Final
Explanation of Significant Differences No. 1 to the Riverbank Army Ammunition Plant (RBAAP) Record of Decision

January 2013

United States Department of the Army
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**LIST OF ACRONYMS AND ABBREVIATIONS**

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<thead>
<tr>
<th>Acronym</th>
<th>Full Form</th>
</tr>
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<tbody>
<tr>
<td>µg/L</td>
<td>Micrograms per Liter</td>
</tr>
<tr>
<td>AES</td>
<td>Ahtna Engineering Services</td>
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<tr>
<td>AGSC</td>
<td>Ahtna Government Services Corporation</td>
</tr>
<tr>
<td>ALCOA</td>
<td>Aluminum Company of America</td>
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<tr>
<td>ARAR</td>
<td>Applicable or Relevant and Appropriate Requirement</td>
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<td>Army</td>
<td>United States Department of the Army</td>
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<tr>
<td>CDHS</td>
<td>California Department of Health Services</td>
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<td>CDPH</td>
<td>California Department of Public Health</td>
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<tr>
<td>Cal/EPA</td>
<td>California Environmental Protection Agency</td>
</tr>
<tr>
<td>CERCLA</td>
<td>Comprehensive Environmental Response, Compensation and Liability Act</td>
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<td>Cr[III]</td>
<td>Trivalent Chromium</td>
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<tr>
<td>Cr[VI]</td>
<td>Hexavalent Chromium</td>
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<td>DHS</td>
<td>Department of Health Services</td>
</tr>
<tr>
<td>DTSC</td>
<td>Department of Toxic Substances Control</td>
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<td>EE/CA</td>
<td>Engineering Evaluation/Cost Analysis</td>
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<td>Evaporation/Percolation</td>
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<td>ESD</td>
<td>Explanation of Significant Differences</td>
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<td>FFA</td>
<td>Federal Facility Agreement</td>
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<td>GWTP</td>
<td>Groundwater Treatment Plant</td>
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<tr>
<td>GWTS</td>
<td>Groundwater Treatment System</td>
</tr>
<tr>
<td>IGWTS</td>
<td>Interim Groundwater Treatment System</td>
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<td>In Situ Pilot Test</td>
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<td>Industrial Waste Treatment Plant</td>
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<td>Harding Lawson Associates</td>
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<tr>
<td>MCL</td>
<td>Maximum Contaminant Level</td>
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<td>National Contingency Plan</td>
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<tr>
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<td>National Priorities List</td>
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<tr>
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<td>Office of Environmental Health Hazard Assessment</td>
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<td>Public Health Goal</td>
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<td>POTW</td>
<td>Publically Owned Treatment Works</td>
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<td>Permanent Potable Water Supply</td>
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<td>RAO</td>
<td>Remedial Action Objective</td>
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<td>Riverbank Army Ammunition Plant</td>
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<td>ROD</td>
<td>Record of Decision</td>
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<tr>
<td>TPH</td>
<td>Total Petroleum Hydrocarbons</td>
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<tr>
<td>USAEC</td>
<td>United States Army Environmental Command</td>
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<td>USEPA</td>
<td>United States Environmental Protection Agency</td>
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1.0 INTRODUCTION AND STATEMENT OF PURPOSE

1.1 SITE NAME AND LOCATION
The Riverbank Army Ammunition Plant (RBAAP) is located near the City of Riverbank at 5300 Claus Road in Stanislaus County, California. The site is about 1 mile south of the Stanislaus-San Joaquin County boundary and approximately 10 miles northeast of the City of Modesto (Figure 1). The main plant consists of 145 acres and four industrial waste treatment evaporation/percolation (E/P) ponds covering an additional 28 acres located approximately 1.5 miles north of the main plant. The RBAAP is situated in a primarily rural area, bordered on the east by pastureland and on the north, west and south by sparse residential areas.

1.2 LEAD AND SUPPORT AGENCIES
Environmental investigations by the U.S. Department of the Army (Army) began at the RBAAP in 1980. The preliminary site characterization was completed in 1986 and identified chromium and cyanide as the contaminants of concern in groundwater on- and off-site of the RBAAP. An interim response action was initiated in 1989 and the RBAAP was placed on the United States Environmental Protection Agency's (USEPA's) National Priorities List (NPL) on February 16, 1990. Since that time, environmental investigations and remedial actions at the RBAAP have been conducted under the federal Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), also known as Superfund. A Federal Facility Agreement (FFA) was signed by the Army as the lead agency, and the USEPA, the Department of Toxic Substances Control (DTSC, part of the California Environmental Protection Agency [Cal/EPA] and formerly the Department of Health Services [DHS]); and the Central Valley Regional Water Quality Control Board (Regional Water Board, also part of the Cal/EPA) as the support agencies. Effective in June 1990, the FFA established schedules for performing remedial investigations and feasibility studies and requires that remedial actions be completed as expeditiously as possible.

1.3 RECORD OF DECISION
A final remedial action plan for the RBAAP was adopted in a Record of Decision (ROD) signed by the USEPA, the DTSC, the Regional Water Board and the Army in March 1994. If the lead agency (Army) determines a significant change to the selected remedy, as described in the ROD, is necessary after the ROD is signed, CERCLA §117(c) and National Contingency Plant (NCP) §300.435(c)(2)(i) require the lead agency to address post-ROD significant changes.

1.4 SUMMARY OF CIRCUMSTANCES REQUIRING AN ESD
In accordance with the ROD, the Army began operating the existing groundwater treatment system (GWTS) in 1996 to treat groundwater contaminated with chromium and cyanide. Groundwater contamination plumes are defined as areas of groundwater that exceed the Maximum Contaminant Level (MCL) identified in the ROD for either chromium (50 μg/L) or cyanide (200 μg/L). Analytical data from groundwater samples collected since initiation of the remedial action show that, overall, the GWTS has been effective at capturing the groundwater contamination plumes and treating groundwater to below the MCLs. However, the results of recent studies indicate the GWTS system has not been effective at reducing chromium concentrations to below the MCL in certain small,
localized areas. To reach the cleanup goal of 50 µg/L for chromium, a modified remedial approach is needed. In situ treatment technologies will be used to treat the remaining areas that exceed the chromium MCL.

1.5 ADMINISTRATIVE RECORD

In accordance with NCP §300.825(a)(2), this Explanation of Significant Differences (ESD) will become part of the Administrative Record file for the RBAAP and will be available to the public at:

Stanislaus County Library, Riverbank Branch
3442 Santa Fe Avenue, Riverbank, California, 95367
(209) 869-7008
http://www.stanislauslibrary.org/

Administrative Record Hours (as of February 2011):
Monday 10 a.m. – 5 p.m.
Tuesday 10 a.m. – 6 p.m.
Wednesday 10 a.m. – 8 p.m.
Thursday 10 a.m. – 6 p.m.
Friday Closed
Saturday 12 p.m. – 5 p.m.

1.6 PUBLIC HEALTH GOAL

Chromium-6 is currently regulated under the 50-micrograms per liter (µg/L) MCL for total chromium. California's MCL for total chromium was established in 1977, when the state adopted what was then a "National Interim Drinking Water Standard" for chromium. The US EPA adopted the same standard, but in 1991 raised the federal MCL to 100 µg/L. California did not follow US EPA's lead and stayed with its 50-µg/L MCL for total chromium.

In 1999, as part of the process of reviewing MCLs in response to public health goals (PHGs), California Department of Public Health's (CDPH) precursor, the California Department of Health Services (CDHS), identified the chromium MCL as one for review. In particular, California sought to determine whether or not an MCL that is specific for chromium-6 would be appropriate. Subsequently, concerns about chromium-6's potential carcinogenicity when ingested resulted in a state law that required CDPH to adopt a chromium-6-specific MCL by January 1, 2004. On July 27, 2011, Office of Environmental Health Hazard Assessment (OEHHA) established its PHG for chromium-6 at a concentration of 0.02 µg/L. The availability of a final PHG enables CDPH to proceed with setting a MCL. To date, California has not adopted a chromium-6-specific MCL.
2.0 SITE HISTORY, CONTAMINATION, AND SELECTED REMEDY

2.1 SITE HISTORY AND CONTAMINATION PROBLEMS

The Aluminum Company of America (ALCOA) originally constructed the RBAAP in 1942 as an aluminum reduction plant supplying the military. The facility was subsequently closed in August 1944. From 1951 to 2010, the RBAAP produced steel cartridge cases with production peaking during the Korean and Vietnam conflicts. The Army’s Installation Restoration Program at RBAAP concluded that chromium, primarily in the hexavalent form, and free cyanide associated with past operations had contaminated groundwater both on and off the facility (Weston, 1991).

Aboveground tanks that were part of the Industrial Waste Treatment Plant (IWTP) were identified as one source of chromium contamination (Figure 2). The tanks were used for IWTP wastewaters generated from the electroplating, cleaning, and metal finishing processes at the facility. These processes involved use of zinc chromate solutions. The original IWTP storage and equalization tanks were made of redwood and are believed to have periodically leaked.

The landfill, a 4.5-acre parcel that was used for surface and trench disposal and debris burning from 1942 to 1966, was identified as another source of contamination (Figure 2). Monitoring wells installed downgradient of the landfill indicated that it was a likely source of cyanide and chromium contamination in groundwater. The cyanide contamination was linked to the disposal of potliners from the aluminum reduction process on the southern portion of the landfill. Chromium contamination in this area of the facility has been traced to construction debris, which included chromium-contaminated bricks.

Implementation of the interim groundwater remedial action (groundwater extraction with treatment) began with initial operations of the Interim Groundwater Treatment System (IGWTS), which was completed in 1990 and brought on-line in October 1991. The IGWTS was used initially to provide capture of contaminated groundwater flowing westward across the facility boundaries. The GWTS was brought online in 1996 and groundwater was treated by both systems.

In accordance with the RBAAP Permanent Potable Water Supply (PPWS) Engineering Evaluation/Cost Analysis (EE/CA), approved in 1991, the existing public water supply system of the City of Riverbank was extended to service the properties adjacent to the RBAAP. This response action was completed in 1992. Thus, residents were provided with a public water supply for domestic use and use of contaminated groundwater was limited to irrigation.

Four E/P ponds, located approximately 1.5 miles north of the facility along the southeastern bank of the Stanislaus River, were used for the disposal of treated effluent generated by the RBAAP (Figure 1). Effluent either evaporated or percolated through underlying sediments to the saturated zone, leaving contaminants in pond sediments. Characterization of the ponds identified zinc and total petroleum hydrocarbons (TPH) as the contaminants of concern. Excavation and off-site disposal of pond sediments was determined to be the appropriate remedial action. This action was completed in 1993 and subsequent monitoring indicated pond sediments no longer exceeded cleanup criteria. Therefore, the ROD stated no further remedial action is necessary at the E/P ponds (USAEC, 1994). Influent to the E/P ponds continues to be monitored monthly for pH, nitrates, chemical oxygen demand, oil and
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grease, total dissolved solids, hardness, standard minerals, total and hexavalent chromium, cyanide, zinc and other USEPA Method 6000/7000 metals.

2.2 SELECTED REMEDY

2.2.1 Groundwater

The remedy for the RBAAP groundwater contamination selected in the 1994 ROD was increased groundwater extraction with treatment by chemical reduction/precipitation until the aquifer meets federal and state MCLs of 50 µg/L for chromium and 200 µg/L for cyanide. The ROD-defined MCLs are also the project Remedial Action Objectives (RAOs).

After completion of the remedial design effort in 1995, the Army modified the groundwater extraction system to include extraction wells west of the RBAAP facility. The system was designed to provide full capture of the portions of the chromium and cyanide plumes that exceeded MCLs. Expansion of the overall Groundwater Treatment Plant (GWTP), consisting of the IGWTS and the GWTS, to handle increased pumping from the expanded extraction system was completed in November 1996. In October 2005, optimization of the GWTS was implemented and the IGWTS was shut down.

A monitoring plan for evaluating hydraulic capture and changes in water quality and water levels was established in conjunction with the design of the GWTS (CH2M Hill, 1997). Subsequently, the monitoring plan was evaluated and modified as detailed in the Groundwater Treatment Assessment Report (HLA, 1998) and the quarterly monitoring reports, particularly in the first quarter of 2000 (CH2M Hill, 2000). In accordance with the PPWS response action, adjacent residential wells, used for irrigation and livestock watering, continue to be monitored.

2.2.2 Landfill

The remedy for the RBAAP landfill selected in the 1994 ROD was a final cover to be maintained to ensure its integrity for a period of 20 years, and the installation of up to two additional groundwater monitoring wells adjacent to the landfill. Requirements for the final cover are outlined in the ROD (USAEC, 1994). The final cover was constructed in 1995. The effectiveness of the remedy is regularly evaluated using groundwater monitoring, surface water monitoring, final cover monitoring, and surface water drainage monitoring.

2.2.3 Evaporation/Percolation Ponds

The remedy for the RBAAP E/P ponds selected in the 1994 ROD was that no further action was needed. Removal of zinc and TPH contaminated sediments, prior to the ROD, eliminated the need for addition remedial action.
3.0 BASIS FOR THE ESD

The Army has prepared this ESD to:

- Present the rationale for modifying the selected remedy identified in the RBAAP ROD for the treatment of chromium contaminated groundwater, and
- Describe the treatment modification.

Chromium and cyanide groundwater contamination at the RBAAP was widespread; however, the groundwater remedial action identified in the ROD (i.e., the existing GWTS) was effective and significantly contained and reduced the area of contamination.

3.1 CHROMIUM

Chromium contamination was reduced from a large continuous plume, located in the A/A'-, B- and C-zones of the aquifer, to localized areas of contamination in the A/A'- and B-zones by 2006 (Figure 3). In 2010, localized areas of chromium contamination remained at the site at concentrations similar to 2006, but located in the A'-, B- and C-zones (Figures 4 through 6). The aquifer zones in the RBAAP area are hydraulically interconnected; therefore, it is possible for contaminants to migrate from the upper zones (i.e., A/A'- and B-zones) to the lower zones (i.e., the C-zone).

A year-long rebound study conducted from September 2007 through August 2008 at the RBAAP confirmed the current GWTS has little impact on reducing chromium concentrations in the localized areas of chromium contamination (AGSC, 2009b). Figures 7 and 8 show that during periods of GWTS operation and shutdown, chromium concentrations remained relatively stable in the A/A'- and B-zones, although during shutdown several wells (MW117A', MW65A' and MW34A') reflected seasonal groundwater elevation fluctuations that were not apparent during GWTS operation.

The stability and localized nature of the remaining chromium contamination in the groundwater at the RBAAP indicate the existing GWTS is effective in containing chromium contamination exceeding 50 µg/L, but is no longer efficiently removing chromium mass from site groundwater. To reach the clean up goal of 50 µg/L for chromium defined in the ROD, a modified remedial approach is needed.

3.2 CYANIDE

Cyanide contamination concentrations have been reduced from a peak of 22,600 µg/L in 1993 to 320 µg/L in the Second Quarter of 2010 (AGSC, 2006; AES, 2010). This plume was also significantly reduced in size by operation of the GWTS (Figure 9). The rebound study (AGSC, 2009b) showed cyanide concentrations are greatly influenced by GWTS operations (Figure 10); therefore, the selected remedial action remains effective for this contaminant.

3.3 ALTERNATIVE CHROMIUM TREATMENT

A pilot test was conducted at the RBAAP to evaluate the effectiveness of using an organic carbon and ferrous iron in situ treatment on chromium contaminated groundwater (AGSC, 2009a). The In Situ Pilot Test (ISPT) focused on EW54B, located in the B-zone of the aquifer, which had consistently exceeded the chromium MCL. The injections into the saturated zone created a reduced environment in
which dissolved hexavalent chromium (Cr\([\text{VI}]\)) was reduced to trivalent chromium (Cr\([\text{III}]\)) and precipitated. Once in the trivalent form, the chromium geochemically fixated onto the aquifer matrix where it remained stable and did not re-dissolve under ambient groundwater conditions or normal shifts in reduction-oxidation (redox) conditions and pH in groundwater. Results indicated there was a sustained treatment for a minimum of six months, with a rapid reduction of dissolved chromium to below the MCL by the precipitation of low solubility trivalent chromium. Secondary byproducts (i.e. iron and manganese) generated by the injections of organic carbon and ferrous iron were shown to attenuate downgradient (Table 1). Soil partitioning indicated sorbed chromium is not a significant contributor to residual groundwater concentrations; therefore, minimal injections were necessary to reach the site cleanup goal in the area of EW54B.

Injection rates, volume-delivery radius relationships, groundwater flow conditions, and the effects of anisotropy and aquifer heterogeneities on reagent distribution were evaluated during the ISPT. The ISPT found these parameters were not obstacles to full-scale site application of this treatment method (AGSC, 2009a). The results of the ISPT will be used for a full-scale organic carbon and ferrous iron in situ treatment design. However, other regulatory agency-approved in situ treatment technologies may be used to treat chromium contamination.

The findings of the ISPT and Rebound Study are reported in the “Geochemical Fixation In Situ Pilot Test Draft Final Report” and “Rebound Study Report Draft Final” (AGSC, 2009a and b) which are available for public review in the Administrative Record.
4.0 DESCRIPTION OF SIGNIFICANT DIFFERENCES

The ROD defines the groundwater contamination remedy as increased extraction with treatment using chemical reduction/precipitation for chromium and cyanide and additional treatment for cyanide using ion exchange. Secondary treatment by flocculation and clarification was to be conducted at the IWPT. Treated effluent is to be discharged to the E/P ponds. Long term monitoring is to be conducted to monitor the effectiveness of the extraction and treatment system in fully capturing the plumes and meeting defined discharge limits of less than 50 µg/L for chromium and 22 µg/L for cyanide for the E/P ponds.

4.1 SIGNIFICANT DIFFERENCES

The ROD remedy worked effectively for over a decade, but the current inefficiency of the GWTS at further reducing groundwater chromium concentrations requires a change in the treatment approach to meet site cleanup goals. Therefore, the use of in situ treatment technologies is proposed to reduce dissolved chromium to below the MCL (50 µg/L) in the localized areas of contamination in the A', B- and C-zones. This approach does not involve groundwater extraction or the discharge of treated water, but instead involves the injection of regulatory agency-approved amendments directly into the saturated zone. The previous application of in situ treatment technology at the RBAAP shows in situ treatment effectively reduces chromium concentrations to below the MCL (AGSC, 2009a), and can be applied to localized areas.

In situ treatment would be applied in the A', B-, and C-zones of the aquifer. In situ treatment in the A- zone is not planned as the A-zone is dry for the majority of the year and in situ treatment cannot be applied in such a case. However, if the A-zone recharges in situ treatment may be applied to this aquifer zone. In situ treatment in the D-zone is unnecessary as chromium has not been detected in the D-zone since at least 1999 (AES, 2010).

The ROD selected remedial action will continue to be used to treat groundwater contaminated with cyanide at concentrations above the MCL and will continue to be used to contain chromium plumes until the in situ treatment design is implemented, after which operation of individual extraction wells within chromium plume areas will be evaluated within the context of the in situ treatment. Treated water will continue to be discharged to the E/P ponds, infiltration galleries, or publically owned treatment works (POTW). All other ROD requirements will be met, including continued maintenance of existing extraction wells and groundwater monitoring.

4.2 CHANGES IN EXPECTED OUTCOMES

As specified in the ROD, the time to achieve RAOs for chromium and cyanide using the GWTS was estimated to be ten years from the time of remedy implementation (USAEC, 1994); however, the expanded GWTS has now been in operation for 14 years. Furthermore, current projections for achieving the RAOs using the GWTS are approximately 10 additional years. The average annual GWTS O&M cost is approximately $797,000, which includes an annual cost of $150,000 for monitoring and reporting. Therefore, projected costs for operating the GWTS for ten additional years to achieve chromium and cyanide RAOs is $7.97 million. Long term monitoring would then be conducted to monitor the effectiveness of the treatment, costing an estimated $750,000. Therefore,
continued reliance on the GWTS as the sole treatment for chromium and cyanide contamination is estimated to cost $8.72 million.

With the use of in situ treatment, the chromium RAO is expected to be achieved within approximately two years of treatment application. The initial in situ application is estimated to cost approximately $575,000 and will include installation of injection wells, treatment injections, and monitoring. It is estimated that two rounds of follow-on spot treatment injections and monitoring will be needed, at a cost of approximately $95,000 each. The in situ treatment of chromium will allow for the GWTS to be optimized for treatment of cyanide contaminated groundwater. Routine GWTS operations costs would still apply for cyanide-only treatment for an estimated two years, at a total cost of approximately $1.6 million. Post injection verification and long term monitoring will then be performed to monitor the effectiveness of the treatment, costing an estimated additional $1.2 million. In sum, the use of the GWTS for cyanide treatment combined with the use of in situ treatment for chromium contamination is estimated to cost a total of $3.56 million.

The incorporation of in situ treatment at the RBAAP is estimated to provide a cost savings of roughly $5.2 million. This savings will be primarily realized through the reduction of GWTS O&M costs by not having to treat for chromium for approximately eight years. All estimates costs and savings are summarized below.

<table>
<thead>
<tr>
<th>Cost Description</th>
<th>GWTS Treatment of Chromium and Cyanide Contamination</th>
<th>In Situ Treatment of Chromium Contamination and GWTS Treatment of Cyanide Contamination</th>
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<tr>
<td>Annual GWTS O&amp;M Cost (including $150,000 for monitoring and reporting)</td>
<td>$797,000</td>
<td>$797,000</td>
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<tr>
<td>Projected Number of Years of GWTS Operation until RAOs are achieved</td>
<td>10</td>
<td>2</td>
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<tr>
<td><strong>Total GWTS Cost:</strong></td>
<td>$7,970,000</td>
<td>$1,594,000</td>
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<tr>
<td>Initial In Situ Application Cost (including injection well installation, injections, and monitoring)</td>
<td>Not Applicable</td>
<td>$575,000</td>
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<tr>
<td>Additional In Situ Injections &amp; Monitoring (two at $95,000 each)</td>
<td>Not Applicable</td>
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<td><strong>Total In Situ Cost:</strong></td>
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<tr>
<td>Post Injection Verification Monitoring</td>
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<td>Projected Years of Monitoring</td>
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<td>Monitoring Subtotal:</td>
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<td>Projected Years of Monitoring</td>
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<td>Monitoring Subtotal:</td>
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<td><strong>Total Post Treatment Monitoring Cost:</strong></td>
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<td><strong>Total Remedial Cost:</strong></td>
<td>$8,720,000</td>
<td>$3,559,000</td>
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1 Based on the results of the ISPT (AGSC, 2009a).
5.0 SUPPORT AGENCY COMMENTS

Comments on the Draft ESD were received from the support agencies. No comments on the Draft Final ESD were received from the support agencies; however, additional comments were provided on the review version of the Final ESD. Comments, “no comment” letters, and responses are provided in Appendix A.

6.0 STATUATORY DETERMINATIONS

With this ESD, the remedy continues to satisfy the requirements of CERCLA §121. The Army, the USEPA, the DTSC and the Regional Water Board believe the remedy remains protective of human health and the environment and complies with Federal and State Applicable or Relevant and Appropriate Requirements (ARARs).

7.0 PUBLIC PARTICIPATION COMPLIANCE

Public participation requirements set out in the NCP §300.435(c)(2)(i) will be met with the placement of this ESD in the Administrative Record and with the publication of a notification to the public concerning this ESD in a local newspaper after signature. The RBAAP ROD and this ESD are available to the public at:

Stanislaus County Library, Riverbank Branch
3442 Santa Fe Avenue, Riverbank, California, 95367
(209) 869-7008
http://www.stanislauslibrary.org/
8.0 REFERENCES


EXPLANATION OF SIGNIFICANT DIFFERENCES No. 1
RIVERBANK ARMY AMMUNITION PLANT
RIVERBANK, CALIFORNIA

United States Department of the Army

[Signatures and dates]

Thomas E. Lederle
Chief Base Realignment and Closure (BRAC) Division
Assistant Chief of Staff Installation Management

Robert Smith
Commander's Representative
Riverbank Army Ammunition Plant

[Signatures and dates]
The State of California, Department of Toxic Substances Control (DTSC) had an opportunity to review and comment on the ESD and its concerns were addressed.

Noel D. Shrum
Unit Chief
Cleanup Program, Sacramento Office
California Environmental Protection Agency
Department of Toxic Substances Control
EXPLANATION OF SIGNIFICANT DIFFERENCES No. 1
RIVERBANK ARMY AMMUNITION PLANT
RIVERBANK, CALIFORNIA

California Environmental Protection Agency
Regional Water Board, Central Valley Region

The State of California, Central Valley Regional Water Board had an opportunity to review and comment on the ESD and its concerns were addressed.

Pamela C. Creedon
Executive Officer
California Environmental Protection Agency
Regional Water Board, Central Valley Region

Date
TABLE
### Table 1. ISPT Secondary Byproduct Attenuation

<table>
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<tr>
<th>Well ID</th>
<th>Sample Date</th>
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<th>Dissolved Iron (µg/L)</th>
<th>Dissolved Manganese (µg/L)</th>
<th>Sample Date</th>
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<th>Sample Date</th>
<th>Total Iron (µg/L)</th>
<th>Dissolved Iron (µg/L)</th>
<th>Dissolved Manganese (µg/L)</th>
</tr>
</thead>
<tbody>
<tr>
<td>PT-01</td>
<td>05/29/08</td>
<td>15,000</td>
<td>14,000</td>
<td>930</td>
<td>08/18/09</td>
<td>6,300</td>
<td>320</td>
<td>160</td>
<td>05/18/10</td>
<td>1,400</td>
<td>ND</td>
<td>110</td>
</tr>
<tr>
<td>PT-02</td>
<td>05/29/08</td>
<td>710</td>
<td>59</td>
<td>100</td>
<td>08/18/09</td>
<td>ND</td>
<td>ND</td>
<td>ND</td>
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<td>830</td>
<td>ND</td>
<td>58</td>
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<tr>
<td>PT-03</td>
<td>05/29/08</td>
<td>21,000</td>
<td>21,000</td>
<td>430</td>
<td>08/18/09</td>
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<td>ND</td>
<td>05/18/10</td>
<td>340</td>
<td>ND</td>
<td>ND</td>
</tr>
</tbody>
</table>

**Note:** ND = Non Detected
Evaporation Percolation (E/P) Ponds

Riverbank, California

Source: USGS 7.5-minute Riverbank, CA Quadrangle

Explanation of Significant Differences
Riverbank Army Ammunition Plant
Riverbank, California

Ahtna Engineering

LOCATION MAP 1
Chromium isoconcentration Contours
1993 and Fourth Quarter 2006

Chromium concentrations in this area have historically fluctuated around the MCL.

Notes:
Explanation of Significant Differences
Riverbank Army Ammunition Plant, Riverbank, California

Chromium Isoconcentration Contours
Fourth Quarter 2006 and Second Quarter 2010
A/A' Zone

Notes:
Explanation of Significant Differences
Riverbank Army Ammunition Plant, Riverbank, California

Chromium Isoconcentration Contours
Fourth Quarter 2006 and Second Quarter 2010
B-Zone

FIGURE 5

Active Extraction Well
Monitoring Well

MWRA
Well ID
Fourth Quarter 2006 Chromium Concentration (green; µg/L)
Second Quarter 2010 Chromium Concentration (purple; µg/L)

ND
Non Detect
NS
Not Sampled

Fourth Quarter 2006 Chromium Isoconcentration Contour (50 µg/L)
Second Quarter 2010 ChromiumIsoconcentration Contour (50 µg/L)
2010 Chromium Isoconcentration Contour (50 µg/L); Not sampled, but above MCL in 2009
Fourth Quarter 2010 B-Zone Groundwater Flow Direction

Notes:

Explaination of Significant Differences
Riverbank Army Ammunition Plant,
Riverbank, California

Chromium Isoconcentration Contours
Fourth Quarter 2006 and Second Quarter 2010
C-Zone

Notes:
Figure 7
Rebound Study Chromium Groundwater Concentration Trends, A/A'-Zone.
Explanation of Significant Differences
Riverbank Army Ammunition Plant
Riverbank, California


Figure 8
Rebound Study Chromium Groundwater Concentration Trends, B-Zone. Explanation of Significant Differences - Riverbank Army Ammunition Plant Riverbank, California
Explanation of Significant Differences
Riverbank Army Ammunition Plant, Riverbank, California

Cyanide Isoconcentration Contours
Fourth Quarter 2004 and Second Quarter 2010
A/A'-Zone

Notes:
Figure 10

Rebound Study Cyanide Groundwater Concentration Trends
Explanation of Significant Differences
Riverbank Army Ammunition Plant
Riverbank, California
APPENDIX A

Response to Support Agency Comments
Response to Comments
U.S. Environmental Protection Agency, Region 9
January 2009

GENERAL COMMENTS

1. Through this ESD, the Army is proposing to add an underground injection element to the existing Groundwater Treatment System. In so doing, the Army should identify all of the applicable and/or relevant and appropriate laws and regulations with which it will comply in implementing this activity, or those which it will consider in doing so. For example, Army should evaluate 40 CFR Parts 144, 146, and 147 as potential ARARs. Specifically, 40 CFR 144.12 (excluding 144.12(b) and 144.12(c)(1)), 144.82-83, 144.89, 146.5, 146.10, and 147.251. Finally, Army should solicit potential ARARs from the State of California for this activity. It is EPA’s understanding that California’s Porter Cologne Act requires application of waste discharge requirements for injection into groundwater basins, just as it requires NPDES for discharges into surface waters. The Los Angeles Regional Water Quality Control Board has issued an order in furtherance of this goal, Order R4-2007-0019. Perhaps the Central Valley Regional Board has too.

Response – The Army reviewed potential ARARs, including 40 CFR Parts 144, 146 and 147 as suggested, and determined they are not applicable as the injection wells to be used at RBAAP do not fall under the defined well specifications in the regulations. Therefore, no additional federal ARARs, other than those identified in the ROD, are applicable to the proposed change in the remedy. The Army also solicited potential ARARs from the State of California with the distribution of the Draft ESD. The State of California did not comment with regard to ARARS and the Army determined there are no additional applicable state or local ARARs.

2. The original Record of Decision (ROD) as well as previous monitoring reports describe multiple aquifer zones (Aquifer A, A’, B and C) that are impacted by contamination; however the Draft Explanation of Significant Differences (ESD) lacks this differentiation. Therefore it is unclear which aquifer zones are subject to this ESD. Please provide additional information discussing the groundwater zones that will be affected by this ESD.

Response – A paragraph was added to Section 4.0 to provide additional information regarding the aquifer zones that will be affected by this ESD.

3. The wells used to define the contaminant plumes were not identified on Figures 3, 4 and 6; it would be helpful to include the wells and concentrations used to identify the plume boundaries. Please consider revising these figures to include the wells, and concentrations used to delineate the plume boundaries. For completeness, it would also be helpful to include groundwater flow directions and the current groundwater extraction network on these figures.

Response – The purpose of Figure 3 is to demonstrate the general change in chromium plume size and configuration between 1993 and 2006. Adding wells and concentrations would not enhance this and would make the figure unnecessarily complex. Additionally, the 1993
chromium contour on Figure 3 was copied from Figure 5 of the “First Five-Year Review Report for Riverbank Army Ammunition Plant, City of Riverbank, Stanislaus County, California” (Five-Year Review; Army, 2001). The wells and concentrations used to construct the 1993 plume contour were not identified in the Five-Year Review and therefore cannot be identified on Figure 3. Figure 4 was revised into three separate figures (Figures 4, 5, and 6), one for each aquifer zone, and the wells, including extraction wells, chromium concentrations and groundwater flow directions were added to each figure as suggested. Figure 6 (now Figure 9) was also revised to include wells, cyanide concentrations and groundwater flow directions.

SPECIFIC COMMENTS

1. Figure 4, 2006 and 2008 Chromium Concentration Contours: In the northern portion of the figure there is a 50 microgram/Liter (μg/L) closed contour that appears to be unreported prior to 2008. It is unclear if this concentration represents a previously unknown source or if the concentration is due to regional groundwater flow or localized pumping that may have cause contaminant migration. Please provide greater detail in the text describing the contaminant distribution over time.

Response – The localized chromium plume adjacent to the landfill (MW65A') in Figure 4 is thought to be the result of a continued chromium source within the landfill. Chromium concentrations in MW65A' have fluctuated around the MCL since monitoring began in 1999. Therefore, Figures 3 and 4 have been revised to show the continuous presence of the plume, in lieu of revising the text.

End of comments.
Response to Comments
California Regional Water Quality Control Board, Central Valley Region
March 12, 2009

GENERAL COMMENTS

1. While the ESD generally follows the EPA guidance for preparing ESDs, there are several components the document does not address. Please revise the Draft ESD to include:
   a. Description of how the proposed changes in the ESD will impact performance and cost of the remedy, including the change in remediation timeframe.
   b. Statement that the ROD remains protective and continues to meet Applicable or Relevant and Appropriate Requirements (ARARs).
   c. Statement/documentation that the public participation requirements set out in the National Contingency Plant (NCP) §300.435(c)(2)(i) have been met or will be met with the placement of the ESD in the Administrative Record/Information Repository and the publishing of the public notice.
   d. Reference to any information in the Administrative Record File that supports the need for change, including any documents the public should review to understand the need for the proposed changes (e.g., pilot study results report). Additionally, the final ESD should include a summary of support agency comments on the ESD.

Response – The following changes have been made to the ESD:
   a. Information was added to Section 4.0 to describe how the proposed changes in the ESD will impact remedy performance, cost and timeframe.
   b. The following statement was added to Section 5.0 (now Section 6.0), “The Army, the USEPA, the DTSC and the Regional Board believe the remedy remains protective of human health and the environment and complies with Federal and State Applicable or Relevant and Appropriate Requirements (ARARs).”
   c. The following statement was added to Section 6.0 (now Section 7.0), “Public participation requirements set out in the NCP §300.435(c)(2)(i) will be met with the placement of this ESD in the Administrative Record and with the publication of a notification to the public concerning this ESD in a local newspaper after signature.”
   d. The following statement was added to the last paragraph of Section 3.3, “The findings of the ISPT and Rebound Study are reported in the “Geochemical Fixation In Situ Pilot Test Draft Final Report” and “Rebound Study Report Draft Final” (AGSC, 2009a and b) which are available for public review in the Administrative Record.” Responses to support agency comments have been added to the ESD as Appendix A.

2. The Draft ESD indicates groundwater extraction and treatment is no longer effective and implies that groundwater extraction/treatment will not be conducted in the future to remove/contain hexavalent chromium contamination. Regional Water Board staff agrees that groundwater extraction/treatment has not been effective in recent years, but disagree that it is no longer useful in containing the hexavalent chromium plume. Regional Water Board staff will consider any reasonable reductions in groundwater extraction as part of annual assessment/optimization of the groundwater remedy, but we do not concur with permanent
shutdown of all extraction wells that were previously used to contain/remove the hexavalent chromium plume. Revise the Draft ESD to state that groundwater extraction/treatment will continue until aquifer cleanup levels are achieved.

Response – Section 4.1 was revised to state the remedial action for groundwater selected in the ROD will continue to be used to contain chromium plumes until the in situ treatment design is implemented, after which operation of individual extraction wells within chromium plume areas will be evaluated within the context of the in situ treatment.

3. The State maximum contaminant level (MCL) for cyanide was lowered from 200 to 150 μg/L in 2003. The Draft ESD should be revised to discuss this change in the standard used to determine the ROD-specified cleanup level and propose reducing the cleanup level to 150 μg/L.

Regional Water Board staff is aware that this change in ARARs was briefly discussed in the Final Second Five-Year Review Report (AHTNA, November 2006). However, this report concludes that the new MCL for cyanide is based on the same toxicity data and risk evaluations as the Federal MCL for 200 μg/L, but “the federal MCL is merely rounded up from 150 to 200 μg/L.” This report does not provide sufficient rationale to support the conclusion that 200 μg/L is still protective of human health and the environment. RBAAP needs to provide this rationale in response to this comment letter or revise the cyanide cleanup level to 150 μg/L in the Final ESD.

Response – The purpose of this ESD is to address a change in remedial approach for hexavalent chromium. The ROD established the remedial goal for cyanide at 200 μg/L. This will be evaluated in the next five-year review to be issued in 2011 within the context of new ARARs, including revised MCLs. It is anticipated the GWTS will still be operational in 2011; therefore, should the remedial goal for cyanide be revised in an appropriate decision document, groundwater extraction and treatment may continue until this goal is met.

4. Figures 3 through 7 are based on data discussed in more detail in other reports. Please add a footnote to each figure that references the source(s) of the data displayed on these figures.

Response – References were added to Figures 3 through 7.

5. The Draft ESD discusses capture and/or removal of the chromium plume in several sections, but is somewhat misleading in what constitutes the “chromium plume”. As Regional Water Board staff has discussed in recent meetings and correspondence with RBAAP, we are concerned that RBAAP may be overlooking areas of groundwater contamination that are below the current cleanup level, but may be identified as a concern if/when the State of California adopts a public health goal (PHG) and MCL and/or the USEPA adopts a MCL for hexavalent chromium. Therefore, we believe it is prudent to be very clear on what currently constitutes the “chromium plume” and is subject to the requirements of the 1994 ROD. For clarity, revise the Draft ESD to clearly state only those portions of the plume that exceed the ROD-specified cleanup level of 50 μg/L are/were being contained/removed by the
groundwater extraction system and will be targeted by the proposed in situ treatment technologies.

Response – Section 1.4 was revised to clarify what constitutes a “plume” and that in situ technology will be applied to remaining chromium plumes.

6. Regional Water Board staff recommends broadening the scope of in situ treatment to include more than injection of organic carbon and ferrous sulfate. Region Water Board staff would like to avoid preparation of an additional future ESD if other in situ treatment technologies prove to be more successful or are shown to have fewer potential adverse water quality impacts than injection of organic carbon and ferrous sulfate. We understand that RBAAP would also like to keep their remedial options open to new technologies, but that description of in situ treatment in the Draft ESD only refers to the recent geochemical fixation pilot test. RBAAP should consider revising the Draft ESD to clearly allow future use of other in situ treatment technologies approved by the regulatory team.

Response – Sections 3.3 and 4.1 were revised to allow future use of other in situ treatment technologies as approved by the regulatory team.

7. Please consider adding a List of Acronyms (perhaps in an Appendix or Attachment) to make it easier for the public to review this document.

Response – A List of Acronyms and Abbreviations was added after the Table of Contents.

8. Replace all references to “RWQCB” or “CVRWQCB” with ‘Regional Water Board’ as these abbreviations are no longer being used. Please also run a spell check on the document.

Response – All references to “RWQCB” or “CVRWQCB” were replaced as requested. A spell check was completed.

SPECIFIC COMMENTS

1. Page 3, Selected Remedy, Groundwater: Per General Comment [5] above, revise the second sentence of the second paragraph to “The system was designed to provide full capture of the portions of the chromium and cyanide plumes that exceed MCLs” or something similar.

Response – Revision completed.

2. Page 4, Basis for the Explanation of Significant Differences, Chromium: In the third paragraph, revise “…the existing GWTS has effectively captured the groundwater contamination plume, but the contamination concentrations are not being effectively reduced” to “…the existing GWTS is effective in containing chromium contamination exceeding 50 µg/L, but is no longer efficiently removing chromium mass from site groundwater”.

Response – Revision completed.
3. Page 5, Description of Significant Differences: In the third sentence of the second paragraph, add a space between "approved" and "amendments".

*Response – A space was added.*

End of comments.
10 February 2011

Mr. Robert Smith
Commanders Representative
Riverbank Army Ammunition Plant
P.O. Box 670
Riverbank, CA 95637.

Dear Mr. Smith:

The U.S. Environmental Protection Agency (EPA) has reviewed the Draft Final Explanation of Significant Differences No.1 to the Riverbank Army Ammunition Plant (RBAAP) Record of Decision (DF-ESD). The Army’s responses to EPA’s comments have been addressed in the DF-ESD. We have no additional comments to the DF-ESD.

EPA recommends the DF-ESD be finalized, signed by the Army and submitted to the regulatory agencies for signature. If you have any questions, please give me a call at (415) 972-3032.

Sincerely,

Lewis Mitani
Remedial Project Manager

CC: Distribution List
California Regional Water Quality Control Board
Central Valley Region
Katherine Hart, Chair

7 February 2011

Mr. Robert Smith
BRAC Riverbank Army Ammunition Plant
PO Box 670
Riverbank, CA 95637

DRAFT FINAL EXPLANATION OF SIGNIFICANT DIFFERENCES NO. 1,
RIVERBANK ARMY AMMUNITION PLANT (RBAAP), STANISLAUS COUNTY

California Regional Water Quality Control Board, Central Valley Region (Central Valley Water Board) staff has reviewed the Draft Final Explanation of Significant Differences No. 1 (Draft Final ESD) for the Riverbank Army Ammunition Plant. The Draft Final ESD addresses Central Valley Water Board staff comments dated 12 March 2009 on the Draft ESD. We have no additional comments on the Draft Final ESD.

If you have any questions, please contact me at (916) 464-4733 or email me at mpierce@waterboards.ca.gov.

Marcus Pierce
Associate Engineering Geologist
Federal Facilities Unit

cc: Mr. Lewis Mitani, United States Environmental Protection Agency, San Francisco
Mr. Jim Pinasco, Department of Toxic Substances Control, Sacramento
Ms. Debbie Olson, City of Riverbank Local Redevelopment Agency
Mr. Chuck Holman, Ahtna Engineering Services, Marina, CA
SIGNATURE PAGE

EXPLANATION OF SIGNIFICANT DIFFERENCES No. 1
RIVERBANK ARMY AMMUNITION PLANT
RIVERBANK, CALIFORNIA

United States Environmental Protection Agency

[Signature]
Michael M. Montgomery
Assistant Director
Federal Facilities and Site Cleanup Branch
U.S. Environmental Protection Agency
Region 9

6/18/13
Date