Inhalation of Fugitive Dust, Dermal Contact
	Landscapers	

TABLE 2–3

EXPOSURE PATHWAY SUMMARY FOR THE RRA
Record of Decision
Pesticide Storage Facility
Fort Riley, Kansas

Medium	Land Use/Populations	Exposure Pathway
Sediments	Current Land Use:	
	Site Workers	Dermal Contact, Incidential Ingestion
	Landscapers	Dermal Contact, Incidential Ingestion
	Recreational Children	Dermal Contact, Incidential Ingestion
	Future Land Use:	
	Site Workers	Dermal Contact, Incidential Ingestion
	Landscapers	Dermal Contact, Incidential Ingestion
	Residents	Dermal Contact, Incidential Ingestion
Surface Water	Current Land Use:	
	Site Workers	Dermal Contact
	Landscapers	Dermal Contact
	Recreational Children	Dermal Contact
	Future Land Use:	
	Site Workers	Dermal Contact
	Landscapers	Dermal Contact
	Residents	Dermal Contact

TABLE 2–4

TOXICITY VALUES FOR NONCARCINOGENIC EFFECTS
Record of Decision
Pesticide Storage Facility
Fort Riley, Kansas

Parameter	Chronic RfD (mg/kg–day)	Confidence Level[a]	Critical Effect	Uncertainty Factor[b]	Source
Oral Route					
Chlordane	6.0E–05	low	Regional liver hypertrophy in females	1000	IRIS
4,4'–DDD	no data				IRIS
4,4'–DDE	no data				IRIS
4,4'–DDT	5.0E–04	medium	Liver lesions	100	IRIS
Dieldrin	5.0E–05	medium	Liver lesions	100	IRIS
Heptachlor	5.0E–04	low	Liver weight increases	300	IRIS
Benzene	no data				
Methylene chloride	6.0E–02	medium	Histological alterations of the liver	100	IRIS
Toluene	2.0E–01	medium	Changes in liver and kidney weights	1000	IRIS
Benzo[a]anthracene	no data				IRIS
bis(2–Ethylhexyl)phthalate	2.0E–02	medium	Increased relative liver weights	1000	IRIS
Chrysene	no data				IRIS
Diethylphthalate	8.0E–01	low	Altered organ weights	1000	IRIS
Fluoranthene	4.0E–02	low	Liver weight increases	3000	IRIS
Phenanthrene	no data				IRIS
Pyrene	3.0E–02	low	Kidney effects	3000	IRIS
Aluminum	2.9E+00				EPA
Arsenic	3.0E–04	medium	Hyperpigmentation, keratosis, vascular complications	3	IRIS
Barium	7.0E–02	medium	Increased blood pressure	3	IRIS
Beryllium	5.0E–03	low	No adverse effects	100	IRIS
Cadmium	1.0E–03 (food)	high	Significant proteinuria	10	IRIS
	5.0E–04 (water)				
Chromium	5.0E–03	low	No effects reported	500	IRIS
Lead	no data				IRIS
Manganese	1.4E–01 (food)		Central nervous system effects	1	IRIS
	5.0E–03 (water)				
Mercury	pending (3.0E–04)		Kidney effects	1000	HEAST
Selenium	5.0E–03	high	Clinical selenosis	3	IRIS
Silver	withdrawn (5.0E–03)	low	Argyria	3	IRIS
Thallium	7.0E–05	low	Increased levels of SGOT & LDH	3000	IRIS
Vanadium	9.0E–03	low	Decreased hair cystine	100	IRIS
Nitrate	1.6E+00	high	Methemoglobinemia	1	IRIS

TABLE 2–4

TOXICITY VALUES FOR NONCARCINOGENIC EFFECTS
Record of Decision
Pesticide Storage Facility
Fort Riley, Kansas

Parameter	Chronic RfD (mg/kg–day)		Confidence Level[a]	Critical Effect	Uncertainty Factor[b]	Source
Inhalation Route						
Chlordane	pending					IRIS
4,4'–DDD	no data					IRIS
4,4'–DDE	no data					IRIS
4,4'–DDT	no data					IRIS
Dieldrin	no data					IRIS
Heptachlor	no data					IRIS
Benzene	1.4E–04					EPA
Methylene chloride	8.6E–01			Liver toxicity	100	HEAST
Toluene	1.1E–01		medium	Neurological effects	300	IRIS
Benzo[a]anthracene	no data					IRIS
bis(2–Ethylhexyl)phthalate	no data					IRIS
Chrysene	no data					IRIS
Diethylphthalate	no data					IRIS
Fluoranthene	no data					IRIS
Phenanthrene	no data					IRIS
Pyrene	no data					IRIS
Aluminum	no data					IRIS
Arsenic	no data					IRIS
Barium	pending	(1.4E–04)		Fetotoxicity	1000	HEAST
Beryllium	no data					IRIS
Cadmium	pending					IRIS
Chromium	pending					IRIS
Lead	no data					IRIS
Manganese	1.4E–05		medium	Increased prevalence of respiratory symptoms and psychomotor disturbances	300	IRIS
Mercury	pending	(8.6E–05)		Neurotoxicity		HEAST
Selenium	no data					IRIS
Silver	no data					IRIS
Thallium	no data					IRIS
Vanadium	no data					IRIS
Nitrate	no data					IRIS

(a) Confidence Level (i.e., high, medium, or low) as reported in IRIS
(b) Uncertainty Factors (UF) are assigned by USEPA in multiples of 10 based on the following limitations in the database used to develop the RfC/RfD:
A – Animal to human extrapolation (UF of 10)
H – Variations in human sensitivity (UF of 10)
S – Extrapolation from a subchronic NOAEL instead of a chronic NOAEL (UF of 10)
L – Extrapolation from a LOAEL to a NOAEL (UF of 10)

Withdrawn – Withdrawn (from IRIS) as a result of further review
Pending – Under review by an EPA work group

TABLE 2–5

TOXICITY VALUES FOR POTENTIAL CARCINOGENIC EFFECTS
Record of Decision
Pesticide Storage Facility
Fort Riley, Kansas

Parameter	Cancer Slope Factor [a] (kg–day/mg)	Weight of Evidence Classification [d]	Type of Cancer	Source
Oral Route				
Chlordane	1.3E+00	B2	Liver tumors	IRIS
4,4'–DDD	2.4E–01	B2	Lung, liver, and thyroid tumors in rodents	IRIS
4,4'–DDE	3.4E–01	B2	Liver tumors, liver cancer, and thyroid tumors	IRIS
4,4'–DDT	3.4E–01	B2	Liver tumors	IRIS
Dieldrin	1.6E+01	B2	Liver cancer	IRIS
Heptachlor	4.5E+00	B2	Liver tumors	IRIS
Benzene	2.9E–02	A	Increased incidence of nonlymphocytic leukemia	IRIS
Methylene chloride	7.5E–03	B2	Increased incidence of hepatocellular neoplasms	IRIS
Toluene	no data			IRIS
Benzo[a]anthracene	1.1E+00 *	B2	Tumors in mice via various routes	IRIS
bis(2–Ethylhexyl)phthalate	1.4E–02	B2	Increases in liver tumor responses	IRIS
Chrysene	2.9E–02 *	B2	Malignant lymphoma, skin cancers, in mice	IRIS
Diethylphthalate	no data			IRIS
Fluoranthene	no data			IRIS
Phenanthrene	no data			IRIS
Pyrene	no data			IRIS
Aluminum [b]	no data			EPA [e]
Arsenic	1.8E+00	A	Skin cancer	EPA [e]
Barium	no data			IRIS
Beryllium	4.3E+00	B2	Lung cancer in rats/monkeys via inhalation	IRIS
Cadmium	no data			IRIS
Chromium [c]	no data			IRIS
Lead	no data	B2	Renal tumors, affects gene expression	IRIS
Manganese	no data			IRIS
Mercury	no data			IRIS
Selenium	no data			IRIS
Silver	no data			IRIS
Thallium	no data			IRIS
Vanadium	no data			IRIS

TABLE 2-5

TOXICITY VALUES FOR POTENTIAL CARCINOGENIC EFFECTS
Record of Decision
Pesticide Storage Facility
Fort Riley, Kansas

Parameter	Cancer Slope Factor [a] (kg-day/mg)	Weight of Evidence Classification [d]	Type of Cancer	Source
Inhalation Route				
Chlordane	1.3E+00	B2	Liver tumors	IRIS
4,4'-DDD	no data			IRIS
4,4'-DDE	no data			IRIS
4,4'-DDT	3.4E-01	B2	Liver tumors	IRIS
Dieldrin	1.6E+01	B2	Liver cancer	IRIS
Heptachlor	4.6E+00	B2	Liver tumors	IRIS
Benzene	2.9E-02	A	Increased incidence of nonlymphocytic leukemia	IRIS
Methylene chloride	1.6E-03	B2	Increased incidence of hepatocellular neoplasms	IRIS
Toluene	no data			IRIS
Benzo[a]anthracene	no data			IRIS
bis(2-Ethylhexyl)phthalate	no data			IRIS
Chrysene	no data			IRIS
Diethylphthalate	no data			IRIS
Fluoranthene	no data			IRIS
Phenanthrene	no data			IRIS
Pyrene	no data			IRIS
Aluminum [b]	no data			EPA [e]
Arsenic	1.5E+01	A	Lung cancer	IRIS
Barium	no data			IRIS
Beryllium	8.4E+00	B2	Lung cancer in rats/monkeys (inh)	IRIS
Cadmium	6.3E+00	B1	Carcinogenic in mice by various routes	IRIS
Chromium [c]	4.2E+01	A	Lung cancer	IRIS
Lead	no data	B2	Renal tumors, affects gene expression	IRIS
Manganese	no data			IRIS
Mercury	no data			IRIS
Selenium	no data			IRIS
Silver	no data			IRIS
Thallium	no data			IRIS
Vanadium	no data			IRIS
Nitrate	no data			IRIS

No Data - No value listed in reference
(Values listed in parentheses are from HEAST, and were used in the absence of current IRIS values)
* CSF generated using toxicity equivalency factors, based on benzo[a]pyrene toxicity (see LAW, 1993)
(a) Slope factors provided in terms of unit risk were converted prior to input on this table as follows:
for oral route: UNIT RISK (L/*ug*) * 1,000 *ug*/mg * day/2 L * 70 kg = CSF (kg-day/mg)
for inhalation route: UNIT RISK (m^3/*ug*) * 1,000 *ug*/mg * day/20 m^3 * 70 kg = CSF (kg-day/mg)
(b) IRIS or HEAST listing not available for this chemical
(c) Value is for hexavalent chromium
(d) Weight of Evidence Classification:
A - Human Carcinogen
B1 - Probable human carcinogen; limited human data available
B2 - Probable human carcinogen; insufficient evidence in animals and inadequate or no evidence in humans

(e) Memorandum to Assistant Administrators. Recommended Agency Policy on the Carcinogenicity Risk Associated with the Ingestion of Inorganic Arsenic. USEPA, Office of the Administrator, Washington, D.C. June 21, 1988.

TABLE 2–6

EXPOSURE PATHWAY SUMMARY FOR THE RRA
Record of Decision
Pesticide Storage Facility
Fort Riley, Kansas

Medium	Land Use/Populations	Exposure Pathway
Surface Soils	Current Land Use:	
	Landscapers	Dermal Contact
	Site Workers	Dermal Contact, Incidental Ingestion
	Utility Workers	Dermal Contact
	Future Land Use:	
	Construction Workers	Dermal Contact, Incidental Ingestion
	Landscapers	Dermal Contact
	Recreational Children	Dermal Contact
	Site Workers	Dermal Contact, Inhalation of Fugitive Dust, Incidential Ingestion
	Utility Workers	Dermal Contact
Subsurface Soils	Current Land Use:	
	Landscapers	Dermal Contact
	Utility Workers	Dermal Contact
	Future Land Use: Construction Workers	Dermal Contact
	Landscapers	Dermal Contact
	Utility Workers	Dermal Contact
Sediment	Future Land Use:	
	Site Workers	Dermal Contact

TABLE 2-7

SUMMARY OF HAZARD INDICES
RESIDUAL RISK ASSESSMENT
Record of Decision
Pesticide Storage Facility
Fort Riley, Kansas

RECEPTOR	EXPOSURE ROUTE AND MEDIUM	HAZARD INDEX	TOTAL HAZARD INDEX
Current Site Worker	Incidental Ingestion of surface soil	0.002	
Current Site Worker	Dermal contact with surface soil	0.01	
			0.01
Future Site Worker	Incidental ingestion of surface soil	0.003	
Future Site Worker	Dermal contact with surface soil	0.02	
Future Site Worker	Inhalation of fugitive dust	NA	
Future Site Worker	Dermal contact with sediments	0.00003	
			0.02
Current Utility Worker	Dermal contact with surface soil	0.00002	
Current Utility Worker	Dermal contact with subsurface soil	0.00001	
			0.00003
Future Utility Worker	Dermal contact with surface soil	0.00007	
Future Utility Worker	Dermal contact with subsurface soil	0.00004	
			0.00001
Current Landscaper	Dermal contact with surface soil	0.00005	
Current Landscaper	Dermal contact with subsurface soil	0.000009	
			0.00006
Future Landscaper	Dermal contact with surface soil	0.00006	
Future Landscaper	Dermal contact with subsurface soil	0.00004	
			0.0001
Future Construction Worker	Incidental ingestion of surface soil	0.01	
Future Construction Worker	Dermal contact with surface soil	0.007	
Future Construction Worker	Dermal contact with subsurface soil	0.004	
			0.02
Current/Future Recreational Child	Dermal contact with surface soil	0.0009	

NA – Not assessed because toxicity data for inhalation of the chemicals of concern were not available
* Receptor-specific sums of hazard indices

TABLE 2-8

SUMMARY OF CANCER RISKS
RESIDUAL RISK ASSESSMENT
Record of Decision
Pesticide Storage Facility
Fort Riley, Kansas

RECEPTOR	EXPOSURE ROUTE AND MEDIUM	CANCER RISK	TOTAL CANCER INDEX *
Current Site Worker	Incidental ingestion of surface soil	2E-07	
Current Site Worker	Dermal contact with surface soil	1E-06	
			1E-06
Future Site Worker	Incidental ingestion of surface soil	3E-07	
Future Site Worker	Dermal contact with surface soil	1E-06	
Future Site Worker	Inhalation of fugitive dust	3E-10	
Future Site Worker	Dermal contact with sediments	8E-09	
			1E-06
Current Utility Worker	Dermal contact with surface soil	2E-09	
Current Utility Worker	Dermal contact with subsurface soil	1E-09	
			3E-09
Future Utility Worker	Dermal contact with surface soil	6E-09	
Future Utility Worker	Dermal contact with subsurface soil	5E-09	
			1E-08
Current Landscaper	Dermal contact with surface soil	1E-09	
Current Landscaper	Dermal contact with subsurface soil	1E-09	
			2E-09
Future Landscaper	Dermal contact with surface soil	6E-09	
Future Landscaper	Dermal contact with subsurface soil	5E-09	
			1E-08
Future Construction Worker	Incidental ingestion of surface soil	5E-08	
Future Construction Worker	Dermal contact with surface soil	3E-08	
Future Construction Worker	Dermal contact with subsurface soil	2E-08	
			1E-07
Current/Future Recreational Child	Dermal contact with surface soil	NA	NA

NA - Not assessed because cancer risks are not estimated for children
* Receptor-specific sums of hazard indices

ATTACHMENT

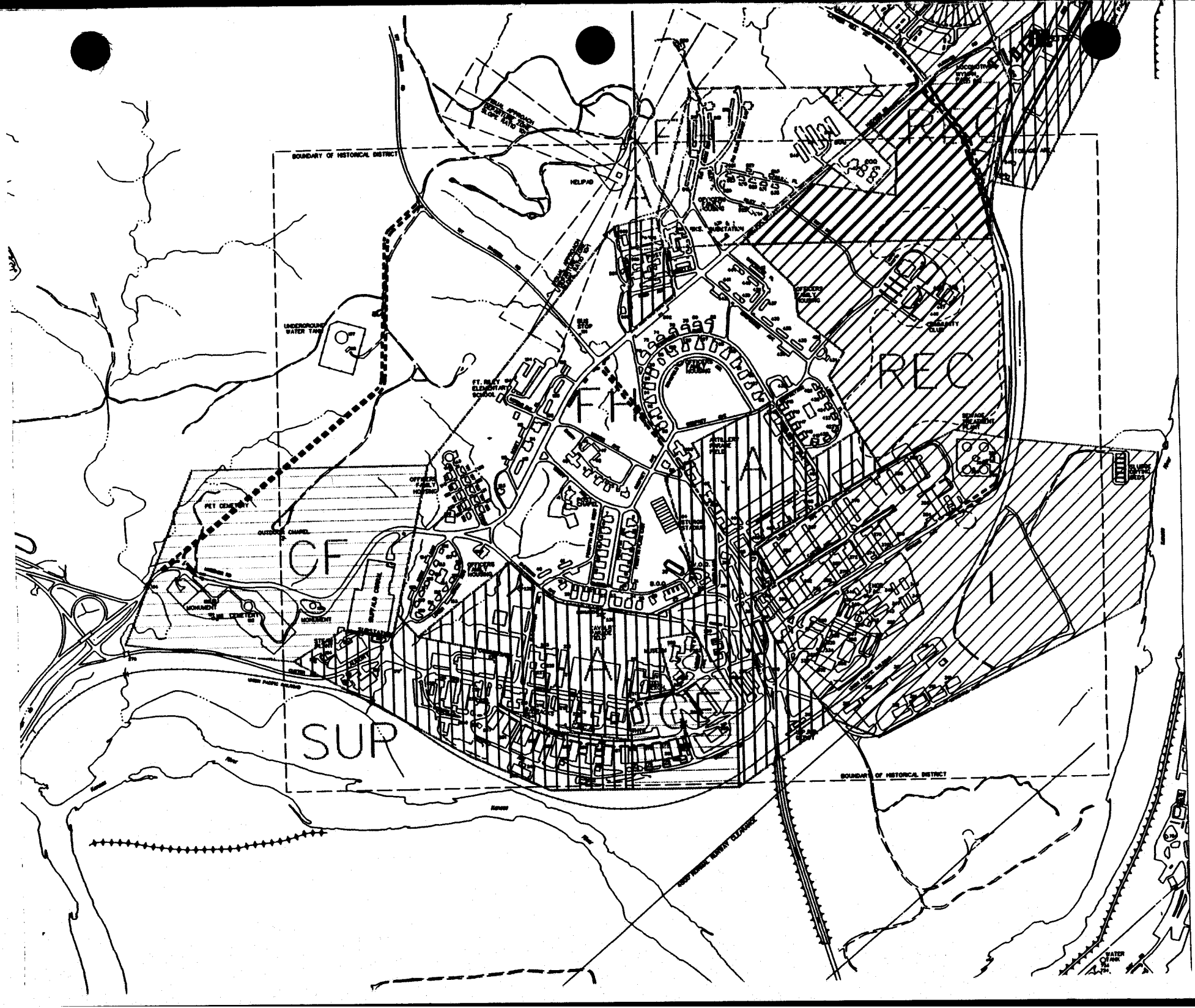
FILE
PSF / Main Post

Land Uses

- AVN - Aviation
- M - Maintenance
- I - Industrial
- SUP - Supply Storage
- A - Admin
- TRNG - Training
- UPH - Barracks
- FH - Family Housing
- CF - Community Fac
- MED - Medical
- REC - Outdoor Recreation
- OPEN - Open Space

Installation Planning Board
September 1997

Land Use Categories identified in Master Planning Instructions.
Attached Map File: MAINFFF.DGN maintained by PW, Master Planner.
A land use change is a reconfiguration of a land use zone and requires an amendment to the Installation Real Property Master Plan.. Supporting environmental documentation must also be adjusted. (AR 210-20)


BOUNDARY OF HISTORICAL DISTRICT
FT
REC
CF
SUP
PET CEMETERY
OUTDOOR CHAPEL
MONUMENT
HELIPAD
UNDERGROUND WATER TANK
FT. RILEY ELEMENTARY SCHOOL
OFFICERS FAMILY HOUSING
COMMUNITY CLUB
SEWAGE TREATMENT PLANT
WATER TANK
BOUNDARY OF HISTORICAL DISTRICT