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FEB 24 2011

DAIM-ODB-RM

17 February 2011

MEMORANDUM FOR U.S. Environmental Protection Agency, (Mr. Greg Hargreaves), Region VIII, Mail Code 8EPR-F, 1595 Wynkoop Street, Denver, Colorado 80202-1129

SUBJECT: Explanation of Significant Differences for Basin F/Basin F Exterior Remediation Project, Revision 0

1. Enclosed is the completed and signed Explanation of Significant Differences (ESD) for Basin F/Basin F Exterior Remediation Project, Revision 0, for your information and records. This ESD summarizes two significant changes to the remedy for the Basin F/Basin F Exterior Remediation Project developed by the Army since the Record of Decision was signed. Significant changes include an increase in remediation volumes and a decrease in overall project costs.

2. The point of contact on this matter is Mr. Lou Greer at 303-853-3951.

Encl

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EXPLANATION OF SIGNIFICANT DIFFERENCES FOR BASIN F/BASIN F EXTERIOR REMEDIATION PROJECT

ROCKY MOUNTAIN ARSENAL FEDERAL FACILITY SITE

Prepared by:
Tetra Tech EC, Inc.

Prepared for:
Rocky Mountain Arsenal Committee
Department of the Army
Shell Oil Company
U.S. Fish and Wildlife Service
U.S. Environmental Protection Agency
Colorado Department of Public Health and Environment

Revision	Prepared By	Reviewed By	Approved By	Date	Pages Affected
0	A. Todd	S. Ache	L. Stewart	December 31, 2010	All

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TABLES

FIGURES

ACRONYMS AND ABBREVIATIONS

BBM	Biota Barrier Material
bgs	below ground surface
CAMU	Corrective Action Management Unit
CAR	Contamination Assessment Report
CCR	Construction Completion Report
CDPHE	Colorado Department of Public Health and Environment
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act
CFR	Code of Federal Regulations
COC(s)	Contaminant(s) of Concern
CSV	Contingent Soil Volume
cy	cubic yard(s)
EPA	U.S. Environmental Protection Agency
ESD	Explanation of Significant Differences
FS	Feasibility Study
HHE	Human Health Exceedance
HWL	Hazardous Waste Landfill
IRA	Interim Response Action
JARDF	Joint Administrative Record Document Facility
NCP	National Contingency Plan
NCSA	North Central Study Area
NPL	National Priorities List
OCPs	Organochlorine Pesticides
OU	Operable Unit
ppm	parts per million
RAB	Restoration Advisory Board
RCRA	Resource Conservation and Recovery Act
RI	Remedial Investigation
RMA	Rocky Mountain Arsenal
ROD	Record of Decision
SAR	Study Area Report
SEC	Site Evaluation Criteria
SQCSR	Soil Quantity Calculation Summary Report
SQI	Submerged Quench Incinerator
TCHD	Tri-County Health Department

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1.0 INTRODUCTION

This Explanation of Significant Differences (ESD) documents a significant change in a portion of the remedy for the Basin F/Basin F Exterior Remediation of the Rocky Mountain Arsenal (RMA) Federal Facility Site. The RMA On-Post Operable Unit (OU) is a federally owned facility located in southern Adams County, Colorado, approximately 10 miles northeast of downtown Denver, directly north of the former Stapleton International Airport and west of Denver International Airport (Figure 1.0-1). The RMA On-Post OU site encompasses approximately 1.7 square miles and is currently on the U.S. Environmental Protection Agency (EPA) National Priorities List (NPL) for environmental cleanup as a result of contamination released during previous RMA operations. The Basin F/Basin F Exterior Remediation Project area is located in the north-central part of the On-Post OU as shown on Figure 1.0-2.

The Record of Decision (ROD), which describes the remedy for the entire On-Post OU of RMA, was signed by the U.S. Army (Army), the EPA, and the Colorado Department of Public Health and Environment (CDPHE) on June 11, 1996 (FWENC 1996b). The selected remedy includes cleanup projects for soil, structures, and treatment of groundwater contamination (PMRMA 2009). As the site-wide remediation is completed, most of the On-Post OU of RMA will become a National Wildlife Refuge, as provided for in Public Law #102-402.

The Army is the lead agency for RMA and is issuing this ESD as part of its responsibilities under Section 117 of the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) of 1980, as amended by the Superfund Amendment and Reauthorization Act of 1986, and pursuant to the National Contingency Plan (NCP), 40 Code of Federal Regulations (CFR) Section 300.435(c)(2)(i). The NCP requires an ESD when the remedial action taken differs significantly from the remedy selected in the ROD with respect to scope, performance or cost. Regulatory Agency oversight is conducted by the EPA, CDPHE, and Tri-County Health Department (TCHD). The TCHD oversees local public health and environmental issues in Adams, Arapahoe, and Douglas Counties.

This ESD summarizes two significant changes to the remedy for the Basin F/Basin F Exterior Remediation Project developed by the Army since the ROD was signed. Significant changes include an increase in remediation volumes and a decrease in overall project cost. These changes, while resulting in the need for an ESD, do not alter the overall hazardous waste management remedy that was selected in the ROD.

The remedy requirements for the Basin F/Basin F Exterior Remediation Project include excavation of human health exceedance (HHE) soil and biota risk soil from the areas outside Basin F (the Basin F Exterior) and constructing a RCRA-Equivalent cover over Basin F.

During design, changes were made to both site and project boundaries (including the Basin F boundary), resulting in increased design remediation volumes of both HHE and biota risk soils in the Basin F Exterior areas. Sampling conducted after excavation of the design remediation volumes resulted in additional remediation volume increases and contingent soil volume (CSV). CSV is defined as all soil excavated in excess of design or actual volume that is located outside the ROD remediation limits as identified in the Soil Quantity Calculation Summary Report

(SQCSR)(FWENC 1996a). Over-excavation beyond the required design and CSV limits, to ensure complete remediation, also contributed to the total volume increase. The total actual volume of HHE soil removed was 141,496 cubic yards (cy), a 97 percent increase above the ROD-identified HHE soil volume of 71,906 cy. The total actual volume of biota soil removed was 254,116 cy, a 60 percent increase above the ROD-identified biota soil volume of 158,700 cy.

Changes to the project also resulted in a significant cost decrease for the project. The ROD-estimated cost for implementation of the Basin F/Basin F Exterior Remediation Project was approximately $32.3 million. There was some cost growth due to increased remediation volumes for HHE soil and biota risk soil, revegetation and engineering oversight and reporting cost increases. However reduction in mobilization costs, and most significantly; reduction of the area requiring a Resource Conservation and Recovery Act (RCRA)-equivalent cover and reduction in required gradefill volume more than offset all cost increases. Overall, project costs decreased to approximately $19.7 million, which represents a cost decrease of approximately 39 percent from the ROD estimate.

This ESD will become part of the Administrative Record as required by the NCP, 40 CFR 300.825(a)(2) (EPA 1990). The Administrative Record is available to the public at the Joint Administrative Record Document Facility (JARDF) that is located on the RMA in Building 129, Room 1010. The JARDF is open Monday through Friday between Noon and 4 pm or by appointment. The telephone number for the JARDF is 303-289-0983.

2.0 SITE HISTORY, CONTAMINATION AND SELECTED REMEDY

2.1 RMA Operational History

The RMA was established in 1942 by the Army to manufacture chemical warfare agents and agent-filled munitions and to produce incendiary munitions for use in World War II. Following the war and through the early 1980s, the facilities continued to be used by the Army. Beginning in 1946, some facilities were leased to private companies to manufacture industrial and agricultural chemicals. Shell Oil Company, the principal lessee, manufactured pesticides from 1952 to 1982 at the site. Common industrial and waste disposal practices during those years resulted in contamination of structures, soil, surface water, and groundwater.

The On-Post OU is one of two operable units at RMA. The Off-Post OU primarily addresses groundwater contamination north and northwest of RMA. The On-Post OU addresses contamination within the approximately 26.6 square miles of RMA. As of September 2010, approximately 24.9 square miles of the On-Post OU have met cleanup requirements and are no longer part of the NPL site. Implementation of the remedy for the remaining approximately 1.7 square miles is ongoing and is scheduled for completion in 2011. Groundwater has also been deleted in the eastern and southern perimeter areas of the RMA. However, groundwater underlying the central and northwestern portions of the site has not met remediation goals and remains on the NPL.

The contaminated areas within the On-Post OU included approximately 3,000 acres of soil, 15 groundwater plumes, and 798 structures. The most highly contaminated areas were identified in

South Plants (the Central Processing Area, Hex Pit, Buried M-1 Pits, and the chemical sewers), Basins A and F, the Lime Basins, the Complex (Army) Trenches and the Shell Trenches. The primary contaminants found in soil and groundwater in these areas were organochlorine pesticides (OCPs), solvents, metals, and chemical warfare agent byproducts.

The areas with the highest levels and/or the greatest variety of contaminants were located in the central manufacturing, transport, and waste disposal areas. The highest contaminant concentrations tended to occur in soil within five feet of the ground surface, although exceptions are noted, particularly where burial trenches, disposal basins, or manufacturing complexes were located.

The characteristics and locations of the groundwater plumes suggest that the greatest contaminant releases to the groundwater have occurred from Basin A and the Lime Basins, the South Plants chemical sewer, the South Plants tank farm and production area, the Complex (Army) Trenches and Shell Disposal Trenches in Section 36, and the former Basin F. The Motor Pool/Rail Yard and North Plants areas have been other sources of contaminant releases to the groundwater.

2.2 Basin F/Basin F Exterior Remediation Project History and Contamination Summary

The Basin F/Basin F Exterior Remediation Project is located in Sections 26 and 23 and entailed the remediation of the North Central Study Area (NCSA) sites listed below:

Basin F

- Basin F (NCSA-3)

Basin F Exterior

- Deep Injection Well Site (NCSA-4a)
- Basin F Exterior Soils (NCSA-4b)
- Sand Creek Lateral (NCSA-5c)
- Former Chemical Sewer (NCSA-6a)

A summary of the information collected during the Remedial Investigation (RI)/Feasibility Study (FS) process can be found in various Contamination Assessment Reports, the RI Summary Report (Ebasco 1992) and in the *Detailed Analysis of Alternatives Report* (FWENC 1995). A summary of use and contamination history for each area is provided below.

Risk-based analysis of data collected during the RI resulted in designation of HHE and biota risk soil in the Basin F and Basin F Exterior project areas. The ROD-defined areas and volumes of HHE and biota risk soil are defined in the SQCSR. Modifications of HHE and biota risk soil areas and volumes made during the design process are described in Section 3.1.1.

2.2.1 Basin F (NCSA-3)

2.2.1.1. Basin F Site Use History

Construction of the Basin F surface impoundment (NCSA-3) occurred between July and December 1956. The impoundment was created by constructing a dike around a natural depression and lining it with a 3/8-inch asphalt membrane and a 1-foot-thick soil protective layer. The impoundment had a surface area of approximately 93 acres and a capacity of approximately 243 million gallons. The impoundment was to be used to contain liquid wastes from Army and Shell chemical operations, including the Chlorine Plant, Shell Manufacturing Area and the Sarin (GB) complex (North Plants).

Basin F was used continuously between December 1956 and December 1981 for the solar evaporation of contaminated liquid wastes. Liquid wastes were conveyed to Basin F from South Plants and North Plants through the chemical sewer system. Following the termination of all waste discharges to the chemical sewer in December 1981, the Army implemented a series of measures designed to accelerate the evaporation of the remaining liquids in the basin, prevent sewer-transported flows from infiltrating both ground and surface waters, and prevent surface runoff from generating additional liquid waste volumes contained in the basin. These measures included: 1) removal of the chemical sewer trunk line and lateral connection to Basin F from South Plants and North Plants; 2) construction of a pipe trickler system in the basin to enhance natural solar evaporation; 3) installation of a dike in the basin separating the 'wet' from 'dry' areas; and 4) construction of a north-south surface runoff interceptor ditch along the eastern basin perimeter. The basin was preliminarily closed by the removal of all conveyance systems into the basin on July 14, 1982.

2.2.1.2. Basin F Contamination Summary

The RI for Basin F was conducted in two phases. Phase I was performed in the fall of 1985 and the summer of 1986 and included soil sampling and field observations. Results are presented in the Phase I Contamination Assessment Report (CAR) (ESE 1988d). The Phase II program began in February 1988 to complement the Basin F Interim Response Action (IRA) by indicating the lateral and vertical extents of contamination remaining at the site.

The Phase I results showed samples with elevated concentrations of organic contaminants at depths down to 20 feet in areas where the physical integrity of the liner was poor. The concentrations in these locations remained relatively uniform with depth, and high concentrations of many contaminants occurred in the soil at or above the water table elevation. In contrast, moderate to low contaminant concentrations were detected in most samples taken where the liner was still intact and concentrations decreased with depth.

The Phase II program was conducted in two stages. Phase IIa consisted of sample collection outside the basin area, conducted to assess both the lateral and vertical extent of soil contamination outside the Basin F fence. Phase IIb consisted of sample collection inside the basin during the IRA after the overburden, liner and some of the underlying soils were removed. The results of Phase IIa and IIb are presented in separate CARs (ESE 1988a and Ebasco 1989).

Results from Phase IIa demonstrated that the highest contaminant concentrations were located on the east side of the basin, primarily on the surface. These surface areas, located outside the Basin F boundary, were part of the Basin F Exterior project area. The Phase IIb sampling results generally paralleled the results collected during the Phase I sampling effort. The Phase IIb sampling again showed that the greatest concentrations of contaminants were found in the eastern and southern portions of the basin with organic contaminants exceeding the site evaluation criteria.

2.2.2 Deep Injection Well Site (NCSA-4a)

Site NCSA-4a (Deep Well Injection Site) was used from 1962 to 1966 to inject fluid retained in Basin F into strata 12,000 feet below ground surface. The site was located northeast of Basin F in the northeast quarter of Section 26. Other infrastructure that existed during operation of the Deep Well Injection System included a pump house, treatment plant building, clarifier, several sumps, a clear water storage tank and chemical sewers (21 different lines connecting the various treatment systems and connecting Basin F to the treatment system) carrying the liquid waste from Basin F to the well facilities.

2.2.2.1. NCSA-4a Site Use History

The Deep Injection Well, built between February and December 1961, was designed to ensure environmentally safe disposal of contaminated aqueous wastes contained in Basin F. The well shaft was drilled to a final depth of 12,045 feet and cased and sealed to 11,975 feet. Upon completion the surface facilities had the capacity to pressure inject treated effluent into fissures in Precambrian bedrock at rates up to 400 gallons per minute. The effluent from Basin F was subject to settling, filtration and sterilization prior to being injected, reducing the suspended solids content to 20 mg/l. The sludge resulting from this treatment was pumped back to Basin F.

Operations began in March of 1962 and continued through September 1963. Operations were suspended due to high costs associated with the removal of solids, frequent mechanical breakdowns, and a surplus storage capacity in Basin F. A year later, in September 1964, the pumping operations resumed following a number of modifications designed to improve operating efficiency and lower pretreatment costs. In February 1966, injection operations were suspended because of adverse publicity arising from an apparent correlation between this disposal method and an increased frequency and intensity of earth tremors in the Denver area during 1965 and early 1966.

Between February 1966 and October 1968, the facility was used by a number of governmental agencies in support of ongoing research. Research activities stopped at this point because of minor earth tremors. After this time, the surface facilities were either relocated to other portions of RMA in support of other operations or used as part of the experimental laboratory located at the site.

From September to October 1985, the treatment facilities were closed. When all surface facilities were removed, the well was plugged and abandoned.

2.2.2.2. NCSA-4a Remedial Investigation

The RI for this site was conducted in two phases. Phase I was performed in the fall of 1985 and included soil sampling and field observations. Results are presented in the Phase I CAR for this site (ESE 1988e). Phase II began in March of 1988 and consisted of additional soil sampling and field observations to further define the areal and vertical extent of contamination along the sewer lines and in the vicinity of the support facilities.

The Phase I program consisted of taking 24 soil samples, at the bottom of the excavation, as the chemical sewers connecting the Deep Well Injection facility with Basin F were removed. Sample depths varied from 5 to 12 feet depending on the depth of excavation. The majority of the pipelines were cast iron while two were steel. Samples were taken at points where discoloration from possible leakage was noted, at pipe joints, and to ensure comprehensive coverage of the site.

The Phase I testing detected several target analytes at concentrations above their indicator ranges. The 24 samples contained contaminants of concern (COCs) above their respective indicator levels. However the concentrations detected were below HHE site evaluation criteria.

The Phase II study (ESE 1988c) was initiated to determine the nature and extent of contamination at this site. This second investigation focused on four areas, three sewer line locations (lines B and Z which conveyed liquids from Basin F, and line A which conveyed liquids to Basin F from the surface facilities area) and the surface facilities area. Sixteen additional borings were completed yielding 66 additional samples. Eight borings were drilled in the surface facilities area and eight borings were drilled adjacent to the three sewer line locations.

The Phase II testing provided mixed results. The eight boreholes that were placed to determine the extent of contamination associated with the sewer lines detected COCs above the indicator levels, but significantly below HHE site evaluation criteria. Only one of eight borehole samples drilled in the surface facilities area contained aldrin and dieldrin above HHE site evaluation criteria. The remaining seven detected COCs above their respective indicator levels, but most of the detections were significantly below the HHE site evaluation criteria.

2.2.3 Basin F Exterior Soils (NCSA-4b)

Site NCSA-4b (Basin F Exterior Soils) is an extensive area located in the eastern half of Section 26, the western half of Section 25 and the south-central portion of Section 23. It is adjacent to the eastern boundary of Basins F and C. The site encompasses a large Biota soil area and six noncontiguous HHE soil areas. A portion of the original Biota soil area in Section 26 and all of the Biota soil area in Section 25 was removed as part of the Corrective Action Management Unit (CAMU) Soil Removal Project. A seventh HHE soil area was removed as part of the Section 26 HHE Soil Removal Project (inside the CAMU boundary). Additionally, two stockpiles of Biota soils were located in the northeast corner of Section 26. These stockpiles were constructed from soils removed prior to the construction of the Submerged Quench Incinerator (SQI) in 1991.

Contamination found in these soils was due, in part, to windblown contamination from Basin F. Between 1961 and 1966, the Army intermittently operated a spray raft to enhance evaporation of

liquids in Basin F. Although the Army attempted to prevent contamination of shoreline areas around Basin F by restricting operations to times when wind and humidity conditions were within specific parameters, it is possible that some airborne spray and possibly salt particles resulting from evaporation of mist were transported to adjacent soils.

2.2.3.1. NCSA-4b Site Use History

Portions of the site were used to facilitate different operations. These include the SQI, Ponds A and B and the Tank Farm. Other operations include a current monitoring station in the northeastern portion of the section and miscellaneous access roads that were constructed to support the various projects in Section 26.

2.2.3.2. NCSA-4b Remedial Investigation

The RI for this site was conducted in two phases. Phase I was performed in the summer of 1985 and included soil sampling and field observations. Results are presented in the Phase I CAR for this site (ESE 1987). Phase II began in March of 1988 and consisted of additional soil sampling and field observations to further define the areal and vertical extent of contamination along the sewer lines and in the vicinity of the support facilities.

The Phase I program consisted of taking 36 soil samples from 36 borings to a depth of 5 feet. Composite soil samples were prepared from the 0-1 ft. below ground surface (bgs) and 4-5 ft. bgs intervals of each borehole. The only organic compound detected in these Phase I samples was dieldrin (2 parts per million [ppm]) in borehole 4502. Metals were detected above their indicator ranges in two samples (from boreholes 4512 and 4527). However, these findings were considered anomalous based on disposal history records and absence of contamination in adjacent borings.

The Phase II study (ESE 1988b) focused on sampling and analysis for metals only near boreholes 4512 and 4527. None of these samples indicated metal COCs above their indicator ranges.

A surficial soils sampling program was undertaken to investigate potential contaminant distribution specifically due to windblown transport of material from source areas, including Basin F. The sampling interval for this program was 0-2 inches bgs to ensure that contamination due to windblown transport would be identified without the effects of compositing deeper soil intervals with surficial intervals, as may have been the case in the RI sampling described above. Samples were collected in October 1989 and the results were presented in the *Surficial Soil Program Data Summary* (Ebasco 1991). All 17 of the surficial samples exhibited OCP contamination, some exceeding site exceedance criteria for human health.

The On-Post Feasibility Study Field Data Collection program was conducted to address additional data needs to support the Feasibility Study remedial alternatives assessment. Phases I and II of this program did not involve evaluation of NCSA-4b. However Phase III included collecting 11 surficial samples from the NCSA-4b area. Samples were collected in February 1992 and the results were presented in the *Final Technical Report – Phase III On-Post Feasibility Study Field Data Collection* (Woodward-Clyde 1993a). All 11 of the surficial

samples exhibited OCP contamination, some exceeding site exceedance criteria for human health.

The Feasibility Study Soil Volume Refinement Program was conducted to collect and analyze shallow soil data for use in refining contaminated soil volume estimates generated in the Feasibility Study. Samples were collected between February and August of 1993 and the results were presented in the *Feasibility Study Soil Volume Refinement Program* (Ebasco 1994). At least 9 of the 22 surficial samples exhibited OCP contamination, some exceeding site exceedance criteria for human health.

2.2.4 Sand Creek Lateral (NCSA-5c)

Site NCSA-5c (Sand Creek Lateral) was used to convey liquid waste from the Chlorine Plant, White Phosphorus Plant and M74 Plant. It was also used to convey surface runoff from South Plants. The Sand Creek Lateral enters Section 26 from Section 35 approximately 600 feet west of D Street, flows north to the half-section line and veers to the northeast as it leaves Section 26.

2.2.4.1. NCSA-5c Site Use History

During World War II, the Sand Creek Lateral was used to convey liquid waste from the Chlorine Plant through Sections 35, 26, and 25 to First Creek. This practice was discontinued when sodium chloride concentrations in the waste reached 20,000 ppm. The flows were then redirected from the Sand Creek Lateral using an irrigation ditch (NCSA-5b, located in Section 35) to convey the waste to Basins D and E. The Chlorine Plant aqueous waste contained variable amounts of salt, caustic and acid and was discharged to the lateral until 1957 when the army redirected the waste into the chemical sewer system.

A few years earlier, in 1951, the waste from the White Phosphorus Plant was redirected from Basin A to the Sand Creek Lateral. This waste contained copper, sulfate, and white phosphorus from filling operations occurring at the plant. Also, during an undetermined time period, waste from the M74 Bomb Filling Operations was discharged into the lateral. Records suggest this waste contained trichloroethylene and 1,1,1-trichloroethane.

In 1953, the Sand Creek Lateral was incorporated into the liquid waste disposal system. It was used to convey overflow wastes from Basins A and B downstream to Basin C and subsequently into Basin D. The Sand Creek Lateral was utilized until the chemical sewer system was brought on-line in late 1956/early 1957.

2.2.4.2. NCSA-5c Remedial Investigation

The RI for this site was conducted as part of another program (Woodward-Clyde 1993b). Three borings were completed in the Section 26 segment of the Sand Creek Lateral in February 1992, yielding 8 samples. Two of the borings (26CSO01002 and 26CSO01003) contained concentrations of dieldrin above the HHE site exceedance criteria, but were located outside of the Study Area Report (SAR) site boundary for the Sand Creek Lateral, so they were incorporated as part of site NCSA-4b (Basin F Exterior Surficial Soils). The other boring (26CSO01001) contained concentrations of aldrin and dieldrin resulting in additive risk above HHE site exceedance criteria.

2.2.5 Former Chemical Sewer (NCSA-6a)

Site NCSA-6a represents the former location of a vitrified clay, gravity flow chemical sewer line connecting South Plants with Basin F (located in Section 26). Two segments of sewer line entered Section 35 from the South Plants area: one, approximately 820 feet west of D Street and another, approximately 800 feet north of 7th Avenue. These sewer segments converged in southeast Section 35 and carried aqueous waste north into Section 26 and to Basin F. A subsidiary sewer line (NCSA-6b) from North Plants facility (located in Section 25) joined the former chemical sewer line in the northeast corner of Section 35.

2.2.5.1. NCSA-6a Site Use History

The chemical sewer was constructed in stages as RMA facilities were built or expanded. The first part of NCSA-6a was constructed in 1942. This original line was 12-inch clay tile and connected the Chlorine Plant with what was to be the caustic waste basin. Although this line was never used for caustic waste disposal, the southern portion of the line eventually became part of the chemical sewer system connecting South Plants to Basin F.

Between 1944 and 1946, the Army constructed a 12-inch clay sewer line that received waste from South Plants and transported the waste to Basin A. In 1953, a second 12-inch line was constructed to segregate Hyman waste flows from Army waste. This line crossed the existing Army sewer line and discharged waste into a stilling basin in Section 36. Effluent from the stilling basin entered Basin A via an open ditch.

After the completion of Basin F in 1956, the original chemical sewer lines leading from South Plants to Basin A were modified and a 10-inch vitrified clay gravity flow chemical sewer line was extended to Basin F. The new sewer line intercepted flows from both 12-inch lines and carried the waste to Basin F. This sewer was identified during the RI/FS as NCSA-6a. The southern part of the 12-inch line from the Chlorine Plant to the unused Caustic Waste Basin was connected to the 10-inch main line using an 8-inch clay tile pipe. The sewer line from North Plants to Basin A was also modified and connected with the 10-inch main in the northeast corner of Section 35.

In 1960, an investigation of the chemical sewer line was conducted and pipeline flow measurements were recorded. The results indicated that a considerable amount of fluid had been lost through the pipeline and the chemical sewer was considered a potential source of groundwater contamination. However, because the chemical sewer was located within areas of groundwater contamination due to RMA waste disposal in South Plants and Section 36, a specific relationship could not be determined.

In 1975 the Army replaced a portion of the sewer near Basin F in response to discovery of contaminants in groundwater contamination north of RMA. Records show that this pipeline segment adjacent to Basin F was leaking and possibly deteriorating and the sewer was identified as a potential source of groundwater contamination (Army 1975). Therefore, this segment was abandoned in-place, without any grouting or other mitigation, and replaced with a new sewer pipe approximately 50 feet south of the original sewer alignment (Watson 1975). Although Army correspondence estimated this sewer segment at approximately 800 feet, inspection of

record drawings from the original sewer construction show this segment to be closer to 700 feet (USACE 1957).

Removal of the majority of chemical sewer line NCSA-6a took place in 1982 (ESE 1988f). The process included removal of the sewer line and manholes appurtenant to the line. The previously abandoned portion of the line was not removed as part of this effort. Soil within two feet (at least) of any point of the excavated lines and manholes was also removed because of suspected leakage. Additional soil could also be removed at the direction of the Contracting Officer. Sewer pipe and potentially contaminated soils were disposed within Basin F. All trenches created during the chemical sewer removal were backfilled with clean soil from a borrow area.

2.2.5.2. NCSA-6a Remedial Investigation

The RI for this site was conducted in the spring of 1986 and included soil sampling and field observations. Results from soil sampling and field observations are presented in the Phase I CAR for this site (ESE 1988f). A Phase II program was not recommended for the site, because further soil investigations would not provide a more accurate determination of potential leakage points along the sewer line.

The Phase I program consisted of 20 soil borings in Sections 26 and 35, yielding 22 soil samples. Using as-built drawings from the sewer line removal and other documents, boring locations were placed as close as possible to the centerline locations. Thirteen of the borings were located in Section 35 and yielded 15 samples. The remaining 7 borings were located in Section 26 and yielded 7 samples. Samples were taken immediately below the base of backfill in undisturbed alluvium, unless field conditions required an adjustment in the intervals. The depths of the interface of backfill placed after the sewer removal and underlying undisturbed native soil indicated that at least 2 feet of soil from beneath the sewer, and significantly more at many locations, was removed with the sewer line.

The Phase I analytical results indicate that the removal of the chemical sewer line and associated soils removed the vast majority of the potential contamination in Sections 35 and 26. Samples retrieved from 8 of the 13 borings in Section 35 detected no analytes at concentrations above their indicator levels. Samples retrieved from the 7 borings in Section 26 detected only metals, all of which were also below the human health site evaluation criteria. In addition, the ROD identified remaining chemical sewers as potential chemical agent sites. However, NCSA-6a was not included as a potential chemical agent site because the ROD-identified sewer site had been previously removed.

2.3 Summary of the Selected On-Post Remedy

The overall remedy required by the 1996 ROD for the On-Post OU includes the following:

- Interception and treatment of contaminated groundwater at the three existing on-site treatment plants
- Construction of a new RCRA- and Toxic Substances Control Act-compliant hazardous waste landfill (HWL) on-post

- Demolition of structures with no designated future use and disposal of the debris in either the new, on-post HWL or the Basin A consolidation area, depending upon the degree of contamination
- The contaminated soil at RMA is addressed primarily through containment in the on-post HWL or under caps/covers, or through treatment depending upon the type and degree of contamination. Areas that have caps or covers require long-term maintenance and will be retained by the Army. These areas will not become part of the wildlife refuge.
- The Basin A disposal area is used for consolidation of biota risk soil and structural debris from other RMA contamination areas and is covered with a soil cover including a biota barrier.

2.4 Summary of the Selected Remedy for the Basin F/Basin F Exterior Project

The original ROD remedy for the Basin F/Basin F Exterior project included removal and disposal of contaminated soils from the Basin F Exterior and construction of a RCRA-equivalent cover over Basin F.

During the remedial design process, several changes to the Basin F/Basin F Exterior remedy were developed during the Part – 1 and Part – 2 designs (FWENC 2000b and TtEC 2008a).

Two of these changes were documented in previous ESDs. The *Explanation of Significant Differences for Chemical Sewer Remediation Section 35 and Section 26* (FWENC 2000a) eliminated the ROD required removal of contaminated soil beneath and adjacent to the former chemical sewer (NCSA-6a). The *Explanation of Significant Differences for Basin F/Basin F Exterior Remediation Project – Part 2 (Basin F Cover) and Chemical Sewer Remediation* (TtEC 2009a) added the requirement for construction of a RCRA-equivalent cover over a segment of chemical sewer encountered during construction of the Basin F Cover. An expanded description of these two changes and a third change (Basin F boundary refinement) is provided in Section 2.4.1.

It is noted here that the chemical sewer remediation volume and cost was eliminated by the first ESD described above. The ROD remediation volume (Table 4.1-1) and ROD costs (Table 4.2-1) have been adjusted to reflect elimination of the chemical sewer soil remediation (see 'Note 2' of each of these tables). Similarly, the cost to add the cover over the chemical sewer segment, per the second ESD described above, has been incorporated into the ROD costs for RCRA-equivalent cover (see 'Note 3' of Table 4.2-1), though grouting was not. So, other than the minor sewer grouting cost, the remediation volume and cost changes documented in these two previous ESDs is not a factor in the volume increase and cost decrease discussed in this ESD for the Basin F/Basin F Exterior Remediation Project.

The required remedial actions based on the ROD and subsequent changes are identified below.

Soil Remediation of Basin F Exterior

- Excavate HHE and biota soil from the Deep Well Injection Site *(NCSA-4a)*, Basin F Exterior Soils *(NCSA-4b)* and Sand Creek Lateral *(NCSA-5c)* in the Basin F Exterior Remediation project area. Dispose of excavated HHE soil in the Hazardous Waste Landfill (HWL) and biota soil in either Basin A or Basin F, as designated.
- Backfill remediated HHE soil areas with clean soil.
- Finish grade and revegetate all disturbed remediation and borrow areas.

Cover Construction over Basin F

- Place additional gradefill as necessary.
- Construct the RCRA-Equivalent cover system (including Biota Barrier Material [BBM] layer, capillary barrier layer and cover soil layer).
- Re-vegetate all cover areas and other disturbed areas.
- Install lysimeters, drainage channels and site Engineering Controls (erosion/settlement monuments, survey monuments, signs and obelisks) and fence and perimeter access road around Army-maintained area.

2.4.1 Previously Documented Changes

There were several changes to the project boundaries, as well as changes to site areas within the project area. One change refined the boundary and reduced the area of Basin F (correspondingly increasing the Basin F Exterior areas), which reduced the area requiring a RCRA-equivalent cover. Other changes eliminated the remedy for soil related to the majority of the former chemical sewer, but added a cover remedy for a chemical sewer segment, which increased (by a minor amount) the area requiring RCRA-equivalent cover.

2.4.1.1. Change to the Chemical Sewer Remedy

During the Section 35 Soil design process, information was discovered that documented removal of soil beneath and adjacent to most of the chemical sewer (NCSA-6a) within Sections 35 and 26 (FWENC 2002b). Although removal of the majority of this sewer was known to have occurred in 1982, the ROD remedy required removal of soil immediately beneath and adjacent to the former sewer location. No contamination exceeding site evaluation criteria was detected during RI soil sampling. However, soil beneath and adjacent to the former sewer location was inferred to be HHE soil based on sewer-associated soil contamination within South Plants. The portion of NCSA-6a within Section 26 (i.e., the portion assigned to the Basin F/Basin F Exterior Remediation Project) was transferred to the Section 35 Soil Remediation Project during the design phases of each project (refer to Section 1.2.4 of the *Basin F/Basin F Exterior Remediation Project - Part 1 100 Percent Design Package* [FWENC 2000b]) because re-evaluation of the remedy would apply to the entire sewer within the two sections.

Additional soil sampling was conducted in April 2000 to augment the previous RI sampling along the centerline of the former, removed chemical sewer and to evaluate potential lateral contamination at locations between where soil had been removed in 1982 and the ROD-prescribed limit of remediation (10 feet from the former sewer centerline). The analytical results, documented in the *Former Chemical Sewer Sections 26 and 35 Data Summary Report* (FWENC 2000c), showed no evidence of contaminated soil remaining requiring excavation. Because the potentially contaminated soil nearest the sewer had already been removed and no contaminants exceeding the human health site evaluation criteria were found in the remaining nearby soil, the ROD requirement for further soil excavation was eliminated. The changes to the chemical sewer remediation requirements for NCSA-6a were documented in the *Explanation of Significant Differences for Chemical Sewer Remediation Section 35 and Section 26* (FWENC 2000a).

Because the ROD requirement for further remediation soil excavation was previously eliminated via the *Explanation of Significant Differences for Chemical Sewer Remediation Section 35 and Section 26*, the remediation soil volume and cost related to this site (except as described in the next section) is not included/considered in this ESD for the Basin F/Basin F Exterior Remediation Project.

2.4.1.2. Chemical Sewer Extension of RCRA-Equivalent Cover

In June 2008, while excavating a drainage channel east of the Basin F cover area, vitrified clay pipe was encountered. The source of this pipe was ultimately traced back to records that showed this encountered pipe to be part of the original chemical sewer constructed in 1957. Records showed that in 1975, an approximately 600-feet-long segment of the original chemical sewer was abandoned in-place and replaced with a new sewer pipe approximately 50 feet south of the original sewer alignment (Watson 1975). The newer pipe segment was removed, along with the rest of the sewer to the south through Section 35, in 1982. The abandoned segment was believed to still exist from near the discharge point within Basin F upslope (to the east-southeast) to a former manhole location (at the directional change near the upslope end) then another approximately 50 feet upslope to the southeast.

Consistent with remedial actions identified in the ROD for chemical sewers, the remedy was to grout the pipe and construct a RCRA-Equivalent cover over the potentially contaminated soil associated with NCSA-6a (the chemical sewer). The selection of this remedy is described in the *Explanation of Significant Differences for Basin F/Basin F Exterior Remediation Project – Part 2 (Basin F Cover) and Chemical Sewer Remediation* (TtEC 2009a). The presumed contaminated soil limits were defined consistent with the ROD as 2 feet (ft.) below the pipe and 10 ft. laterally on each side of the pipe. The resultant 20-feet-wide RCRA-Equivalent cover limits and 50-ft. BBM runout limits were defined and approved through Design Change Notice (DCN)-BFC-008 in November 2008. The Basin F RCRA-Equivalent cover was extended over the 0.3-acre potentially contaminated soil associated with the chemical sewer (refer to Figure 1.0-2).

2.4.1.3. Basin F Boundary Refinement

The Basin F boundary (i.e., the impoundment/basin area requiring RCRA-equivalent cover) was modified from the ROD boundary. As a result, the Basin F surface impoundment area decreased from the ROD area of 108.2 acres to 92.2 acres.

As part of the Basin F/Basin F Exterior - Part 1 design activities, the boundary of Basin F was modified to more accurately correspond to the historic limits of the basin. Historic photographs were used to establish the maximum limits of liquid waste during the history of the basin as a waste impoundment. Historic topographic mapping, along with the photography, indicated that impounded liquid waste did not exceed the limits of the elevation contour that defined the western and northern soil berm that bounded the basin.

Additional soil contamination characterization was performed to help justify the boundary modification. The results of this characterization (sampling and analysis) were documented in the *Final Data Summary Report for the Basin F Perimeter* (FWENC 2002a).

Establishment of the modified boundary was documented and approved through DCN-BFE-005 to the Basin F/Basin F Exterior - Part 1 design in December 2001. The boundary modification is also documented in the Fact Sheet: Remedy Modification for the Basin F/Basin F Exterior Soil Remediation Project (RVO 2003) and the *Amendment to the Record of Decision for the On-Post Operable Unit, Rocky Mountain Arsenal Federal Facility Site, Section 36 Lime Basins, Basin F Principal Threat Soil Remediation* (TtEC 2005).

2.5 Basin F/Basin F Exterior Remediation Project Implementation

The Basin F/Basin F Exterior Remediation Project was implemented in two parts, each with a separate design. Part 1 (Basin F Exterior remediation) was implemented in two phases starting in December 2001. Part 1, Phase 1 included excavation of contaminated soil from Basin F Exterior areas with disposal in the HWL or Basin A depending on level of contamination (FWENC 2000b). Remediation of all Basin F Exterior Remediation Project-Phase 1 areas included in the final design was completed in January 2003. Additional HHE soil excavation was completed in fall 2004. This additional excavation addressed soil at depths greater than 1 foot that exceeded the acute human health site evaluation criteria. All remediation work completed under Basin F Exterior Remediation Project-Phase 1 of the project is documented in the *Construction Completion Report for Basin F/Basin F Exterior Remediation Project – Part 1* (TTFW 2005).

Part 1, Phase 2 of the Basin F/Basin F Exterior Remediation Project consisted of excavation of biota soil located in the northern part of the Basin F Exterior that was designated for consolidation within Basin F. This was completed in 2008 concurrent with the Basin F Principal Threat Soil Remediation Project to allow use of the biota soil for backfill of principal threat soil excavations within Basin F. Remediation efforts completed under Phase 2 are documented in the *Basin F/Basin F Exterior Remediation Project – Part 1 Phase 2 Construction Completion Report* (CCR) (TtEC 2008a).

Part 2 of the Basin F/Basin F Exterior Remediation Project, or the Basin F Cover Project, included completion of gradefill placement and construction of the Basin F RCRA-Equivalent cover as well as excavation of soil and surface grading around most of the perimeter of the cover area, and installation of engineering controls on and around the cover. Remediation efforts under the Basin F Cover Project were completed in early 2010 and are documented in the Basin F Cover Project CCR (TtEC 2010).

3.0 BASIS FOR THE ESD

This ESD summarizes two significant changes to the remedy for the Basin F/Basin F Exterior Remediation Project developed by the Army since the ROD was signed. Significant changes include an increase in remediation volumes and a decrease in overall project cost.

3.1 Increase in Remediation Volumes

Increases in remediation volumes that occurred during the design process and as part of remedial implementation when CSV was identified and over-excavation occurred are described below.

3.1.1 Remediation Volume Changes During Design

The Basin F/Basin F Exterior Remediation was divided into two parts for both design and construction. The *Basin F/Basin F Exterior Remediation Project – Part 1 (Basin F Exterior)* design (FWENC 2000b) addressed remediation of contaminated soil outside the limits of Basin F. The *Basin F/Basin F Exterior Remediation Project – Part 2 (Basin F Cover)* design (TtEC 2008a) addressed the RCRA-Equivalent Cover construction over Basin F. The Basin F Cover design had nearly insignificant impact on remediation volumes (17 cy of deep acute HHE soil). The following describes changes to remediation areas and volumes developed during the Basin F Exterior design, including changes made to the design through the DCN process after completion of the initial accepted (Rev. 0) Basin F Exterior design.

Notable adjustments made during the design process include the following:

The Sand Creek Lateral (NCSA-5c) site boundary was reduced from the ROD-identified boundary to better reflect this site's bank-to-bank limits. Narrowing the site limits reduced remediation volume from 14,378 bcy to 1,888 bcy. Additionally, the remediation soil designation was changed from biota soil to HHE soil, based on evaluation of soil data and to make the remedy of the SCL in Section 26 consistent with the SCL remedy in Section 35. Narrowing this site's limits correspondingly expanded the site limits and remediation volumes of site NCSA-4b.

Remediation of HHE soil associated with the Chemical Sewer was eliminated, as described in Section 2.4.1.1.

An estimated 30,602 cy of biota soil, removed during the Basin F IRA to construct a liquid waste storage tank and ponds A and B, were placed on biota soil within the northeast corner of site NCSA-4b. The volume of these stockpiles was not included in the ROD volume of NCSA-4b for the Basin F/Basin F Exterior project, but this volume was added to the design volume for this project.

Relatively small areas within NCSA-4b that were not designated as contaminated, but that were within larger areas of contaminated soils were designated biota soil. Between this adjustment and expansion of NCSA-4b limits due to the narrowing of the SCL, the design biota soil volume increased from the ROD estimate of 139,556 cy to 170,235 cy. Note that this latter volume was identified in DCN-BFE-002 as this DCN corrected the design volume cited in the Rev. 0 design due to an omission.

DCN-BFE-001 increased the areas and volumes of biota and HHE soil within NCSA-4b due to a boundary adjustment to Basin C of the Secondary Basins project. The Basin C area was reduced, correspondingly increasing the area of NCSA-4b and adding 733 cy of HHE soil and 11,493 cy of biota soil.

DCN-BFE-003 transferred a portion of NCSA-4b biota soil area, representing approximately 9,690 cy, to the Secondary Basins project. A minor adjustment was also made to the SCL limits and volume.

DCN-BFE-005 made adjustments to NCSA-4b due to the adjustment of the Basin F boundary, described in Section 2.4.1.3. The reduction of the Basin F (NCSA-3) site area resulted in a corresponding expansion of the NCSA-4b area and remediation volumes. Most of the volume increase was HHE soils around the southeast corner of Basin F where design remediation depths of 2 to 3 ft. were designated, resulting in an increase of 17,701 cy.

3.1.2 Remediation Volume Changes During Remediation

In addition to the soil volume increases made during design, the Basin F/Basin F Exterior project experienced volume growth due to actual excavation beyond the design depth requirements.

Based on results of confirmatory samples collected after excavation to design excavation depths, the Agencies requested that additional HHE-designated soils be removed. CSV is defined as all soil excavated in excess of design or actual volume that is located outside the ROD remediation limits as identified in the SQCSR. The CSV is identified in the ROD as a remediation element and is tracked separately from actual remediation volumes. The majority of this additional HHE soil was around the southeast corner of Basin F, where 12,030 cy of HHE soil and 13,910 cy of CSV was removed. CSV was also removed from NCSA-4a (3,176cy) and NCSA-5c (1,869 cy). There was some over-excavation beyond the design limits of remediation waste. The over-excavated soil was disposed at the HWL along with the HHE soil and the entire volume was accounted for as HHE soil volume in the *Construction Completion Report for Basin F/Basin F Exterior Remediation Project – Part 1* (TTFW 2005). The difference between the actual volumes and the combination of design volume and CSV is all presumed to be over-excavation.

Design changes resulted in an approximate 32 percent increase in biota soil remediation volume above the ROD estimate. Over-excavation resulted in an additional 28 percent increase. The actual biota soil volume remediated was 254,116 cy, an approximate 60 percent increase over the ROD estimate of 158,700 cy.

Design changes resulted in an approximate 28 percent increase in HHE soil remediation volume above the ROD estimate. Additional HHE soil removal accounted for an additional 17 percent increase. Over-excavation resulted in an additional 52 percent increase. The actual HHE soil volume remediated was 141,496 cy, an approximate 97 percent increase over the ROD estimate of 71,906 cy.

3.2 Decrease in Project Cost

Changes to the overall project scope resulted in a significant decrease in project cost.

Estimated costs for the Basin F/Basin F Exterior Remediation project decreased due to reduction of the soil cover area and reduction of gradefill for the cover. Other cost reduction was realized in subcontractor mobilization and demobilization.

Actual costs for excavation of remediation soils, revegetation and project oversight and reporting costs were higher than ROD estimates.

3.2.1 Mobilization/Demobilization

Decreases in mobilization/demobilization costs were realized, primarily due to awarding the Basin F Cover project to a subcontractor that was already implementing the Integrated Cover System cover construction project. The final mobilization/demobilization costs total was $586,000, a $685,000 decrease compared to the ROD estimate of $1,271,000.

3.2.2 Remedial Excavation Costs

The increased excavation costs were driven primarily by increases in design remediation volumes for HHE and biota soil and CSV removal.

The final remediation soil excavation costs total $4,233,000, a $730,000 increase compared to the ROD estimate of $3,503,000.

3.2.3 Gradefill

Gradefill is soil placed within the Basin F surface impoundment to create a mound configuration prior to cover placement, so that stormwater runoff flows off and away from the covered area.

The ROD gradefill volume was 1,860,289 cy.

As described in Section 2.4.1.3, the Basin F surface impoundment area decreased from the ROD area of 108.2 acres to 92.2 acres as part of the Basin F Exterior design process. It is estimated that this reduction in cover area reduced gradefill requirement by approximately 460,000 cy.

During the Basin F Cover design development, channels and a key-cut were incorporated to further reduce gradefill requirements. It is estimated that the two channels designed in the cover area reduced gradefill requirements by at least 300,000 cy to an estimated 1,100,000 cy. Incorporation of the key-cut into the design reduced gradefill requirements another 760,000 cy to an estimated 340,000 cy. This 340,000 cy was the final design gradefill volume estimate.

Approximately 220,000 cy of this 340,000 cy was placed during the Basin F Principal Threat Remediation Project, so the cost for this part of the gradefill was not recorded as a cost to the Basin F/Basin F Exterior Remediation project.

The remaining 120,000 cy of gradefill for the Basin F cover plus an additional 30,000 cy of gradefill required for the chemical sewer cover extension was placed as part of the Basin F Cover project. The actual 150,000 cy of gradefill placed as part of the Basin F/Basin F Exterior Remediation project is less than 10 percent of the 1,860,289 cy gradefill estimate for the ROD-identified 108-acre Basin F cover.

For the Basin F/Basin F Exterior Remediation Project, actual gradefill costs were approximately $366,000 (also less than 10 percent of the ROD estimate of $11.2 million); a $10.8 million decrease.

3.2.4 RCRA-Equivalent Cover

As described in Section 2.4.1.3, the Basin F surface impoundment area decreased from the ROD area of 108.2 acres to 92.2 acres. As described in Section 2.4.1.2, the Basin F RCRA-Equivalent cover was extended over the 0.3-acre potentially contaminated soil associated with the chemical sewer. The combined Basin F and chemical sewer cover area of 92.5 acres is approximately 15 percent less than the 108.2 acres assumed in the ROD.

This reduction in cover area resulted in a corresponding reduction in cover construction costs. For the Basin F/Basin F Exterior Remediation Project, actual cover costs were approximately $9.8 million compared to the ROD estimate of $13.7 million.

3.2.5 Revegetation

The final revegetation costs total $1,342,000, a $726,000 increase compared to the ROD estimate of $616,000.

A significant portion of this cost increase can be attributed to the fact that the Basin F Cover project included the cost to re-grade and purchase and incorporate soil amendment into completed areas of Borrow Areas 3 and 4. Costs for borrow area restoration were not included in the ROD cost estimate for the Basin F/Basin F Exterior Remediation Project.

3.2.6 Project Oversight

Another area exhibiting cost increase is project oversight, including engineering and quality assurance inspection, testing and reporting. Although the ROD estimate did include project support and oversight costs, the level of oversight required for the Basin F/Basin F Exterior Remediation Project exceeded that anticipated in the ROD. Extensive QC monitoring and QA monitoring, testing and reporting requirements for the Basin F RCRA-equivalent cover could not be provided at the level of support included in the ROD cost estimate.

The final actual project oversight costs total $3,295,000, a $1,315,000 increase compared to the ROD estimate of $1,980,000.

4.0 DESCRIPTION OF SIGNIFICANT DIFFERENCES

4.1 Changes to Remediation Volumes

Remediation volumes increased significantly compared to the ROD estimates, as shown on Table 4.1-1.

The three primary causes of HHE soil increases were design changes (particularly the Basin F boundary change resulting in new HHE remediation southeast of Basin F), additional soil removal (from the same area southeast of Basin F) and over-excavation. The total actual volume of HHE soil removed was 141,496 cy, a 97 percent increase above the ROD-identified HHE soil volume of 71,906 cy.

The two primary causes of biota soil increases were design changes (particularly the inclusion of stockpiles from the Basin F IRA, narrowing of NCSA-5c and re-designation of areas that were not designated as contaminated in the ROD as biota soil) and over-excavation. The total actual volume of biota soil removed was 254,116 cy, a 60 percent increase above the ROD-identified biota soil volume of 158,700 cy.

Table 4.1-1: Changes to Remediation Volumes for the Basin F/Basin F Exterior Remediation Project

ROD-Prescribed Remedy	Modification	ROD-Prescribed Remediation Volume (bcy)[1,2]	Actual Remediation Volume (bcy)	Percent Change
Excavate HHE soil and dispose in on-post HWL.	**HHE Soil Volume increase.** Design volume increased to 91,682 cy, mainly due to Basin F boundary revision (with corresponding increase in area of NCSA-4b). Added 30,985 cy of CSV and over-excavation of 37,784 cy.	**HHE Soil** **Area — Volume** NCSA-4a 3,381 NCSA-4b 68,525 NCSA 5c 0	**HHE Soil** **Area — Volume** NCSA-4a 7,875 NCSA-4b 130,922 NCSA 5c 2,699	
Total Project HHE Soil Volume Change		**71,906**	**141,496**	**+ 97 %**
Excavate biota risk soil and dispose in Basin A or Basin F, as designated.	**Biota Risk Soil Volume Increase.** Design volume increased to 209,889 cy, due to biota area transfers from Section 35 and Secondary Basins Project areas and Basin C boundary revision that transferred additional biota soil area to NCSA-4b. Added 44,227 cy of over-excavation.	**Biota Soil** **Area — Volume** NCSA-4a 4,756 NCSA-4b 139,566 NCSA-5c 14,378	**Biota Soil** **Area — Volume** NCSA-4a 5,541 NCSA-4b 217,973 NCSA-5c 0 Stockpiles 30,602	
Total Project Biota Risk Soil Volume Change		**158,700**	**254,116**	**+ 60 %**

[1]Original ROD volumes are calculated in the SQCSR.

[2]Chemical sewer (NCSA-6a) remediation volume was eliminated by previous ESD (FWENC 2000a).

4.2 Summary of Cost Change

Remediation costs decreased significantly compared to the ROD estimates, as shown on Table 4.2-1.

The ROD-estimated cost for implementation of the Basin F/Basin F Exterior Remediation Project was approximately $32.3 million.

There was some cost growth due to increased remediation volumes for HHE soil and biota risk soil, revegetation and engineering oversight and reporting cost increases. However, reduction in chemical sewer excavation volume, reduction in mobilization costs, and most significantly; reduction of the area requiring a Resource Conservation and Recovery Act (RCRA)-equivalent cover and reduction in required gradefill volume more than offset all cost increases. Overall, project costs decreased to approximately $19.7 million, which represents a cost decrease of approximately 39 percent from the ROD estimate.

Table 4.2-1: Summary of Costs for Basin F/Basin F Exterior Remediation Project

Cost Element	ROD Cost	Actual Cost[1]	+ Increase or (Decrease)	Reason for Change
Mobilization/Demobilization	$ 1,271,000	$ 586,000	($ 685,000)	Shared Subcontractor with ICS
Chemical Sewer Excavation	$ 0[2]	$ 12,000	+$ 12,000	[actual cost is to grout]
Excavation (HHE and biota soil)	$ 3,503,000	$ 4,233,000	+ $ 730,000	Increase in HHE and biota risk soil volumes
Install Gradefill	$ 11,198,000	$366,000	($ 10,832,000)	Reduced gradefill requirements
RCRA-Equivalent Cover	$ 13,733,000[3]	$ 9,826,000	($ 3,907,000)	Reduced cover area
Revegetation	$ 616,000	$ 1,342,000	+ $ 726,000	Incorporating soil amendments in borrow areas 3 & 4
Other Project Costs	$ 1,980,000	$ 3,295,000	+ $ 1,315,000	Increased engineering, QC and QA oversight and reporting
Total Estimated Project Costs	**$ 32,301,000**	**$ 19,660,000**	**($ 12,641,000)**	**Total % change = - 39 %**

[1]Costs presented are estimates at completion as of September 14, 2010.

[2]Cost for the ROD requirement for further soil excavation related to the majority of the chemical sewer (NCSA-6a) was eliminated by previous ESD. The changes to the chemical sewer remediation requirements for NCSA-6a were documented in the *Explanation of Significant Differences for Chemical Sewer Remediation Section 35 and Section 26* (FWENC 2000a).

[3]Includes ROD cost for Basin F cover ($13,248,000) and estimated cost of cover over chemical sewer extension ($485,000) from ESD (TtEC 2009a).

5.0 PUBLIC PARTICIPATION COMPLIANCE

The Army published a public notice in the Denver Post on November 30, 2010, making the Draft Basin F/Basin F Exterior Project ESD available for public review and comment. Notices were also published in the Brighton Blade and Gateway News. A presentation explaining the proposed changes contained in the ESD was provided to the RMA Restoration Advisory Board (RAB) on November 9, 2010. The RAB is a community group that meets periodically to receive information and provide input on the cleanup being conducted at the RMA. The public comment period closed on December 30, 2010 and no comments were received. The requirements set out in the National Contingency Plan, Section 300.435(c)(2)(i), have been met.

This ESD and all documents that support the changes and clarifications are part of the Administrative Record and are available at the JARDF and the EPA Region 8 Superfund Record Center. The JARDF is open Monday through Friday between Noon and 4 pm or by appointment. The telephone number for the JARDF is 303-289-0983. The EPA Superfund Record Center can be reached at 303-312-7287. Hours of operation are Monday through Friday from 8:00 am to 4:00 pm.

6.0 SUPPORT AGENCY COMMENTS

The EPA, CDPHE, and TCHD have reviewed this ESD. Comments from these Agencies have been incorporated into the document.

7.0 STATUTORY DETERMINATIONS

Considering the new information presented in this ESD, the Army, in consultation with EPA and CDPHE, believes that the Basin F/Basin F Exterior Remediation Project remedy, with the modifications described, satisfies the requirements of CERCLA Section 121 and 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, uses a permanent solution through proper disposal and containment of the wastes in the on-post HWL, Basin A or Basin F, and is cost effective.

Signatures

For U.S. Environmental Protection Agency

Martin Hestmark Date 2/10/11

for Carol L. Campbell
Assistant Regional Administrator
Office of Ecosystems Protection and Remediation

For U.S. Army

Date 1/4/11

Charles T. Scharmann
Program Manager for Rocky Mountain Arsenal

For State of Colorado

Gary W. Baughman Date 1/25/11

Gary W. Baughman
Director, Hazardous Materials and Waste Management Division
Colorado Department of Public Health and Environment

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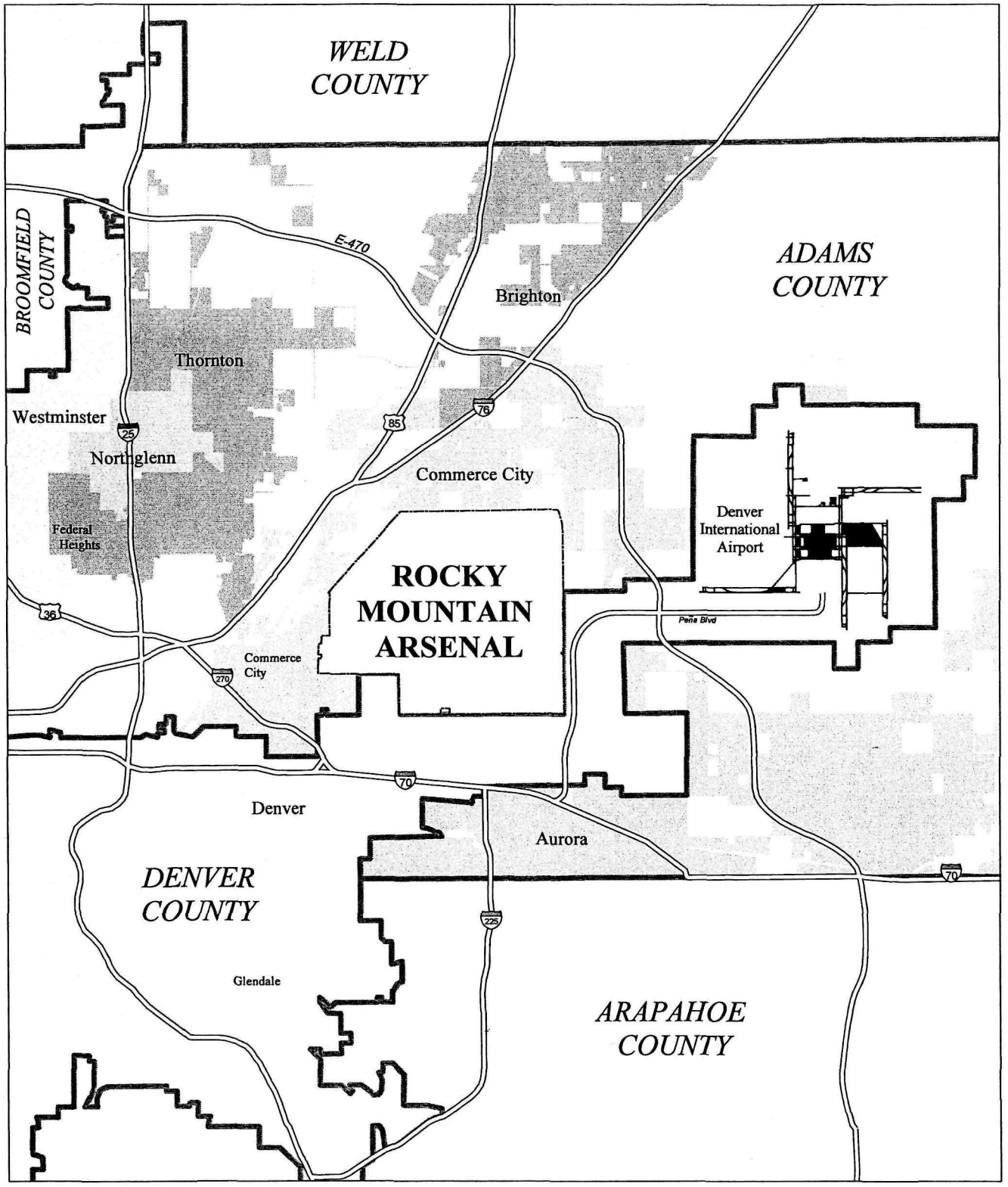
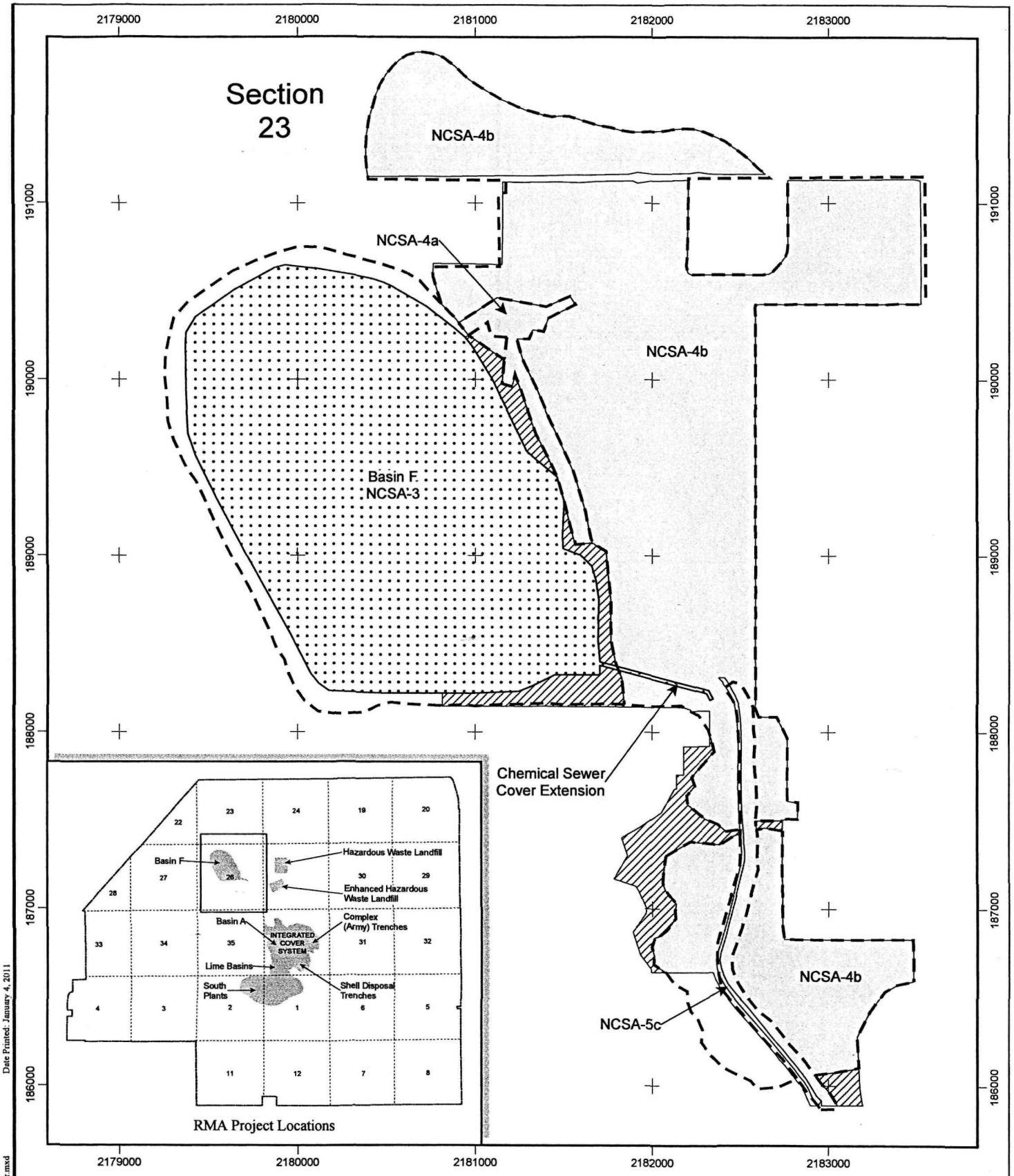


ROCKY MOUNTAIN ARSENAL
Regional Reference

Figure 1.0-1

Map Document: D:/usr2/Map Documents/regional_ref-bw.mxd Printed: June 18, 2008



ROCKY MOUNTAIN ARSENAL
Basin F/Basin F Exterior

Basin F Exterior Project Boundary*

Additional Project Excavation Area

Original ROD Boundary

RCRA-Equivalent Cover

* Boundaries shown are a result of changes made as reflected in the design and as modified by DCN during implementation.

N

0 400 800
Feet

Lambert Conic Conformal Projection
State Plane Coordinate System
Colorado North Zone - NAD 1927

Figure 1.0-2

Date Printed: January 4, 2011

Map Document: D:\Map Documents\ESD_BasinF_Exterior.mxd