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EPA Superfund Record of Decision:

Fort Riley (Southwest Funston Landfill), Operable Unit 1, Hutchinson, KS 1/19/1996

RECORD OF DECISION

SOUTHWEST FUNSTON LANDFILL

OPERABLE UNIT 001

FORT RILEY, KANSAS

NOVEMBER 1995

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1.0 DECLARATION

SITE NAME AND LOCATION

Southwest Funston Landfill (SFL)
Operable Unit 001
Fort Riley, Kansas

STATEMENT OF BASIS AND PURPOSE

This decision document presents the selected remedial action for the Southwest Funston Landfill (SFL), Operable Unit 001, 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), Army Regulation 200-1 (AR 200-1) 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 SFL site.

The SFL, about 120 acres in size, was operated from the mid-1950s to 1981 as a municipal waste landfill. It is located in the flood plain of the Kansas River in the southern portion of the installation. A Removal Action consisting of river bank stabilization (completed) and cover repairs (underway) has been undertaken.

This remedy was chosen by the Department of the Army and Fort Riley, in consultation with the United States Environmental Protection Agency, Region VII (EPA) and the Kansas Department of Health and Environment (KDHE). The EPA and KDHE concur with the selected remedy. This Declaration is the section of the Record of Decision signed by the Department of the Army, Fort Riley and EPA Region VII.

ASSESSMENT OF THE SITE

Actual or threatened releases of hazardous substances from this site, if not addressed by implementing the response action selected in this Record of Decision (ROD), may present a potential future threat to public health, welfare, or the environment. The principal threat pertains to hypothetical future use of site-impacted groundwater.

DESCRIPTION OF THE SELECTED REMEDY

This remedial action is for Operable Unit 001, the Southwest Funston Landfill. This operable unit is one of five currently identified at Fort Riley.

The selected remedy for Operable Unit 001 addresses the principal threat remaining at the SFL site by restricting future site uses, stabilizing the Kansas River bank adjacent to the landfill, repairing and improving the existing native soil cover, and prohibiting the future use of site groundwater.

The major components of the selected remedy include:

- Institutional controls to restrict future site uses and prohibit the future use of site groundwater.
- Placing rock revetment along the Kansas River bank (installed in spring 1994 as a Removal Action).
- Improvement of the existing soil cover over the landfill so that it meets the criteria of 40 CFR 258.60.
- Conducting semi-annual groundwater monitoring at the site.
- A contingency for future active remediation of the site, if warranted.

STATUTORY DETERMINATIONS

The selected remedy is protective of human health and the environment, complies with Federal and State requirements that are legally applicable or relevant and appropriate to the remedial action, and is cost effective. This remedy utilizes permanent solutions and alternative treatment technologies to the maximum extent practicable for the site. However, because the contaminant source, the site itself, could not be effectively excavated and treated due to its large size and absence of hot spots representing major sources of contamination, use of alternative treatment technologies was not practicable. Thus, because treatment of the principal threat was not found to be practicable or appropriate, this remedy does not satisfy the statutory preference for treatment as a principal element of the remedy.

Because this remedy will result in hazardous substances remaining on-site above health-based levels, a review will be conducted within five years after commencement of remedial action in accordance with CERCLA Section 121 (c), 42 U.S.C. § 9621 (c) to ensure that the remedy continues to provide adequate protection of human health and the environment.

LEAD AND SUPPORT AGENCY ACCEPTANCE OF THE RECORD OF DECISION, SOUTHWEST FUNSTON LANDFILL, OPERABLE UNIT 001 FORT RILEY, KANSAS

Signature Sheet for Record of Decision for Operable Unit 001, Southwest Funston Landfill, Fort Riley, Kansas, Final Action

__________________________________ ________
Major General Randolph W. House — Date
Commander, 1st Infantry Division (Mechanized) and Fort Riley
United States Department of the Army

__________________________________ ________
Raymond J. Fatz — Date
Acting Deputy Assistant Secretary of the Army
(Environment, Safety, and Occupational Health),
Office of the Assistant Secretary of the Army
(Installations, Logistics & Environment)
United States Department of the Army

[signature] 1-19-96
Dennis Grams, P.E. — Date
Regional Administrator
U.S. Environmental Protection Agency - Region VII

2.0 DECISION SUMMARY

2.1 SITE NAME, LOCATION, AND DESCRIPTION

Southwest Funston Landfill (SFL) Federal Facility Site
Operable Unit 001
Fort Riley, Kansas

The Fort Riley Military 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), near the cities of Manhattan, Ogden, Junction City and Grandview Plaza, Kansas. The installation comprises about 101,000 acres and is located between two major surface water reservoirs: Tuttle Creek Lake completed in 1962 and Milford Lake completed in 1965.

The Southwest Funston Landfill (SFL) covers about 120 acres and is in the southern portion of Fort Riley, adjacent to the southwest corner of the Camp Funston cantonment area. The limits of the SFL extend from the north bank of the Kansas River north to near Well House Road, and east from the old Kansas River Channel to just west of Threemile Creek (Figure 2-2). The SFL site lies entirely within the 100- and 500-year floodplain of the Kansas River. The nearest surface-water impoundment to the SFL is Whitside Lake, an oxbow lake located about 0.5 miles northwest of the SFL site. This oxbow lake was part of the Kansas River channel prior to the 1951 flood which changed the course of the Kansas River. During flooding in 1993, floodwater passed through the lake following the course of the former channel. Sediment was deposited by the floodwater, substantially reducing the size of the lake.

Fort Riley 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 (1) narrow alluvial bottomlands and wide meander flood plains and associated terraces along the Republican and Kansas Rivers, (2) steep slopes and hilly relief, and (3) flat-lying or slightly dipping uplands.

The SFL is located in the alluvial bottomlands adjacent to the Kansas River, with little topographic relief compared to the surrounding land surface. The landfill area was graded and a continuous soil cover was constructed as part of KDHE-approved closure activities in 1983 and has been (prior to Removal Action cover repairs) covered with grass and other leafy vegetation (weeds, sunflowers, and saplings). The SFL is bounded by agricultural land to the west and the Camp Funston cantonment area to the east. The SFL site slopes very gently toward the east-southeast. Steep slopes exist along the banks of the Kansas River to the south and along Threemile Creek to the east.

FIGURE 2-1
SOUTHWEST FUNSTON LANDFILL LOCATION MAP
FORT RILEY, KANSAS

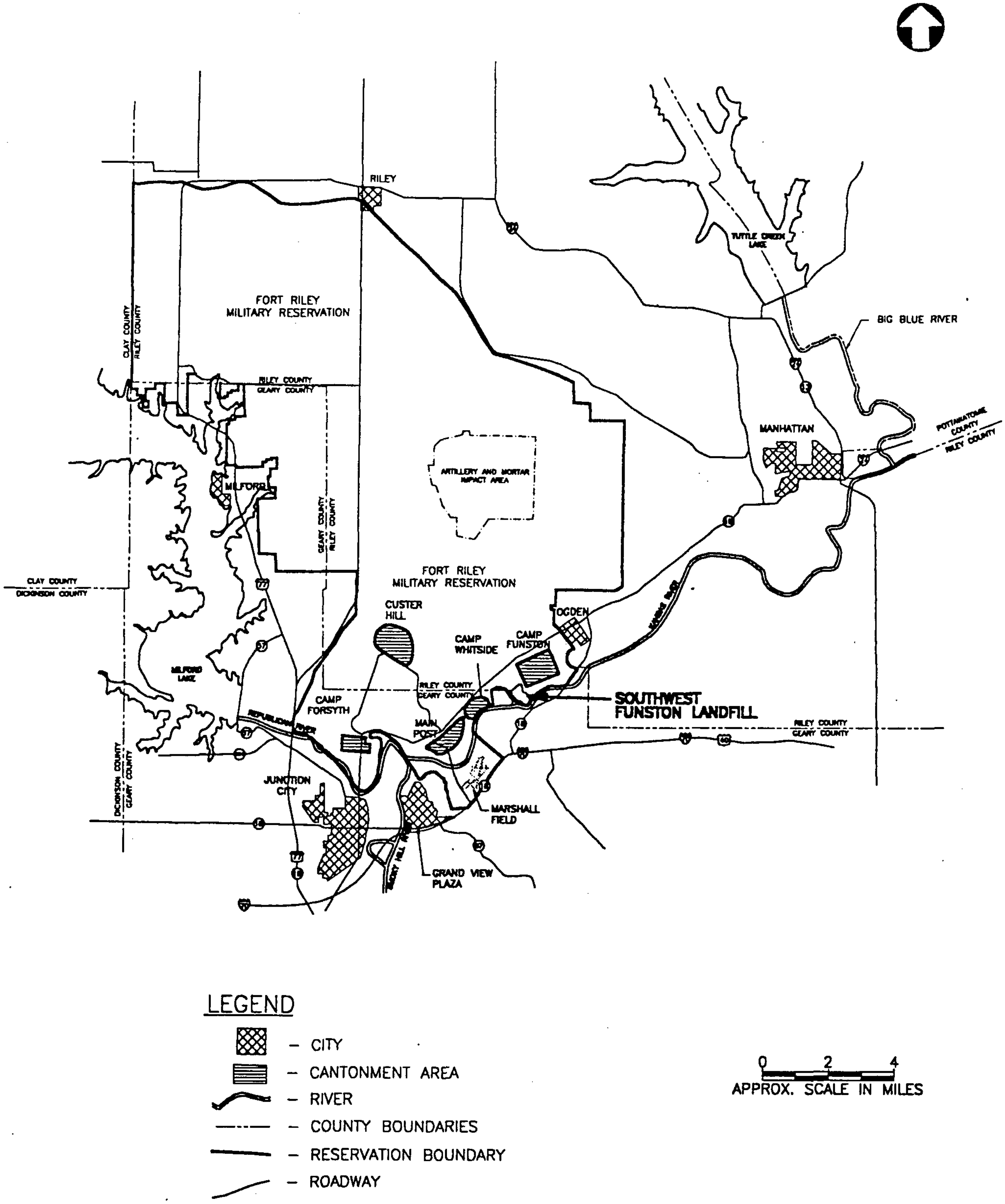
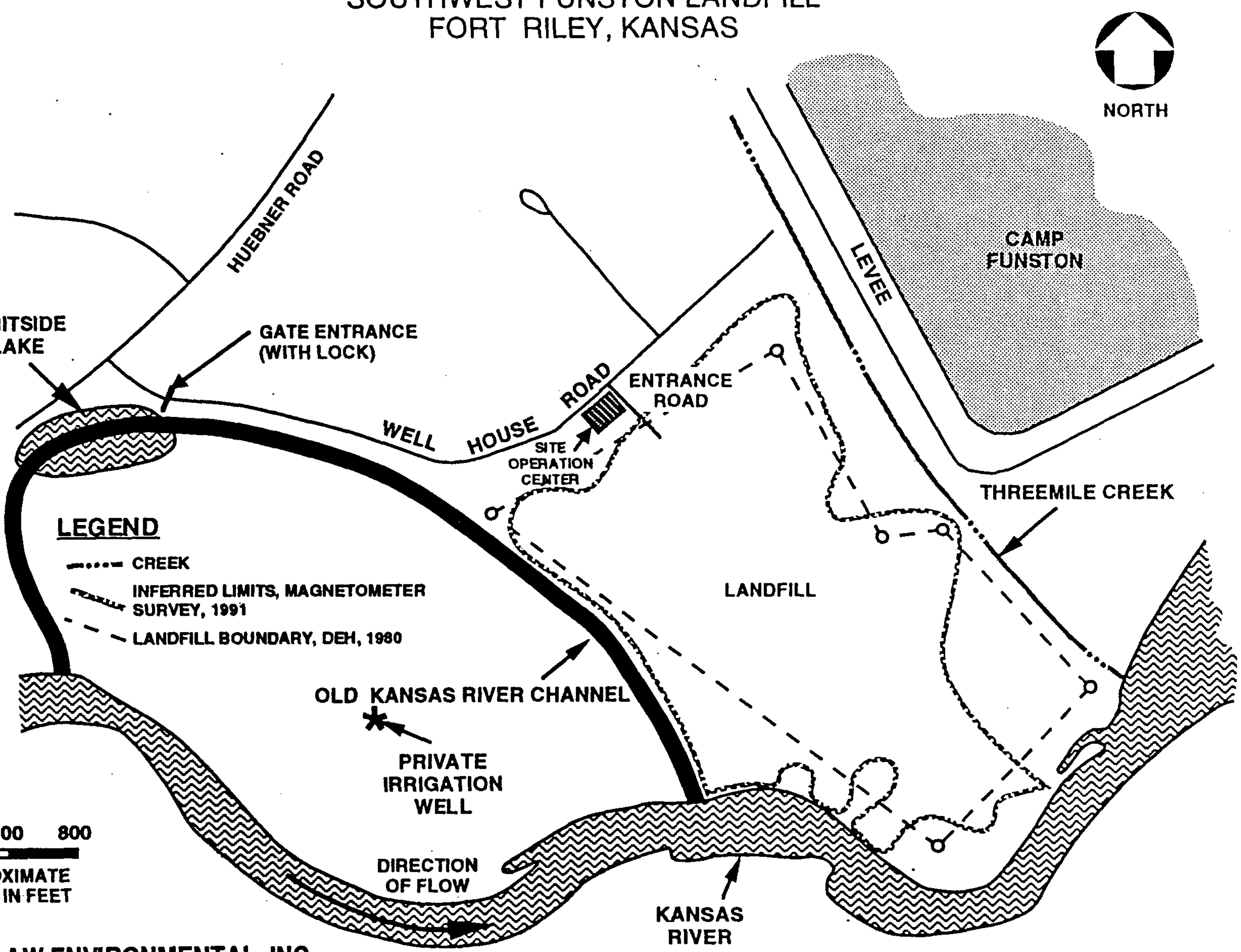


FIGURE 2-2
GENERAL SITE MAP
SOUTHWEST FUNSTON LANDFILL
FORT RILEY, KANSAS



LAW ENVIRONMENTAL, INC.
GOVERNMENT SERVICES DIVISION

2.2 SITE HISTORY AND REMEDIAL ACTIVITIES

Fort Riley was established in 1852 as a small outpost near the confluence of the Republican and Smokey Hill rivers. Since its inception, Fort Riley has continually served as a major center of military education and readiness, at times comprising a population of more than 20,000 military residents and civilian employees. The Fort Riley reservation has historically 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 municipal activities at Fort Riley. Fort Riley's function as a military training, equipment supply, and maintenance center has historically required management and disposal of wastes associated with these activities.

The SFL operated from the mid-1950s to 1981, receiving wastes which included typical municipal waste and industrial wastes from various activities at the installation. Some of these industrial wastes were reported to have contained hazardous substances and are thus potential sources of contamination. Types of materials disposed at the SFL which are potential sources of contamination include wastes generated by vehicle and aircraft maintenance shops, print shops, furniture repair shops, painting facilities, oil analysis laboratory, autoclaved biological waste, pesticide/herbicide storage and preparation, laundry and dry cleaning facilities, and wastewater treatment plants. Wastes from these sources may include metal-laden oils, solvents, inks, paints and heavy metals, and dried wastewater treatment plant sludge. The landfill was closed in 1983 in a manner approved by KDHE. The RI and FS reports provide additional information on landfill operations.

Pursuant to Section 105 of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), Fort Riley was proposed for inclusion on the National Priority List (NPL) on July 14, 1989. Two sites at Fort Riley, the Pesticide Storage Facility and SFL, were combined by the United States Environmental Protection Agency (EPA) as one site for Hazard Ranking System scoring purposes. The NPL listing became effective October 1, 1990. To ensure that environmental impacts associated with activities at the installation were thoroughly investigated and appropriate remedial action taken, Fort Riley, the EPA, and the State of Kansas entered into a Federal Facility Agreement (FFA), effective June 28, 1991. Under Section IX.A., paragraph 2 of the Agreement, the SFL was specifically addressed as a potential area of contamination, and a schedule for a site RI/FS was established. The schedule for the Remedial Action will be established in accordance with Section XI. B. of the FFA.

A site investigation to characterize the contamination at the SFL site and a Baseline Risk Assessment to evaluate the potential risk to human health and the environment have been completed. The results of the investigation and assessment were presented in a Remedial Investigation (RI) Report dated October 1993, with revisions submitted April 1994. The revised RI was accepted by EPA Region VII without additional comment and approved with comment by KDHE on April 20, 1994.

An Engineering Evaluation/Cost Analysis (EE/CA) was performed to assess the appropriateness of performing non-time critical removal actions at the SFL site. These removal actions were proposed to reduce the risk of exposing landfill contents by stabilizing the Kansas River bank immediately adjacent to the landfill and repairing the existing landfill cover. The results of that study are contained in an EE/CA report dated July 1993. In accordance with the requirements of CERCLA, a public comment period on the EE/CA report was provided from August 17 to September 16, 1993. No public comments on the EE/CA report were received. A Removal Action Memorandum and Responsiveness Summary was submitted to EPA and KDHE in December 1993 and signed by Fort Riley and KDHE on December 20, 1993. Having received no public objections to the proposed actions, the riverbank stabilization project was initiated in January 1994 and completed in the spring of 1994. The cover repair project began in the fall of 1994 and construction activities are expected to be completed during the 1995 calendar year.

The RI report provided the basis for the Feasibility Study (FS) report, which presents the alternatives available to address potential risk identified in the RI report. The FS report, dated April 1994, was approved by EPA and KDHE on May 16, 1994 and May 3, 1994 respectively. Responses to comments received from EPA and KDHE were transmitted by Fort Riley on August 4, 1994. The removal actions discussed in the EE/CA report were elements of alternatives considered during the FS.

The Proposed Plan was issued as a supplement to the RI and FS reports to inform the public of Fort Riley's, EPA Region VII's, and KDHE's preferred remedy based on information included in the Administrative Record and to solicit public comments pertaining to the remedial alternatives evaluated, including the preferred alternative. The Proposed Plan described the remedial alternatives considered for the SFL and identified the preferred remedial alternative with the rationale for this preference. Submitted on August 26, 1994, the Draft Final Proposed Plan was accepted by KDHE without comment and by EPA Region VII via letter of October 5, 1994.

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 SFL site. Primary documents developed during the RI/FS process included the RI report, Baseline Risk Assessment, EE/CA, FS report, and Proposed Plan for Operable Unit 001. These reports were released to the public between July 1993 and November 1994 and have been made available for public review as part of the Administrative Record file at the Fort Riley Directorate of Environment and Safety, Planning and Restoration Division. The Administrative Record is the set of supporting information used to determine the preferred alternative and is made available to the public. These reports were also made available to potentially affected persons and the public in the following information repositories: Dorothy Bramlage Public Library (Junction City), 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 on November 6, 7, and 8, 1994, and in the Fort Riley Post on November 4 and 11, 1994.

A public comment period for this remedial action was declared from November 9, 1994 through December 9, 1994 to provide a reasonable opportunity for comment and to disseminate information regarding the Proposed Plan.

A public meeting was held at the Fort Riley Community Club, Building 446, on November 15, 1994, at 6:30 p.m. local time. At this meeting, representatives from the U.S. Army, KDHE and EPA were available to inform the public of the preferred alternative and record public comments. One newspaper reporter attended the public meeting and no comments were received prior to the end of the public comment period. 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 Operable Unit 001 at the SFL site in Fort Riley, Kansas, chosen in accordance with CERCLA, as amended by SARA and, to the extent practicable, the National Contingency Plan. The decision for this site is based on the Administrative Record.

2.4 SCOPE AND ROLE OF OPERABLE UNIT

As with many CERCLA sites, the issues at Fort Riley are complex. As a result, the site has been organized into operable units. This ROD addresses Operable Unit 001, the Southwest Funston Landfill, where the principal threat pertains to hypothetical future use of site-impacted groundwater.

Remedial action objectives (RAOs) are specific goals to protect human health and the environment. The remedial action objectives established for the SFL are as follows:

- Minimize human and ecological direct contact with landfill contents.
- Reduce the potential for leachate generation by reducing storm-water ponding and infiltration as practical.
- Stabilize the Kansas River bank slope adjacent to the SFL to prevent movement of the channel into the landfill and to prevent exposure and erosion of the landfill contents.
- Prevent ingestion, inhalation and dermal contact with groundwater having organic contaminant concentrations exceeding the remediation goals. (The remediation goals are listed in Table 2-3 which follows.)

The scope of the response action for the SFL is to restrict future site uses and prohibit the future use of site groundwater. As indicated in Section 2.2, a Removal Action was implemented at the SFL based on the results of the EE/CA report. This Removal Action included both stabilization of the adjacent Kansas River bank and repairs to the existing soil cover over the SFL. The Kansas River bank stabilization was started in spring 1994 and has been completed. The bank stabilization consisted of installation of rock revetment to minimize erosion of the bank and exposure of the landfill contents. The cover repair project was initiated in the fall of 1994 and construction is expected to be completed by the end of calendar year 1995. Repairs to the existing cover include placing local borrow soil in settled areas and placing additional fill over the existing cover. These repairs plus additional improvements to the landfill surface conditions and the Kansas River bank are an integral part of the remedial action. The selected response action addresses the RAOs established for the SFL.

2.5 SUMMARY OF SITE CHARACTERISTICS

Historic information reviewed during the RI indicated that wastes disposed at the SFL included dried wastewater treatment plant sludge, waste oil, and waste containing chlorinated solvents or heavy metals.

The results of the RI site characterization indicate that some limited, sporadic, low-level volatile organic contamination is present in the site groundwater. Organics detected in groundwater which exceeded the Federal Maximum Contaminant Level (MCL) for drinking water include vinyl chloride, 1,2-dichloroethane, benzene, and 1,1,2-trichloroethane. Metals such as iron, manganese, and aluminum were also detected in the site groundwater but were attributed to naturally occurring conditions. The metals antimony, arsenic, and beryllium were also detected in groundwater. The surface soil investigation indicated that lead is present in the site cover soil at levels consistent with background conditions in the majority of samples analyzed. Subsurface soil data indicate the isolated presence of several low-level constituents, including petroleum hydrocarbons, volatile organic compounds (VOCs), and phthalates. The data from the surface water and sediment investigation indicate that the SFL is not contributing organic contaminants to the Kansas River and its tributary, Threemile Creek. Additionally, surface water and sediment samples collected at locations both upstream and downstream of the SFL contained similar concentrations of inorganics, indicating that the SFL is not contributing inorganics to the Kansas River and Threemile Creek.

The predominant contaminant migration pathway at the SFL is for contaminants to leach or migrate from the landfill contents to the groundwater. Contaminants can be mobilized from the landfill by percolating rainwater that might carry contamination down to the water table. Contaminants can also be mobilized when the water table rises into the landfill and saturates the waste. The water table is influenced in part by the stage of the Kansas River. Groundwater from beneath the landfill is interpreted to primarily discharge to Threemile Creek (directly east of the SFL) and the Kansas River. Once in the groundwater, the contaminants may be transported toward the Kansas River and Threemile Creek. The potential exists for the contaminants in the groundwater to migrate to the river or the creek as the groundwater discharges into these surface water features. The Kansas River and Threemile Creek do not appear to be impacted by the landfill, based on the absence of site-related constituents above background concentrations. Because the groundwater flow conditions vary, it is possible for contaminated groundwater to pass under Threemile Creek and then flow to the Kansas River. VOCs are the predominant groundwater contaminants most likely to migrate in this manner at the site. The VOCs would likely evaporate once they are transported into the surface water. The RI report provides additional information on SFL site characteristics.

2.6 SUMMARY OF SITE RISKS

Based upon the results of the site characterization study, a Baseline Risk Assessment (BLRA) was conducted for the SFL site at Fort Riley to estimate the risks associated with potential current and future exposures to site conditions. The BLRA estimated the potential for adverse effects to human and ecological receptors that might result from site contamination if no remedial action was taken. The results of the BLRA indicates that potentially unacceptable risks as defined in the NCP exist only for hypothetical future receptors.

Chemicals of Potential Concern

As part of the BLRA, contaminants of concern (COCs) were selected for the medium considered to pose the principal threat (i.e., groundwater). The selection of the COCs was based on the concentrations at which the chemicals were detected and their toxicity. The COCs were antimony; arsenic; benzene; beryllium; cis-1,3-dichloropropene; 1,2-dichloroethane; 1,1,2,2-tetrachloroethane; 1,1,2-trichloroethane; and vinyl chloride. These contaminants and the range of concentrations at which they were detected (not including nondetect values) are listed on Table 2-1.

Exposure Assessment

As presented in the risk assessment, the reasonable maximum exposure (RME) evaluation for the SFL site presents a scenario which includes consumption of groundwater from a well located within the site. However, consumption of groundwater from the site is a hypothetical scenario that is not anticipated to occur because a municipal water supply exists for the area and because the site is located in the flood plain. As discussed in the FS, although the use of on-site groundwater for drinking water purposes is considered unlikely to occur, this scenario was evaluated as a conservative approach in lieu of modeling an exposure concentration at an off-site location because of the time, effort, and additional data required for accurate modeling. It should be noted that the evaluation of risk based upon on-site groundwater use is considered to be very conservative, in contrast to an evaluation based on modeling contaminant migration to an off-site receptor. Future development of the SFL site for residential or water supply purposes is considered very unlikely.

TABLE 2-1

CHEMICALS OF POTENTIAL CONCERN - GROUNDWATER
RANGE OF POSITIVE HITS

Southwest Funston Landfill
Fort Riley, Kansas

Chemical	Concentration in Groundwater (mg/L)		
Antimony	0.022	-	0.031
Arsenic	0.002	-	0.045
Benzene	0.0015	-	0.014
Beryllium	0.001	-	0.004
1,2-Dichloroethane	0.0068	-	0.016
cis-1,3-Dichloropropene	0.0054	-	0.0059
1,1,2,2-Tetrachloroethane	0.0063	-	0.015
1,1,2-Trichloroethane	0.0088	-	0.0088
Vinyl Chloride	0.014	-	0.018

Note: Data set includes Baseline (July 1992), First quarter (November 1992, Second quarter (February 1993), and Third quarter (May 1993) sampling events.

The BLRA evaluated the health effects which could potentially result from exposure by ingestion, inhalation, and dermal contact with constituents detected at the site. Risks were estimated for eighteen (18) current and/or future exposure scenarios. They are:

Current Land Uses - Occupational Services (exposures that may occur during work on utility lines located adjacent to Threemile Creek, or other on-site activities)

1. Dermal contact with surface water
2. Dermal contact with sediments
3. Incidental ingestion of sediments

Current Land Uses - Hunter Scenarios (exposures that may occur as a result of present-day hunters on the SFL)

4. Incidental ingestion of soil
5. Inhalation of fugitive dust
6. Dermal contact with soil

Future Land Uses - Occupational Scenarios (exposures that may be experienced by future maintenance/groundskeeping employees at the SFL)

7. Dermal contact with surface water
8. Dermal contact with sediments
9. Incidental ingestion of sediments
10. Incidental ingestion of soil
11. Inhalation of fugitive dust
12. Dermal contact with soil

Future Land Uses - Recreational Hunter Scenarios (exposures that may occur as a result of future hunters at the SFL)

13. Incidental ingestion of soil
14. Inhalation of fugitive dust
15. Dermal contact with soil

Future Hypothetical Land Uses - Groundwater Scenarios (exposures that may occur from hypothetical future residents using groundwater from the water-bearing zone beneath the SFL)

16. Ingestion of drinking water
17. Inhalation of volatiles during bathing and household water use
18. Dermal contact while showering

Toxicity Assessment

The toxicity assessment is an integral part of the preliminary risk evaluation process. A comparison of site concentrations to regulatory requirements, standards, and criteria was made. State or Federal regulations, rules, guidelines, and criteria were compared to site concentrations in a sampled media. This comparison serves as a qualitative guide and points out media which may be serving as potential sources of risk. For groundwater, pertinent comparative measures include the Maximum Contaminant Levels (MCLs), Maximum Contaminant Level Goals (MCLGs), the Kansas Action Levels (KALs), Kansas Notification Levels (KNLs), Alternate Kansas Action Levels (AKALs) and Alternate Kansas Notification Levels (AKNLs). A list of the regulatory and guidance criteria for the constituents of concern in groundwater is presented in Table 2-2.

In addition to comparing detected constituent concentrations to potential applicable or relevant and appropriate requirements (ARARs), quantitative reference values describing the toxicity of the constituents of concern were evaluated. Toxicity values such as Reference Dose or Reference Concentration (RfD/RfC) and Cancer Slope Factor (CSF) were used. The toxicity values used in the BLRA were obtained from the EPA's Integrated Risk Information System (IRIS) database.

Cancer slope factors (CSFs) have been developed by EPA's Carcinogenic Assessment Group for estimating excess lifetime cancer risks associated with exposure to potentially carcinogenic chemicals. CSFs, which are expressed in units of $(mg/kg\text{-}day)^{-1}$, are multiplied by the estimated intake of a potential carcinogen, in mg/kg-day, to provide an upper-bound estimate of the excess lifetime cancer risk associated with exposure at that intake level. The term "upper bound" reflects the conservative estimate of the risks calculated from the CSF. Use of this approach makes underestimation of the actual cancer risk highly unlikely. Cancer slope factors are derived from the results of human epidemiological studies or chronic animal bioassays to which animal-to-human extrapolation and uncertainty factors have been applied.

Reference doses have been developed by EPA for indicating the potential for adverse health effects from exposure to chemicals exhibiting noncarcinogenic effects. RfDs, which are expressed in units of mg/kg-day are estimates of lifetime daily exposure levels for humans, including sensitive individuals. Estimated intakes of chemicals from environmental media (e.g., the amount of a chemical ingested from contaminated drinking water) can be compared to the RfD. RfDs are derived from human epidemiological studies or animal studies to which uncertainty factors have been applied (e.g., to account for the use of animal data to predict effects on humans). These uncertainty factors help ensure that the RfDs will not underestimate the potential for adverse noncarcinogenic effects to occur.

Risk Characterization

As discussed previously, the results of the BLRA indicated that only groundwater at the site poses potentially unacceptable risks to human health. Excess lifetime cancer risks were determined by multiplying the intake level by the cancer slope factor. These risks are probabilities that are generally expressed in scientific notation (e.g., 1×10^{-6}). An excess

TABLE 2-2

REGULATORY AND GUIDANCE CRITERIA FOR GROUNDWATER

Southwest Funston Landfill
Fort Riley, Kansas

Parameter	Exposure Point Concentration (A) (mg/L)	Maximum Detected Concentration (mg/L)	Federal Maximum Contaminant Level (B) (mg/L)	Federal Maximum Contaminant Level Goal (B) (mg/L)	Kansas Maximum Contaminant Level (C) (mg/L)	Kansas Action Level (D) (mg/L)	Kansas Notification Level (D) (mg/L)	Alternate Kansas Action Level (D) (mg/L)	Alternate Kansas Notification Level (D) (mg/L)
Antimony	0.012	0.031	0.006 (E)	0.006 (E)	--	0.143	--	--	--
Arsenic	0.019	0.045	0.05	0	0.05	0.05	--	--	--
Benzene	0.0014	0.014	0.005	0	--	0.005	0.0005	--	--
Beryllium	0.0021	0.004	0.004 (E)	0.004 (E)	--	0.00013	--	--	--
1,2-Dichloroethane	0.0028	0.016	0.005	0	--	0.005	0.0005	--	--
cis-1,3-Dichloropropene	0.0017	0.0059	--	--	--	0.002	0.0002	--	--
1,1,2,2-Tetrachloroethane	0.003	0.015	--	--	--	0.0017	0.00017	--	--
1,1,2-Trichloroethane	0.0027	0.088	0.005	0.003	--	0.0061	0.00061	--	--
Vinyl Chloride	0.0054	0.018	0.002	0	--	0.002	0.0002	--	--

Boxed values indicate exceedence of regulatory or guidance criteria
(A) - The 95% UCL (or maximum detected concentration if 95 % UCL > maximum concentration) of concentrations detected in ground water samples
(B) - Maximum Contaminant Levels and Maximum Contaminant Level Goals (40 CFR 141 Subpart B)
(C) - Kansas Drinking Water Rules (KAR 28.15), last amended 1 May, 1988
(D) - KDHE Memorandum, dated 5 December, 1988; Revised Groundwater Contaminant Cleanup Target Concentraions for Aluminum and Selenium
(E) - Drinking Water Regulations and Health Advisories, USEPA Office of Water, December 1992
-- No guidance value available
* - Data set includes Baseline (July 1992), First quarter (November 1992), Second quarter (February 1993), and Third quarter (May 1993) sampling events.

lifetime cancer risk of 1 x 10^{-6} indicates that, as a plausible upper bound, an individual would have a one in one million chance of developing cancer as a result of site-related exposure to a carcinogen over a 70-year lifetime under the specific exposure conditions at a site.

Estimated site-related carcinogenic risks due to potential future household uses of groundwater obtained at the site were 5 x 10^{-4} for ingestion and 3 x 10^{-4} for inhalation (during showering). Estimated total risk, including that risk due to background or naturally occurring levels of constituents, were 1 x 10^{-3} for ingestion and 3 x 10^{-4} for inhalation. Due to the conservative nature of the risk assessment assumptions, these risk estimates represent extremely conservative estimates. That is, it is reasonable to presume that the actual risks are less than those estimated.

Potential concern for noncarcinogenic effects of a single contaminant in a single medium is expressed as the hazard quotient (HQ), or the ratio of the estimated intake derived from the contaminant concentration in a given medium to the contaminant's reference dose. By adding the HQs for all contaminants within a medium or across all media to which a given population may reasonably be exposed, the Hazard Index (HI) can be calculated. The HI provides a useful reference point for gauging the potential significance of multiple contaminant exposures within a single medium or across two or more media.

Estimated site-related noncarcinogenic risks (expressed as Hazard Indices) due to potential future household uses of the groundwater at the site were 16 for ingestion by adults and 29 for children. Hazard Indices for total risk for ingestion of groundwater, including background levels, were 26 for adults and 54 for children. These Hazard Indices also represent upper-bound estimates. That is, it is reasonable to presume that the actual potential for adverse effects are overestimated by these estimated values.

As discussed in the NCP, current federal guidelines for acceptable exposures call for a maximum Hazard Index equal to 1.0 for noncarcinogens and carcinogenic risk between 10^{-4} and 10^{-6}. A Hazard Index greater than 1.0 indicates that concern may exist for potential non-cancer health effects due to exposure to site-related contaminants. A carcinogenic risk greater than 10^{-4} indicates that potential exposures may result in an unacceptable increase in the probability of an individual developing cancer due to site-related contaminants (A carcinogenic risk of 10^{-4} represents a probability of one in 10,000 that an individual would develop cancer as a result of site-related exposure to a carcinogen over a 70-year period). Because risk assessments are conditional estimates for which uncertainty is typically large (factor of 10 to 100), the NCP provides for the consideration of uncertainty when examining what constitutes unacceptable risk.

On the basis of the BLRA, and because the groundwater at the site is not currently used as a source of potable water, the site does not present an imminent or substantial endangerment to public health. However, based on the carcinogenic and noncarcinogenic risk estimates for potential hypothetical exposures to groundwater at the site, releases of hazardous substances from this site may present a future threat to public health if the groundwater beneath the site or site-impacted groundwater is used as a source of potable water. As indicated, use of site groundwater is considered unlikely to occur. Furthermore, it should be noted that the estimate of risk for groundwater pathways is very conservative, because it is based on the assumption that all of the drinking water ingested in a given day comes from a contaminated source. In actuality, it is highly improbable that the SFL site will ever be developed for residential use or as a residential water supply because it is in the flood plain and a public supply of potable water already exists in the area. Thus, the calculated risks due to consumption of on-site groundwater are considered to be much larger than the actual risks posed by the site. The primary human health risk concern is the future migration of contaminants to off-site groundwater receptor points.

Human health-based remediation goals (RGs) were calculated for organic constituents of concern detected in the groundwater at the site (Table 2-3). As prescribed in the NCP, these goals were based on Maximum Contaminant Levels (MCLs) or non-zero MCL goals (MCLGs) where available. Where MCLs or non-zero MCLGs were not available, RGs were calculated using an acceptable risk range of between 1×10^{-4} and 1×10^{-6} for carcinogens and Hazard Indices of 1.0 for noncarcinogens. Table 2-3 indicates the detection frequency (an indication of the extent of the constituent), the maximum concentration detected, the exposure concentration (an indication of potential concentration which could be encountered), the remediation goal, and the frequency at which the RG was exceeded.

Uncertainties - The following paragraphs identify and attempt to characterize the various uncertainties associated with the Baseline Risk Assessment results, based on assumptions made and existing data gaps:

- Toxicity values are not available for several constituents of concern, and therefore, the risk due to these constituents was not quantified. Thus, the overall noncarcinogenic and carcinogenic risks calculated for a particular pathway of concern at the site may be slightly underestimated.

- The exposure scenario assuming a sustained, long-term use of contaminated groundwater may not be reasonable based on the limited and sporadic detection of contaminants in the groundwater.

- The assumption of the exclusive use of the groundwater beneath the site for a future potable water source is unlikely because a public supply of potable water is readily available nearby. Also, Executive Order 11988, "Floodplain Management," would likely restrict residential (or other) construction in the floodplain, as alternative building sites exist on the installation.

- The noncarcinogenic and carcinogenic risks calculated for future exposures to groundwater are based on the concentrations of constituents detected at the site. Constituent concentrations were not modeled to the nearest potential exposure point (i.e., the nearest potable water well), because further study would be needed before an accurate and justifiable modeling effort can be made. Modeled concentrations at an off-site exposure point would most likely be significantly less than the concentrations detected in site samples. Therefore, the risks estimated for future groundwater pathways in the risk assessment are overestimated.

TABLE 2-3

GOVERNING REMEDIATION GOALS FOR GROUNDWATER [a]
Southwest Funston Landfill
Fort Riley, Kansas

Analyte	Detection Frequency[d]	Maximum Detection Concentration	Exposure Concentration[f]	Remediation Goal	Exceedance Frequency[e]
Benzene	7/56	14	1.4	5[b]	2/56
1,2-Dichloroethane	3/56	16	2.8	5[b]	3/56
cis-1,3-Dichloropropene	2/56	5.9	1.7	0.28, 2.8, 28[c]	2/56
1,1,2,2-Tetrachloroethane	2/56	15	3	0.042, 0.42, 4.2[c]	2/56
1,1,2-Trichloroethane	1/56	8.8	2.7	3[g]	1/56
Vinyl Chloride	2/56	18	5.4	2[b]	2/56

Note: All units are μg/L.

[a] The governing remediation goals are Maximum Contaminant Levels (MCLs) (if they exist); otherwise risk-based remediation goals are presented.

[b] Remediation goal is based on MCL (Drinking Water Regulations and Health Advisories, US EPA, Office of Water, May 1993).

[c] Remediation goals are based on carcinogenic risks of 1×10^{-4}, 1×10^{-5}, and 1×10^{-6}, respectively.

[d] The frequency of detection of the analyte above its respective laboratory detection limit. The detection (and exceedance) frequencies include Well Cluster 5 (which was omitted from the risk assessment).

[e] The frequency of detections exceeding the remediation goal (MCL, MCLG, or a concentration calculated using a carcinogenic target risk of 1×10^{-5}).

[f] 95% Upper confidence limit (UCL)

[g] Remediation Goal is based on MCLG.

Data set includes Baseline (July 1992), First quarter (November 1992), Second quarter (February 1993), and Third quarter (May 1993) sampling events.

- In accordance with EPA Region VII guidance (USEPA, 1992b), metals with maximum detected concentrations greater than the site-specific maximum background concentration in a given medium were identified as chemicals of concern, provided they "passed" the concentration-toxicity screen. Metals that have been identified as chemicals of concern using EPA Region VII guidance may, in fact, be within the range of naturally-occurring background and may not be attributable to the site.

- In evaluating risks from future exposures to site media, the assumption was made that future constituent concentrations will remain the same as current concentrations. Dilution, decay, degradation, and attenuation of constituents occurs naturally over time, and site contaminants may thus present a reduced risk in future scenarios.

The risk assessment should not be viewed as an absolute quantitative measure of the risk to public health presented by site-specific contaminants. The assumptions and inherent uncertainties in the process do not allow that level of confidence. This risk assessment provides a conservative indication of the potential for risk due to exposure to site-specific chemicals. As such, it should be used as a tool to help guide the management of the site to reduce potential risks to acceptable levels.

Conclusions of the Baseline Risk Assessment are as follows:

- The SFL site lies entirely within the 100- and 500-year floodplain of the Kansas River. Therefore, the only receptors expected to be on or adjacent to the site are occupational and recreational receptors. The risks to these receptors (utility workers, grounds maintenance workers, and recreational hunters) are within the acceptable range for both noncarcinogenic and carcinogenic compounds.

- Future residential development of the site is not considered in this risk assessment. In lieu of undertaking extensive efforts to estimate risks at potential off-site receptor locations, the potential risks to hypothetical future residential users of the on-site groundwater were estimated.

- A hazard index greater than one (1) was calculated for future residential adults (HI = 16) and children (HI = 29) using the groundwater as a source of drinking water. Arsenic, antimony, and manganese are the major contributors to the HI. Arsenic concentrations detected in the groundwater were all at levels below the maximum contaminant level (MCL) of 0.05 mg/L. Manganese concentrations were consistent with historical levels of manganese in alluvial wells throughout the Kansas River valley. Antimony was only detected once in two of the four groundwater sampling events, in different wells. Therefore, it is questionable whether antimony is a widespread, site-related constituent.

- Risks due to the carcinogenic compounds are also calculated as part of the human health evaluation. The acceptable cancer risk range of 1×10^{-6} to 1×10^{-4} is exceeded for future residential adults hypothetically using the groundwater beneath the SFL as a potable water source (5×10^{-4} for ingestion and 3×10^{-4} for inhalation). The constituents contributing most to this risk estimate are vinyl chloride, 1,1,2,2-tetrachloroethane, arsenic, and beryllium. Neither arsenic nor beryllium were detected at concentrations greater than their MCLs. Several organics including vinyl chloride, 1,1,2,2-tetrachloroethane, 1,2-dichloroethane, benzene, 1,1,2-trichloroethane, and cis-1,3-dichloropropane were infrequently detected at concentrations greater than their MCLs or KALs.

- It should be noted that the estimate of risk for the groundwater pathways is very conservative, as it is based on the assumption that all of the drinking water ingested in a given day comes from the contaminated source. In addition, the reduction of constituent concentrations through attenuation are not accounted for in the assessment. Since a public water supply is already available in the area, and since it is highly improbable that the SFL site will be developed for residential use or be developed as a residential water supply field in the future, the calculated risks due to the consumption of on-site groundwater are likely to be overestimations.

The Remedial Investigation report, including the Baseline Risk Assessment which presents additional information regarding site risks, is included in the SFL Administrative Record and Information Repositories.

Environmental (Ecological) Assessment

The Baseline Risk Assessment included an Ecological Risk Assessment to qualitatively assess site-related ecological risks. Contaminated media which could reach potential ecological receptors at the site include soil, surface water, and sediment. Exposure pathways of potential concern include: dermal contact with, ingestion of, and inhalation of surface and subsurface soil (for terrestrial receptors); and dermal contact with and ingestion of surface water and sediments (for terrestrial and aquatic receptors). In addition to these potential pathways, the ecological risk assessment considered whether visible signs of stress to receptors at the site were present and whether exposures to endangered and threatened species might occur.

The ecological risk assessment also evaluated potential receptors in the vicinity of the SFL and potential pathways by which these receptors might be exposed to chemicals of concern present in surface soils, surface water, and sediments. Potential receptors include terrestrial vegetation, terrestrial wildlife, endangered species, and aquatic species.

Results of the ecological risk assessment indicate that risk to ecological receptors at the site is very slight. Negative impacts to flora and fauna by contaminants are not expected. Suitable habitat for several threatened or endangered species exists at the site. Though one species, the bald eagle, has been seen on occasion in areas bordering the site, more suitable habitats and foraging areas exist in the general area. In addition, signs of stress to the flora and fauna at the site were not observed. Therefore, population-scale effects on ecological receptors at the site are not anticipated. Additional information describing risks to the ecological environment is provided in the BLRA.

2.7 DESCRIPTION OF ALTERNATIVES

CERCLA requires that each selected site remedy be protective of human health and the environment and comply with ARARs. Additionally, CERCLA requires that the selected site remedy be cost effective, comply with other statutory laws, and, to the maximum extent practicable, utilize permanent solutions, alternative treatment technologies and resource recovery alternatives. In addition, the statute includes a preference for the use of treatment as a principal element for reducing toxicity, mobility, or volume of the hazardous substances.

As mentioned above, CERCLA remedial response actions must address the requirements of environmental laws which are determined to be "applicable" or "relevant and appropriate" on a site-specific basis. Factors such as the types of hazardous substances present (chemical-specific), the types of remedial actions considered (action-specific), and the physical nature of the site (location-specific) are compared to the statutory or regulatory requirements of the relevant environmental laws. Principal ARARs which are relevant and appropriate for the site are MCLs and RCRA Subtitle D, Criteria for Municipal Solid Waste Landfills (40 CFR 258.60 and 258.61). Maximum Contaminant Levels (MCLs), commonly referred to as Drinking Water Standards, are applicable to public water systems. While future use of site groundwater is unlikely, there is a limited potential future threat to nearby downgradient groundwater users. MCLs are, therefore, considered relevant and appropriate. RCRA Subtitle D discusses criteria for cover construction and monitoring for solid waste landfills and is an ARAR which is relevant and appropriate to cover alternatives.

The FS report evaluated six remedial alternatives for addressing the contamination associated with the SFL site. Seven remedial alternatives were originally screened in the FS, with one alternative being eliminated due to its potential ineffectiveness. Thus, a description and evaluation of Alternative 5, which was eliminated during the screening process of the FS, is not provided in this document. The FS report provides further information regarding the remedial alternatives evaluated for the site and is available in the SFL Administrative Record and Information Repositories.

The six alternatives evaluated are discussed below:

Alternative 1 - No Action: The CERCLA program requires that the "no-action" alternative be considered as a baseline for comparison of other alternatives. As the name implies, this alternative does not involve any remedial action. Alternative 1 did not account for the bank stabilization and cover repair actions already implemented. The alternative includes the same potential threats to human health and the environment as those identified in the baseline risk assessment. This alternative did not address potential future groundwater exposure. This alternative addressed the MCL ARAR considering current site use, but it fails this criterion considering potential future site-impacted groundwater use.

The "no-action" alternative involves no costs and no time to implement. Because contaminants would remain, CERCLA requires that the site be reviewed every 5 years. If justified by the review, remedial actions could be implemented to remove or treat the wastes.

Alternative 2 - Institutional Controls, Riverbank Stabilization, Long-term Groundwater Monitoring, and Future Action Contingency: Alternative 2 included implementation of institutional controls, including signage, to restrict future site uses and prohibit the future use of site groundwater. Restrictions on future site uses included restricting the construction of structures that involve excavation for foundations, restricting the permanent occupancy of any structure, and limiting future utility easements to outside the edge of the landfill. The alternative also includes placing rock revetment along the Kansas River bank (installed in spring 1994 as a Removal Action) and conducting groundwater monitoring at the site. As described in the FS report, the objectives of the long-term groundwater monitoring program are to detect increases in contaminant concentrations in the vicinity of the SFL which would warrant additional actions, and to determine if constituents from the SFL are migrating under Threemile Creek (i.e., toward potential receptors). Long-term groundwater monitoring would also be valuable for developing a better understanding of groundwater flow paths. The program would initially include semi-annual groundwater sampling and analysis for VOCs, antimony, and lead. The program may utilize existing monitoring wells installed for the RI/FS and/or additional wells installed specifically for the long-term monitoring program. The program may be modified, including reduction or ceasation, if monitoring results warrant and a 5-year review justifies. Additional discussion of the conceptual long-term groundwater monitoring program is provided in the FS report.

Alternative 2 does not involve treatment, and therefore provides no reduction in toxicity and volume of contamination. The riverbank stabilization effectively meets the RAO of preventing movement of the Kansas River Channel into the landfill. The restrictions on site use prevent exposure to subsurface materials and future use of groundwater at the site. Thus, this alternative complies with the MCL ARAR by including a contingency for future active remediation, if warranted, as well as preventing use of groundwater as drinking water. However, this alternative is not an active response anticipated to improve site groundwater quality. Because contaminants would remain on site, CERCLA requires that the site be reviewed every five years. If justified by the review, additional remedial actions might be implemented. Furthermore, if long-term groundwater monitoring indicated a need for further action, a contingency (potentially including groundwater remediation) would be implemented.

The estimated capital cost is $500,000, including the costs already incurred for riverbank stabilization activities. The estimated annualized operational and maintenance (O&M) costs are $40,000. The estimated net present worth cost for construction and 30 years of O&M is $850,000. This alternative is readily implementable. Construction of the riverbank stabilization has been completed. The groundwater monitoring has been ongoing at the site, and additional wells could easily be installed. The estimated time to install any additional monitoring wells is one month, not including any time for design activities or procurement of contracts. Implementation of institutional controls would also be straightforward. The contingency is anticipated to be implemented if the long-term groundwater monitoring program detects significant increases in constituent concentrations in the vicinity of the SFL or if the program reveals that significant concentrations of constituents from the SFL are migrating under Threemile Creek and/or off site. The elements of this alternative are also included in Alternatives 3, 4, 6, and 7.

Alternative 3 - Institutional Controls, Riverbank Stabilization, Long-Term Groundwater Monitoring, Future Action Contingency, and Native Soil Cover: Alternative 3 included all the elements of Alternative 2, plus a native soil cover meeting the requirements of 40 CFR 258.60. The post-closure cover was classified as a native soil cover, but was in need of repair and improvements to restore positive drainage and minimize the ponding of storm water, to fill in cracks and eroded rills, to ensure proper thickness and to enhance evapotranspiration. This alternative would involve performing work to establish a more effective native soil cover which would minimize infiltration (by increasing evapotranspiration) and the subsequent generation of leachate. Repairs (performed in 1995 as part of the Removal Action) include placing local borrow soil in settled areas and placing additional fill over the existing cover. The area would be revegetated to control erosion caused by storm-water run-off and promote evapotranspiration of soil water that would otherwise percolate through the cover and potentially contact the landfill contents. This alternative would involve placing additional fill over some portions of the landfill to meet the minimum thickness criteria of two feet.

Bank stabilization and cover improvements are expected to reduce mobility of constituents within the landfill. However, this alternative will not reduce mobility, toxicity, or volume of contamination through treatment. The alternative addresses the MCL ARAR considering current groundwater use, and it meets MCL ARARs in the future by restricting groundwater use and site operations, by implementing an active response (i.e, bank stabilization and cover improvements) which is anticipated to improve groundwater quality and by including a contingency for future action if warranted. This alternative meets the RCRA Subtitle D ARAR by providing a cover which meets the requirements of 40 CFR 258.60. Alternative 3 also meets the RAOs for the SFL. Because the alternative would result in contaminants remaining on site, CERCLA requires that the site be reviewed every five years. If justified by the review, implementation of additional remedial actions might be required. Furthermore, if long-term groundwater monitoring indicated a need for further action, a contingency (potentially including groundwater remediation) would be implemented. The native soil cover is also included in Alternatives 6 and 7.

The updated conceptual estimated capital cost is $2,530,000. The estimated annualized O&M costs are $50,000. The estimated net present worth cost for construction and 30 years of O&M is $3,150,000. This alternative can be implemented with standard construction methods. The estimated time to construct the native soil cover is nine months.

Alternative 4 - Institutional Controls, Riverbank Stabilization, Long-Term Groundwater Monitoring, Future Action Contingency, and Single Barrier Cover: Alternative 4 included the elements of Alternative 2, plus a landfill cover with a hydraulic barrier made of clay or a geosynthetic to reduce infiltration of storm water. The cover would exceed the requirements of 40 CFR 258.60. The cover would also have a lateral drainage layer and vegetative soil surface above the barrier. The single barrier cover alternative includes an infiltration layer made of clay or geosynthetic, a drainage system, and an optional gas collection system. Bank stabilization and cover improvements would be expected to reduce mobility of constituents within the landfill. However, this alternative would not reduce mobility, toxicity, or volume of contamination through treatment. The alternative would meet the MCL ARAR considering current groundwater use. It would also meet MCL ARARs in the future by restricting groundwater use and site operations by implementing an active response (i.e., cover) which would be anticipated to improve groundwater quality and by including a contingency for future action if warranted. This alternative would also meet the RCRA Subtitle D ARAR and the RAOs for the SFL. Because the alternative would result in contaminants remaining on site, CERCLA would require that the site be reviewed every five years. If justified by the review, implementation of additional remedial actions might be required. Furthermore, if long-term groundwater monitoring indicated a need for further action, a contingency (potentially including groundwater remediation) would be implemented.

The estimated capital cost is $12,700,000. The estimated annualized O&M costs are $50,000. The estimated net present worth cost for construction and 30 years O&M is $13,100,000. This alternative is implementable using standard construction methods. The estimated time to construct the single barrier cover is six to eight months. This time does not include any time for design activities or procurement of contracts.

Alternative 6 - Institutional Controls, Riverbank Stabilization, Long-Term Groundwater Monitoring, Native Soil Cover, Hydraulic Containment of Groundwater and Groundwater Extraction, Treatment, and Discharge: Alternative 6 included a slurry wall surrounding the landfill, plus a groundwater extraction well(s) within the confines of the slurry wall to assure effective containment of groundwater. In order to create an effective hydraulic barrier, groundwater from within the landfill would be extracted by a recovery well(s). The intent of this system would be to pump from within the slurry wall to maintain an inward gradient toward the landfill. Alternative 6 would also include treating the extracted groundwater on the site to reduce the levels of organics. A groundwater treatment system would possibly consist of a filtration system for solids/metals removal, an air stripper for VOC removal, and carbon adsorption vessels for polishing prior to discharge. Treated groundwater would be discharged directly to Threemile Creek. The quality of the treated water would meet or exceed the requirements of the Clean Water Act for discharging water to the environment. This alternative would also include the elements of Alternative 2 and Alternative 3. The alternative would effectively collect the potentially contaminated groundwater from the SFL and thus reduce and control the volume of contaminated groundwater at the site. This alternative would be expected to reduce the toxicity and mobility of the groundwater. A lengthy time period (estimated at greater than ten years) would be expected to meet remedial goals, however, and complete remediation might not be feasible. This alternative would meet the MCL ARAR by restricting groundwater and site use and by potential future attainment of MCLs in site groundwater. The RCRA Subtitle D ARAR would be met with the cover improvements.

The estimated capital cost is $7,000,000. The estimated annualized O&M costs are $170,000. The estimated net present worth cost for construction and 30 years of operation is $9,500,000. Installation of a recovery well(s) should be readily implementable. Overall, this alternative could be implemented using available equipment and construction techniques. However, during the design phase, an aquifer test to confirm the projected groundwater recovery rate, a geotechnical evaluation to confirm site conditions before installing a slurry wall, and treatability testing to confirm effectiveness of the proposed treatment system would be required prior to any construction activities associated with the installation of the slurry wall and groundwater extraction and treatment systems. The estimated time to construct the slurry wall is four to six months, construction of the groundwater extraction system would require approximately three months, and construction of the groundwater treatment system would take approximately six months. Nine months would be required for improvements to the existing native soil cover. These times do not include any time for design activities or procurement of contracts.

Alternative 7 - Institutional Controls, Riverbank Stabilization, Long-Term Groundwater Monitoring, Native Soil Cover, and Groundwater Extraction, Treatment and Discharge: Alternative 7 involved the extraction of contaminated groundwater from the SFL. The intent of this alternative would be to form a hydraulic barrier in the SFL which would prevent contaminants in the groundwater from migrating. This barrier would be created by installing groundwater recovery wells and removing sufficient water from these wells to create a hydraulic barrier. Extracted groundwater would be treated for organics and discharged to Threemile Creek in a manner similar to that discussed in Alternative 6. The treatment system for Alternative 7 would possibly consist of air stripper(s) for VOC removal, a filtration system for solids removal, and carbon adsorption vessels for polishing prior to discharge. Alternative 7 also includes the elements of Alternative 2 and Alternative 3. Potentially contaminated groundwater from the SFL would be effectively collected, thus reducing and controlling the volume of contaminated groundwater at the site. This alternative would be expected to reduce the toxicity and mobility of the groundwater. A lengthy time period (estimated at greater than ten years) would be expected to meet remedial goals, however, and complete remediation might not be feasible. Alternative 7 would meet ARARs.

The estimated capital cost is $4,200,000. The estimated O&M costs are $330,000. The estimated net present worth cost for construction and 30 years of operation is $8,500,000. As discussed in Alternative 6, implementation of this alternative would require an aquifer test to confirm the projected groundwater recovery rate and treatability testing to confirm effectiveness of the proposed treatment system. A building for the treatment system would be designed to function in a 50-year floodplain. Overall, this alternative could be implemented using available equipment and construction techniques, but confirmatory testing would be required prior to installation of the groundwater recovery and treatment system. The estimated time to install the groundwater extraction system is three months and construction of the treatment system would require approximately six months, not including time for design activities or procurement of contracts. (As with Alternative 6, this duration does not include the construction of the native soil cover.)

2.8 SUMMARY OF THE COMPARATIVE ANALYSIS OF ALTERNATIVES

In the detailed evaluation of remedial alternatives, each alternative was assessed against nine evaluation criteria, namely: overall protection of human health and the environment; compliance with applicable or relevant and appropriate requirements; long-term effectiveness and permanence; reduction of toxicity, mobility, or volume; short-term effectiveness; implementability; cost; and State and community acceptance.

The evaluation criteria are described below.

- Overall protection of human health and the environment addresses whether or not a remedy provides adequate protection and describes how risks posed through each pathway are eliminated, reduced, or controlled through treatment, engineering controls, or institutional controls.

- Compliance with applicable or relevant and appropriate requirements (ARARs) addresses whether or not a remedy will meet all of the applicable or relevant and appropriate requirements of other federal and state environmental statutes and requirements or provide grounds for invoking a waiver.

- Long-term effectiveness and permanence refers to the ability of a remedy to maintain reliable protection of human health and the environment over time, once cleanup goals have been met.

- Reduction of toxicity, mobility, or volume through treatment is the anticipated performance of the treatment technologies a remedy may employ.

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

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

- Cost includes estimated capital and operation and maintenance costs, and net present worth costs.

- Regulatory Agency acceptance indicates whether, based on its review of the RI/FS reports and Proposed Plan, the EPA and KDHE concur, oppose, or have no comment on the preferred alternative at the present time.

- Community acceptance is assessed in the Record of Decision (ROD) following a review of the public comments received on the RI/FS reports and Proposed Plan.

A comparative analysis of the alternatives, based upon the evaluation criteria noted above, is as follows:

Overall Protection of Human Health and the Environment

The existing conditions are currently protective of human health and the environment because groundwater at the site is not currently used for drinking water and there is no unacceptable human exposure to the site. Considering the reasonable maximum exposure scenario discussed in the risk assessment, the no action alternative (Alternative 1) is not protective of human health and the environment because this alternative does not address the potential exposure to landfill contents and the potential future exposure from using the groundwater as drinking water. The remaining alternatives (Alternatives 2, 3, 4, 6, 7) provide protection against the potential exposure scenarios discussed in the baseline risk assessment and therefore meet this criterion. For these alternatives, protection of human health is achieved with institutional controls that would prohibit the future use of site groundwater, with erosion control measures which protect against exposure to landfill contents, with long-term groundwater monitoring, and with a contingency for future remedial actions. This contingency, potentially including groundwater remediation, is anticipated to be implemented if the long-term groundwater monitoring program detects significant increases in constituent concentrations in the vicinity of the SFL or if the program reveals that significant concentrations of constituents from the SFL are migrating under Threemile Creek and/or off site. Alternative 2 details these institutional controls, the erosion control measures, and long-term monitoring. The elements of Alternative 2 (including institutional controls, riverbank stabilization, long-term groundwater monitoring, and future action contingency) are included in Alternatives 3, 4, 6, and 7. Alternatives 6 and 7 collect and treat the potentially contaminated groundwater and thus reduce and control the volume of contaminated groundwater at the site. Alternatives 6 and 7 are expected to reduce the toxicity and mobility of the groundwater.

Compliance with ARARs

The RI indicates that groundwater is the only environmental medium at the site that has constituent levels above their corresponding chemical-specific ARARs. As stated in Section 2.7, principal ARARs which are relevant and appropriate for the site are MCLs and RCRA Subtitle D. All of the alternatives, including the No Action, are currently in compliance with ARARs because use of groundwater with concentrations above MCLs is not occurring. Alternative 1 (no-action) does not, however, comply with ARARs considering a potential, future groundwater use scenario as discussed in the FS report. Because the other alternatives (Alternatives 2, 3, 4, 6, 7) include institutional controls prohibiting future groundwater use and a contingency (Alternatives 2, 3 and 4) for future active remediation if appropriate, compliance with the MCL ARAR is achieved. However, Alternative 2 is not expected to be acceptable for the site because groundwater quality is not actively addressed. Alternatives 3 and 4 are in compliance with the RCRA Subtitle D ARAR.

Long-Term Effectiveness and Permanence

As a "no-action" alternative, Alternative 1 would not address potential future groundwater exposure or potential exposure to landfill contents. Evaluation of this alternative for long-term effectiveness and permanence is not applicable.

Alternative 2 relies on institutional controls to address future groundwater use, but does not address proper drainage and erosion control on the existing cover. Alternative 2 includes erosion control measures along the riverbank to protect against exposure to landfill contents and a long-term groundwater monitoring program to detect future changes in groundwater quality, if any. If long-term groundwater monitoring indicated a need for further action, a contingency would be implemented. Periodic inspections of the riverbank conditions are appropriate, and a five year review to assess riverbank and groundwater conditions and the overall site condition would be required.

Alternatives 3 and 4 rely on the institutional controls detailed in Alternative 2 to address future groundwater use. Additionally, these alternatives include actions to prevent ponding and erosion on the cover along with the erosion control measures along the riverbank, thus helping to protect against exposure to landfill contents. With these alternatives, the long-term groundwater monitoring program would detect future changes in groundwater quality, if any. If long-term groundwater monitoring indicated a need for further remediation, a contingency which might include groundwater remediation would be implemented. Periodic inspections of the landfill cover and riverbank conditions are appropriate, and a 5-year review to assess overall site conditions would be required.

Alternatives 6 and 7 include the institutional controls and riverbank stabilization detailed in Alternative 2 and the native soil cover described in Alternative 3. The long-term effectiveness and permanence of these alternatives is described above. Additionally, Alternatives 6 and 7 involve groundwater recovery and treatment, and active restoration of the aquifer. As discussed in the FS, it is currently unknown how long the restoration of the aquifer to RGs would require, and it is questionable whether it is technically feasible to achieve contaminant levels at or below RGs in the aquifer. Several references indicate that restoration of contaminated groundwater to low concentration levels (ppb) may not be technically feasible or practicable. In addition to the periodic inspections of the landfill cover and riverbank conditions, various operation and maintenance activities would be associated with the treatment system in order to maintain its effectiveness.

Short-Term Effectiveness

Evaluation of Alternative 1 for short-term effectiveness is not applicable since this is a "no-action" alternative. Currently, no human exposure to groundwater exists and the landfill is not a significant threat to human health and the environment.

Alternative 2 would not involve on-site activities or disturbances of the existing landfill cover. Risks to the community and on-site workers during construction activities associated with riverbank stabilization would be minimal. The potential risk of exposure to groundwater sampling personnel would be controlled with adherence to OSHA requirements.

Alternatives 3, 4, 6, and 7 involve on-site work, but there are no anticipated significant adverse impacts to on-site workers or the community during construction activities. Alternatives 6 and 7 would involve intrusive activities and require additional on-site activities prior to construction to confirm design parameters.

Reduction in Toxicity, Mobility, or Volume

Alternatives 1, 2, 3, and 4 would not involve treatment and thus would not reduce the toxicity or volume of the waste. By reducing infiltration, Alternatives 3 and 4 may reduce the mobility of contaminants. Hydrologic Evaluation of Landfill Performance (HELP) analysis of a repaired native soil cover, as provided for in Alternative 3, indicated that a reduction in infiltration equivalent to that of a RCRA Subtitle D cover could be achieved. The single barrier cover of Alternative 4 would be anticipated to be more effective than the repaired native soil cover of Alternative 3 in limiting infiltration into the SFL. Alternatives 6 and 7 involve recovery and treatment of groundwater. The recovery well/slurry wall of Alternative 6 and the recovery well collection system of Alternative 7 would reduce the mobility and volume of groundwater contaminants. Treatment of collected groundwater for organics would reduce the toxicity and volume of contamination in the groundwater. However, because groundwater contamination has been characterized as isolated, sporadic exceedances of RGs, and because complete restoration of groundwater is expected to require long-term operation and may not be practical or feasible, the actual benefit of groundwater recovery and treatment may not be significant.

Implementability

Alternative 1 is a "no-action" alternative, so implementability would not be applicable.

The institutional controls and groundwater monitoring associated with Alternative 2 can be readily implemented. Construction of the riverbank stabilization was completed in spring 1994.

Alternative 3 is readily implementable with standard construction methods. Repairs to the existing landfill cover have been implemented.

Alternative 4 would be implementable using standard construction methods.

Alternative 6 would not be readily implementable. The installation of a slurry wall would require additional geotechnical evaluation and coordination with various regulatory agencies and contractors. Adverse site conditions may impact the construction duration and cost of the slurry wall installation. Design of the groundwater recovery system would require an aquifer test to confirm the potential effectiveness of the system as designed. Treatability testing of recovered groundwater would be required to confirm the effectiveness of the treatment system as designed. A treatment building would be required to contain the treatment system. This building and the treatment system would be designed to function in a 50-year floodplain. Equipment for the proposed treatment system is readily available from vendors.

Uncertainties exist relative to the design of the extraction and treatment system of Alternative 7. An aquifer pumping test would be required to address the pumping rate required to meet the alternative's objectives. The pumping rate might be so high that treatment would be impractical or cost prohibitive. The required flow rates might be excessively high for discharge to the receiving stream. Also, a treatability test of the groundwater to confirm the treatment design and project costs would be required. Thus, Alternative 7 would not be readily implementable.

Cost

The estimated capital, operation and maintenance, and present worth costs for each alternative are presented in the "Description of Alternatives" section of this ROD.

No costs are associated with Alternative 1, and limited capital, O&M, and net present worth costs would be associated with Alternative 2 ($850,000). The costs of Alternative 3 ($3,150,000) would be higher than those of Alternative 2, but significantly lower than Alternatives 4, 6, and 7.

Alternatives 4 ($13,100,000), 6 ($9,500,000), and 7 ($8,500,000) would be significantly greater in cost than the other alternatives, with Alternative 4 being the costliest in terms of capital and present worth costs.

Cost projections for these alternatives are detailed in Appendix C of the FS report. Cost estimates utilized in the Proposed Plan and ROD for the cover repairs and bank stabilization were updated to include actual costs of Removal Action implementation.

Regulatory Agency Acceptance

EPA and KDHE have indicated their preference for Alternative 3 as evidenced by their review comments and approval of the RI/FS reports and the Proposed Plan.

Community Acceptance

Community acceptance of the preferred alternative is assessed in this Record of Decision. No public comments were received during the public comment period which was held November 9, 1994 through December 9, 1994, and no members of the public attended the public meeting on the Proposed Plan held at Fort Riley on November 15, 1994. Based on the nature of the public response, the remedy described in the Proposed Plan is acceptable to the community.

2.9 SELECTED REMEDY

The remedy selected on the basis of conformity with the nine EPA criteria, as discussed in the previous section, is Alternative 3. This alternative includes institutional controls, long-term groundwater monitoring, Kansas River bank stabilization (installed in spring 1994 as part of the Removal Action), repairs (performed in 1995 as part of the Removal Action) and improvements to the existing soil cover, and a contingency for future remediation of groundwater.

The institutional controls included in this alternative are groundwater monitoring, land use controls, and access controls. The long-term groundwater monitoring program will focus on the perimeter of the landfill and will include groundwater sampling and analysis for VOCs, antimony, and lead. The groundwater monitoring program may utilize existing monitoring wells installed for the RI/FS and/or additional wells installed specifically for the long-term monitoring program. The objective of the monitoring program would be to monitor for increases in contaminant concentrations in the vicinity of the SFL which might warrant additional actions at the SFL and to determine if constituents from the SFL are migrating under Threemile Creek. Additional description of the conceptual long-term groundwater monitoring program is provided in the FS report. For the institutional controls involving land use and access controls, the Fort Riley land use and planning documents will include restrictions on the type of development at the SFL (i.e., restrict construction of structures that involve excavation for the foundation and restrict the permanent occupancy of any structure), restrictions on future utility easements (i.e, limit future utility easements to outside the edge of the landfill), and prohibition on groundwater use in the vicinity of the landfill.

The Kansas River bank stabilization project was completed in the spring of 1994. The project provided for placement of quarry run stone revetment parallel to 1200 lineal feet of river bank. Stone baffles were constructed perpendicular to the revetment and bank at 75 foot intervals to slow the river currents and promote deposition of silt between the revetment and the river bank. The revetment is designed so that this silt deposition process will restore the exposed river bank and the revetment will minimize the potential for future erosion.

A native soil cover provides cover over the landfill contents and supports vegetation. The vegetation controls erosion caused by storm-water run-off and promotes evapotranspiration which uses soil water that would otherwise percolate through the cover and potentially contact the landfill contents. This alternative provides for repair and improvements to the existing cover. The conditions that need repair are settlement (that causes storm water to pond), inadequate cover thickness, settlement cracks, and erosional rills. The repairs and improvements include placing local borrow as required to restore positive drainage, provide adequate cover thickness and revegetating the cover. Annual inspections would be appropriate for monitoring the cover conditions. Long-term maintenance would include mowing, periodic burning, and seeding and fertilizing to maintain the grass. Filling and other earthwork might be required to correct long-term settlement or erosion. Revegetating might also be required in eroded areas, particularly after dry years.

Bank stabilization and cover improvements are expected to reduce mobility of constituents within the landfill. However, this alternative will not reduce mobility, toxicity, or volume of contamination through treatment. The alternative addresses the MCL ARAR considering current groundwater use, and it meets MCL ARARs in the future by restricting groundwater use and site operations, by implementing an active response (i.e, cover improvements) which is anticipated to improve groundwater quality and by including a contingency for future action, if warranted. This alternative meets the RCRA Subtitle D ARAR.

Alternative 3 also meets the RAOs for the SFL. Because the alternative would result in contaminants remaining on site, CERCLA requires that the site be reviewed every five years. If justified by the review, additional remedial actions will be implemented. Furthermore, if long-term groundwater monitoring indicated a need for further action, a contingency would be implemented.

The purpose of the contingency is to protect current and future groundwater receptors from exposures to contaminants at unacceptable levels. The contingency will be implemented based on long-term groundwater monitoring data which will be evaluated annually from a risk perspective. A contingency action would be developed, based on the risk evaluation, in a focused feasibility study which would evaluate methods to address unacceptable risks including such alternatives as providing well head treatment or alternate water supply as well as active groundwater remediation.

The updated conceptual estimated capital cost is $2,530,000. These costs are broken down as follows:

Institutional Controls	$ 20,000
Rock Revetment	$ 500,000
Native Soil Cover	$ 1,600,000
Groundwater Monitoring (Semi-annual)	$ 400,000
Inspections	$ 10,000

The estimated annualized O&M costs are $50,000. The estimated net present worth cost for construction and 30 years of O&M is $3,150,000.

This alternative is implementable using standard construction methods. The bank stabilization has been implemented and repairs to eliminate depressions in the cover and establish positive drainage across the landfill surface are being implemented as a Removal Action. Additional work is needed to establish appropriate cover thickness in some areas. The estimated time to construct the native soil cover is approximately nine months.

2.10 STATUTORY DETERMINATIONS

In accordance with the statutory requirements of Section 121 of CERCLA, as amended, remedial actions that are selected are required to:

- Protect human health and the environment
- Comply with applicable or relevant and appropriate requirements (ARARs)
- Be cost effective
- Use permanent solutions and alternative treatment technologies to the maximum extent practicable
- Satisfy the preference for treatment which, as a principal element, reduces toxicity, mobility or volume

The manner in which the selected remedy for the SFL satisfies the above requirements is discussed in the following sections.

The selected remedy must undergo a five-year review as specified in CERCLA Section 121(c) because hazardous substances will remain on site.

2.10.1 Protection of Human Health and the Environment

The existing conditions are currently protective of human health and the environment because groundwater at the site is not currently used for drinking water and there is no unacceptable human exposure to the site. Considering the reasonable maximum exposure scenario discussed in the risk assessment, Alternative 3 provides protection against the potential exposure scenarios discussed in the Baseline Risk Assessment, and, therefore meet this criterion. For Alternative 3, protection of human health is achieved with institutional controls that would prohibit the future use of site groundwater, with erosion control measures and cover improvements which protect against exposure to landfill contents, with long-term groundwater monitoring, and with a contingency for future remedial actions. As discussed in Section 2.8, this contingency, potentially including groundwater remediation, is anticipated to be implemented if the long-term groundwater monitoring program detects significant concentrations in the vicinity of the SFL or if the program reveals that significant concentrations of constituents from the SFL are migrating under Threemile Creek and/or off site.

2.10.2 Compliance with Applicable or Relevant and Appropriate Requirements

The RI indicates that groundwater is the only environmental medium at the site that has constituent levels above their corresponding chemical-specific ARARs. Alternative 3 is currently in compliance with ARARs because use of groundwater with concentrations above MCLs is not occurring. Because Alternative 3 includes institutional controls prohibiting future groundwater use and a contingency for future active remediation, if appropriate, compliance with the MCL ARAR is achieved. Alternative 3 is in compliance with the RCRA Subtitle D ARAR. Table 2-4 presents the ARARs that will be met or addressed by the selected remedy.

2.10.3 Cost Effectiveness

The selected remedy has been estimated to cost $2,530,000 (capital cost) and require approximately nine months to implement. These figures are estimates originally developed during the FS and revised and updated in the Proposed Plan. The selected remedy is considered cost effective.

2.10.4 Use Of Permanent Solutions And Alternative Treatment Technologies To The Maximum Extent Practicable

To the extent practicable the selected remedy utilizes permanent solutions and alternative treatment technologies. However, because the contaminant source, the site itself, could not be effectively excavated and treated due to its large size and absence of hot spots representing major sources of contamination, use of alternative treatment technologies was not practicable. Thus, because treatment of the principal threat was not found to be practicable or appropriate, this remedy does not satisfy the statutory preference for treatment as a principal element of the remedy. Therefore, the selected alternative relies solely on containment and source control, not treatment, as principal elements of the remedy.

2.10.5 Preference for Treatment Which Reduces Toxicity, Mobility, or Volume

The selected remedy does not involve treatment and thus will not reduce the toxicity or volume of the landfill waste. Bank stabilization and cover improvements are expected to reduce the volume of leachate produced. This remedy utilizes permanent solutions and alternative treatment technologies to the maximum extent practicable for the site. However, because the contaminant source, the site itself, could not be effectively excavated and treated due to its large size and absence of hot spots representing major sources of contamination, use of alternative treatment technologies was not practicable.

TABLE 2-4

APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS (ARARs) AND TO BE CONSIDERED (TBC) REQUIREMENTS
Southwest Funston Landfill
Fort Riley, Kansas

TYPE OF ARAR	ARARs	TBC REQUIREMENTS
Chemical-Specific	Maximum Contaminant Levels (MCLs) (40 CFR 141 Subpart B)	Proposed RCRA Subpart S
	Maximum Contaminant Level Goals (MCLGs) (40 CFR 141 Subpart F)	
	Alternate Cleanup Levels (40 CFR 264.94)	
	Kansas Drinking Water Rules (KAR 28.15)	
	Ambient Water Quality Criteria (40 CFR 131)	Kansas Notification Levels (KNLs)
		Kansas Action Levels (KALs)
		Risk-Based Remediation Goals
Location-Specific	Flood Plain Management Executive Order 11988 (16 USC 661 et. seq., 40 CFR 6.302, Appendix A)	None Identified
	Endangered Species Act of 1973 (16 USC 1531-1544)	
	Fish and Wildlife Coordination Act Requirements (33 CFR 320-330; 40 CFR 6.302)	
	Surface Water Use Designations (KAR 28.16.28d)	
	Designation of Critical Water Quality Management Areas (KAR 28.16.70)	
	Clean Water Act Section 404 Permitting Requirements (3 U.S.C. 1341, 33 CFR 320 through 330, 40 CFR 230)	
	Clean Water Act Section 401 Water Quality Certification (33 U.S.C. 1341)	
	National Historic Preservation Act (16 U.S.C. 469; 36 CFR 65 and 36 CFR 800)	

TABLE 2-4

APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS (ARARs)
AND TO BE CONSIDERED (TBC) REQUIREMENTS
Southwest Funston Landfill
Fort Riley, Kansas

TYPE OF ARAR	ARARs	TBC REQUIREMENTS
Action-Specific	OSHA - Employee Exposure (29 CFR 1910.1000)	None Identified
	OSHA - Standards for Hazardous Waste Operations and Emergency Response (29 CFR 1910.120)	
	Kansas Solid Waste Management Regulations (KAR 28.29 Part II)	
	Kansas Hazardous Waste Management Regulations (KAR 28.31)	
	National Ambient Air Quality Standards (NAAQS) (40 CFR 50)	
	National Emission Standards for Hazardous Air Pollutants (40 CFR 61)	
	Kansas Ambient Air Quality Standards and Air Pollution Control Regulations (KAR 28.19)	
	Criteria for Municipal Solid Waste Landfills (40 CFR 258)	
	Standards Applicable to Generators of Hazardous Waste (40 CFR 262 Subpart A)	
	Standards for Identification of Hazardous Waste (40 CFR 261)	
	Standards Applicable to Transporters of Hazardous Waste (40 CFR 263)	
	Standards Applicable to Generators of Hazardous Waste (40 CFR 262 Subpart B, C, D)	
	DOT Hazardous Waste Transportation Regulations (49 CFR 107)	
	Land Disposal Restrictions (40 CFR 268)	

2.11 DOCUMENTATION OF SIGNIFICANT CHANGES

The Proposed Plan for Operable Unit 001 Southwest Funston Landfill was released to the public on November 9, 1994. The Proposed Plan identified Alternative 3 (Institutional Controls, Riverbank Stabilization, Long-Term Groundwater Monitoring, Future Action Contingency, and Native Soil Cover) as the preferred alternative. Fort Riley received no public comments on the Proposed Plan during the designated public comment period. No significant changes to the alternative, as it was originally identified in the Proposed Plan, are necessary.

3.0 RESPONSIVENESS SUMMARY

During the public comment period from November 9, 1994 through December 9, 1994, no public comments concerning the SFL were received, and no members of the public attended the public meeting on the Proposed Plan held at Fort Riley on November 15, 1994. Because there was no public response to the preferred alternative of the Proposed Plan, this Responsiveness Summary contains no comments.

GLOSSARY
Of Terms Used In The ROD

This glossary defines the technical terms used in this Record of Decision (ROD). The terms and abbreviations contained in this glossary are often defined in the context of hazardous waste management, and apply specifically to work performed under the CERCLA program. Therefore, these terms may have other meanings when used in a different context.

Administrative Record: A file which is maintained and contains all information used by the lead agency to make its decision on the selection of a response action under CERCLA.

Alluvial: An area of sand, clay, or other similar material that has been gradually deposited by moving water, such as along a river bed or the shore of a lake.

Applicable or Relevant and Appropriate Requirements (ARARs): Those cleanup standards, standards of control, and other substantive environmental protection requirements, criteria, or limitations promulgated under federal or state law that specifically address a hazardous pollutant, location, or other circumstance at a CERCLA site, or while not "applicable," address problems or situations sufficiently similar to those encountered at the CERCLA site that their use is well suited to the particular site.

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

Baseline Risk Assessment (BLRA): An evaluation of the potential threat to human health and the environment in the absence of any remedial action.

Carcinogenic: Capable of causing the cells of an organism to react in such a way as to produce cancer.

Closure: The process by which a landfill stops accepting wastes and is shut down under federal or state guidelines that ensure the public and the environment is protected.

Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA): The federal law that addresses problems resulting from releases of hazardous substances to the environment, primarily at inactive sites.

Containment: The process of enclosing or containing hazardous substances in a structure, typically in ponds and lagoons, to prevent the migration of contaminants into the environment.

Contingency Plan: A document setting out an organized, planned and coordinated course of action to be followed in the case that an event threatens human health or the environment.

Downgradient: A downward hydrologic slope that causes groundwater to move toward lower elevations. Therefore, wells downgradient of a contaminated groundwater source are prone to receiving pollutants.

Evapotranspiration: The loss of water from soil both by evaporation and transpiration from plants growing in the soil.

Federal Facility Agreement (FFA): See Interagency Agreement.

Five Year Review: CERCLA requirement for alternatives which would result in contaminants staying on site is that the site be reviewed every 5 years.

Institutional Controls: Actions taken to limit unauthorized access to the site, control the way in which an area of the site is used, and monitor contaminant migration, such as fencing, deed restrictions, and ground-water monitoring.

Interagency Agreement: A written agreement between EPA and a federal agency that has the lead for site cleanup activities (e.g., the Department of Defense), that sets forth the roles and responsibilities of the agencies for performing and overseeing the activities. States are often parties to interagency agreements.

Landfill: A disposal facility where waste is placed in or on land.

Leachate: The liquid that trickles through or drains from waste, carrying soluble components from the waste.

Leach/Leaching: The process by which soluble chemical components are dissolved and carried through soil by water or some other percolating liquid.

Long-Term Monitoring: Ground-water monitoring, typically for a period of 30 years; normally required with alternatives which leave contaminants on site.

Migrate/Migration: The movement of contaminants through environmental media.

National Contingency Plan (NCP): A plan which puts into effect the response powers and responsibilities created by CERCLA. The plan includes policies and procedures that the federal government follows in implementing responses to hazardous substances.

National Priorities List (NPL): A roster compiled by EPA of waste sites identified for possible cleanup under CERCLA regulations.

Percolate/Percolation: The downward flow or filtering of water or other liquids through subsurface rock or soil layers, usually continuing downward to groundwater.

Receptor: An organism that receives, may receive, or has received environmental exposure to a chemical.

Remedial: A course of study combined with actions to correct site contamination problems through identifying the nature and extent of cleanup strategies under the CERCLA program.

Resource Conservation and Recovery Act, PL 94-580 (RCRA): Found at 40 CFR 240-271. Enacted November 21, 1976, and amended since. RCRA's major emphasis is the control of hazardous waste disposal. It controls all solid-waste disposal and encourages recycling and alternative energy sources.

Sediment: The layer of soil, and minerals at the bottom of surface waters, such as streams, lakes, and rivers that may absorb contaminants.

Slurry Wall: Barrier used to contain the flow of contaminated groundwater or subsurface liquids. Slurry walls are constructed by digging a trench around a contaminated area and filling the trench with an impermeable material that prevents water from passing through it. The groundwater or contaminated liquids trapped within the area surrounded by the slurry wall can be extracted and treated.

Stabilization: The process of changing an active substance to inert, harmless material, or physical activities at a site that act to limit the further spread of contamination without actual reduction of toxicity.

Upper Confidence Limit (UCL): A statistical parameter used to estimate an upper bound on the mean value of a data set with a stated degree of confidence. Typically, the 95% UCL is used as an estimate of exposure point concentrations at CERCLA sites.

Volatile Organic Compounds (VOCs): VOCs are made as secondary petrochemicals. They include light alcohols, acetone, trichloroethylene, perchloroethylene, dichloroethylene, benzene, vinyl chloride, toluene, and methylene chloride. These potentially toxic chemicals are used as solvents, degreasers, paints, thinners, and fuels. Because of their volatile nature, they readily evaporate into the air, increasing the potential exposure to humans. Due to their low water solubility, environmental persistence, and wide-spread industrial use, they are commonly found in soil and groundwater.