ATTACHMENT E

(3 OF 5)

ATTACHMENT E

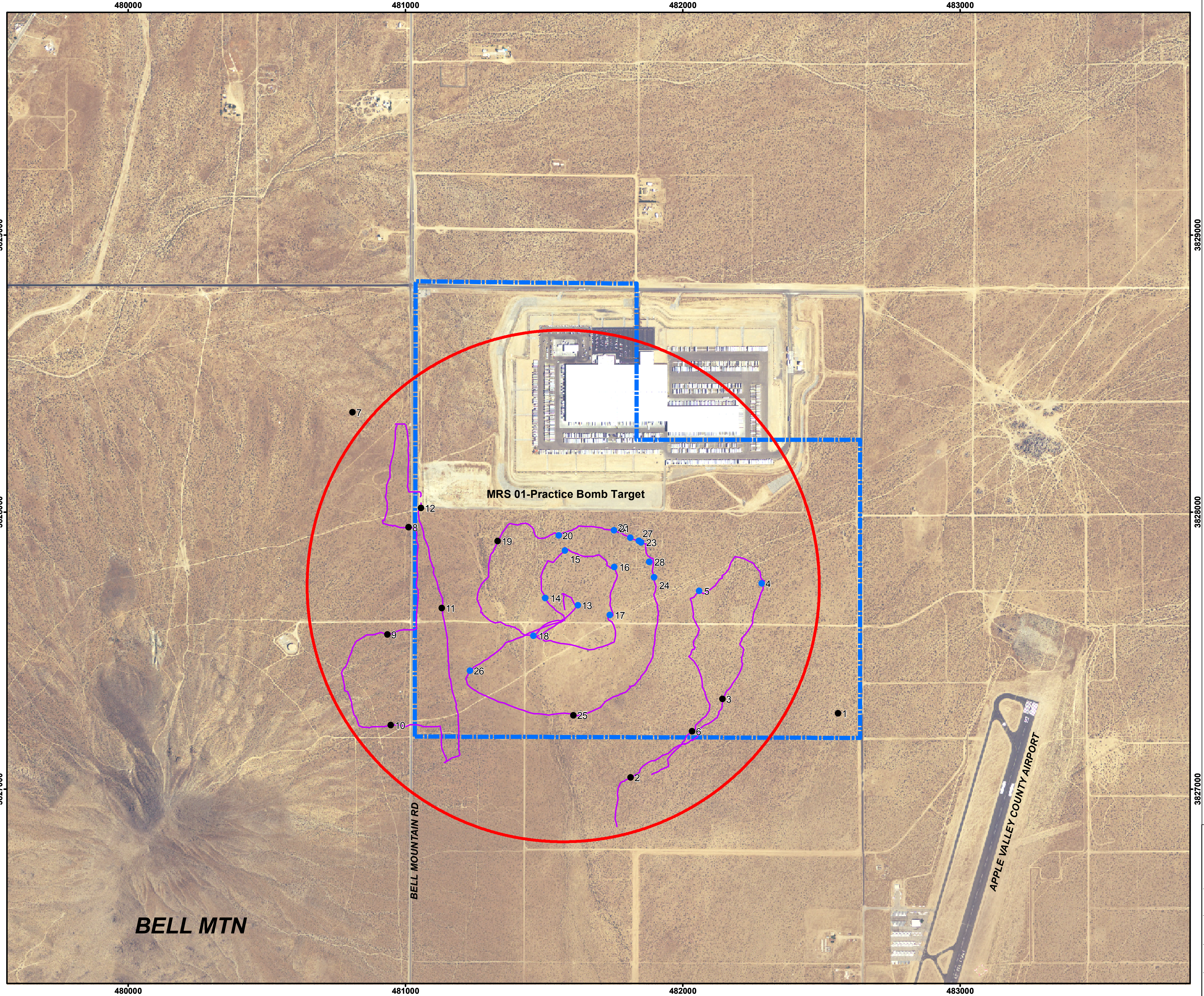
(3 OF 5)

Figure 4.1

Qualitative Reconnaissance and Field Observation Locations
Victorville PBR No.1

FUDS Project No. J09CA067501

San Bernardino County, California



Legend

- 4 ● Munitions Debris Observation Location
- 3 ● Other Field Observation Location
- Range Boundary
- Project Boundary
- Qualitative Reconnaissance Track

Site Location in California

Image: Orthophoto, 2005
Projection: UTM Zone 11 NAD83, Map Units in Meters

Feet: 1,000 500 0 1,000

N

PARSONS	U.S. ARMY SOUTH PACIFIC DIVISION RANGE SUPPORT CENTER

DESIGNED BY: BT	Qualitative Reconnaissance and Field Observation Locations		
DRAWN BY: BT			
CHECKED BY: BB	SCALE: As Shown	PROJECT NUMBER: 744653.74000	
SUBMITTED BY: DS	DATE: March 2008	PAGE NUMBER: 4-10	
	FILE: X:\GIS\Site_inspections_sw\Maps\victorville_ca\Fig4_1_pbr1.mxd		

CHAPTER 5

MIGRATION/EXPOSURE PATHWAYS AND RECEPTORS

5.1 INTRODUCTION

5.1.1 This chapter of the SI Report evaluates the potential presence or absence of migration/exposure pathways and receptors, based on site-specific conditions. It is necessary to evaluate site-specific conditions and land use to evaluate risks posed to potential receptors under current and future land use scenarios. Exposure pathways for groundwater, surface water and sediment, soil, and air are evaluated. The CSEM for the Victorville PBR No. 1 site (Appendix J) summarizes which potential receptor exposure pathways are (or may be) complete and which are (and are likely to remain) incomplete. An exposure pathway is not considered to be complete unless all four of the following elements are present (USEPA, 1989). An example regarding a hypothetical groundwater exposure pathway is included.

- *A source of contamination*: e.g., a site has known MEC from which MC have leached and contaminated surface soil.
- *An environmental transport and/or exposure medium*: e.g., the MC in soil is mobile and can contaminate groundwater.
- *A point of exposure at which the contaminant can interact with a receptor*: e.g., a drinking water well drawing from the contaminated aquifer is located at the site.
- *A receptor and a likely route of exposure at the exposure point*: e.g., an on-site resident uses groundwater as a source of water.

5.1.2 In the hypothetical example above, all four conditions are present and, therefore, the groundwater exposure pathway is complete. If any single factor was absent (e.g., MC contamination was not present in soil, or the resident obtained drinking water from another source), the pathway would be incomplete.

5.2 GENERAL INFORMATION

General information regarding the geology, hydrogeology, and hydrology of the Victorville PBR No. 1 site presented below was obtained from the ASR (CEMVR, 1996), except where noted. Regional information is followed by a discussion of MRS-specific characteristics and sampling results for the MRS investigated as part of the SI.

5.2.1 Regional Geologic Setting

5.2.1.1 Victorville PBR No. 1 is located within Segment 1 of the Basin and Range physiographic province where rocks and deposits exposed at the surface range in age from Precambrian to Quaternary. They consist of pyroclastic and extrusive volcanic rocks, igneous intrusive rocks, and marine and continental sediments. Many of these have been intensely metamorphosed, folded, and faulted (USGS, 2006a).

5.2.1.2 During Precambrian time and the Paleozoic Era, a nearly uniform thickness of roughly 40,000 feet of marine sediments was deposited in the Cordilleran geosyncline; an elongated trough that extended south to north in western North America and included the area that is now eastern Nevada and southern California. Marked by two sedimentation periods of alternating clastic and carbonate deposition, the results were the following sequence: quartzite and siltstone, limestone and dolomite, argillite and quartzite, and limestone (USGS, 2006a).

5.2.1.3 Volcanoes were active on a large scale in eastern California and western Nevada at the end of the Paleozoic Era, marking the beginning of the igneous activity that became increasingly important during the Mesozoic time (USGS, 2006a).

5.2.1.4 The first great orogeny in the western part of North America since Precambrian time took place at the close of middle Mesozoic time. With the rising mountain ranges, the marine, continental, and volcanic deposits of the Pacific Coast were folded, metamorphosed, and completely faulted. Late in the Mesozoic Era, the region of the Pacific Coast was downwarped and the sea intruded (USGS, 2006a).

5.2.1.5 Volcanic rocks and sedimentary deposits accumulated over a wide area of the region during the Cenozoic Era. The Basin and Range area was a high mountain surface with external drainage early in the Cenozoic Era. During middle to late Cenozoic time though, large-scale block faulting formed the Coast Range Mountains, the California Trough, and the Sierra Nevada and caused the Basin and Range Structures (USGS, 2006a).

5.2.1.6 The California Trough and the structural basins in the Coast Range were filled with marine and terrestrial deposits in late Cenozoic that ranged from a few thousand to 50,000 feet in thickness. The grabens of the Basin and Range were filled with continental deposits and minor lava flows to thicknesses ranging from less than 2,000 feet to 50,000 feet (USGS, 2006a).

5.2.1.7 The Victorville PBRs are located within the eastern Mojave Desert Section of the Basin and Range physiographic province. The Mojave Desert is outlined by the San Andreas Fault on the south and the Garlock Fault on the north. The right lateral slip on the San Andreas and the left-lateral slip on the Garlock indicate the Mojave block is moving relatively east.

5.2.1.8 The eastern portion of the Mojave Desert is characterized by basins and open valleys between mountainous masses. In the southern part, the mountains and valleys have a northwest alignment. In the northern half, this alignment is non-existent (CEMVS, 1995).

5.2.1.9 There are many faults in the area. Most of which are aligned in a northwest-southeast direction. Evidence suggests that there existed in the Mojave Desert during one or more of the pluvial Pleistocene ages a number of lakes now represented by playas or salines. Two or three such systems existed (CEMVS, 1995).

5.2.1.10 Various deformational structures, including faults, anticlinal folds, and monoclinal flexures, are present in the Mojave River Basin. These particular structures are manifested by truncated or tilted topographic and stratigraphic surfaces that can be observed in the field, as well as by scarps and other linear features visible on aerial photographs. The Helendale Fault is the westernmost in a series of long, northwest-striking Quaternary-age faults that traverse the southern Mojave Desert. The northwest-flowing Mojave River intersects the Helendale Fault at nearly right angles. The Helendale Fault includes an irregular zone of discontinuous, overlapping fault strands with varying west-northwest to north-northwest trends (USGS, 2003).

5.2.2 Regional Hydrogeologic Setting

5.2.2.1 Groundwater in Segment 1 is contained in five major aquifers, four of which consist mostly of basin-fill deposits that occupy structural depressions caused by deformation of the Earth's crust. The Basin and Range aquifers are located in an area that comprises the southern California desert and most of Nevada. Consisting primarily of unconsolidated alluvial-fan deposits, the water-yielding materials in this area are in valleys and basins. Flood plain and lacustrine (lake) beach deposits might also yield water to wells in the region. Carbonate and consolidated volcanic rocks that underlie the unconsolidated alluvium are a source of water if the rocks are sufficiently fractured or have solution openings (USGS, 2006a).

5.2.2.2 Groundwater is generally under unconfined, or water-table, conditions at the margins of the basins, but as the unconsolidated deposits become finer grained (towards the center of the basins), the water becomes confined (USGS, 2006a).

5.2.2.3 Basins may be hydraulically connected by fractures or solution openings in the underlying bedrock. Such multiple-basin systems end in a terminal discharge area (sink) from which water leaves the flow system by evaporation. Additionally, several valleys or basins may develop surface-water drainage that hydraulically connects the basins, and groundwater will flow between the basins, primarily through unconsolidated alluvial stream/flood plain sediments (USGS, 2006a).

5.2.2.4 The site footprint is included in the Mojave River groundwater basin which extends from the San Bernardino and the San Gabriel Mountains in the south, to north of Harper and Coyote Lakes (dry) and is approximately 1,400 square miles (miles^2). The basin is bordered on the west by Antelope Valley, the Lucerne Valley to the southeast, Afton Canyon to the northeast (it shares its southeastern boundary with the Morongo groundwater basin). For the purpose of managing the water resources, the basin has been divided into five subareas: Alto (including the Transition zone), Baja, Centro, Este, and Oeste (USGS, 2002 and 2004a).

5.2.2.5 Within the Mojave River groundwater basin, there are two aquifers formed of unconsolidated alluvial sands and gravels of the Pliocene and Quaternary age. The floodplain aquifer is formed of recent and younger alluvium of the Mojave River deposits, and the regional aquifer that underlies and surrounds the floodplain aquifer is composed of younger fan deposits, older alluvium of the ancestral Mojave River, older fan and stream deposits, and playa deposits.

5.2.2.6 The floodplain aquifer, as much as 200 to 300 feet thick (data differ from 200, 250, to 300 feet thick), is more productive than the regional aquifer which yields most of the water pumped from the basin. Most, if not all, of the recharge from surface water flows are received in these deposits (USGS, 2003).

5.2.2.7 Near Helendale, the floodplain aquifer is primarily recharged by the infiltration of winter stormflows from the Mojave River (USGS, 2003). Recharge is also accomplished with sporadic releases of imported water from the California State Water Project (SWP) at the Rock Springs, Hodge, and Lenwood recharge sites (USGS, 2004a). Mojave Water Agency (MWA), one of 29 State Water Contractors in California allowed to take water deliveries from the California Aqueduct to recharge underground aquifers is using the imported water for artificial recharge by surface spreading (USGS, 2001 and MWA, 2007). MWA is actually entitled to a maximum of 75,800 acre feet (af) annually from the SWP, though routinely it only uses an average of 15,000 af (MWA, 2007). When the river is not flowing and during the summer months, water levels in the floodplain aquifer decline primarily due to pumping and also by transpiration by riparian vegetation (USGS, 2003).

5.2.2.8 The regional aquifer is recharged by infiltration of stormflow in ephemeral washes along the southern boundary of the Mojave River groundwater basin. In the vicinity of Helendale, data suggest that infiltration of runoff from the local desert mountains may also be an important source of recharge. Recharge to the regional aquifer is small in comparison to the floodplain aquifer. Although the regional aquifer does contain a significant amount of groundwater in storage, the fine-grained texture of the sediments and low permeability in the aquifer results in well yields lower than those of the floodplain aquifer, and the water is generally of poor quality (high dissolved solids concentrations) in most of the Mojave River Basin (USGS, 2003).

5.2.2.9 In most areas of the Mojave River Basin, groundwater flow is mainly toward the Mojave River; however, in the area downgradient of the Helendale Fault, the flow is away from the Mojave River and toward Harper Lake and downstream toward the city of Barstow (Refer to Figure C and D that follow). In the vicinity of the Helendale Fault, groundwater movement in the floodplain aquifer is southwest to northeast (same direction as the intermittent flows in the Mojave River). According to USGS, water-level contours for the area between the Helendale Fault and Iron Mountain suggest that some groundwater flows northward from the floodplain to the regional aquifer (USGS, 2003). Groundwater east of the Helendale Fault is considered part of the Morongo groundwater basin (USGS, 2002). A discussion of the Morongo groundwater basin will be included in the Victorville PBRs located in the Lucerne Valley and east. The floodplain aquifer near Helendale is generally recharged by infiltration of winter stormflows from the Mojave River. Since 1981, Victor Valley Wastewater Reclamation Authority has been discharging treated municipal wastewater into the Mojave River increasing the amount of recharge into the floodplain aquifer in the Transition Zone. The large stormflows in the Mojave River have little effect on the regional aquifer (USGS, 2003). A large, but sporadic contribution to recharge occurs when the Mojave River is flowing with 40 feet of rise in the water table observed in 1969 and an 87 foot rise observed in 1993 (CRWQCB, 2003). For the 1997-1998 water year, natural recharge was estimated at 36,300 af, artificial recharge at 1,870 af, and applied water recharge at 6,800 af (CRWQCB, 2003).

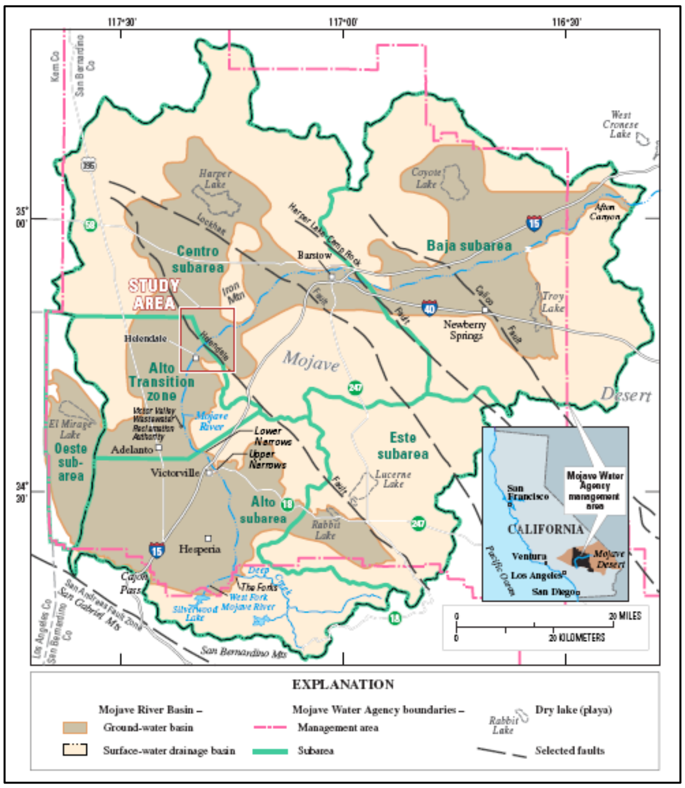


Figure C. Map of Mojave River Basin, San Bernardino County, California (USGS, 2003)

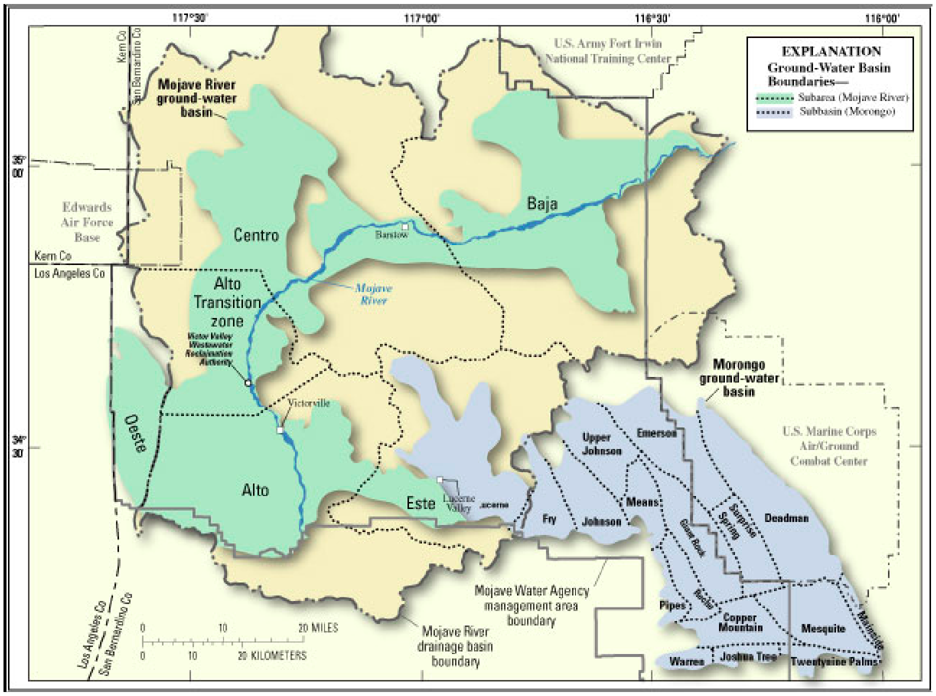


Figure D. Map of Mojave River and Morongo Groundwater Basins (USGS, 2003)

5.2.2.10 Other geologic units that include bedrock and lake deposits will commonly contain groundwater, but they are not considered reliable sources of groundwater (USGS, 2004a).

5.2.2.11 Depth to groundwater in the Mojave River Basin near Helendale range from less than 5 feet below ground surface (bgs) in those wells completed near the Mojave River in the floodplain aquifer to nearly 200 feet bgs in wells completed on the bluffs overlooking the river in the regional aquifer (USGS, 2003). In the general vicinity of the site, and specifically in the Upper Mojave River Valley groundwater basin (part of the Mojave River groundwater basin) depth to groundwater ranges from approximately 140 to 200 feet bgs (DWR, 2007). The ASR stated that the depth to groundwater at the site was approximately 150 feet bgs.

5.2.3 Regional Groundwater Use

5.2.3.1 Since the early 1900s groundwater withdrawal in the Mojave River groundwater basin has resulted in discharge exceeding recharge (both natural and artificial). Such reliance on groundwater has resulted in overdraft conditions since the mid-1940s (USGS, 2003). In fact, water levels have declined between 50 to almost 100 feet in the basin since the mid-1940s (USGS, 2001). For this reason, and existing drought conditions, groundwater in the region is carefully managed.

5.2.3.2 Due to the limited availability of surface water in the region, water supply is derived entirely from groundwater to meet its agricultural and municipal needs (USGS, 2003).

5.2.3.3 The Victorville PBR No. 1 site is situated in the immediate area of the Upper Mojave River Valley groundwater basin. The Upper Mojave River Valley groundwater basin is bounded on the north by a roughly east-west line from basement rock outcrops near Helendale to those in the Shadow Mountains. The contact between Quaternary sedimentary deposits and unconsolidated basement rocks of the San Bernardino Mountains form the southern boundary. The Helendale Fault forms the southeast boundary and the eastern boundary is formed by basement exposures of the mountains surrounding Apple Valley. In the west, the boundary is marked by a surface drainage divide between this basin and El Mirage Valley Basin, and a contact between basement rocks and alluvium that form the Shadow Mountains (CRWQCB, 2004). Groundwater in the Upper Mojave River Valley basin is generally unconfined, though some perched water appears near Adelanto. Groundwater flows primarily toward the active channel of the Mojave River and it then follows the course of the river through the valley. In the southeast corner of the basis, the Helendale Fault forms a barrier to groundwater flow. For the water year of 1997-98, replenishment of groundwater supplies was estimated at 105,000 af from natural recharge; 16,350 af from artificial recharge; and 3,900 af from applied water recharge. For that same water year, extractions were estimated at 58,300 af urban use; 7,800 af for agricultural use; and 11,900 af for recreational and industrial use (CRQWCB, 2004).

5.2.3.4 According to the CRWQCB, Lahontan Region, beneficial uses for the groundwater of the Upper Mojave River Valley basin includes municipal, agricultural, industrial, freshwater replenishment, and aquaculture (CRWQCB, 1995). Freshwater replenishment is considered “natural or artificial maintenance of surface water quantity or quality” (e.g., salinity) (CRWQCB, 1995).

5.2.3.5 Calcium bicarbonate character waters are found near the Mojave River channel and the San Bernardino Mountains. Groundwater near Victorville contains sodium bicarbonate and sodium-calcium sulfate. Groundwater near Apple Valley contains sodium chloride. High iron and manganese concentrations are found near Oro Grande and high nitrate concentrations occur in the southern portion of the basin. Groundwater is contaminated with trichloroethane at the former George Air Force Base, now a Superfund site, and leaking underground storage tanks in and around Victorville have also introduced benzene, toluene, ethybenzene, xylene, and methyl *t*-butyl ether into groundwater (CRWQCB, 2004).

5.2.3.6 Table 5.1 lists the active registered groundwater wells within a 4-mile radius of the Victorville PBR No. 1 site as shown in Figure 5.1. A total of 138 wells are known to exist within a 4-mile radius of the site and they include 99 domestic wells, one industrial well, ten irrigation wells, nine public supply wells, seven test wells, ten “other” wells, and two “not available” wells (Banks Environmental, 2007) (Appendix L).

Table 5.1
Groundwater Wells in the Vicinity of
the Former Victorville PBR No. 1 Site

Distance from MRS	Domestic	Public Supply	Irrigation	Other Wells	Total
On site	0	0	0	1	1
0 to ½ mile	2	1	0	0	3
½ to 1 mile	6	0	0	1	7
1 to 2 miles	27	2	3	5	37
2 to 3 miles	25	4	4	9	42
3 to 4 miles	39	2	3	4	48
Site to 4 miles	99	9	10	20	138

Source: Banks Environmental Data

5.2.3.7 As Table 5.2 depicts, available population data for Victorville PBR No. 1 indicates that there are no residents on the site, 39 residents are located within 1 mile of the site, and an estimated 11,252 residents live within 4 miles of the site. Refer to Figure 5.2 for the available population data associated with Victorville PBR No. 1.

Table 5.2
Population Information in the Vicinity of
the Former Victorville PBR No. 1 Site

Range	On-site	1 mile	2 miles	3 miles	4 miles	Total
Entire Site	0	39	339	2,475	8,399	11,252

Source: U.S. Census 2000 data

5.2.4 Regional Hydrologic Setting

5.2.4.1 Nearly all streams that head in the mountains in southern California are ephemeral and lose flow to alluvial aquifers within a short distance of where the streams leave the mountains and emerge onto the valley floors. And in fact, with the exception of small areas that drain to the Colorado River, no streams that rise within the Basin and Range Province carry water to the ocean. Practically all precipitation that falls in the area is returned to the atmosphere by evapotranspiration, either from the lakes and playas that occupy the lowest points within the basins (considered discharge areas for the alluvial aquifers), or directly from the soil (USGS, 2006a).

5.2.4.2 The Mojave River Basin is located in the western part of the Mojave Desert; the Mojave River is the primary source of surface water in the basin. However, the Mojave River is not a dependable water supply source because significant flows only occur after intense storms, and as a result, groundwater is used for agricultural and municipal uses (USGS, 2003).

5.2.4.3 The water-bearing alluvial deposits of the Mojave River are the major source of groundwater in the area. Hard rock formations along the river divide the coarse river deposits into numerous subsurface basins. Water from the river is trapped in these basins and is the source of groundwater. The Mojave River is sometimes called the "upside-down river" because through most of its course water flows underground; water flows above ground only after storms, yet miles downstream it surfaces and flows for a distance. Perennial flows occur near Victorville, in the vicinity of Camp Cady and in Afton Canyon. The perennial aboveground flows are caused by natural underground barriers, which force groundwater to the surface (CEMVS, 1995). However, based on information to date, there is no surface water located within the Victorville PBR No. 1 site.

5.2.5 Regional Sensitive Ecological Resources

5.2.5.1 The Victorville PBR No. 1 is not located within a national wildlife refuge, national park, national forest, state park, or county park, and there are no identified or designated ecological resources located on the site. There are no federally listed species within Victorville PBR No. 1. One species was identified in the TPP meeting as potentially of concern for this site, the desert tortoise. However, the USACE biologist confirmed there are no T&E species present at the Victorville PBR No. 1 site. According to the U.S. Fish and Wildlife Service National Wetlands Inventory, there are no wetlands known to be present within any of the sampling areas of Victorville PBR No. 1 (Parsons, 2007b).

5.2.5.2 Based on the above information, a review of the Army Checklist for Important Ecological Places (USACE, 2006) has demonstrated that the Victorville PBR No. 1 site is not considered to be an important ecological place and it is not managed for ecological purposes. Therefore, ecological receptors are not considered to be receptors for migration pathways at this site.

5.2.6 Cultural Resources

5.2.6.1 According to the NRHD, NRHP, NHA, NHL, NRIS, and California OHP website databases there are no listed archaeological or cultural resources located within the Victorville PBR No. 1 boundaries. However, according to the 1996 ASR there are five listed cultural or archaeological areas designated by the OHP. Currently, according to the San Bernardino Archeological Information Center historical research record search there are six recorded archaeological finds within the southeastern corner of the site and the site is also located within the area noted as the historic Silver Mountain/Oro Grande Mining District. These archaeological remnants are potentially associated with former mining activities and domestic activity. The map provided to Parsons by San Bernardino Archaeological Information Center was provided to the FTL and referred to when sample locations were relocated in the field. The SVT practiced avoidance of any cultural sites.

5.2.6.2 Prior to mobilization, the BLM archaeologist was contacted to determine if any additional permits were required under the SI effort. Mr. Jim Shearer, BLM archaeologist, indicated that, due to the minimal impact of the proposed site activities, no additional permitting was required. No cultural resources were observed during the SI.

5.2.7 Sample Locations and Methods

5.2.7.1 Surface soil samples were collected from ten locations within the Victorville PBR No. 1 site (Figure 5.4), including eight locations within the MRS that were selected to represent areas with the highest likelihood for the presence of MEC or MC contamination (per the SS-WP Addendum [Parsons, 2007b]). These include two discretionary samples (one was added during the field effort) collected by the SVT and selected from areas of concentrated MD. Additionally, two soil samples were collected outside the MRS, one within the FUDS and one outside of the FUDS, anticipated to represent background conditions. One duplicate sample was also collected. Surface soil samples were collected from 2 to 4 inches bgs, and each of the sampling locations was recorded with a global positioning system (GPS) unit for later reference.

5.2.7.2 As provided in the SS-WP Addendum, the TPP Team determined that groundwater pathways were incomplete because the depth to groundwater is 150 feet bgs, and receptors are not expected to encounter groundwater that is present at depth. For that reason, no groundwater samples were collected.

5.2.7.3 As detailed in the SS-WP Addendum, and agreed with the TPP Team, no surface water or sediment samples were collected from within the site due to a lack of media source.

5.2.7.4 The surface soil sample locations were screened for potential subsurface anomalies and approved by the UXO Technician III prior to final location selection and sample collection. In accordance with the PWP, the CRREL seven-point wheel sampling technique was employed for the surface soil samples. The actual GPS coordinates for each sample location were recorded and updated in the geographic information system (GIS) database.

5.2.7.5 Surface soil samples were analyzed by TestAmerica (formerly Severn Trent Laboratories) in Arvada, Colorado for explosives (Method SW8321A) and MC metals (SW6010B/6020). The TPP Team agreed to the exclusion of arsenic, chromium, lead and mercury from screening due to the absence of these MC metals from the known munitions used on site. However, lead was added as an MC metal for screening due to recently received MC data for spotting charges. Table 4.1 has been updated to include those new data. It was further agreed by the TPP Team that if munitions were found on site containing one or more of these excluded metals, the respective metal(s) would be added for screening. No unanticipated munitions were observed at Victorville PBR No. 1 during the SI; as noted previously, lead was the only metal added for screening.

5.2.8 Background Concentrations

5.2.8.1 No site-specific statistical evaluation of background metals concentrations is available. Due to the limited scope of the SI, conducting a site-specific statistical background evaluation of metals concentrations (which typically requires collection of at least 10 background samples) was not considered practical nor warranted at this stage of investigation. The analytical results of two ambient samples collected during the 2007 SI field activities were used to estimate background metals concentrations at the site. These samples were collected outside of the MRS, one within the FUDS boundary and one outside of the FUDS boundary, in areas that are not expected to be affected by munitions activities.

5.2.8.2 To provide an indication of the range of metals concentrations naturally present at the site, two ambient samples were collected during the SI. Owing to this small number of samples, calculation of a more statistically robust site-specific background concentration is not possible. At the Victorville PBR No. 1, samples VV-1MRS01-SS-24-01 and VV-1MRS01-SS-24-08 were ambient samples. *These samples were collected outside the MRS and no MEC or MD was observed in the vicinity of the two ambient sample locations, suggesting that the sample locations are likely representative of the naturally occurring soils in the area. Analysis of the ambient samples did not detect any explosives*.

5.2.8.3 The maximum concentrations detected in the collected ambient samples are summarized in Table 5.3. These values are used to estimate the background concentration for the site which is one of the criteria used to evaluate whether or not a source of contamination is present (Refer to Subchapter 5.2.9).

5.2.9 MC Source Evaluation

5.2.9.1 As explained earlier in this chapter, an exposure pathway is not considered to be complete unless there is potential MC contamination present. To make this determination, analytical results for MC metals are compared against several criteria to evaluate whether or not potential MC contamination is present. For a chemical to be considered contamination potentially caused by a release from munitions-related activities at the site, it is necessary for the following conditions to be true:

- The chemical is detected in the sample medium; AND
- The chemical is present above the background concentration (see Subchapter 5.2.8); AND
- The chemical is a potential constituent of the munitions formerly used at the site (see Table 4.1); AND
- The chemical is NOT an essential nutrient (calcium, iron, magnesium, potassium, or sodium).

5.2.9.2 Each of the MC metals analyzed at the site were evaluated against these criteria to determine whether or not potential MC contamination was present at the MRS. Only detections of metals that meet the conditions above are evaluated further in the Screening Level Risk Assessments (SLRAs) in Chapter 6. Any detection of explosives at the site would be considered to be potential MC contamination and is evaluated in the SLRA. ***However*, *explosives were not detected in any surface soil samples collected during the SI***.

5.3 MRS 01-PRACTICE BOMB TARGET

5.3.1 This subchapter of the SI Report describes the evaluation of exposure pathways specifically for the MRS 01-Practice Bomb Target and the setting described for the overall site in Subchapters 5.2.1 and 5.2.2.

5.3.2 Over the years, the site has been divided into plots (currently 51), ranging from 160 acres (owned by the State of California) and over 40 privately owned parcels ranging in size from 2 to 20 acres. The site is primarily undeveloped; however, Wal-Mart has recently constructed a warehouse distribution center on the northern end of the site. The remainder of the land is used recreationally (off-road vehicles). The SVT recorded one occupied structure located on site; the Wal-Mart Distribution Center. It is anticipated that the land use will continue for recreational purposes with limited commercial/industrial use.

5.3.1 Historical MC Information

To date, no data exist to indicate that MC related to the use of military munitions has affected the MRS 01-Practice Bomb Target.

5.3.2 Groundwater Migration Pathway

5.3.2.1 Geologic and Hydrogeologic Setting

There are no known differences between the geologic and hydrogeologic setting at MRS 01-Practice Bomb Target and the setting described for the overall site in Subchapters 5.2.1 and 5.2.2.

5.3.2.2 Releases and Potential Releases to Groundwater

There are no known releases or potential releases of MCs to groundwater at MRS 01-Practice Bomb Target. Potable groundwater would not have been directly affected by munitions activities and it is unlikely that any releases to soil would leach to the greater than 150 foot deep groundwater at this MRS.

5.3.2.3 Groundwater Migration Pathways and Receptors

It is unlikely that human receptors would be exposed to contamination via this pathway, as the groundwater would not have been directly affected by munitions activities and soil contaminants would not likely leach to the 150 foot depth to groundwater. Based on the current and future land use of the MRS 01-Practice Bomb Target, potential receptors, if this pathway were complete, would include commercial or industrial workers (*e.g.*, Wal-Mart employees) and site visitors or recreational users through dermal contact, incidental ingestion, and ingestion as drinking water. The only well identified on site is classified as N/A (not available) and it is located at the southernmost boundary of the FUDS. The well was drilled in 1981 and it is unknown if it remains active or its original intended use. Although there is a well of unknown use on the site, the regional depth to groundwater and land use make it unlikely for humans to use this well as a source of drinking water. Refer to Figures 5.1 and 5.2; there are no residents living in the area of the well. There are a total of 138 wells located within the 4-mile radius of the site.

5.3.2.4 Groundwater Sample Locations and Methods

No groundwater samples were collected in the MRS 01-Practice Bomb Target for this SI.

5.3.2.5 Groundwater Migration Pathway Analytical Results

Not Applicable.

5.3.2.6 Groundwater Migration Pathway Conclusions

No drinking water wells are located within the MRS 01- Practice Bomb Target, and it is unlikely there will be any in the future given the anticipated continued use of the site. No explosives were detected in the soil at this MRS. Although lead was detected above background in the soil it is unlikely that this contamination would leach to groundwater (Subchapter 5.3.2.2). Based on this information the groundwater migration pathway is incomplete for all receptors at this MRS.

5.3.3 Surface Water and Sediment Migration Pathway

5.3.3.1 Hydrologic Setting

The hydrologic setting of the Victorville PBR No. 1 site is described in Subchapter 5.2.4.

5.3.3.2 Releases and Potential Releases to Surface Water and Sediment

There are no known releases or potential releases of MC to surface water or sediment at the MRS 01-Practice Bomb Target. Based on the information available, no surface water is present within the MRS 01-Practice Bomb Target; therefore, releases via this pathway are not anticipated.

5.3.3.3 Surface Water and Sediment Migration Pathways and Receptors

There is no surface water located within the MRS 01-Practice Bomb Target, therefore releases via this pathway are not anticipated. Based on the current and future land use of the MRS 01-Practice Bomb Target, potential receptors in these areas if this pathway were complete would include commercial or industrial workers (*e.g.*, Wal-Mart employees) and site visitors or recreational users.

5.3.3.4 Sample Locations and Methods

Surface water and sediment sampling were not performed during the SI at the MRS 01-Practice Bomb Target.

5.3.3.5 Surface Water and Sediment Migration Pathway Analytical Results

Not applicable.

5.3.3.6 Surface Water and Sediment Migration Pathway Conclusions

Because there is no surface water present within or near this MRS and based on the information available, the surface water and sediment migration pathways are incomplete for the MRS 01-Practice Bomb Target.

5.3.4 Soil Exposure Pathway

5.3.4.1 Physical Source Access Conditions

The primary use of MRS 01-Practice Bomb Target is undeveloped desert with some recreational off-road vehicle use and industrial/commercial use. The MRS is located east of Bell Mountain Road approximately eight miles northeast of Victorville, California.

5.3.4.2 Actual or Potential Contamination Areas

Prior to the SI, there were no known contamination areas within the MRS 01-Practice Bomb Target. However, training activities could have directly affected soil. The most likely location for contamination is considered to be the target/impact area. The location of the bombing target was based on analysis of aerial photographs, and was identified in the ASR and ASR Supplement. Eight surface soil samples (VV-1MRS01-SS-24-02 through VV-1MRS01-SS-24-07 and VV-1MRS01-SS-24-09 and VV-1MRS01-SS-24-10) were collected from the identified bombing target, and two soil samples (VV-1MRS01-SS-24-01 and VV-1MRS01-SS-24-08) were collected outside of the MRS (Figure 5.4).

5.3.4.3 Soil Exposure Pathway and Receptors

The soil exposure pathway accounts for the potential risk to human receptors at or near the MRS 01-Practice Bomb Target that may come into contact with contaminated soil. Based on the known current and future uses of the land, the potential receptors for soil at the MRS include commercial or industrial workers (*e.g.,* Wal-Mart employees) and site visitors or recreational users through dermal contact, incidental ingestion, and inhalation of re-suspended particulate matter.

5.3.4.4 Sample Locations and Methods

Eight surface soil samples (VV-1MRS01-SS-24-02 through VV-1MRS01-SS-24-07 and VV-1MRS01-SS-24-09 and VV-1MRS01-SS-24-10) were collected from the identified bombing target, and two soil samples (VV-1MRS01-SS-24-01 and VV-1MRS01-SS-24-08) were collected from outside of the MRS, one inside the FUDS and one outside the FUDS. One duplicate sample was also collected. Soil samples VV-1MRS01-SS-24-01 and VV-1MRS01-SS-24-02 were moved from their originally proposed locations due to the lack of an executed ROE from Wal-Mart. The SVT was able to view the Wal-Mart parcel through the chain-link fence and did not observe MD. Soil samples VV-1MRS01-SS-24-03, VV-1MRS01-SS-24-04, and VV-1MRS01-SS-24-07 were moved from their originally proposed locations due to the lack of MD or MEC in the area. The samples were collected (from a depth of 2 to 4 inches bgs) on 16 and 17 October 2007 and analyzed for select metals and explosives. The analytical results for this MRS are presented in Table 5.4. The soil sample results are also included in Appendix F. The laboratory methods used to analyze for explosives was Method SW8321A, and metals was SW6010B/6020.

5.3.4.5 Soil Analytical Results

The analytical results for the surface soil samples collected from the MRS 01-Practice Bomb Target are presented in Table 5.4. These results were evaluated using the criteria described in Subchapter 5.2.9. No explosives were detected in the surface soil samples, so this evaluation was performed for metals only. As shown in Table 5.5, lead was the only non-essential nutrient MC metal detected above the background concentration in the surface soil samples analyzed. Therefore, based on these sample results, there is potential lead contamination present in the surface soil at the MRS 01-Bomb Target.

5.3.4.6 Soil Exposure Pathway Conclusions

No explosives were detected in the surface soil samples. The non-essential nutrient MC metal lead was detected above background concentration in the surface soil samples collected from the MRS 01-Practice Bomb Target. Therefore, there may be MC contamination present, which is a necessary element for a complete migration pathway. Based on these results, the soil migration pathway is complete for the MRS 01-Practice Bomb Target for all present receptors.

5.3.5 Air Migration Pathway

5.3.5.1 Climate

The climate at the site is described in Subchapter 2.2.3.

5.3.5.2 Releases and Potential Releases to Air

There are no known direct releases of MCs to air at MRS 01-Practice Bomb Target. The occurrence of windblown dust may be expected at the site but releases via this pathway are expected based on the presence of contamination in the site soil (Subchapter 5.3.4.5).

5.3.5.3 Air Migration Pathway Receptors

Receptor populations potentially affected by the air pathway consist of people who reside, work, or go to school within the target distance limit of 4 miles around the range. Receptors could be exposed to MC in air through inhalation of fugitive dust. Based on the known current and future uses of the land, the potential air migration pathway receptors at the MRS 01-Practice Bomb Target would be commercial or industrial workers (*e.g.,* Wal-Mart employees) and site visitors or recreational users through dermal contact, incidental ingestion, and inhalation of re-suspended particulate matter.

5.3.5.4 Sample Monitoring Locations and Methods

No air sampling is known to have been previously performed at MRS 01-Practice Bomb Target. Air sampling was not conducted as part of this SI.

5.3.5.5 Air Analytical Results

Not applicable.

5.3.5.6 Air Migration Pathway Conclusions

As discussed in Subchapter 5.3.4, although explosives were not detected in the soil samples collected from the MRS 01-Practice Bomb Target, the non-essential nutrient MC metal lead was detected above background concentration and, therefore, there is potential MC contamination present. Consequently, there is potential for a receptor's windblown exposure to contaminated particulates. Based on this information, the air migration pathway is complete for all present receptors.

Table 5.3
Soil Background Concentrations
Victorville PBR No. 1

Analyte	Units	Maximum Ambient Concentration
Metals		
Aluminum	mg/kg	13000
Antimony	mg/kg	< 0.25
Barium	mg/kg	93
Beryllium	mg/kg	0.55
Cadmium	mg/kg	0.22
Calcium	mg/kg	4100
Cobalt	mg/kg	5.8
Copper	mg/kg	13
Iron	mg/kg	19000
Lead	mg/kg	7.4
Magnesium	mg/kg	4900
Manganese	mg/kg	360
Nickel	mg/kg	11
Potassium	mg/kg	2900
Selenium	mg/kg	0.25
Silver	mg/kg	0.041
Sodium	mg/kg	91
Thallium	mg/kg	0.16
Vanadium	mg/kg	25
Zinc	mg/kg	42

< - Analyte was analyzed for but not detected above the practical quantitation limit (PQL).

Table 5.4
SUMMARY OF VALIDATED ANALYTICAL RESULTS FOR VICTORVILLE PRECISION BOMBING RANGE NO. 1 MMRP SOIL SAMPLES COLLECTED IN OCTOBER 2007

SAMPLE ID:		VV-1MRS01-SS-24-01*		VV-1MRS01-SS-24-08*		VV-1MRS01-SS-24-02		VV-1MRS01-SS-24-03		VV-1MRS01-SS-24-04		VV-1MRS01-SS-24-05		VV-1MRS01-SS-24-11**		VV-1MRS01-SS-24-06		VV-1MRS01-SS-24-07		VV-1MRS01-SS-24-09		VV-1MRS01-SS-24-10	
DATE SAMPLED:		10/16/07		10/16/07		10/17/07		10/17/07		10/17/07		10/17/07		10/17/07		10/17/07		10/17/07		10/16/07		10/17/07	
LAB SAMPLE ID:		D7J180428003		D7J180428001		D7J180428008		D7J180428011		D7J180428005		D7J180428004		D7J180428006		D7J180428010		D7J180428007		D7J180428002		D7J180428009	
	Units																						
Explosives - SW8321A																							
1,3,5-Trinitrobenzene	ug/kg	120	U	120	U	120	U	120	U	120	U	120	U	120	U	120	U	120	U	120	U	120	U
1,3-Dinitrobenzene	ug/kg	120	U	120	U	120	U	120	U	120	U	120	U	120	U	120	U	120	U	120	U	120	U
2,4,6-Trinitrotoluene (TNT)	ug/kg	120	U	120	U	120	U	120	U	120	U	120	U	120	U	120	U	120	U	120	U	120	U
2,4-Dinitrotoluene	ug/kg	120	U	120	U	120	U	120	U	120	U	120	U	120	U	120	U	120	U	120	U	120	U
2,6-Dinitrotoluene	ug/kg	120	U	120	U	120	U	120	U	120	U	120	U	120	U	120	U	120	U	120	U	120	U
2-Amino-4,6-dinitrotoluene	ug/kg	120	U	120	U	120	U	120	U	120	U	120	U	120	U	120	U	120	U	120	U	120	U
2-Nitrotoluene	ug/kg	120	U	120	U	120	U	120	U	120	U	120	U	120	U	120	U	120	U	120	U	120	U
3-Nitrotoluene	ug/kg	120	U	120	U	120	U	120	U	120	U	120	U	120	U	120	U	120	U	120	U	120	U
4-Amino-2,6-dinitrotoluene	ug/kg	120	U	120	U	120	U	120	U	120	U	120	U	120	U	120	U	120	U	120	U	120	U
4-Nitrotoluene	ug/kg	120	U	120	U	120	U	120	U	120	U	120	U	120	U	120	U	120	U	120	U	120	U
Hexahydro-1,3,5-trinitro-1,3,5-triazine (RDX)	ug/kg	180	U	180	U	180	U	180	U	180	U	180	U	180	U	180	U	180	U	180	U	180	U
Methyl-2,4,6-trinitrophenylnitramine (Tetryl)	ug/kg	300	U	300	U	300	U	300	U	300	U	300	U	300	U	300	U	300	U	300	U	300	U
Nitrobenzene	ug/kg	120	U	120	U	120	U	120	U	120	U	120	U	120	U	120	U	120	U	120	U	120	U
Nitroglycerin	ug/kg	500	U	500	U	500	U	500	U	500	U	500	U	500	U	500	U	500	U	500	U	500	U
Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine (HMX)	ug/kg	120	U	120	U	120	U	120	U	120	U	120	U	120	U	120	U	120	U	120	U	120	U
Pentaerythritol Tetranitrate (PETN)	ug/kg	500	U	500	U	500	U	500	U	500	U	500	U	500	U	500	U	500	U	500	U	500	U
Metals - SW6010B/6020																							
Aluminum	mg/kg	**13000**	J	**9100**	J	**12000**	J	**12000**	J	**13000**	J	**9600**	J	**11000**	J	**7200**	J	**14000**	J	**11000**	J	**7900**	J
Antimony	mg/kg	0.25	U	0.25	U	0.25	U	0.25	U	0.25	U	0.25	UJ	0.25	U	0.25	U	0.25	U	0.25	U	0.25	U
Barium	mg/kg	**93**		**82**		**93**		**86**		**89**		**78**	J	**82**		**60**		**100**		**84**		**61**	
Beryllium	mg/kg	**0.55**		**0.45**		**0.57**		**0.55**		**0.55**		**0.49**		**0.48**		**0.33**		**0.58**		**0.48**		**0.37**	
Cadmium	mg/kg	**0.21**		**0.22**		**0.27**		**0.27**		**0.27**		**0.24**		**0.23**		**0.25**		**0.20**		**0.25**		**0.28**	
Calcium	mg/kg	**4100**		**3200**		**4700**		**4100**		**4900**		**3200**		**3400**		**3000**		**4500**		**4500**		**2800**	
Cobalt	mg/kg	**5.8**		**4.9**		**5.7**		**5.5**		**5.9**		**5.4**		**5.7**		**3.8**		**7.0**		**5.7**		**4.1**	
Copper	mg/kg	**13**		**10**		**12**		**12**		**13**		**11**	J	**12**		**8.1**		**14**		**11**		**8.5**	
Iron	mg/kg	**19000**	J	**12000**	J	**15000**	J	**15000**	J	**18000**	J	**13000**	J	**14000**	J	**11000**	J	**21000**	J	**15000**	J	**11000**	J
Lead	mg/kg	**7.0**		**7.4**		**8.2**		**11**		**10**		**7.8**		**14**		**8.4**		**6.8**		**7.7**		**6.3**	
Magnesium	mg/kg	**4900**		**3600**		**5100**		**4300**		**4800**		**3400**		**3900**		**2800**		**5900**		**3900**		**3000**	
Manganese	mg/kg	**360**		**300**		**330**		**320**		**340**		**300**	J	**320**		**240**		**370**		**330**		**230**	
Nickel	mg/kg	**11**		**9.7**		**12**		**11**		**11**		**10**	J	**11**		**7.6**		**12**		**11**		**7.9**	
Potassium	mg/kg	**2900**		**2400**		**3200**		**3100**		**3400**		**2500**		**2800**		**1900**		**3700**		**2600**		**2000**	
Selenium	mg/kg	**0.25**	J	**0.21**	J	**0.29**	J	**0.32**	J	**0.27**	J	**0.26**	J	**0.27**	J	**0.27**	J	**0.24**	J	**0.23**	J	**0.24**	J
Silver	mg/kg	**0.036**	J	**0.041**	J	**0.044**	J	**0.051**	J	**0.046**	J	**0.036**	J	**0.038**	J	**0.032**	J	**0.034**	J	**0.037**	J	**0.025**	J
Sodium	mg/kg	**90**	J	**91**	J	**71**	J	**69**	J	**88**	J	**75**	J	**70**	J	570	U	**84**	J	**97**	J	**63**	J
Thallium	mg/kg	**0.16**		**0.14**		**0.16**		**0.15**		**0.15**		**0.13**		**0.14**		**0.10**		**0.17**		**0.14**		**0.11**	
Vanadium	mg/kg	**25**		**20**		**23**		**22**		**23**		**22**	J	**21**		**16**		**28**		**22**		**16**	
Zinc	mg/kg	**42**	J	**34**	J	**40**	J	**37**	J	**39**	J	**35**	J	**37**	J	**29**	J	**45**	J	**36**	J	**27**	J

QA NOTES AND DATA QUALIFIERS:

(NO CODE) - Confirmed identification.
U - Analyte was analyzed for but not detected above the practical quantitation limit (PQL).
UJ - Analyte not detected, reported PQL may be inaccurate or imprecise.
J - Analyte detected, estimated concentration.
* - Ambient sample.
** - Field duplicate of sample on left.
Detections are bolded.

Table 5.5
MRS 01-Practice Bomb Target Soil Source Evaluation
Victorville PBR No. 1

Analyte	Units	Maximum Detected Site Conc.	Background Conc. [b]	Exceeds Background Conc.?	Potential MC? [c]	SLRA Required?	Primary reason for exclusion from SLRA
Metals							
Aluminum	mg/kg	14000	13,000	Yes	No	No	Not a potential MC
Antimony	mg/kg	< 0.25	0.25	No	No	No	Not detected at MRS
Barium	mg/kg	100	93	Yes	No	No	Not a potential MC
Beryllium	mg/kg	0.58	0.55	Yes	No	No	Not a potential MC
Cadmium	mg/kg	0.28	0.22	Yes	No	No	Not a potential MC
Calcium [a]	mg/kg	4900	4,100	Yes	No	No	Not a potential MC
Cobalt	mg/kg	7.0	5.8	Yes	No	No	Not a potential MC
Copper	mg/kg	14	13	Yes	No	No	Not a potential MC
Iron [a]	mg/kg	21000	19,000	Yes	Yes	No	Essential nutrient (see Footnote a)
Lead	mg/kg	14	7.4	Yes	Yes	Yes	--
Magnesium [a]	mg/kg	5900	4,900	Yes	No	No	Not a potential MC
Manganese	mg/kg	370	360	Yes	No	No	Not a potential MC
Nickel	mg/kg	12	11	Yes	No	No	Not a potential MC
Potassium [a]	mg/kg	3700	2,900	Yes	Yes	No	Essential nutrient (see Footnote a)
Selenium	mg/kg	0.32	0.25	Yes	No	No	Not a potential MC
Silver	mg/kg	0.051	0.041	Yes	No	No	Not a potential MC
Sodium [a]	mg/kg	97	91	Yes	No	No	Not a potential MC
Thallium	mg/kg	0.17	0.16	Yes	No	No	Not a potential MC

Table 5.5 (Continued)
MRS 01-Practice Bomb Target Soil Source Evaluation
Victorville PBR No. 1

Analyte	Units	Maximum Detected Site Conc.	Background Conc. [b]	Exceeds Background Conc.?	Potential MC? [c]	SLRA Required?	Primary reason for exclusion from SLRA
Vanadium	mg/kg	28	25	Yes	No	No	Not a potential MC
Zinc	mg/kg	45	42	Yes	No	No	Not a potential MC

a - Calcium, Iron, Magnesium, Potassium, and Sodium are essential nutrients and are not expected to pose an unacceptable risk to human receptors
b - Background Concentrations as established in Table 5.3
c - Potential MCs as listed in Table 4.1
< - Analyte was analyzed for but not detected above the practical quantitation limit (PQL).